

TS-Drills

Carbide special
program



2008
price list 04


















HARTNER

Precision Cutting Tools



TS-Drills, Solid carbide high performance drills

Standard	Type	Tool material	Surface finish	Cutting direction	Coolant	Shank form	Drilling depth	Diameter range	Article no.	Page
										
DIN 6537K	TS 100 U	Sol. carb.	F	rh		HA	3 x D	3.00 - 20.00	89413	3
										
DIN 6537K	TS 100 U	Sol. carb.	F	rh		HE	3 x D	3.00 - 20.00	89402	3
										
DIN 6537K	TS 100 U	Sol. carb.	F	rh	□	HA	3 x D	3.00 - 20.00	89410	3
										
DIN 6537K	TS 100 U	Sol. carb.	F	rh	□	HE	3 x D	3.00 - 20.00	89415	3
										
DIN 6537L	TS 100 U	Sol. carb.	F	rh		HA	5 x D	3.00 - 20.00	89414	11
										
DIN 6537L	TS 100 U	Sol. carb.	F	rh		HE	5 x D	3.00 - 20.00	89417	11
										
DIN 6537L	TS 100 U	Sol. carb.	F	rh	□	HA	5 x D	3.00 - 20.00	89411	11
										
DIN 6537L	TS 100 U	Sol. carb.	F	rh	□	HE	5 x D	2.00 - 20.00	89408	11
										
Hartner std.	TS 100 U	Sol. carb.	F	rh	□	HA	7 x D	3.00 - 20.00	89412	18
										
Hartner std.	TS 100 U	Sol. carb.	F	rh	□	HE	7 x D	3.00 - 20.00	89416	18
										
Hartner std.	TS 100 U	Sol. carb.	F	rh	□	HA	12 x D	3.00 - 20.00	89418	23
										
DIN 6539	N	Sol. carb.	○	rh		DZ	3 x D	2.00 - 12.00	89235	29
										
Hartner std.	N	Sol. carb.	○	rh		DZ	5 x D	2.00 - 12.00	89244	29
										
Hartner std.	TS 150 GG	Sol. carb.	○	rh	□	HA	10 x D	3.00 - 16.00	89293	21
										
DIN 6537L	TS 3 G	Sol. carb.	○	rh		HA	5 x D	3.00 - 20.00	89247	26

Application recommendations see page 34

○ bright F FIRE □ with internal coolant



TS-Drills 3 x D, Solid carbide high performance drills, DIN 6537

without internal coolant

Article no. 89413



High-performance drill for the drilling of long and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AISi-alloys.

For drilling depths up to 3 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with small diameter tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. The tool is available without whistle notch flat for application in shrink fit or hydraulic chucks.

Standard	DIN 6537K
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HA
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

without internal coolant

Article no. 89402



High-performance drill for the drilling of long and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AISi-alloys.

For drilling depths up to 3 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with small diameter tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds.

Standard	DIN 6537K
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HE
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

with internal coolant

Article no. 89410



High-performance drill for the drilling of long and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AISi-alloys.

For drilling depths up to 3 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. The tool is available without whistle notch flat for application in shrink fit or hydraulic chucks.

Standard	DIN 6537K
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HA
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

with internal coolant

Article no. 89415



High-performance drill for the drilling of long and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AISi-alloys.

For drilling depths up to 3 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds.

Standard	DIN 6537K
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HE
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

○ bright

● F FIRE



TS-Drills without internal coolant, 3 x D

					89413	89402
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
3.000	6.000	62.00	20.00	36.00	●	●
3.100	6.000	62.00	20.00	36.00	●	●
3.170	6.000	62.00	20.00	36.00	●	●
3.200	6.000	62.00	20.00	36.00	●	●
3.250	6.000	62.00	20.00	36.00	●	●
3.300	6.000	62.00	20.00	36.00	●	●
3.400	6.000	62.00	20.00	36.00	●	●
3.500	6.000	62.00	20.00	36.00	●	●
3.570	6.000	62.00	20.00	36.00	●	●
3.600	6.000	62.00	20.00	36.00	●	●
3.700	6.000	62.00	20.00	36.00	●	●
3.800	6.000	66.00	24.00	36.00	●	●
3.900	6.000	66.00	24.00	36.00	●	●
3.970	6.000	66.00	24.00	36.00	●	●
4.000	6.000	66.00	24.00	36.00	●	●
4.100	6.000	66.00	24.00	36.00	●	●
4.200	6.000	66.00	24.00	36.00	●	●
4.300	6.000	66.00	24.00	36.00	●	●
4.370	6.000	66.00	24.00	36.00	●	●
4.400	6.000	66.00	24.00	36.00	●	●
4.500	6.000	66.00	24.00	36.00	●	●
4.600	6.000	66.00	24.00	36.00	●	●
4.650	6.000	66.00	24.00	36.00	●	●
4.700	6.000	66.00	24.00	36.00	●	●
4.760	6.000	66.00	28.00	36.00	●	●
4.800	6.000	66.00	28.00	36.00	●	●
4.900	6.000	66.00	28.00	36.00	●	●
5.000	6.000	66.00	28.00	36.00	●	●
5.100	6.000	66.00	28.00	36.00	●	●
5.160	6.000	66.00	28.00	36.00	●	●
5.200	6.000	66.00	28.00	36.00	●	●
5.300	6.000	66.00	28.00	36.00	●	●
5.400	6.000	66.00	28.00	36.00	●	●
5.500	6.000	66.00	28.00	36.00	●	●
5.550	6.000	66.00	28.00	36.00	●	●
5.560	6.000	66.00	28.00	36.00	●	●
5.600	6.000	66.00	28.00	36.00	●	●
5.700	6.000	66.00	28.00	36.00	●	●
5.800	6.000	66.00	28.00	36.00	●	●
5.900	6.000	66.00	28.00	36.00	●	●
5.950	6.000	66.00	28.00	36.00	●	●
6.000	6.000	66.00	28.00	36.00	●	●
6.100	8.000	79.00	34.00	36.00	●	●
6.200	8.000	79.00	34.00	36.00	●	●
6.300	8.000	79.00	34.00	36.00	●	●
6.350	8.000	79.00	34.00	36.00	●	●
6.400	8.000	79.00	34.00	36.00	●	●
6.500	8.000	79.00	34.00	36.00	●	●
6.600	8.000	79.00	34.00	36.00	●	●
6.700	8.000	79.00	34.00	36.00	●	●
6.750	8.000	79.00	34.00	36.00	●	●
6.800	8.000	79.00	34.00	36.00	●	●
6.900	8.000	79.00	34.00	36.00	●	●
7.000	8.000	79.00	34.00	36.00	●	●

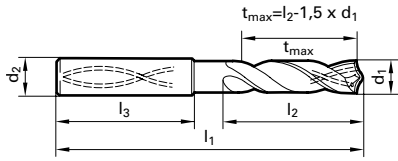
○ bright

● FIRE



HARTNER

TS-Drills with internal coolant, 3 x D



					89410	89415
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
3.000	6.000	62.00	20.00	36.00	●	●
3.100	6.000	62.00	20.00	36.00	●	●
3.170	6.000	62.00	20.00	36.00	●	●
3.200	6.000	62.00	20.00	36.00	●	●
3.250	6.000	62.00	20.00	36.00	●	●
3.300	6.000	62.00	20.00	36.00	●	●
3.400	6.000	62.00	20.00	36.00	●	●
3.500	6.000	62.00	20.00	36.00	●	●
3.570	6.000	62.00	20.00	36.00	●	●
3.600	6.000	62.00	20.00	36.00	●	●
3.700	6.000	62.00	20.00	36.00	●	●
3.800	6.000	66.00	24.00	36.00	●	●
3.900	6.000	66.00	24.00	36.00	●	●
3.970	6.000	66.00	24.00	36.00	●	●
4.000	6.000	66.00	24.00	36.00	●	●
4.100	6.000	66.00	24.00	36.00	●	●
4.200	6.000	66.00	24.00	36.00	●	●
4.300	6.000	66.00	24.00	36.00	●	●
4.370	6.000	66.00	24.00	36.00	●	●
4.400	6.000	66.00	24.00	36.00	●	●
4.500	6.000	66.00	24.00	36.00	●	●
4.600	6.000	66.00	24.00	36.00	●	●
4.650	6.000	66.00	24.00	36.00	●	●
4.700	6.000	66.00	24.00	36.00	●	●
4.760	6.000	66.00	28.00	36.00	●	●
4.800	6.000	66.00	28.00	36.00	●	●
4.900	6.000	66.00	28.00	36.00	●	●
5.000	6.000	66.00	28.00	36.00	●	●
5.100	6.000	66.00	28.00	36.00	●	●
5.160	6.000	66.00	28.00	36.00	●	●
5.200	6.000	66.00	28.00	36.00	●	●
5.300	6.000	66.00	28.00	36.00	●	●
5.400	6.000	66.00	28.00	36.00	●	●
5.500	6.000	66.00	28.00	36.00	●	●
5.550	6.000	66.00	28.00	36.00	●	●
5.560	6.000	66.00	28.00	36.00	●	●
5.600	6.000	66.00	28.00	36.00	●	●
5.700	6.000	66.00	28.00	36.00	●	●
5.800	6.000	66.00	28.00	36.00	●	●
5.900	6.000	66.00	28.00	36.00	●	●
5.950	6.000	66.00	28.00	36.00	●	●
6.000	6.000	66.00	28.00	36.00	●	●
6.100	8.000	79.00	34.00	36.00	●	●
6.200	8.000	79.00	34.00	36.00	●	●
6.300	8.000	79.00	34.00	36.00	●	●
6.350	8.000	79.00	34.00	36.00	●	●
6.400	8.000	79.00	34.00	36.00	●	●
6.500	8.000	79.00	34.00	36.00	●	●
6.600	8.000	79.00	34.00	36.00	●	●
6.700	8.000	79.00	34.00	36.00	●	●
6.750	8.000	79.00	34.00	36.00	●	●
6.800	8.000	79.00	34.00	36.00	●	●
6.900	8.000	79.00	34.00	36.00	●	●
7.000	8.000	79.00	34.00	36.00	●	●

○ bright

● FIRE



HARTNER

TS-Drills without internal coolant, 3 x D

					89413	89402
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm		
7.100	8.000	79.00	41.00	36.00	●	●
7.140	8.000	79.00	41.00	36.00	●	●
7.200	8.000	79.00	41.00	36.00	●	●
7.300	8.000	79.00	41.00	36.00	●	●
7.400	8.000	79.00	41.00	36.00	●	●
7.500	8.000	79.00	41.00	36.00	●	●
7.540	8.000	79.00	41.00	36.00	●	●
7.600	8.000	79.00	41.00	36.00	●	●
7.700	8.000	79.00	41.00	36.00	●	●
7.800	8.000	79.00	41.00	36.00	●	●
7.900	8.000	79.00	41.00	36.00	●	●
7.940	8.000	79.00	41.00	36.00	●	●
8.000	8.000	79.00	41.00	36.00	●	●
8.100	10.000	89.00	47.00	40.00	●	●
8.200	10.000	89.00	47.00	40.00	●	●
8.300	10.000	89.00	47.00	40.00	●	●
8.330	10.000	89.00	47.00	40.00	●	●
8.400	10.000	89.00	47.00	40.00	●	●
8.500	10.000	89.00	47.00	40.00	●	●
8.600	10.000	89.00	47.00	40.00	●	●
8.700	10.000	89.00	47.00	40.00	●	●
8.730	10.000	89.00	47.00	40.00	●	●
8.800	10.000	89.00	47.00	40.00	●	●
8.900	10.000	89.00	47.00	40.00	●	●
9.000	10.000	89.00	47.00	40.00	●	●
9.100	10.000	89.00	47.00	40.00	●	●
9.130	10.000	89.00	47.00	40.00	●	●
9.200	10.000	89.00	47.00	40.00	●	●
9.250	10.000	89.00	47.00	40.00	●	●
9.300	10.000	89.00	47.00	40.00	●	●
9.400	10.000	89.00	47.00	40.00	●	●
9.500	10.000	89.00	47.00	40.00	●	●
9.520	10.000	89.00	47.00	40.00	●	●
9.600	10.000	89.00	47.00	40.00	●	●
9.700	10.000	89.00	47.00	40.00	●	●
9.800	10.000	89.00	47.00	40.00	●	●
9.900	10.000	89.00	47.00	40.00	●	●
9.920	10.000	89.00	47.00	40.00	●	●
10.000	10.000	89.00	47.00	40.00	●	●
10.100	12.000	102.00	55.00	45.00	●	●
10.200	12.000	102.00	55.00	45.00	●	●
10.300	12.000	102.00	55.00	45.00	●	●
10.320	12.000	102.00	55.00	45.00	●	●
10.400	12.000	102.00	55.00	45.00	●	●
10.500	12.000	102.00	55.00	45.00	●	●
10.600	12.000	102.00	55.00	45.00	●	●
10.700	12.000	102.00	55.00	45.00	●	●
10.800	12.000	102.00	55.00	45.00	●	●
10.900	12.000	102.00	55.00	45.00	●	●
11.000	12.000	102.00	55.00	45.00	●	●
11.100	12.000	102.00	55.00	45.00	●	●
11.110	12.000	102.00	55.00	45.00	●	●
11.200	12.000	102.00	55.00	45.00	●	●
11.300	12.000	102.00	55.00	45.00	●	●

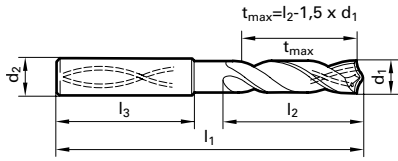
○ bright

● FIRE



HARTNER

TS-Drills with internal coolant, 3 x D



					89410	89415
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
7.100	8.000	79.00	41.00	36.00	●	●
7.140	8.000	79.00	41.00	36.00	●	●
7.200	8.000	79.00	41.00	36.00	●	●
7.300	8.000	79.00	41.00	36.00	●	●
7.400	8.000	79.00	41.00	36.00	●	●
7.500	8.000	79.00	41.00	36.00	●	●
7.540	8.000	79.00	41.00	36.00	●	●
7.600	8.000	79.00	41.00	36.00	●	●
7.700	8.000	79.00	41.00	36.00	●	●
7.800	8.000	79.00	41.00	36.00	●	●
7.900	8.000	79.00	41.00	36.00	●	●
7.940	8.000	79.00	41.00	36.00	●	●
8.000	8.000	79.00	41.00	36.00	●	●
8.100	10.000	89.00	47.00	40.00	●	●
8.200	10.000	89.00	47.00	40.00	●	●
8.300	10.000	89.00	47.00	40.00	●	●
8.330	10.000	89.00	47.00	40.00	●	●
8.400	10.000	89.00	47.00	40.00	●	●
8.500	10.000	89.00	47.00	40.00	●	●
8.600	10.000	89.00	47.00	40.00	●	●
8.700	10.000	89.00	47.00	40.00	●	●
8.730	10.000	89.00	47.00	40.00	●	●
8.800	10.000	89.00	47.00	40.00	●	●
8.900	10.000	89.00	47.00	40.00	●	●
9.000	10.000	89.00	47.00	40.00	●	●
9.100	10.000	89.00	47.00	40.00	●	●
9.130	10.000	89.00	47.00	40.00	●	●
9.200	10.000	89.00	47.00	40.00	●	●
9.250	10.000	89.00	47.00	40.00	●	●
9.300	10.000	89.00	47.00	40.00	●	●
9.400	10.000	89.00	47.00	40.00	●	●
9.500	10.000	89.00	47.00	40.00	●	●
9.520	10.000	89.00	47.00	40.00	●	●
9.600	10.000	89.00	47.00	40.00	●	●
9.700	10.000	89.00	47.00	40.00	●	●
9.800	10.000	89.00	47.00	40.00	●	●
9.900	10.000	89.00	47.00	40.00	●	●
9.920	10.000	89.00	47.00	40.00	●	●
10.000	10.000	89.00	47.00	40.00	●	●
10.100	12.000	102.00	55.00	45.00	●	●
10.200	12.000	102.00	55.00	45.00	●	●
10.300	12.000	102.00	55.00	45.00	●	●
10.320	12.000	102.00	55.00	45.00	●	●
10.400	12.000	102.00	55.00	45.00	●	●
10.500	12.000	102.00	55.00	45.00	●	●
10.600	12.000	102.00	55.00	45.00	●	●
10.700	12.000	102.00	55.00	45.00	●	●
10.800	12.000	102.00	55.00	45.00	●	●
10.900	12.000	102.00	55.00	45.00	●	●
11.000	12.000	102.00	55.00	45.00	●	●
11.100	12.000	102.00	55.00	45.00	●	●
11.110	12.000	102.00	55.00	45.00	●	●
11.200	12.000	102.00	55.00	45.00	●	●
11.300	12.000	102.00	55.00	45.00	●	●

○ bright

● FIRE



HARTNER

Precision Cutting Tools

TM MULTI VENDING MACHINE

Intelligent tool management
around the clock





TS-Drills 5 x D, Solid carbide high performance drills, DIN 6537

without internal coolant

Article no. 89414



High-performance drill for the drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 5 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. The tool is available without whistle notch flat for application in shrink fit/hydraulic chucks.

Standard	DIN 6537L
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HA
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

without internal coolant

Article no. 89417



High-performance drill for the drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 5 x D.

Advantages:

Highest speed and feed rates (see application

recommendations page 34) possible, high alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds.

Standard	DIN 6537L
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HE
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

with internal coolant

Article no. 89411



High-performance drill for the drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 5 x D.

Advantages:

Highest speed and feed rates (see application recommendations page 34) possible, high

alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. The tool is available without whistle notch flat for application in shrink fit/hydraulic chucks.

Standard	DIN 6537L
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HA
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

with internal coolant

Article no. 89408



High-performance drill for the drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable steels and alloyed steels with a tensile strength of up to 1200 N/mm², including carbon steels, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 5 x D.

Advantages:

Highest speed and feed rates (see application

recommendations page 34) possible, high alignment accuracy with tight tolerance and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds.

Standard	DIN 6537L
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HE
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

○ bright

● FIRE



HARTNER

TS-Drills without internal coolant, 5 x D

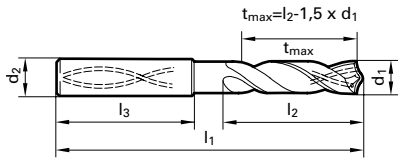
					89414	89417
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
3.000	6.000	66.00	28.00	36.00	●	●
3.100	6.000	66.00	28.00	36.00	●	●
3.170	6.000	66.00	28.00	36.00	●	●
3.200	6.000	66.00	28.00	36.00	●	●
3.250	6.000	66.00	28.00	36.00	●	●
3.300	6.000	66.00	28.00	36.00	●	●
3.400	6.000	66.00	28.00	36.00	●	●
3.500	6.000	66.00	28.00	36.00	●	●
3.570	6.000	66.00	28.00	36.00	●	●
3.600	6.000	66.00	28.00	36.00	●	●
3.700	6.000	66.00	28.00	36.00	●	●
3.800	6.000	74.00	36.00	36.00	●	●
3.900	6.000	74.00	36.00	36.00	●	●
3.970	6.000	74.00	36.00	36.00	●	●
4.000	6.000	74.00	36.00	36.00	●	●
4.100	6.000	74.00	36.00	36.00	●	●
4.200	6.000	74.00	36.00	36.00	●	●
4.300	6.000	74.00	36.00	36.00	●	●
4.370	6.000	74.00	36.00	36.00	●	●
4.400	6.000	74.00	36.00	36.00	●	●
4.500	6.000	74.00	36.00	36.00	●	●
4.600	6.000	74.00	36.00	36.00	●	●
4.650	6.000	74.00	36.00	36.00	●	●
4.700	6.000	74.00	36.00	36.00	●	●
4.760	6.000	82.00	44.00	36.00	●	●
4.800	6.000	82.00	44.00	36.00	●	●
4.900	6.000	82.00	44.00	36.00	●	●
5.000	6.000	82.00	44.00	36.00	●	●
5.100	6.000	82.00	44.00	36.00	●	●
5.160	6.000	82.00	44.00	36.00	●	●
5.200	6.000	82.00	44.00	36.00	●	●
5.300	6.000	82.00	44.00	36.00	●	●
5.400	6.000	82.00	44.00	36.00	●	●
5.500	6.000	82.00	44.00	36.00	●	●
5.550	6.000	82.00	44.00	36.00	●	●
5.560	6.000	82.00	44.00	36.00	●	●
5.600	6.000	82.00	44.00	36.00	●	●
5.700	6.000	82.00	44.00	36.00	●	●
5.800	6.000	82.00	44.00	36.00	●	●
5.900	6.000	82.00	44.00	36.00	●	●
5.950	6.000	82.00	44.00	36.00	●	●
6.000	6.000	82.00	44.00	36.00	●	●
6.100	8.000	91.00	53.00	36.00	●	●
6.200	8.000	91.00	53.00	36.00	●	●
6.300	8.000	91.00	53.00	36.00	●	●
6.350	8.000	91.00	53.00	36.00	●	●
6.400	8.000	91.00	53.00	36.00	●	●
6.500	8.000	91.00	53.00	36.00	●	●
6.600	8.000	91.00	53.00	36.00	●	●
6.700	8.000	91.00	53.00	36.00	●	●
6.750	8.000	91.00	53.00	36.00	●	●
6.800	8.000	91.00	53.00	36.00	●	●
6.900	8.000	91.00	53.00	36.00	●	●
7.000	8.000	91.00	53.00	36.00	●	●

○ bright

● FIRE



TS-Drills with internal coolant, 5 x D



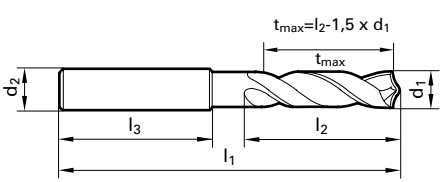
					89411	89408
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
3.000	6.000	66.00	28.00	36.00	●	●
3.100	6.000	66.00	28.00	36.00	●	●
3.170	6.000	66.00	28.00	36.00	●	●
3.200	6.000	66.00	28.00	36.00	●	●
3.250	6.000	66.00	28.00	36.00	●	●
3.300	6.000	66.00	28.00	36.00	●	●
3.400	6.000	66.00	28.00	36.00	●	●
3.500	6.000	66.00	28.00	36.00	●	●
3.570	6.000	66.00	28.00	36.00	●	●
3.600	6.000	66.00	28.00	36.00	●	●
3.700	6.000	66.00	28.00	36.00	●	●
3.800	6.000	74.00	36.00	36.00	●	●
3.900	6.000	74.00	36.00	36.00	●	●
3.970	6.000	74.00	36.00	36.00	●	●
4.000	6.000	74.00	36.00	36.00	●	●
4.100	6.000	74.00	36.00	36.00	●	●
4.200	6.000	74.00	36.00	36.00	●	●
4.300	6.000	74.00	36.00	36.00	●	●
4.370	6.000	74.00	36.00	36.00	●	●
4.400	6.000	74.00	36.00	36.00	●	●
4.500	6.000	74.00	36.00	36.00	●	●
4.600	6.000	74.00	36.00	36.00	●	●
4.650	6.000	74.00	36.00	36.00	●	●
4.700	6.000	74.00	36.00	36.00	●	●
4.760	6.000	82.00	44.00	36.00	●	●
4.800	6.000	82.00	44.00	36.00	●	●
4.900	6.000	82.00	44.00	36.00	●	●
5.000	6.000	82.00	44.00	36.00	●	●
5.100	6.000	82.00	44.00	36.00	●	●
5.160	6.000	82.00	44.00	36.00	●	●
5.200	6.000	82.00	44.00	36.00	●	●
5.300	6.000	82.00	44.00	36.00	●	●
5.400	6.000	82.00	44.00	36.00	●	●
5.500	6.000	82.00	44.00	36.00	●	●
5.550	6.000	82.00	44.00	36.00	●	●
5.560	6.000	82.00	44.00	36.00	●	●
5.600	6.000	82.00	44.00	36.00	●	●
5.700	6.000	82.00	44.00	36.00	●	●
5.800	6.000	82.00	44.00	36.00	●	●
5.900	6.000	82.00	44.00	36.00	●	●
5.950	6.000	82.00	44.00	36.00	●	●
6.000	6.000	82.00	44.00	36.00	●	●
6.100	8.000	91.00	53.00	36.00	●	●
6.200	8.000	91.00	53.00	36.00	●	●
6.300	8.000	91.00	53.00	36.00	●	●
6.350	8.000	91.00	53.00	36.00	●	●
6.400	8.000	91.00	53.00	36.00	●	●
6.500	8.000	91.00	53.00	36.00	●	●
6.600	8.000	91.00	53.00	36.00	●	●
6.700	8.000	91.00	53.00	36.00	●	●
6.750	8.000	91.00	53.00	36.00	●	●
6.800	8.000	91.00	53.00	36.00	●	●
6.900	8.000	91.00	53.00	36.00	●	●
7.000	8.000	91.00	53.00	36.00	●	●

○ bright

● FIRE



TS-Drills without internal coolant, 5 x D

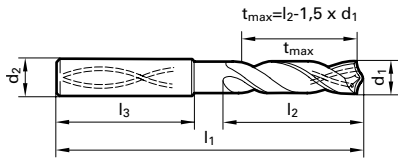
					89414	89417
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
7.100	8.000	91.00	53.00	36.00	●	●
7.140	8.000	91.00	53.00	36.00	●	●
7.200	8.000	91.00	53.00	36.00	●	●
7.300	8.000	91.00	53.00	36.00	●	●
7.400	8.000	91.00	53.00	36.00	●	●
7.500	8.000	91.00	53.00	36.00	●	●
7.540	8.000	91.00	53.00	36.00	●	●
7.600	8.000	91.00	53.00	36.00	●	●
7.700	8.000	91.00	53.00	36.00	●	●
7.800	8.000	91.00	53.00	36.00	●	●
7.900	8.000	91.00	53.00	36.00	●	●
7.940	8.000	91.00	53.00	36.00	●	●
8.000	8.000	91.00	53.00	36.00	●	●
8.100	10.000	103.00	61.00	40.00	●	●
8.200	10.000	103.00	61.00	40.00	●	●
8.300	10.000	103.00	61.00	40.00	●	●
8.330	10.000	103.00	61.00	40.00	●	●
8.400	10.000	103.00	61.00	40.00	●	●
8.500	10.000	103.00	61.00	40.00	●	●
8.600	10.000	103.00	61.00	40.00	●	●
8.700	10.000	103.00	61.00	40.00	●	●
8.730	10.000	103.00	61.00	40.00	●	●
8.800	10.000	103.00	61.00	40.00	●	●
8.900	10.000	103.00	61.00	40.00	●	●
9.000	10.000	103.00	61.00	40.00	●	●
9.100	10.000	103.00	61.00	40.00	●	●
9.130	10.000	103.00	61.00	40.00	●	●
9.200	10.000	103.00	61.00	40.00	●	●
9.250	10.000	103.00	61.00	40.00	●	●
9.300	10.000	103.00	61.00	40.00	●	●
9.400	10.000	103.00	61.00	40.00	●	●
9.500	10.000	103.00	61.00	40.00	●	●
9.520	10.000	103.00	61.00	40.00	●	●
9.600	10.000	103.00	61.00	40.00	●	●
9.700	10.000	103.00	61.00	40.00	●	●
9.800	10.000	103.00	61.00	40.00	●	●
9.900	10.000	103.00	61.00	40.00	●	●
9.920	10.000	103.00	61.00	40.00	●	●
10.000	10.000	103.00	61.00	40.00	●	●
10.100	12.000	118.00	71.00	45.00	●	●
10.200	12.000	118.00	71.00	45.00	●	●
10.300	12.000	118.00	71.00	45.00	●	●
10.320	12.000	118.00	71.00	45.00	●	●
10.400	12.000	118.00	71.00	45.00	●	●
10.500	12.000	118.00	71.00	45.00	●	●
10.600	12.000	118.00	71.00	45.00	●	●
10.700	12.000	118.00	71.00	45.00	●	●
10.800	12.000	118.00	71.00	45.00	●	●
10.900	12.000	118.00	71.00	45.00	●	●
11.000	12.000	118.00	71.00	45.00	●	●
11.100	12.000	118.00	71.00	45.00	●	●
11.110	12.000	118.00	71.00	45.00	●	●
11.200	12.000	118.00	71.00	45.00	●	●
11.300	12.000	118.00	71.00	45.00	●	●

○ bright

● FIRE



TS-Drills with internal coolant, 5 x D



					89411	89408
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
7.100	8.000	91.00	53.00	36.00	●	●
7.140	8.000	91.00	53.00	36.00	●	●
7.200	8.000	91.00	53.00	36.00	●	●
7.300	8.000	91.00	53.00	36.00	●	●
7.400	8.000	91.00	53.00	36.00	●	●
7.500	8.000	91.00	53.00	36.00	●	●
7.540	8.000	91.00	53.00	36.00	●	●
7.600	8.000	91.00	53.00	36.00	●	●
7.700	8.000	91.00	53.00	36.00	●	●
7.800	8.000	91.00	53.00	36.00	●	●
7.900	8.000	91.00	53.00	36.00	●	●
7.940	8.000	91.00	53.00	36.00	●	●
8.000	8.000	91.00	53.00	36.00	●	●
8.100	10.000	103.00	61.00	40.00	●	●
8.200	10.000	103.00	61.00	40.00	●	●
8.300	10.000	103.00	61.00	40.00	●	●
8.330	10.000	103.00	61.00	40.00	●	●
8.400	10.000	103.00	61.00	40.00	●	●
8.500	10.000	103.00	61.00	40.00	●	●
8.600	10.000	103.00	61.00	40.00	●	●
8.700	10.000	103.00	61.00	40.00	●	●
8.730	10.000	103.00	61.00	40.00	●	●
8.800	10.000	103.00	61.00	40.00	●	●
8.900	10.000	103.00	61.00	40.00	●	●
9.000	10.000	103.00	61.00	40.00	●	●
9.100	10.000	103.00	61.00	40.00	●	●
9.130	10.000	103.00	61.00	40.00	●	●
9.200	10.000	103.00	61.00	40.00	●	●
9.250	10.000	103.00	61.00	40.00	●	●
9.300	10.000	103.00	61.00	40.00	●	●
9.400	10.000	103.00	61.00	40.00	●	●
9.500	10.000	103.00	61.00	40.00	●	●
9.520	10.000	103.00	61.00	40.00	●	●
9.600	10.000	103.00	61.00	40.00	●	●
9.700	10.000	103.00	61.00	40.00	●	●
9.800	10.000	103.00	61.00	40.00	●	●
9.900	10.000	103.00	61.00	40.00	●	●
9.920	10.000	103.00	61.00	40.00	●	●
10.000	10.000	103.00	61.00	40.00	●	●
10.100	12.000	118.00	71.00	45.00	●	●
10.200	12.000	118.00	71.00	45.00	●	●
10.300	12.000	118.00	71.00	45.00	●	●
10.320	12.000	118.00	71.00	45.00	●	●
10.400	12.000	118.00	71.00	45.00	●	●
10.500	12.000	118.00	71.00	45.00	●	●
10.600	12.000	118.00	71.00	45.00	●	●
10.700	12.000	118.00	71.00	45.00	●	●
10.800	12.000	118.00	71.00	45.00	●	●
10.900	12.000	118.00	71.00	45.00	●	●
11.000	12.000	118.00	71.00	45.00	●	●
11.100	12.000	118.00	71.00	45.00	●	●
11.110	12.000	118.00	71.00	45.00	●	●
11.200	12.000	118.00	71.00	45.00	●	●
11.300	12.000	118.00	71.00	45.00	●	●

○ bright

● FIRE



TS-Drills 7 x D, Solid carbide high performance drills, Hartner std.

with internal coolant

Article no. 89412



For drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable and alloyed steels with tensile strength of up to 1200 N/mm², incl. carbon steels, bronze, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 7 x D.

Advantages:

Highest speed and feed rates possible, high alignment accuracy with tight tolerance

and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. The tool is available without whistle notch flat for the application in hydraulic/shrink fit chucks.

Standard	Hartner std.
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HA
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7

with internal coolant

Article no. 89416



For drilling of long- and short-chipping materials such as structural and case hardened steels, cast steels, heat-treatable and alloyed steels with tensile strength of up to 1200 N/mm², incl. carbon steels, bronze, cast iron and high-alloyed AlSi-alloys. For drilling depths up to 7 x D.

Advantages:

Highest speed and feed rates possible, high alignment accuracy with tight tolerance

and excellent surface finish. Excellent self-centering qualities as well as producing short chips thanks to a straight cutting point geometry with special point grind and web thinning.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds.

Standard	Hartner std.
Tool material	Solid carbide
Surface finish	F
Type	TS 100 U
Shank	HE
Cutting direction	rh
Point grinding	2-facet
Point angle °	140
Tolerance on Ø	m7



TS-Drills with internal coolant, 7 x D

					89412	89416
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
3.000	6.000	70.00	30.00	36.00	●	●
3.100	6.000	70.00	30.00	36.00	●	●
3.170	6.000	70.00	30.00	36.00	●	●
3.200	6.000	70.00	30.00	36.00	●	●
3.250	6.000	70.00	30.00	36.00	●	●
3.300	6.000	70.00	30.00	36.00	●	●
3.400	6.000	75.00	35.50	36.00	●	●
3.500	6.000	75.00	35.50	36.00	●	●
3.570	6.000	75.00	35.50	36.00	●	●
3.600	6.000	75.00	35.50	36.00	●	●
3.700	6.000	75.00	35.50	36.00	●	●
3.800	6.000	75.00	37.50	36.00	●	●
3.900	6.000	75.00	37.50	36.00	●	●
3.970	6.000	75.00	37.50	36.00	●	●
4.000	6.000	75.00	37.50	36.00	●	●
4.100	6.000	75.00	37.50	36.00	●	●
4.200	6.000	75.00	37.50	36.00	●	●
4.300	6.000	85.00	45.00	36.00	●	●
4.370	6.000	85.00	45.00	36.00	●	●
4.400	6.000	85.00	45.00	36.00	●	●
4.500	6.000	85.00	45.00	36.00	●	●
4.600	6.000	85.00	45.00	36.00	●	●
4.650	6.000	85.00	45.00	36.00	●	●
4.700	6.000	85.00	45.00	36.00	●	●
4.760	6.000	90.00	50.00	36.00	●	●
4.800	6.000	90.00	50.00	36.00	●	●
4.900	6.000	90.00	50.00	36.00	●	●
5.000	6.000	90.00	50.00	36.00	●	●
5.100	6.000	90.00	50.00	36.00	●	●
5.160	6.000	90.00	50.00	36.00	●	●
5.200	6.000	90.00	50.00	36.00	●	●
5.300	6.000	90.00	50.00	36.00	●	●
5.400	6.000	97.00	57.00	36.00	●	●
5.500	6.000	97.00	57.00	36.00	●	●
5.700	6.000	97.00	57.00	36.00	●	●
5.800	6.000	97.00	57.00	36.00	●	●
5.900	6.000	97.00	57.00	36.00	●	●
6.000	6.000	97.00	57.00	36.00	●	●
6.200	8.000	106.00	66.00	36.00	●	●
6.300	8.000	106.00	66.00	36.00	●	●
6.350	8.000	106.00	66.00	36.00	●	●
6.500	8.000	106.00	66.00	36.00	●	●
6.600	8.000	106.00	66.00	36.00	●	●
6.700	8.000	106.00	66.00	36.00	●	●
6.800	8.000	106.00	66.00	36.00	●	●
6.900	8.000	116.00	76.00	36.00	●	●
7.000	8.000	116.00	76.00	36.00	●	●
7.100	8.000	116.00	76.00	36.00	●	●
7.200	8.000	116.00	76.00	36.00	●	●
7.500	8.000	116.00	76.00	36.00	●	●
7.600	8.000	116.00	76.00	36.00	●	●
7.700	8.000	116.00	76.00	36.00	●	●
7.800	8.000	116.00	76.00	36.00	●	●
8.000	8.000	116.00	76.00	36.00	●	●

○ bright

● FIRE



TS-Drills with internal coolant, 7 x D

					89412	89416
					Solid carbide	Solid carbide
					155	155
					HA	HE
					TS 100 U	TS 100 U
					F	F
d1	d2	l1	l2	l3	Availability	
mm	mm	mm	mm	mm	Availability	
8.100	10.000	131.00	87.00	40.00	●	●
8.200	10.000	131.00	87.00	40.00	●	●
8.400	10.000	131.00	87.00	40.00	●	●
8.500	10.000	131.00	87.00	40.00	●	●
8.600	10.000	131.00	87.00	40.00	●	●
8.700	10.000	131.00	87.00	40.00	●	●
8.800	10.000	131.00	87.00	40.00	●	●
9.000	10.000	131.00	87.00	40.00	●	●
9.100	10.000	139.00	95.00	40.00	●	●
9.200	10.000	139.00	95.00	40.00	●	●
9.300	10.000	139.00	95.00	40.00	●	●
9.400	10.000	139.00	95.00	40.00	●	●
9.500	10.000	139.00	95.00	40.00	●	●
9.520	10.000	139.00	95.00	40.00	●	●
9.700	10.000	139.00	95.00	40.00	●	●
9.800	10.000	139.00	95.00	40.00	●	●
9.900	10.000	139.00	95.00	40.00	●	●
10.000	10.000	139.00	95.00	40.00	●	●
10.200	12.000	155.00	106.00	45.00	●	●
10.500	12.000	155.00	106.00	45.00	●	●
10.800	12.000	155.00	106.00	45.00	●	●
11.000	12.000	155.00	106.00	45.00	●	●
11.200	12.000	163.00	114.00	45.00	●	●
11.500	12.000	163.00	114.00	45.00	●	●
11.800	12.000	163.00	114.00	45.00	●	●
12.000	12.000	163.00	114.00	45.00	●	●
12.200	14.000	182.00	133.00	45.00	●	●
12.500	14.000	182.00	133.00	45.00	●	●
12.700	14.000	182.00	133.00	45.00	●	●
13.000	14.000	182.00	133.00	45.00	●	●
13.500	14.000	182.00	133.00	45.00	●	●
14.000	14.000	182.00	133.00	45.00	●	●
14.200	16.000	204.00	152.00	48.00	●	●
14.500	16.000	204.00	152.00	48.00	●	●
15.000	16.000	204.00	152.00	48.00	●	●
15.500	16.000	204.00	152.00	48.00	●	●
16.000	16.000	204.00	152.00	48.00	●	●
16.500	18.000	223.00	171.00	48.00	●	●
17.000	18.000	223.00	171.00	48.00	●	●
17.500	18.000	223.00	171.00	48.00	●	●
18.000	18.000	223.00	171.00	48.00	●	●
18.500	20.000	244.00	190.00	50.00	●	●
19.000	20.000	244.00	190.00	50.00	●	●
19.050	20.000	244.00	190.00	50.00	●	●
19.500	20.000	244.00	190.00	50.00	●	●
20.000	20.000	244.00	190.00	50.00	●	●

○ bright

● FIRE



TS-Drills 10 x D, Solid carbide high performance drills, Hartner std.

with internal coolant

Article no. 89293



Straight fluted drill for the drilling of short-chipping materials such as cast iron, grey cast iron, spheroidal graphite and malleable cast iron. For the production of holes with high alignment accuracy (minimal deviation from straightness).

The drills are available bright or with T-, A-, C- and F-coating, for further performance in special machining processes. Recoating is not necessary when regrinding.

For drilling depths up to 10 x D.

Advantages: Extremely good self-centering qualities, small diameter tolerances (to H7), excellent surface finish, high cutting rates, high productivity.

Preconditions for use:

Powerful machines. No play in spindle bearings.

Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. We recommend the application of shrink fit/hydraulic chucks.

Standard Hartner std.

Tool material **Solid carbide**

Surface finish ○

Type TS 150 GG

Shank HA

Cutting direction rh

Point grinding relieved cone

Point angle ° 120

Tolerance on Ø m7

○ bright

● FIRE



TS-Drills 12 x D, Solid carbide high performance drills, Hartner std.

with internal coolant

Article no. 89418



High-performance drill for drilling deep holes in steel, cast iron and non-ferrous metals. For drilling depths up to 12 x D.

Advantages:

Excellent self-centering qualities thanks to special point grind. Provides safe chip flow even with tough and long-chipping materials due to adapted drill profile and large flute space. Double margins for excellent hole alignment and with good surface

qualities and optimal support of the tool during exit.

Preconditions for use:

Powerful machines. No play in spindle bearings. Alignment accurate tool holders. Max. concentricity error of clamped tools: 0.02 mm. Chatterfree, mechanical feeds. We recommend the application of hydraulic chucks.

Standard Hartner std.

Tool material **Solid carbide**

Surface finish **F**

Type TS 100 U

Shank HA

Cutting direction rh

Point grinding 2-facet

Point angle ° 140

Tolerance on Ø m7

○ bright

● F FIRE



TS-Drills with internal coolant, 12 x D

					89418				
					Solid carbide				
					155				
					HA				
					TS 100				
					F				
d1	d2	l1	l2	l3	Availability				
mm	mm	mm	mm	mm					
3.000	6.000	90.00	50.00	36.00	●				
3.100	6.000	90.00	50.00	36.00	●				
3.170	6.000	90.00	50.00	36.00	●				
3.200	6.000	90.00	50.00	36.00	●				
3.300	6.000	90.00	50.00	36.00	●				
3.400	6.000	90.00	50.00	36.00	●				
3.500	6.000	90.00	50.00	36.00	●				
3.600	6.000	90.00	50.00	36.00	●				
3.700	6.000	90.00	50.00	36.00	●				
3.800	6.000	102.00	64.00	36.00	●				
3.900	6.000	102.00	64.00	36.00	●				
4.000	6.000	102.00	64.00	36.00	●				
4.100	6.000	102.00	64.00	36.00	●				
4.200	6.000	102.00	64.00	36.00	●				
4.300	6.000	102.00	64.00	36.00	●				
4.400	6.000	102.00	64.00	36.00	●				
4.500	6.000	102.00	64.00	36.00	●				
4.600	6.000	102.00	64.00	36.00	●				
4.700	6.000	102.00	64.00	36.00	●				
4.800	6.000	116.00	78.00	36.00	●				
4.900	6.000	116.00	78.00	36.00	●				
5.000	6.000	116.00	78.00	36.00	●				
5.100	6.000	116.00	78.00	36.00	●				
5.200	6.000	116.00	78.00	36.00	●				
5.300	6.000	116.00	78.00	36.00	●				
5.400	6.000	116.00	78.00	36.00	●				
5.500	6.000	116.00	78.00	36.00	●				
5.600	6.000	116.00	78.00	36.00	●				
5.700	6.000	116.00	78.00	36.00	●				
5.800	6.000	116.00	78.00	36.00	●				
5.900	6.000	116.00	78.00	36.00	●				
6.000	6.000	116.00	78.00	36.00	●				
6.100	8.000	146.00	108.00	36.00	●				
6.200	8.000	146.00	108.00	36.00	●				
6.300	8.000	146.00	108.00	36.00	●				
6.350	8.000	146.00	108.00	36.00	●				
6.400	8.000	146.00	108.00	36.00	●				
6.500	8.000	146.00	108.00	36.00	●				
6.600	8.000	146.00	108.00	36.00	●				
6.700	8.000	146.00	108.00	36.00	●				
6.800	8.000	146.00	108.00	36.00	●				
6.900	8.000	146.00	108.00	36.00	●				
7.000	8.000	146.00	108.00	36.00	●				
7.100	8.000	146.00	108.00	36.00	●				
7.200	8.000	146.00	108.00	36.00	●				
7.300	8.000	146.00	108.00	36.00	●				
7.400	8.000	146.00	108.00	36.00	●				
7.500	8.000	146.00	108.00	36.00	●				
7.600	8.000	146.00	108.00	36.00	●				
7.700	8.000	146.00	108.00	36.00	●				
7.800	8.000	146.00	108.00	36.00	●				
7.900	8.000	146.00	108.00	36.00	●				
8.000	8.000	146.00	108.00	36.00	●				
8.100	10.000	162.00	120.00	40.00	●				

○ bright

● FIRE



TS-Drills with internal coolant, 12 x D

					89418
					Solid carbide
					155
					HA
					TS 100
					F
					Availability
d1	d2	l1	l2	l3	
mm	mm	mm	mm	mm	
8.200	10.000	162.00	120.00	40.00	●
8.300	10.000	162.00	120.00	40.00	●
8.400	10.000	162.00	120.00	40.00	●
8.500	10.000	162.00	120.00	40.00	●
8.600	10.000	162.00	120.00	40.00	●
8.700	10.000	162.00	120.00	40.00	●
8.800	10.000	162.00	120.00	40.00	●
8.900	10.000	162.00	120.00	40.00	●
9.000	10.000	162.00	120.00	40.00	●
9.100	10.000	162.00	120.00	40.00	●
9.200	10.000	162.00	120.00	40.00	●
9.300	10.000	162.00	120.00	40.00	●
9.400	10.000	162.00	120.00	40.00	●
9.500	10.000	162.00	120.00	40.00	●
9.520	10.000	162.00	120.00	40.00	●
9.600	10.000	162.00	120.00	40.00	●
9.700	10.000	162.00	120.00	40.00	●
9.800	10.000	162.00	120.00	40.00	●
9.900	10.000	162.00	120.00	40.00	●
10.000	10.000	162.00	120.00	40.00	●
10.200	12.000	204.00	156.00	45.00	●
10.500	12.000	204.00	156.00	45.00	●
11.000	12.000	204.00	156.00	45.00	●
11.500	12.000	204.00	156.00	45.00	●
12.000	12.000	204.00	156.00	45.00	●
12.500	14.000	230.00	182.00	45.00	●
12.700	14.000	230.00	182.00	45.00	●
13.000	14.000	230.00	182.00	45.00	●
13.500	14.000	230.00	182.00	45.00	●
14.000	14.000	230.00	182.00	45.00	●
14.500	16.000	260.00	208.00	48.00	●
15.000	16.000	260.00	208.00	48.00	●
15.500	16.000	260.00	208.00	48.00	●
16.000	16.000	260.00	208.00	48.00	●
16.500	18.000	285.00	234.00	48.00	●
17.000	18.000	285.00	234.00	48.00	●
17.500	18.000	285.00	234.00	48.00	●
18.000	18.000	285.00	234.00	48.00	●
18.500	20.000	310.00	258.00	50.00	●
19.000	20.000	310.00	258.00	50.00	●
19.050	20.000	310.00	258.00	50.00	●
19.500	20.000	310.00	258.00	50.00	●
20.000	20.000	310.00	258.00	50.00	●

○ bright

● FIRE



TS-Drills 5 x D, Solid carbide high performance drills, 3-flute, DIN 6537

without internal coolant

Article no. 89247



A tool for heavy duty drilling from the solid, giving precise centering and accurate hole form. This includes applications such as oblique centering or interrupted drilling. Precision in size and surface finish correspond to those achieved with core drills. Centering or spotting is not normally required. Suitable for drilling cast iron and long-chipping aluminium alloys. For drilling depths up to 5 x D.

Standard	DIN 6537L
Tool material	Solid carbide
Surface finish	○
Type	TS 3 G
Shank	HA
Cutting direction	rh
Point grinding	Spiropoint
Point angle °	130
Tolerance on Ø	m7

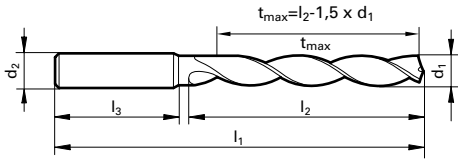
○ bright

● FIRE



HARTNER

TS-Drills, 3-fluted



					89247
					Solid carbide
					155
					HA
					TS 3 G
					○
d1	d2	l1	l2	l3	Availability
mm	mm	mm	mm	mm	
3.000	6.000	66.00	28.00	36.00	●
3.100	6.000	66.00	28.00	36.00	●
3.200	6.000	66.00	28.00	36.00	●
3.300	6.000	66.00	28.00	36.00	●
3.500	6.000	66.00	28.00	36.00	●
3.700	6.000	66.00	28.00	36.00	●
3.800	6.000	74.00	36.00	36.00	●
4.000	6.000	74.00	36.00	36.00	●
4.100	6.000	74.00	36.00	36.00	●
4.200	6.000	74.00	36.00	36.00	●
4.500	6.000	74.00	36.00	36.00	●
4.800	6.000	82.00	44.00	36.00	●
5.000	6.000	82.00	44.00	36.00	●
5.100	6.000	82.00	44.00	36.00	●
5.200	6.000	82.00	44.00	36.00	●
5.300	6.000	82.00	44.00	36.00	●
5.500	6.000	82.00	44.00	36.00	●
5.800	6.000	82.00	44.00	36.00	●
6.000	6.000	82.00	44.00	36.00	●
6.100	8.000	91.00	53.00	36.00	●
6.200	8.000	91.00	53.00	36.00	●
6.400	8.000	91.00	53.00	36.00	●
6.500	8.000	91.00	53.00	36.00	●
6.700	8.000	91.00	53.00	36.00	●
6.800	8.000	91.00	53.00	36.00	●
7.000	8.000	91.00	53.00	36.00	●
7.100	8.000	91.00	53.00	36.00	●
7.400	8.000	91.00	53.00	36.00	●
7.500	8.000	91.00	53.00	36.00	●
7.800	8.000	91.00	53.00	36.00	●
8.000	8.000	91.00	53.00	36.00	●
8.100	10.000	103.00	61.00	40.00	●
8.200	10.000	103.00	61.00	40.00	●
8.400	10.000	103.00	61.00	40.00	●
8.500	10.000	103.00	61.00	40.00	●
8.600	10.000	103.00	61.00	40.00	●
8.700	10.000	103.00	61.00	40.00	●
8.800	10.000	103.00	61.00	40.00	●
9.000	10.000	103.00	61.00	40.00	●
9.100	10.000	103.00	61.00	40.00	●
9.500	10.000	103.00	61.00	40.00	●
9.800	10.000	103.00	61.00	40.00	●
10.000	10.000	103.00	61.00	40.00	●
10.100	12.000	118.00	71.00	45.00	●
10.200	12.000	118.00	71.00	45.00	●
10.300	12.000	118.00	71.00	45.00	●
10.500	12.000	118.00	71.00	45.00	●
11.000	12.000	118.00	71.00	45.00	●
11.200	12.000	118.00	71.00	45.00	●
11.500	12.000	118.00	71.00	45.00	●
11.800	12.000	118.00	71.00	45.00	●
12.000	12.000	118.00	71.00	45.00	●
12.100	14.000	124.00	77.00	45.00	●
12.500	14.000	124.00	77.00	45.00	●

○ bright

● FIRE



HARTNER

Solid carbide twist drills

Stub drills 3 x D without internal coolant

Article no. 89235



A very rigid drill for use in automatics and capstan lathes. Especially suitable for the drilling of high tensile steel, cast steel, grey cast iron, CrNi-steels, bronzes, light metals and nonferrous metals. Ideally suited to the economic machining of abrasive materials (AlSi-alloys), fibre-reinforced plastics and other Duroplastics that are liable to cause severe abrasion on cutting lips and lands.

Standard	DIN 6539
Tool material	Solid carbide
Surface finish	○
Type	N
Shank	rh
Cutting direction	2-facet
Point grinding	118
Point angle °	2,00
Tolerance on Ø	h7

Jobber drills 5 x D without internal coolant

Article no. 89244



A standard drill for the drilling of high tensile steels, cast steel, grey cast iron, chilled cast iron, austenitic manganese steel, CrNi-steels, bronzes, light metals and nonferrous metals. Ideally suited to the economic machining of abrasive materials (AlSi-alloys), fiber-reinforced plastics and other Duroplastics liable to cause severe abrasion on cutting lip and lands.

Standard	Hartner std.
Tool material	Solid carbide
Surface finish	○
Type	N
Shank	rh
Cutting direction	2-facet
Point grinding	118
Point angle °	2,00
Tolerance on Ø	h7

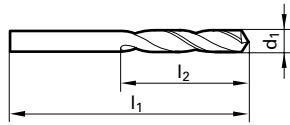
○ bright

● FIRE



HARTNER

Stub drills, 3 x D



			89235
			Solid carbide
			155
			DZ
			N
			○
d1	l1	l2	Availability
mm	mm	mm	
2.000	38.00	12.00	●
2.100	38.00	12.00	●
2.200	40.00	13.00	●
2.300	40.00	13.00	●
2.380	43.00	14.00	●
2.400	43.00	14.00	●
2.500	43.00	14.00	●
2.600	43.00	14.00	●
2.700	46.00	16.00	●
2.780	46.00	16.00	●
2.800	46.00	16.00	●
2.900	46.00	16.00	●
3.000	46.00	16.00	●
3.100	49.00	18.00	●
3.170	49.00	18.00	●
3.200	49.00	18.00	●
3.300	49.00	18.00	●
3.400	52.00	20.00	●
3.500	52.00	20.00	●
3.570	52.00	20.00	●
3.600	52.00	20.00	●
3.700	52.00	20.00	●
3.800	55.00	22.00	●
3.900	55.00	22.00	●
3.970	55.00	22.00	●
4.000	55.00	22.00	●
4.100	55.00	22.00	●
4.200	55.00	22.00	●
4.300	58.00	24.00	●
4.370	58.00	24.00	●
4.400	58.00	24.00	●
4.500	58.00	24.00	●
4.600	58.00	24.00	●
4.700	58.00	24.00	●
4.760	62.00	26.00	●
4.800	62.00	26.00	●
4.900	62.00	26.00	●
5.000	62.00	26.00	●
5.200	62.00	26.00	●
5.500	66.00	28.00	●
5.800	66.00	28.00	●
6.000	66.00	28.00	●
6.350	70.00	31.00	●
6.500	70.00	31.00	●
6.800	74.00	34.00	●
7.000	74.00	34.00	●
7.140	74.00	34.00	●
7.500	74.00	34.00	●
7.940	79.00	37.00	●
8.000	79.00	37.00	●
8.500	79.00	37.00	●
8.730	84.00	40.00	●
8.800	84.00	40.00	●
9.000	84.00	40.00	●

○ bright

● FIRE



HARTNER

Jobber drills, 5 x D

			89244	
			Solid carbide	
			155	
			DZ	
			N	
			○	
d1	l1	l2	Availability	
mm	mm	mm		
2.000	49.00	24.00	●	
2.100	49.00	24.00	●	
2.200	53.00	27.00	●	
2.300	53.00	27.00	●	
2.380	57.00	30.00	●	
2.400	57.00	30.00	●	
2.500	57.00	30.00	●	
2.600	57.00	30.00	●	
2.700	61.00	33.00	●	
2.780	61.00	33.00	●	
2.800	61.00	33.00	●	
2.900	61.00	33.00	●	
3.000	61.00	33.00	●	
3.100	65.00	36.00	●	
3.170	65.00	36.00	●	
3.200	65.00	36.00	●	
3.300	65.00	36.00	●	
3.400	70.00	39.00	●	
3.500	70.00	39.00	●	
3.570	70.00	39.00	●	
3.600	70.00	39.00	●	
3.700	70.00	39.00	●	
3.800	75.00	43.00	●	
3.900	75.00	43.00	●	
3.970	75.00	43.00	●	
4.000	75.00	43.00	●	
4.100	75.00	43.00	●	
4.200	75.00	43.00	●	
4.300	80.00	47.00	●	
4.370	80.00	47.00	●	
4.400	80.00	47.00	●	
4.500	80.00	47.00	●	
4.600	80.00	47.00	●	
4.700	80.00	47.00	●	
4.760	86.00	52.00	●	
4.800	86.00	52.00	●	
4.900	86.00	52.00	●	
5.000	86.00	52.00	●	
5.160	86.00	52.00	●	
5.500	93.00	57.00	●	
5.560	93.00	57.00	●	
5.950	93.00	57.00	●	
6.000	93.00	57.00	●	
6.350	101.00	63.00	●	
6.500	101.00	63.00	●	
6.800	109.00	69.00	●	
7.000	109.00	69.00	●	
7.140	109.00	69.00	●	
7.500	109.00	69.00	●	
7.940	117.00	75.00	●	
8.000	117.00	75.00	●	
8.500	117.00	75.00	●	
8.730	125.00	81.00	●	
9.000	125.00	81.00	●	

○ bright

● FIRE



Application recommendations for Solid carbide twist drills

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

General hints:

For safety reasons it is very important, that a drill does not exceed a speed of $n = 6\,000$ rev./min when not supported. The centrifugal forces could break these long tools before reaching the workpiece surface!

Pilot holes are always necessary for drilling depths over 7xD-, 10xD- and 12xD:

1.) The pilot hole can be produced with a short, rigid drill. The diameter should be 0.01 - 0.02 mm larger than the diameter of the Ratio drill. Drilling depth $\geq 1 \times D$.

2.) Alternatively, the Ratio Drills can produce their own pilot hole. Cutting speed and feed rate must therefore be reduced by 30-40%.

A coolant pressure of 40 bar is recommended.

$\leq 3 \times D$ drilling depth

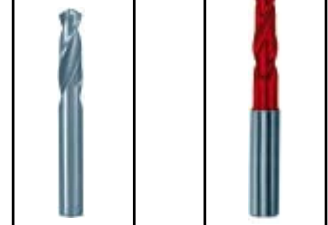
Tool material	Sol. carb.	Sol. carb.
Carbide grade	K10/K20	K/P
Carbide description	Carbide	Carbide-UF
Surface finish		
Type	N	TS 100 U
Coolant ducts	-	

Article no.	Form HA, plain shank	
	DIN 6537 Form HE, whistle notch	
	DIN 6539	89235
	Hartner std.	

drill dia. mm	Feed column nos.								
	1	2	3	4	5	6	7	8	9
	f (mm/rev.)								
0.50	0.004	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.019
1.00	0.006	0.008	0.012	0.014	0.016	0.018	0.020	0.023	0.025
2.00	0.020	0.025	0.032	0.040	0.050	0.063	0.080	0.100	0.125
2.50	0.025	0.032	0.040	0.050	0.063	0.080	0.100	0.125	0.160
3.15	0.032	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.160
4.00	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.200
5.00	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.250
6.30	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.250	0.315
8.00	0.063	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.315
10.00	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.400
12.50	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500
16.00	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630
20.00	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.630
25.00	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
31.50	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000
40.00	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000	1.250
50.00	0.250	0.310	0.400	0.500	0.630	0.800	1.000	1.250	1.250
63.00	0.315	0.400	0.500	0.630	0.800	1.000	1.250	1.600	1.600
80.00	0.400	0.500	0.630	0.800	1.000	1.250	1.600	1.600	2.000

- with coolant ducts
- bright
- FIRE-coated
- UF Ultra fine grain
- * Cutting lip corrected to appr. 10°

- Coolant
- soluble oil
- oil
- air



Material group	Material examples, new description (old description in brackets) Figures in bold = material no. to DIN EN	Tensile str. MPa (N/mm²)	Hardness	Coolant	Vc m/min	Feed column no.	Vc m/min	Feed column no.
Common structural steels	1.0035 S185(St33), 1.0486 P275N(StE285), 1.0345 P235GH(H1), 1.0425 P265GH(H2), 1.0050 E295 (St50-2), 1.0070 E360 (St70-2), 1.8937 P500NH (WStE500)	≤500 >500-850			80 70	4 4	145 120	7 6
Free-cutting steels	1.0718 T1SMnPb30 (9SMnPb28), 1.0736 T1SMn37 (9SMn36), 1.0727 46S20 (45S20), 1.0728 (60S20), 1.0757 46SPb20 (45SPb20)	≤850 850-1000			80 70	5 4	170 145	8 8
Unalloyed heat-treatable steels	1.0402 C22, 1.1178 C30E (Ck30), 1.0503 C45, 1.1191 C45E (Ck45), 1.0601 C60, 1.1221 C60E (Ck60)	≤ 700 700-850 850-1000			80 70 60	4 4 4	130 125 120	8 7 7
Alloyed heat-treatable steels	1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4, 1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4	850-1000 1000-1200			60	4	120 105	7 7
Unalloyed case hardened steels	1.0301 (C10), 1.1121 C10E (Ck10)	≤750			80	5	145	8
Alloyed case hardened steels	1.7043 38Cr4, 1.5752 15NiCr13 (15NiCr13), 1.7131 16MnCr5, 1.7264 20CrMo5	850-1000 1000-1200			60	4	85 120	5 7
Nitriding steels	1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	≥850-1000 1000-1200			50	4	110 105	7 5
Tool steels	1.1750 C75W, 1.2067 102Cr6, 1.2307 29CrMoV9, 1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 105WCr6, 1.2767 X45NiCrMo4	≤850 850-1000			50	3	80 65	6 5
High speed steels	1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3	≥650-1000						
Spring steels	1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4 (51CrV4)	≤330 HB			25	2	60	3
Stainless steels, sulphured	1.4005 X12CrS13, 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305	≤850			25	4	60	5
Stainless steels, austenitic	1.4301 X5CrNi18-10 (V2A), 1.4541 X6CrNiTi18-10, 1.4571 X6CrNiMoTi	≤850			25	3	55	5
Stainless steels, martensitic	1.4057 X20CrNi17 2 (X17CrNi16-2), 1.4122 X39CrMo17-1, 1.4521 X2CrMoTi18-2	≤850			25	3	45	5
Hardened steels	-	≤40-48 HRC >48-60 HRC			20	3	55 35	3 2
Special alloys	Nimonic, Inconel, Monel, Hastelloy	≤1200			15	2	35	4
Cast iron	0.6010 EN-GJL-100(GG10), 0.6020 EN-GJL-200(GG20), 0.6025 EN-GJL-250(GG25), 0.6035 EN-GJL-350(GG35)	≤240 HB ≤300 HB			90 80	4 4	195 160	9 9
Spheroidal graphite iron and malleable cast iron	0.7050 EN-GJS-500-7(GGG50), 0.8035 EN-GJMW-350-4(GTW35), 0.7070 EN-GJS-700-2(GGG70), 0.8170 EN-GJMB-700-2(GTS70)	≤240 HB ≤300 HB			80 70	4 4	140 130	9 8
Chilled cast iron	-	≤350 HB					40	3
Ti and Ti-alloys	3.7024 Ti99.5, 3.7114 TiAl5Sn2.5, 3.7124 TiCu2, 3.7154 TiAl6Zr5, 3.7165 TiAl6V4, 3.7184 TiAl4Mo4Sn2.5, - TiAl8Mo1V1	≤850 850-1200			20 15	3 2	45 40	4 3
Aluminium and Al-alloys	3.0255 Al99.5, 3.2315 AlMgSi1, 3.3515 AlMg1	≤400			200	7	310	9
Al wrought alloys	3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1.5	≤450			200	7	310	9
Al cast alloys ≤ 10 % Si	3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9	≤600			150	6	260	9
Al cast alloys > 10 % Si	3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	≤600			120	6	220	9
Magnesium alloys	3.5200 MgMn2, 3.5812.05 G-MgAl8Zn1, 3.5612.05 G-MgAl6Zn1	≤450			180	5	280	8
Copper, low-alloyed	2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5Zn1Pb	≤400			80	5	125	7
Brass, short-chipping	2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2	≤600			180	5*	325	8
Brass, long-chipping	2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0.5	≤600			180	5*	220	7
Bronze, short-chipping	2.1090 CuSn7Zn1Pb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn, 2.0790 CuNi8Zn19Pb	≤600 >600-850			120 120	5 5	125 105	7 6
Bronze, long-chipping	2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10, 2.0980 CuAl11Ni, 2.1247 CuBe2	≤850 850-1000			70 50	4 3	90 80	6 6
Duroplastics	Bakelit, Resopal, Pertinax, Moltopren	-			50	4		
Thermoplastics	Plexiglass, Hostalen, Novodur, Makralon	-			40	3		
Kevlar	Kevlar	-						
Glass, carbon concent. plastics	GFK/CFK	-			80	3		



≤ 5xD drilling depth

≤ 7xD ≤ 10xD ≤ 12xD

Sol. carb.		Sol. carb.		Sol. carb.		Sol. carb.		Sol. carb.		Sol. carb.		Sol. carbide	
K/P		K10/K20		K/P		K/P		K		K/P		K/P	
Carbide-UF		Carbide		Carbide-UF		Carbide-UF		Carbide-UF		Carbide-UF		Carbide-UF	
Ⓡ TS 100 U		○ N		Ⓡ TS 100 U		Ⓡ TS 100 U		○ TS 3 G		Ⓡ TS 100 U		○ TS 150 GG	
-		-		■		-		-		■		■	
89413				89411		89414		89247		89412			
89402				89408		89417				89416			
		89244										89293	
												89418	
V _c m/min	Feed column no.	V _c m/min	Feed column no.	V _c m/min	Feed column no.	V _c m/min	Feed column no.	V _c m/min	Feed column no.	V _c m/min	Feed column no.	V _c m/min	Feed column no.
130	7	80	4	145	7	130	7			145	6		
110	6	70	4	120	6	110	6			120	5		
145	8	80	5	170	8	145	8			170	7		
110	7	70	4	145	8	110	7			145	7		
120	7	80	4	130	8	120	7			130	7		
110	7	70	4	125	7	110	7			125	6		
105	7	60	4	120	7	105	7			120	6		
105	7	60	4	120	7	105	7			120	6		
100	6			105	7	100	6			105	6		
130	8	80	5	145	8	130	8			145	7		
120	7	60	4	120	7	120	7			120	6		
85	5			85	5	85	5			85	4		
100	6	50	4	110	7	100	6			110	6		
90	5			105	5	90	5			105	4		
65	6	50	3	80	6	65	6			80	5		
55	5			65	5	55	5			65	4		
				60	5					60	4		
45	3	25	2			45	3			60	2		
55	4	25	4	60	5	55	4			60	4		
45	4	25	3	55	5	45	4			55	4		
45	3	25	3	45	5	45	3			45	4		
45	3	20	3	55	3	45	3			55	2		
25	2			35	2	25	2			35	1		
25	4	15	2	35	4	25	4			35	3		
210	8	90	4	210	9	195	8	100	6	210	8	120	6
155	8	80	4	160	9	155	8	80	6	180	8	100	6
155	7	70	4	140	9	145	7	80	6	160	8	90	6
125	7	80	4	130	8	125	7	70	6	130	7	80	6
35	3			40	3	35	3			40	2	40	2
40	4	20	3	45	4	40	4			40	3		
35	3	15	2	40	3	35	3			40	2		
260	9	200	7	310	9	260	9	180	7	310	8	410	8
260	9	200	7	310	9	260	9	160	7	310	8	410	8
220	9	150	6	260	9	220	8	150	7	260	8	380	8
180	8	120	6	220	9	170	8	120	6	220	8	330	8
260	8	180	5	280	8	260	8	180	6	280	7		
105	7	80	5*	125	7	105	7			125	6		
270	8	180	5*	325	8	270	8	180	6	325	7	280	7
180	7	180	5*	220	7	180	7			220	6		
105	6	120	5	125	7	105	6			125	6	110	6
85	6	120	5	105	6	85	6			105	5	80	5
80	5	70	4	90	6	80	5			90	5		
60	5	50	3	80	6	60	5			80	5		
		50	4									40	5
		40	3										
		80	3										

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Precision Cutting Tools