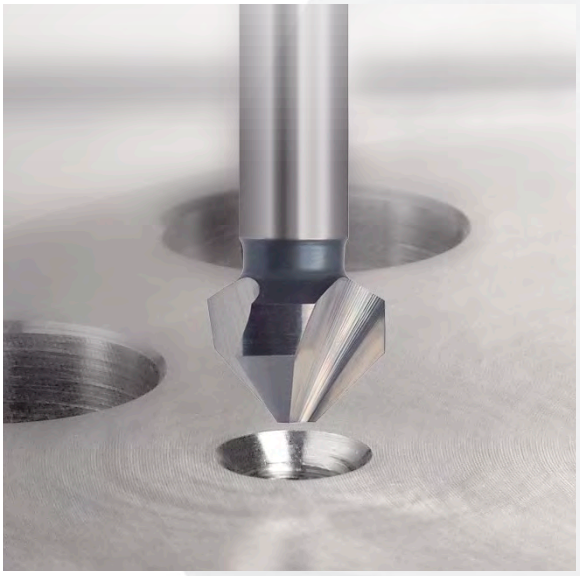
EN

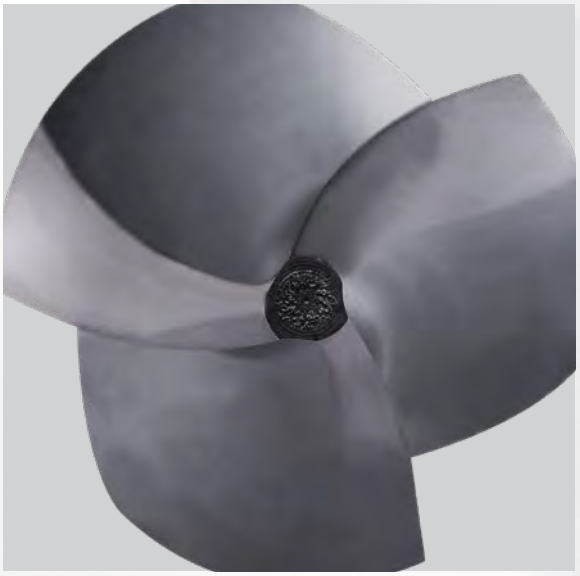
HARTNER

Precision Cutting Tools

COUNTERSINKS

MADE OF HSS AND HSCO





+ NEW: 3-flats on shank

ISO code

P	Steel, high-alloyed steel
M	Stainless steel
K	Grey cast iron, spher. graphite iron/malleable cast iron
N	Aluminium and other non-ferrous metals
S	Special, super and titanium alloys
H	Hardened steel and chilled cast iron

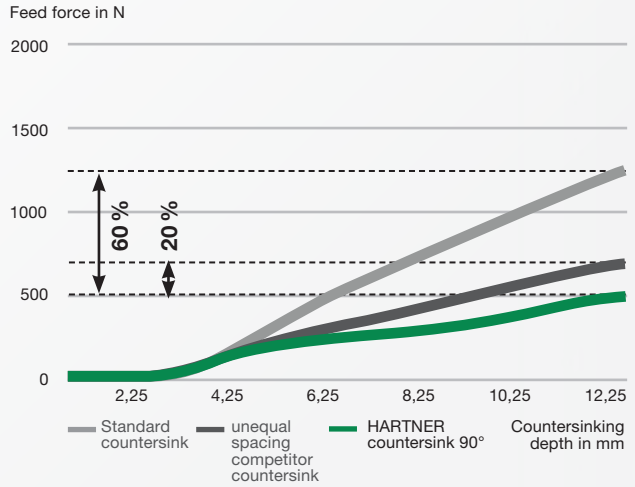
Pictograms

Tool material	HSS HSS-E High speed steel
Surface	bright TiAlN
Standard	DIN 335
Point angle	90°
Cutting direction	R right
Shank form	Cyl cylindrical 3 3-flats on shank
Form	C

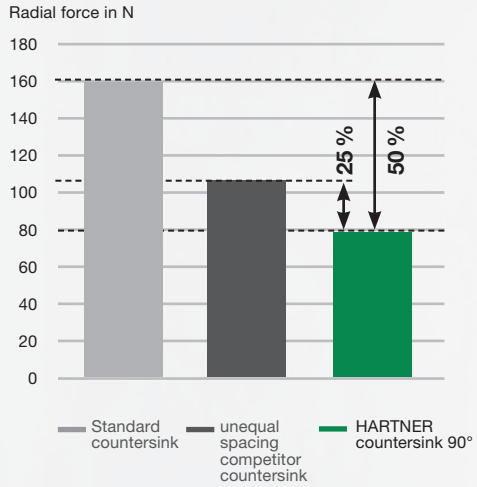
THE 90° TWISTED COUNTERSINK WITH CONVEX CUTTING EDGES

The axial and radial forces that occur during countersinking operations are strongly reduced due to the newly developed geomtery of the cutting edges. Also with hand drills an easy and convenient countersinking is guaranteed.

Different convex radii of the cutting edges with variable helical pitch provide a stable and low-vibration countersinking process. Round, precise and chatter-free countersinking is guaranteed. The specially designed TiAlN coating ensures a higher wear resistance and high-temperature hardness which guarantee longer tool life for nearly all materials and applications.

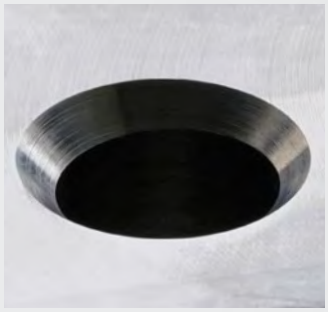


LOWER FEED FORCE by approx. 60 %
COMPARED TO STANDARD COUNTERSINKS



LOWER RADIAL FORCE by approx. 50 %
COMPARED TO STANDARD COUNTERSINKS

Countersinking with standard countersink



Countersinking with twisted countersink

Three different convex cutting edges in combination with three unequal helix angles enable extremely stable and low-vibration cutting processes without any chatter marks.

- universal application in nearly any material
- round, precise and chatter-free countersinking
- reduction of feed force by 60 %
- reduction of radial force by 50 %

HARTNER

90° Countersink sets

Article no. 88021

P	M	K	N	S	H
●	○	●	●	○	

HSS | DIN 335 | 90° | R | Cyl | C

set in case, consisting of item no. 88200 • radial relieved • 3-fluted

Ø-range mm	Pieces/set	Code no.
6.3/8.3/10.4/12.4/16.5/20.5	6	7.000

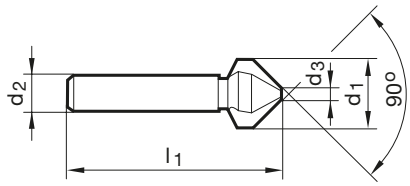
90° Countersinks

Article no. 88200

P	M	K	N	S	H
●	○	●	●	○	

HSS | ○ | DIN 335 | 90° | R | Cyl | C

radial relieved • 3-fluted



d1 mm	d2 mm	d3 mm	l1 mm	Z	Code no.
4.300	4.000	1.300	40.000	3	4.300
5.000	4.000	1.500	40.000	3	5.000
5.300	4.000	1.500	40.000	3	5.300
5.800	5.000	1.500	45.000	3	5.800
6.000	5.000	1.500	45.000	3	6.000
6.300	5.000	1.500	45.000	3	6.300
7.000	6.000	1.800	50.000	3	7.000
7.300	6.000	1.800	50.000	3	7.300
8.000	6.000	2.000	50.000	3	8.000
8.300	6.000	2.000	50.000	3	8.300
9.400	6.000	2.200	50.000	3	9.400
10.000	6.000	2.500	50.000	3	10.000
10.400	6.000	2.500	50.000	3	10.400
11.500	8.000	2.800	56.000	3	11.500
12.400	8.000	2.800	56.000	3	12.400
13.400	8.000	2.900	56.000	3	13.400
15.000	10.000	3.200	60.000	3	15.000
16.500	10.000	3.200	60.000	3	16.500
19.000	10.000	3.500	63.000	3	19.000
20.500	10.000	3.500	63.000	3	20.500
23.000	10.000	3.800	67.000	3	23.000
25.000	10.000	3.800	67.000	3	25.000
26.000	10.000	3.800	67.000	3	26.000
28.000	12.000	4.000	71.000	3	28.000
30.000	12.000	4.200	71.000	3	30.000
31.000	12.000	4.200	71.000	3	31.000

90° Countersink sets SpyroTec

Article no. 88022

P	M	K	N	S	H
●	●	●	○	○	

HSS-E | A | DIN 335 | 90° | R | Cyl | C

set in case, consisting of item no. 88201 • 3 different convex cutting edges • low-vibration cutting processes • for round and chatter-free countersinking • considerably lower feed force required • for universal application • smallest hole-Ø to allow countersinking see “Application recommendations for countersinks”

Ø-range mm	Pieces/set	Code no.
6.3/8.3/10.4/12.4/16.5/20.5	6	1.000

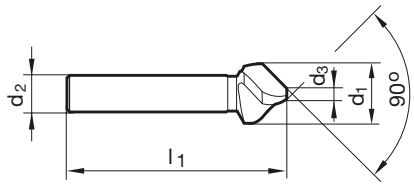
90° Countersinks SpyroTec

Article no. 88201

P	M	K	N	S	H
●	●	●	○	○	

HSS-E | A | DIN 335 | 90° | R | Cyl | C

3 different convex cutting edges • low-vibration cutting processes • for round and chatter-free countersinking • considerably lower feed force required • for universal application • smallest hole-Ø to allow countersinking see “Application recommendations for countersinks”



d1 mm	d2 mm	d3 mm	l1 mm	Z	Code no.
6.300	5.000	1.500	45.000	3	6.300
8.000	6.000	2.000	50.000	3	8.000
8.300	6.000	2.000	50.000	3	8.300
10.000	6.000	2.500	50.000	3	10.000
10.400	6.000	2.500	50.000	3	10.400
11.500	8.000	2.800	56.000	3	11.500
12.400	8.000	2.800	56.000	3	12.400
15.000	10.000	3.200	60.000	3	15.000
16.500	10.000	3.200	60.000	3	16.500
19.000	10.000	3.500	63.000	3	19.000
20.500	10.000	3.500	63.000	3	20.500
23.000	10.000	3.800	67.000	3	23.000
25.000	10.000	3.800	67.000	3	25.000
31.000	12.000	4.200	71.000	3	31.000

HARTNER

90° Countersink sets SpyroTec

Article no. 88023

P	M	K	N	S	H
●	●	●	○	●	

HSS-E | A | DIN 335 | 90° | R | 3 | C

• 3 different convex cutting edges • 3-flats on shank prevent slipping in the chuck • perfect for hand drills • low-vibration cutting • for round and chatter-free countersinking • considerably lower feed force required • for universal application

Ø-range mm	Pieces/set	Code no.
6.3/8.3/10.4/12.4/16.5/20.5	6	1.000
6.3/10.4/16.5/20.5/25.0	5	2.000

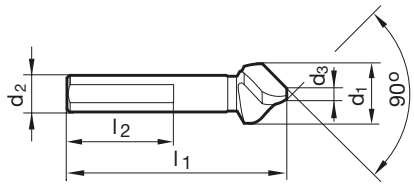
90° Countersinks SpyroTec

Article no. 88202

P	M	K	N	S	H
●	●	●	○	●	

HSS-E | A | DIN 335 | 90° | R | 3 | C

3 different convex cutting edges • 3-flats on shank prevent slipping in the chuck • perfect for hand drills • low-vibration cutting • for round and chatter-free countersinking • considerably lower feed force required • for universal application



d1 mm	d2 mm	d3 mm	l1 mm	Z	Code no.
6.300	5.000	1.500	45.000	3	6.300
8.000	6.000	2.000	50.000	3	8.000
8.300	6.000	2.000	50.000	3	8.300
10.000	6.000	2.500	50.000	3	10.000
10.400	6.000	2.500	50.000	3	10.400
11.500	8.000	2.800	56.000	3	11.500
12.400	8.000	2.800	56.000	3	12.400
15.000	10.000	3.200	60.000	3	15.000
16.500	10.000	3.200	60.000	3	16.500
19.000	10.000	3.500	63.000	3	19.000
20.500	10.000	3.500	63.000	3	20.500
23.000	10.000	3.800	67.000	3	23.000
25.000	10.000	3.800	67.000	3	25.000
31.000	12.000	4.200	71.000	3	31.000
40.000	12.000	10.000	75.000	3	40.000

APPLICATION RECOMMENDATIONS

APPLICATION RECOMMENDATIONS FOR TWISTED COUNTERSINKS

Ø to allow countersinking

Important note for the use of twisted countersinks:

Smallest hole diameter to allow countersinking and suitable for countersunk screws for spiral-fluted countersinks

d1	smallest hole-Ø to allow countersinking	for countersunk screws ISO 2009, 2010, 7046, 7047	for countersunk screws DIN 7991
6.30	2.00	-	M3
8.00	2.50	M4	-
8.30	2.50	-	M4
10.00	3.00	M5	-
10.40	3.00	-	M5
11.50	3.30	M6	-
12.40	3.30	-	M6
15.00	3.70	M8	-
16.50	3.70	-	M8
19.00	4.50	M10	-
20.50	4.50	-	M10
23.00	4.80	M12	-
25.00	4.80	-	M12
31.00	5.20	-	M16

Standard HSS Countersink

Machining group				f (mm/rev) with nom. Ø								
	v_c (m/min)			2	8.3	12.4	16.5	25	31	40	50	100
P1.1.1 Unalloyed steel, annealed, 0.15 % C, Rm 420 N/mm², 125 HB	29	33	36	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
P1.1.2 Unalloyed steel, heat-treated, 0.15 % C, Rm 420 N/mm², 125 HB	25	28	31	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P1.1.3 Unalloyed steel, annealed, 0.45 % C, Rm 640 N/mm², 190 HB	25	28	31	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P1.1.4 Unalloyed steel, heat-treated, 0.45 % C, Rm 640 N/mm², 190 HB	25	28	31	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P1.1.5 Unalloyed steel, heat-treated, 0.45 % C, Rm 850 N/mm², 250 HB	22	25	27	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P1.1.6 Unalloyed steel, annealed, 0.75 % C, Rm 915 N/mm², 270 HB	20	23	25	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P1.1.7 Unalloyed steel, heat-treated, 0.75 % C, Rm 1020 N/mm², 300 HB	17	20	22	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P2.1.1 Low-alloy steel, annealed, Rm 610 N/mm², 180 HB	17	20	21	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
P2.1.2 Low-alloy steel, heat-treated, Rm 930 N/mm², 275 HB	12	14	15	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P2.1.3 Low-alloy steel, heat-treated, Rm 1020 N/mm², 300 HB	10	12	13	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
P2.1.4 Low-alloy steel, heat-treated, Rm 1190 N/mm², 350 HB	9	11	12	0.045	0.080	0.095	0.110	0.125	0.140	0.170	0.180	0.225
P3.1.1 High-alloy steel and tool steel, annealed, Rm 680 N/mm², 200 HB	13	15	16	0.045	0.085	0.100	0.110	0.130	0.140	0.170	0.185	0.225
P3.1.2 High-alloy steel and tool steel, hardened and tempered, Rm 1100 N/mm², 325 HB	10	11	12	0.040	0.065	0.080	0.090	0.105	0.115	0.150	0.160	0.200
M1.1.1 Stainless steel, ferritic/martensitic, with machining additives	13	15	16	0.045	0.085	0.100	0.110	0.130	0.140	0.170	0.185	0.225
M1.1.2 Stainless steel, ferritic/martensitic, annealed, Rm 680 N/mm², 200 HB	12	13	15	0.045	0.085	0.100	0.110	0.130	0.140	0.170	0.185	0.225
M1.1.3 Stainless steel, ferritic/martensitic, heat-treated, Rm 810 N/mm², 240 HB	11	13	14	0.040	0.065	0.080	0.090	0.105	0.115	0.150	0.160	0.200
M2.1.1 Stainless steel, austenitic, quenched, 180 HB	12	14	15	0.030	0.055	0.065	0.075	0.085	0.095	0.135	0.145	0.180
M2.2.1 Duplex steel, high-strength stainless steels												
K1.1.1 Grey cast iron, pearlitic/ferritic, 180 HB	25	29	31	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
K1.1.2 Grey cast iron, pearlitic/martensitic, 260 HB	20	23	25	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
K1.2.1 Cast iron with spheroidal graphite, ferritic, 160 HB	21	24	27	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
K1.2.2 Cast iron with spheroidal graphite, pearlitic, 250 HB	19	22	23	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
K1.3.1 Malleable cast iron, ferritic, 130 HB	21	24	27	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
K1.3.2 Malleable cast iron, pearlitic, 230 HB	16	19	20	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
K2.1.1 Vermicular graphite cast iron (GJV)	20	23	25	0.045	0.085	0.100	0.110	0.130	0.140	0.170	0.185	0.225
K2.2.1 Austenitic-ferritic spheroidal graphite cast iron (ADI)		12	13	0.025	0.040	0.050	0.055	0.065	0.070	0.120	0.125	0.155
N1.1.1 Wrought aluminium alloys, non-hardened, 60 HB	50			0.090	0.160	0.185	0.210	0.245	0.265	0.270	0.285	0.355
N1.1.2 Wrought aluminium alloys, hardened, 100 HB	50			0.090	0.160	0.185	0.210	0.245	0.265	0.270	0.285	0.355
N2.1.1 Aluminium casting alloys, non-hardened, ≤ 12 % Si, 75 HB	40	46	50	0.075	0.130	0.155	0.170	0.200	0.220	0.230	0.250	0.305
N2.1.2 Aluminium casting alloys, hardened, ≤ 12 % Si, 90 HB	32	37	40	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
N2.1.3 Aluminium casting alloys, non-hardened, > 12 % Si, 130 HB	28	32	35	0.060	0.105	0.120	0.135	0.160	0.175	0.200	0.210	0.260
N3.1.1 Copper and copper alloys: Free-machining alloy, Pb > 1 %	55	63	69	0.090	0.160	0.185	0.210	0.245	0.265	0.270	0.285	0.355
N3.1.2 Copper and copper alloys: CuZn, CuSnZn	33	38	41	0.070	0.125	0.150	0.165	0.195	0.215	0.225	0.245	0.300
N3.1.3 Copper and copper alloys: CuSn, lead-free copper and copper electrolyte	44	51	55	0.070	0.125	0.150	0.165	0.195	0.215	0.225	0.245	0.300
N4.1.1 Non-metallic materials: Duroplastics, fibre-reinforced plastics	35	40	44	0.090	0.160	0.185	0.210	0.245	0.265	0.270	0.285	0.355
N4.1.2 Non-metallic materials: Hard rubber, wood, etc.	35	40	44	0.090	0.160	0.185	0.210	0.245	0.265	0.270	0.285	0.355
N4.1.3 Non-metallic materials: Graphite												
S1.1.1 Heat-resistant alloys, Fe-based, annealed, 200 HB	10	12	13	0.030	0.055	0.065	0.075	0.085	0.095	0.135	0.145	0.180
S1.1.2 Heat-resistant alloys, Fe-based, hardened, 280 HB	8	9	10	0.025	0.045	0.050	0.060	0.070	0.075	0.120	0.130	0.160
S1.1.3 Heat-resistant alloys, Ni- or Co-based, annealed, 250 HB	9	10	11	0.030	0.055	0.065	0.075	0.085	0.095	0.135	0.145	0.180
S1.1.4 Heat-resistant alloys, Ni- or Co-based, hardened, 350 HB	5	6	6	0.025	0.045	0.050	0.060	0.070	0.075	0.120	0.130	0.160
S1.1.5 Heat-resistant alloys, Ni- or Co-based, cast, 320 HB	6	7	8	0.025	0.045	0.050	0.060	0.070	0.075	0.120	0.130	0.160
S2.1.1 Titanium alloys, pure titanium, Rm 400 N/mm²	10	12	13	0.045	0.085	0.100	0.110	0.130	0.140	0.170	0.185	0.225
S2.1.2 Titanium alloys, Alpha and Beta alloys, hardened, Rm 1050 N/mm²	7	7	8	0.040	0.065	0.080	0.090	0.105	0.115	0.150	0.160	0.200
H1.1.1 Hardened steel, hardened and tempered, < 55 HRC												
H1.1.2 Hardened steel, hardened and tempered, < 60 HRC												
H1.1.3 Hardened steel, hardened and tempered, > 60 HRC												
H2.1.1 Chilled cast iron, 400 HB	8	9	10	0.030	0.055	0.065	0.075	0.085	0.095	0.135	0.145	0.180
H2.1.2 Chilled cast iron, hardened and tempered, < 55 HRC												

Twisted HSS-E Countersink

Machining group	HSS	HSCO	f (mm/rev) with nom. Ø								
	v_c (m/min)		6.3	8.3	10.4	12.4	16.5	20.5	25	31	40
P1.1.1 Unalloyed steel, annealed, 0.15 % C, Rm 420 N/mm², 125 HB	36	42	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
P1.1.2 Unalloyed steel, heat-treated, 0.15 % C, Rm 420 N/mm², 125 HB	31	35	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P1.1.3 Unalloyed steel, annealed, 0.45 % C, Rm 640 N/mm², 190 HB	31	35	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P1.1.4 Unalloyed steel, heat-treated, 0.45 % C, Rm 640 N/mm², 190 HB	31	35	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P1.1.5 Unalloyed steel, heat-treated, 0.45 % C, Rm 850 N/mm², 250 HB	27	31	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P1.1.6 Unalloyed steel, annealed, 0.75 % C, Rm 915 N/mm², 270 HB	25	29	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P1.1.7 Unalloyed steel, heat-treated, 0.75 % C, Rm 1020 N/mm², 300 HB	22	25	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P2.1.1 Low-alloy steel, annealed, Rm 610 N/mm², 180 HB	21	24	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
P2.1.2 Low-alloy steel, heat-treated, Rm 930 N/mm², 275 HB	15	17	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P2.1.3 Low-alloy steel, heat-treated, Rm 1020 N/mm², 300 HB	13	15	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
P2.1.4 Low-alloy steel, heat-treated, Rm 1190 N/mm², 350 HB	12	13	0.075	0.080	0.090	0.095	0.110	0.120	0.125	0.140	0.170
P3.1.1 High-alloy steel and tool steel, annealed, Rm 680 N/mm², 200 HB	16	19	0.075	0.085	0.090	0.100	0.110	0.120	0.130	0.140	0.170
P3.1.2 High-alloy steel and tool steel, hardened and tempered, Rm 1100 N/mm², 325 HB	12	14	0.060	0.065	0.075	0.080	0.090	0.095	0.105	0.115	0.150
M1.1.1 Stainless steel, ferritic/martensitic, with machining additives	16	19	0.075	0.085	0.090	0.100	0.110	0.120	0.130	0.140	0.170
M1.1.2 Stainless steel, ferritic/martensitic, annealed, Rm 680 N/mm², 200 HB	15	17	0.075	0.085	0.090	0.100	0.110	0.120	0.130	0.140	0.170
M1.1.3 Stainless steel, ferritic/martensitic, heat-treated, Rm 810 N/mm², 240 HB	14	16	0.060	0.065	0.075	0.080	0.090	0.095	0.105	0.115	0.150
M2.1.1 Stainless steel, austenitic, quenched, 180 HB	15	17	0.050	0.055	0.060	0.065	0.075	0.080	0.085	0.095	0.135
M2.2.1 Duplex steel, high-strength stainless steels											
K1.1.1 Grey cast iron, pearlitic/ferritic, 180 HB	31	36	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
K1.1.2 Grey cast iron, pearlitic/martensitic, 260 HB	25	29	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
K1.2.1 Cast iron with spheroidal graphite, ferritic, 160 HB	27	31	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
K1.2.2 Cast iron with spheroidal graphite, pearlitic, 250 HB	23	27	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
K1.3.1 Malleable cast iron, ferritic, 130 HB	27	31	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
K1.3.2 Malleable cast iron, pearlitic, 230 HB	20	23	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
K2.1.1 Vermicular graphite cast iron (GJV)	25	29	0.075	0.085	0.090	0.100	0.110	0.120	0.130	0.140	0.170
K2.2.1 Austenitic-ferritic spheroidal graphite cast iron (ADI)	13	14	0.035	0.040	0.045	0.050	0.055	0.060	0.065	0.070	0.120
N1.1.1 Wrought aluminium alloys, non-hardened, 60 HB	63	72	0.140	0.160	0.175	0.185	0.210	0.225	0.245	0.265	0.270
N1.1.2 Wrought aluminium alloys, hardened, 100 HB	63	72	0.140	0.160	0.175	0.185	0.210	0.225	0.245	0.265	0.270
N2.1.1 Aluminium casting alloys, non-hardened, ≤ 12 % Si, 75 HB	50	58	0.115	0.130	0.140	0.155	0.170	0.185	0.200	0.220	0.230
N2.1.2 Aluminium casting alloys, hardened, ≤ 12 % Si, 90 HB	40	46	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
N2.1.3 Aluminium casting alloys, non-hardened, > 12 % Si, 130 HB	35	40	0.095	0.105	0.115	0.120	0.135	0.150	0.160	0.175	0.200
N3.1.1 Copper and copper alloys: Free-machining alloy, Pb > 1 %	69	79	0.140	0.160	0.175	0.185	0.210	0.225	0.245	0.265	0.270
N3.1.2 Copper and copper alloys: CuZn, CuSnZn	41	47	0.115	0.125	0.140	0.150	0.165	0.180	0.195	0.215	0.225
N3.1.3 Copper and copper alloys: CuSn, lead-free copper and copper electrolyte	55	63	0.115	0.125	0.140	0.150	0.165	0.180	0.195	0.215	0.225
N4.1.1 Non-metallic materials: Duroplastics, fibre-reinforced plastics	44	50	0.140	0.160	0.175	0.185	0.210	0.225	0.245	0.265	0.270
N4.1.2 Non-metallic materials: Hard rubber, wood, etc.	44	50	0.140	0.160	0.175	0.185	0.210	0.225	0.245	0.265	0.270
N4.1.3 Non-metallic materials: Graphite											
S1.1.1 Heat-resistant alloys, Fe-based, annealed, 200 HB	13	14	0.050	0.055	0.060	0.065	0.075	0.080	0.085	0.095	0.135
S1.1.2 Heat-resistant alloys, Fe-based, hardened, 280 HB	10	12	0.040	0.045	0.050	0.050	0.060	0.065	0.070	0.075	0.120
S1.1.3 Heat-resistant alloys, Ni- or Co-based, annealed, 250 HB	11	12	0.050	0.055	0.060	0.065	0.075	0.080	0.085	0.095	0.135
S1.1.4 Heat-resistant alloys, Ni- or Co-based, hardened, 350 HB	6	7	0.040	0.045	0.050	0.050	0.060	0.065	0.070	0.075	0.120
S1.1.5 Heat-resistant alloys, Ni- or Co-based, cast, 320 HB	8	9	0.040	0.045	0.050	0.050	0.060	0.065	0.070	0.075	0.120
S2.1.1 Titanium alloys, pure titanium, Rm 400 N/mm²	13	14	0.075	0.085	0.090	0.100	0.110	0.120	0.130	0.140	0.170
S2.1.2 Titanium alloys, Alpha and Beta alloys, hardened, Rm 1050 N/mm²	8	9	0.060	0.065	0.075	0.080	0.090	0.095	0.105	0.115	0.150
H1.1.1 Hardened steel, hardened and tempered, < 55 HRC											
H1.1.2 Hardened steel, hardened and tempered, < 60 HRC											
H1.1.3 Hardened steel, hardened and tempered, > 60 HRC											
H2.1.1 Chilled cast iron, 400 HB	10	12	0.050	0.055	0.060	0.065	0.075	0.080	0.085	0.095	0.135
H2.1.2 Chilled cast iron, hardened and tempered, < 55 HRC											

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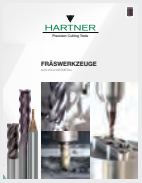

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XXXX | Printed in Germany | 2024

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