

GUHRING



NC Spot Drills

GUHRING – YOUR WORLDWIDE PARTNER

GUHRING

SpyroTec

- round, precise and chatter-free countersinking
- reduction of feed force by 60 %
- reduction of radial force by 50 %



THE INNOVATIVE, HELICAL HSS AND HSCO COUNTERSINK

The axial and radial forces that occur during countersinking operations are significantly reduced due to the unique geometry of the SpyroTec cutting edges. The convex form and variable pitch of the helical cutting edges results in a stable countersinking process with minimal vibration, even when

using a hand drill. Round, precise, chatter-free countersinking is guaranteed. The TiAlN coating ensures higher wear resistance and thermal protection, which guarantees longer tool life in many different materials and applications.

- standard program
- 90°, 82°, and 60° countersinks
- round shank version
- tri-flat shank version
- long length round shank version



CONVEX CUTTING EDGES

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

ALSO AVAILABLE IN SETS!



Visit www.Guhring.com for further information on SpyroTec countersinks



90° NC spot drills

Series

557

568



Guhring Std.



Type



Point angle



Tolerance on Ø



Cutting direction

Tool material

HSS

HSS

Coating

Uncoated

TiN

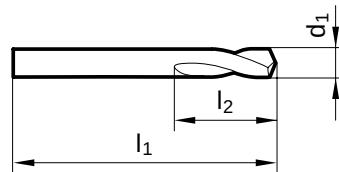
Shank form

cyl.

cyl.

Material		Suitability uncoated	Suitability TiN
P	Steel	○	●
M	Stainless steel	○	○
K	Cast iron	○	●
N	Aluminum	●	●
S	Ni / Ti alloys		
H	Hardened steel		
●=Optimal ○=Secondary			

relieved cone
only suitable for spotting
Shank diameter = cut diameter



Operating parameters pg. 13



Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1181			3.00	46.00	12.00	3.000	9005570030000	9005680030000
0.1575			4.00	55.00	12.00	4.000	9005570040000	9005680040000
0.1969			5.00	62.00	14.00	5.000	9005570050000	9005680050000
0.2362			6.00	66.00	16.00	6.000	9005570060000	9005680060000
0.2500	1/4	E	6.35	70.00	17.00	6.350	9005570063500	9005680063500
0.3150			8.00	79.00	21.00	8.000	9005570080000	9005680080000
0.3748	3/8		9.52	89.00	25.00	9.520	9005570095200	9005680095200
0.3937			10.00	89.00	25.00	10.000	9005570100000	9005680100000
0.4724			12.00	102.00	30.00	12.000	9005570120000	9005680120000
0.5000	1/2		12.70	102.00	30.00	12.700	9005570127000	9005680127000
0.6248	5/8		15.87	115.00	38.00	15.870	9005570158700	9005680158700
0.6299			16.00	115.00	38.00	16.000	9005570160000	9005680160000
0.7500	3/4		19.05	131.00	45.00	19.050	9005570190500	9005680190500
0.7874			20.00	131.00	45.00	20.000	9005570200000	9005680200000
0.9843	63/64		25.00	151.00	53.00	25.000	9005570250000	9005680250000
1.0000	1		25.40	156.00	53.00	25.400	9005570254000	9005680254000

559



HSS

Uncoated

cyl.

relieved cone
only suitable for spotting
Shank diameter = cut diameter

[illegible]

90° NC spot drills



Tool material

Coating

Shank form

1136

1133

HSCO

HSCO

Uncoated

FIREX

cyl./flat

cyl./flat

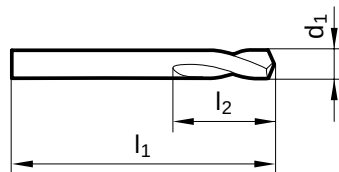
Material		Suitability uncoated	Suitability FIREX
P	Steel	○	●
M	Stainless steel	○	●
K	Cast iron	○	●
N	Aluminum	●	●
S	Ni / Ti alloys	○	○
H	Hardened steel		

●=Optimal ○=Secondary

relieved cone
only suitable for spotting
Co-alloyed high speed steel
increased wear resistance

Shank diameter = cut diameter

* Weldon flat on drills ≥ 6mm diameter



Operating parameters pg. 14

Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1181			3.00	46.00	12.00	3.000	9011360030000	9011330030000
0.1575			4.00	55.00	12.00	4.000	9011360040000	9011330040000
0.1969			5.00	62.00	14.00	5.000	9011360050000	9011330050000
0.2362			6.00	66.00	16.00	6.000	9011360060000*	9011330060000*
0.3150			8.00	79.00	21.00	8.000	9011360080000*	9011330080000*
0.3937			10.00	89.00	25.00	10.000	9011360100000*	9011330100000*
0.4724			12.00	102.00	30.00	12.000	9011360120000*	9011330120000*
0.6299			16.00	115.00	37.50	16.000	9011360160000*	9011330160000*
0.7874			20.00	131.00	45.00	20.000	9011360200000*	9011330200000*

90° NC spot drills
Series
723
6027

Tool material
Carbide
Carbide
Coating
Uncoated
FIREX
Shank form
cyl./flat
cyl./flat

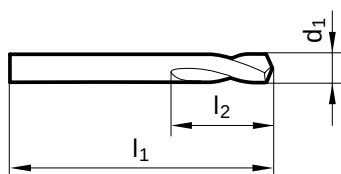
Material		Suitability uncoated	Suitability FIREX
P	Steel	○	●
M	Stainless steel	○	●
K	Cast iron	○	●
N	Aluminum	●	○
S	Ni / Ti alloys	○	●
H	Hardened steel	○	○
●=Optimal ○=Secondary			

facet point grinding
only suitable for spotting
Shank diameter = cut diameter

* Weldon flat on drills $\geq 6\text{mm}$ diameter



Operating parameters pg. 15



Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1575			4.00	55.00	12.00	4.000	9007230040000	9060270040000
0.1969			5.00	62.00	14.00	5.000	9007230050000	9060270050000
0.2362			6.00	66.00	16.00	6.000	9007230060000*	9060270060000*
0.2500	1/4	E	6.35	70.00	17.00	6.350	9007230063500*	9060270063500*
0.3150			8.00	79.00	21.00	8.000	9007230080000*	9060270080000*
0.3748	3/8		9.52	89.00	25.00	9.520	9007230095200*	9060270095200*
0.3937			10.00	89.00	25.00	10.000	9007230100000*	9060270100000*
0.4724			12.00	102.00	30.00	12.000	9007230120000*	9060270120000*
0.5000	1/2		12.70	102.00	30.00	12.700	9007230127000*	9060270127000*
0.6248	5/8		15.87	115.00	37.50	15.870	9007230158700*	9060270158700*
0.6299			16.00	115.00	37.50	16.000	9007230160000*	9060270160000*
0.7500	3/4		19.05	131.00	45.00	19.050	9007230190500*	9060270190500*
0.7874			20.00	131.00	45.00	20.000	9007230200000*	9060270200000*

120° NC spot drills

Series

556

567



Tool material

HSS

HSS

Coating

Uncoated

TiN

Shank form

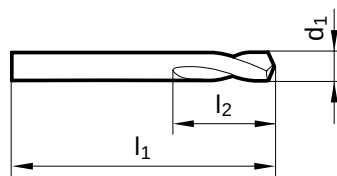
cyl.

cyl.

Material		Suitability uncoated	Suitability TiN
P	Steel	○	●
M	Stainless steel	○	○
K	Cast iron	○	●
N	Aluminum	●	●
S	Ni / Ti alloys		
H	Hardened steel		

●=Optimal ○=Secondary

relieved cone
only suitable for spotting
Shank diameter = cut diameter



Operating parameters pg. 13



Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1181			3.00	46.00	12.00	3.000	9005560030000	9005670030000
0.1575			4.00	55.00	12.00	4.000	9005560040000	9005670040000
0.1969			5.00	62.00	14.00	5.000	9005560050000	9005670050000
0.2362			6.00	66.00	16.00	6.000	9005560060000	9005670060000
0.2500	1/4	E	6.35	70.00	17.00	6.350	9005560063500	9005670063500
0.2559			6.50	70.00	17.00	6.500	9005560065000	
0.3150			8.00	79.00	21.00	8.000	9005560080000	9005670080000
0.3748	3/8		9.52	89.00	25.00	9.520	9005560095200	9005670095200
0.3937			10.00	89.00	25.00	10.000	9005560100000	9005670100000
0.4724			12.00	102.00	30.00	12.000	9005560120000	9005670120000
0.5000	1/2		12.70	102.00	30.00	12.700	9005560127000	9005670127000
0.6248	5/8		15.87	115.00	38.00	15.870	9005560158700	9005670158700
0.6299			16.00	115.00	38.00	16.000	9005560160000	9005670160000
0.7500	3/4		19.05	131.00	45.00	19.050	9005560190500	9005670190500
0.7874			20.00	131.00	45.00	20.000	9005560200000	9005670200000
0.9843	63/64		25.00	151.00	53.00	25.000	9005560250000	9005670250000
1.000	1		25.40	156.00	53.00	25.400	9005560254000	9005670254000



120° NC spot drills

Series

1134

1135



Tool material

HSCO

HSCO

Coating

Uncoated

FIREX

Shank form

cyl./flat

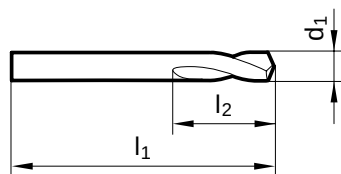
cyl./flat

Material		Suitability uncoated	Suitability FIREX
P	Steel	○	●
M	Stainless steel	○	●
K	Cast iron	○	●
N	Aluminum	●	●
S	Ni / Ti alloys	○	○
H	Hardened steel		

●=Optimal ○=Secondary

relieved cone
only suitable for spotting
Co-alloyed high speed steel
increased wear resistance

Shank diameter = cut diameter

* Weldon flat on drills $\geq 6\text{mm}$ diameter

Operating parameters pg. 14

Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1181			3.00	46.00	12.00	3.000	9011340030000	9011350030000
0.1575			4.00	55.00	12.00	4.000	9011340040000	9011350040000
0.1969			5.00	62.00	14.00	5.000	9011340050000	9011350050000
0.2362			6.00	66.00	16.00	6.000	9011340060000*	9011350060000*
0.3150			8.00	79.00	21.00	8.000	9011340080000*	9011350080000*
0.3937			10.00	89.00	25.00	10.000	9011340100000*	9011350100000*
0.4724			12.00	102.00	30.00	12.000	9011340120000*	9011350120000*
0.6299			16.00	115.00	37.50	16.000	9011340160000*	9011350160000*
0.7874			20.00	131.00	45.00	20.000	9011340200000*	9011350200000*



120° NC spot drills

Series

724

6028



Tool material

Carbide

Carbide

Coating

Uncoated

FIREX

Shank form

cyl./flat

cyl./flat

Material		Suitability ucoat	Suitability FIREX
P	Steel	○	●
M	Stainless steel	○	●
K	Cast iron	○	●
N	Aluminum	●	○
S	Ni / Ti alloys	○	●
H	Hardened steel	○	○
		●=Optimal ○=Secondary	

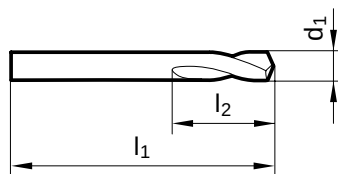
facet point grinding
only suitable for spotting

Shank diameter = cut diameter

* Weldon flat on drills ≥ 6mm diameter

NEW

Operating parameters pg. 15



Diameter (d1)				l1	l2	Code no.	EDP Number	EDP Number
inch	wire	ltr	mm	mm	mm			
0.1181			3.00	46.00	12.00	3.000		9060280030000
0.1969			5.00	62.00	14.00	5.000	9007240050000	9060280050000
0.2362			6.00	66.00	16.00	6.000	9007240060000*	9060280060000*
0.2500	1/4	E	6.35	70.00	17.00	6.350	9007240063500*	9060280063500*
0.3150			8.00	79.00	21.00	8.000	9007240080000*	9060280080000*
0.3748	3/8		9.52	89.00	25.00	9.520	9007240095200*	9060280095200*
0.3937			10.00	89.00	25.00	10.000	9007240100000*	9060280100000*
0.4724			12.00	102.00	30.00	12.000	9007240120000*	9060280120000*
0.5000	1/2		12.70	102.00	30.00	12.700	9007240127000*	9060280127000*
0.6248	5/8		15.87	115.00	37.50	15.870	9007240158700*	9060280158700*
0.6299			16.00	115.00	37.50	16.000	9007240160000*	9060280160000*
0.7500	3/4		19.05	131.00	45.00	19.050	9007240190500*	9060280190500*
0.7874			20.00	131.00	45.00	20.000	9007240200000*	9060280200000*

142° NC spot drills



Tool material

546

6029

Carbide

Carbide

Coating

Uncoated

FIREX

Shank form

cyl./flat

cyl./flat

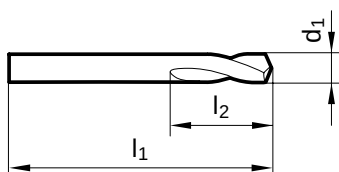
Material		Suitability uncoated	Suitability FIREX
P	Steel	○	●
M	Stainless steel	○	●
K	Cast iron	○	●
N	Aluminum	●	○
S	Ni / Ti alloys	○	●
H	Hardened steel	○	○

●=Optimal ○=Secondary

facet point grinding
only suitable for spotting

Shank diameter = cut diameter

* Weldon flat on drills $\geq 6\text{mm}$ diameter



Operating parameters pg. 15

[illegible]

GUHRING

Solid Carbide Thread Milling Cutters

- ▶ Thread milling cutters with and without chamfer
- ▶ Universal thread milling cutters
- ▶ Drill/thread milling cutters
- ▶ Micro thread milling cutters
- ▶ Thread milling cutters for hardened steels

Featuring NEW micro thread mills:



MTMH 3 Z – Micro drill/thread milling

Universally applicable in unhardened and hardened materials up to 66 Rc. No core hole necessary, machine with coolant or dry



MTM 3 SP – Micro thread milling

Thread size and pitch are predetermined



SC MTM3 SP – Micro thread milling

Applicable in unhardened and hardened materials up to 55 Rc



MTM 1 SP – Micro thread milling

Universal production of nominal thread diameters



NEW

Programming software
for thread milling cutters and drill thread milling cutters

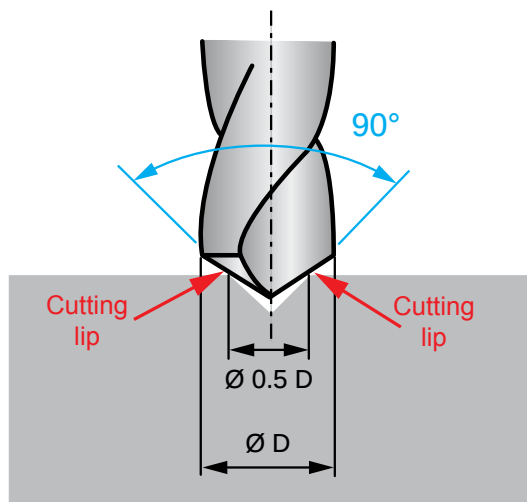
CNC Gühro ThreadMill



Tips and technical information - NC Spot Drills

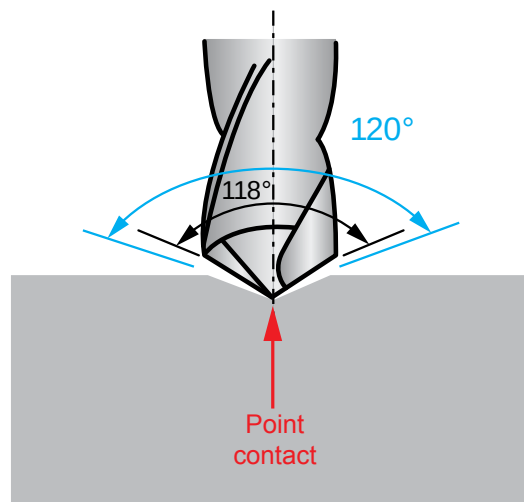
Note: A spot drill is designed without any margin on the drill, therefore it is not meant to be used to drill deeper than the height of the point angle.

When to use a 90° spot drill



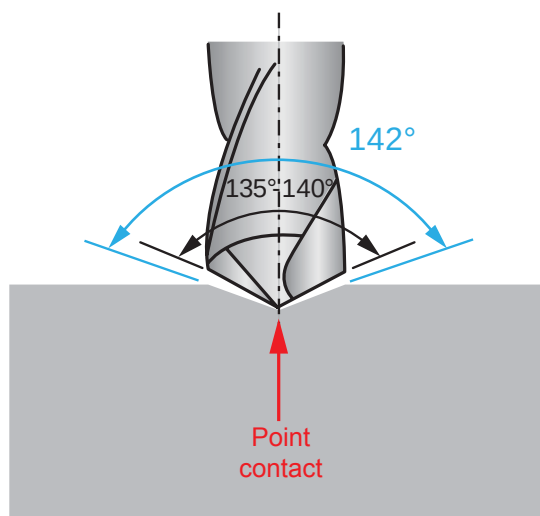
For use with HSS, HSCO, or PM subsequent drills. Ensures subsequent drill makes contact with cutting lip first. Generally not suitable for carbide drills due to small point angle.

When to use a 120° spot drill



Ideal if subsequent drill has a smaller chisel edge, and has a point angle smaller than 120°. Ensures subsequent drill makes contact with point first (not cutting lip) and is guided on-center.

When to use a 140° spot drill



*Ideal if subsequent drill has point angle smaller than 142°. Ensures subsequent drill makes contact with point first (not cutting lip) and is guided on-center. **This is especially important for carbide drills.** If corners or cutting lip of carbide drill contact part first, there is increased risk of premature wear/breakage.*

Uncoated vs. Coated:

Guhring thin film PVD coatings can improve productivity. They increase surface hardness, lower the friction coefficient and thermal conductivity and provide a chemically inert surface.

TiN coating provides effective protection against abrasive and adhesive wear. TiN is also good as a wear indicator.

FIREX® proprietary hard coating combines the heat and wear resistance of TiAlN with the universal applicability of TiN coating, all in one multi-layer structure.



HSS Series # 556, 557, 559

Material group	Hardness		SFM	Feed Rate - IPR							
	HRC	BHN		1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	100		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	80		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Free-cutting steels	≤ 25	≤ 255	105		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	100		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Unalloyed heat-treatable steels	≤ 20	≤ 220	80		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 25	≤ 255	80		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 32	≤ 301	65		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Alloyed heat-treatable steels	≤ 32	≤ 301	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Unalloyed case hardened steels	≤ 25	≤ 255	100		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Alloyed case hardened steels	≤ 32	≤ 301	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	25		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Nitriding steels	≤ 32	≤ 301									
	≤ 43	≤ 402									
Tool steels	≤ 25	≤ 255	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402									
High speed steels	≤ 43	≤ 402									
Spring steels	≤ 38	≤ 354									
Hardened steels	≤ 48	≤ 460									
	≤ 66	-									
Stainless steels, sulphured austenitic	≤ 28	≤ 273	35		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 36	≤ 337	20		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 46	≤ 435	25		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Cast iron	≤ 23	≤ 242	100		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	100		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	80		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	65		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Chilled cast iron	≤ 38	≤ 354									
New cast materials GGV	≤ 20	≤ 220									
	≤ 32	≤ 301									
New cast materials ADI	≤ 32	≤ 301									
	≤ 43	≤ 402									
Special alloys	≤ 54	≤ 549									
Ti and Ti-alloys	≤ 25	≤ 255									
	≤ 43	≤ 402									
Aluminium and Al-alloys	-	≤ 120	230		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
Al wrought alloys	-	≤ 200	230		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
Al cast alloys ≤ 10 % Si	-	≤ 180	165		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
≤ 24 % Si	-	≤ 180	165		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Magnesium alloys	-	≤ 120	230		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Copper, low-alloyed	-	≤ 150	195		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Brass, short-chipping	-	≤ 180	195		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
long-chipping	-	≤ 180	130		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Bronze, short-chipping	-	≤ 180	100		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 25	≤ 255	80		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Bronze, long-chipping	≤ 25	≤ 255	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 32	≤ 301	40		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Duroplastics			60		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Thermoplastics			90		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157

Material group	Hardness		SFM	Feed Rate - IPR							
	HRC	BHN		1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	105		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	85		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Free-cutting steels	≤ 25	≤ 255	115		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	110		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Unalloyed heat-treatable steels	≤ 20	≤ 220	90		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 25	≤ 255	90		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 32	≤ 301	80		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Alloyed heat-treatable steels	≤ 32	≤ 301	70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	55		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Unalloyed case hardened steels	≤ 25	≤ 255	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Alloyed case hardened steels	≤ 32	≤ 301	65		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Nitriding steels	≤ 32	≤ 301	45		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402									
Tool steels	≤ 25	≤ 255	60		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402									
High speed steels	≤ 43	≤ 402									
Spring steels	≤ 38	≤ 354									
Hardened steels	≤ 48	≤ 460									
	≤ 66	-									
Stainless steels, sulphured austenitic	≤ 28	≤ 273	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 36	≤ 337	25		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 46	≤ 435	35		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Cast iron	≤ 23	≤ 242	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	90		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	70		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Chilled cast iron	≤ 38	≤ 354									
New cast materials GGV	≤ 20	≤ 220									
	≤ 32	≤ 301									
New cast materials ADI	≤ 32	≤ 301									
	≤ 43	≤ 402									
Special alloys	≤ 54	≤ 549									
Ti and Ti-alloys	≤ 25	≤ 255									
	≤ 43	≤ 402									
Aluminium and Al-alloys	-	≤ 120									
Al wrought alloys	-	≤ 200									
Al cast alloys ≤ 10 % Si	-	≤ 180									
≤ 24 % Si	-	≤ 180	195		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Magnesium alloys	-	≤ 120	260		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Copper, low-alloyed	-	≤ 150	215		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Brass, short-chipping	-	≤ 180	230		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
long-chipping	-	≤ 180	150		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Bronze, short-chipping	-	≤ 180	110		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 25	≤ 255	90		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Bronze, long-chipping	≤ 25	≤ 255	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 32	≤ 301	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Duroplastics			70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Thermoplastics			120		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157

HSS Series # 567, 568



HSCO Series # 1134, 1136

Material group	Hardness		SFM	Feed Rate - IPR							
	HRC	BHN		1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	115		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	100		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Free-cutting steels	≤ 25	≤ 255	130		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 32	≤ 301	130		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Unalloyed heat-treatable steels	≤ 20	≤ 220	115		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 25	≤ 255	115		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 32	≤ 301	100		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Alloyed heat-treatable steels	≤ 32	≤ 301	70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	55		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Unalloyed case hardened steels	≤ 25	≤ 255	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Alloyed case hardened steels	≤ 32	≤ 301	65		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	50		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Nitriding steels	≤ 32	≤ 301	45		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Tool steels	≤ 25	≤ 255	60		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
High speed steels	≤ 43	≤ 402	25		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Spring steels	≤ 38	≤ 354	25		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
Hardened steels	≤ 48	≤ 460									
	≤ 66	-									
Stainless steels, sulphured austenitic	≤ 28	≤ 273	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 36	≤ 337	35		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
	≤ 46	≤ 435	35		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Cast iron	≤ 23	≤ 242	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	100		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	80		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Chilled cast iron	≤ 38	≤ 354									
New cast materials GGV	≤ 20	≤ 220									
	≤ 32	≤ 301									
New cast materials ADI	≤ 32	≤ 301									
	≤ 43	≤ 402									
Special alloys	≤ 54	≤ 549	20		0.0013	0.0020	0.0031	0.0031	0.0039	0.0049	0.0063
Ti and Ti-alloys	≤ 25	≤ 255	25		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
	≤ 43	≤ 402	20		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
Aluminium and Al-alloys	-	≤ 120	260		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
Al wrought alloys	-	≤ 200	260		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
Al cast alloys ≤ 10 % Si	-	≤ 180	195		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
≤ 24 % Si	-	≤ 180	195		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Magnesium alloys	-	≤ 120	230		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Copper, low-alloyed	-	≤ 150	215		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Brass, short-chipping	-	≤ 180	230		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
long-chipping	-	≤ 180	150		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Bronze, short-chipping	-	≤ 180	115		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 25	≤ 255	110		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Bronze, long-chipping	≤ 25	≤ 255	65		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 32	≤ 301	50		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Duroplastics			70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Thermoplastics			120		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157

HSCO Series # 1133, 1135

Material group	Hardness		SFM	Feed Rate - IPR							
	HRC	BHN		1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	140		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	120		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Free-cutting steels	≤ 25	≤ 255	155		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	140		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Unalloyed heat-treatable steels	≤ 20	≤ 220	145		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 25	≤ 255	145		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 32	≤ 301	130		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Alloyed heat-treatable steels	≤ 32	≤ 301	90		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	70		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Unalloyed case hardened steels	≤ 25	≤ 255	120		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Alloyed case hardened steels	≤ 32	≤ 301	70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	60		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Nitriding steels	≤ 32	≤ 301	60		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	50		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Tool steels	≤ 25	≤ 255	70		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 43	≤ 402	50		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
High speed steels	≤ 43	≤ 402	40		0.0020	0.0031	0.0049	0.0049	0.0063	0.0079	0.0098
Spring steels	≤ 38	≤ 354	35		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
Hardened steels	≤ 48	≤ 460									
	≤ 66	-									
Stainless steels, sulphured austenitic	≤ 28	≤ 273	60		0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
	≤ 36	≤ 337	50		0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
	≤ 46	≤ 435	40		0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
Cast iron	≤ 23	≤ 242	125		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	115		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	110		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
	≤ 38	≤ 354	90		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Chilled cast iron	≤ 38	≤ 354									
New cast materials GGV	≤ 20	≤ 220									
	≤ 32	≤ 301									
New cast materials ADI	≤ 32	≤ 301									
	≤ 43	≤ 402									
Special alloys	≤ 54	≤ 549	25		0.0013	0.0020	0.0031	0.0031	0.0039	0.0049	0.0063
Ti and Ti-alloys	≤ 25	≤ 255	35		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
	≤ 43	≤ 402	25		0.0016	0.0025	0.0039	0.0039	0.0049	0.0063	0.0079
Aluminium and Al-alloys	-	≤ 120									
Al wrought alloys	-	≤ 200	280		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
Al cast alloys ≤ 10 % Si	-	≤ 180	215		0.0049	0.0079	0.0124	0.0124	0.0157	0.0197	0.0248
≤ 24 % Si	-	≤ 180	215		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Magnesium alloys	-	≤ 120	260		0.0039	0.0063	0.0098	0.0098	0.0124	0.0157	0.0197
Copper, low-alloyed	-	≤ 150	230		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Brass, short-chipping	-	≤ 180	245		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
long-chipping	-	≤ 180	165		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
Bronze, short-chipping	-	≤ 180	150		0.0031	0.0049	0.0079	0.0079	0.0098	0.0124	0.0157
	≤ 25	≤ 255	130		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Bronze, long-chipping	≤ 25	≤ 255	80		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
	≤ 32	≤ 301	65		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Duroplastics			80		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124
Thermoplastics			130		0.0025	0.0039	0.0063	0.0063	0.0079	0.0098	0.0124


Carbide Series # 546, 723, 724

Material group	Hardness		SFM	Feed Rate - IPR								
	HRC	BHN		1/64 in. 0.500 mm	1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	245			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
	≤ 32	≤ 301	205			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
Free-cutting steels	≤ 25	≤ 255	260			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
	≤ 32	≤ 301	245			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
Unalloyed heat-treatable steels	≤ 20	≤ 220	205			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
	≤ 25	≤ 255	205			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
	≤ 32	≤ 301	165			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
Alloyed heat-treatable steels	≤ 32	≤ 301	125			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
	≤ 43	≤ 402	100			0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
Unalloyed case hardened steels	≤ 25	≤ 255	245			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
Alloyed case hardened steels	≤ 32	≤ 301	125			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
	≤ 43	≤ 402	65			0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
Nitriding steels	≤ 32	≤ 301										
	≤ 43	≤ 402										
Tool steels	≤ 25	≤ 255	130			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
	≤ 43	≤ 402										
High speed steels	≤ 43	≤ 402										
Spring steels	≤ 38	≤ 354										
Hardened steels	≤ 48	≤ 460	65			0.0015	0.0025	0.0040	0.0040	0.0050	0.0065	0.0080
	≤ 66	-										
Stainless steels, sulphured austenitic	≤ 28	≤ 273	80			0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
	≤ 36	≤ 337	50			0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
	≤ 46	≤ 435	65			0.0020	0.0030	0.0050	0.0050	0.0065	0.0080	0.0100
Cast iron	≤ 23	≤ 242	245			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
	≤ 38	≤ 354	245			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	205			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
	≤ 38	≤ 354	165			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
Chilled cast iron	≤ 38	≤ 354										
New cast materials GGV	≤ 20	≤ 220										
	≤ 32	≤ 301										
New cast materials ADI	≤ 32	≤ 301										
	≤ 43	≤ 402										
Special alloys	≤ 54	≤ 549	50			0.0015	0.0025	0.0040	0.0040	0.0050	0.0065	0.0080
Ti and Ti-alloys	≤ 25	≤ 255	50			0.0015	0.0020	0.0030	0.0030	0.0040	0.0050	0.0065
	≤ 43	≤ 402	50			0.0015	0.0020	0.0030	0.0030	0.0040	0.0050	0.0065
Aluminium and Al-alloys	-	≤ 120	575			0.0050	0.0080	0.0125	0.0125	0.0155	0.0195	0.0250
Al wrought alloys	-	≤ 200	575			0.0050	0.0080	0.0125	0.0125	0.0155	0.0195	0.0250
Al cast alloys ≤ 10 % Si	-	≤ 180	410			0.0050	0.0080	0.0125	0.0125	0.0155	0.0195	0.0250
≤ 24 % Si	-	≤ 180	410			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
Magnesium alloys	-	≤ 120	575			0.0040	0.0065	0.0100	0.0100	0.0125	0.0155	0.0195
Copper, low-alloyed	-	≤ 150	490			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
Brass, short-chipping	-	≤ 180	490			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
long-chipping	-	≤ 180	330			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155
Bronze, short-chipping	-	≤ 180	245			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
	≤ 25	≤ 255	205			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
Bronze, long-chipping	≤ 25	≤ 255	125			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
	≤ 32	≤ 301	100			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
Duroplastics			150			0.0025	0.0040	0.0065	0.0065	0.0080	0.0100	0.0125
Thermoplastics			230			0.0030	0.0050	0.0080	0.0080	0.0100	0.0125	0.0155

Material group	Hardness		SFM	Feed Rate - IPR								
	HRC	BHN		1/64 in. 0.500 mm	1/16 in. 1.590 mm	1/8 in. 3.170 mm	1/4 in. 6.350 mm	3/8 in. 9.520 mm	1/2 in. 12.700 mm	5/8 in. 15.870 mm	3/4 in. 19.050 mm	1 in. 25.400 mm
Common structural steels	-	≤ 150	330		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
	≤ 32	≤ 301	280		0.0005	0.0005	0.0030	0.0050	0.0080	0.0100	0.0125	0.0155
Free-cutting steels	≤ 25	≤ 255	345		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
	≤ 32	≤ 301	330		0.0005	0.0005	0.0030	0.0050	0.0080	0.0100	0.0125	0.0155
Unalloyed heat-treatable steels	≤ 20	≤ 220	280		0.0005	0.0005	0.0030	0.0050	0.0080	0.0100	0.0125	0.0155
	≤ 25	≤ 255	280		0.0005	0.0005	0.0030	0.0050	0.0080	0.0100	0.0125	0.0155
	≤ 32	≤ 301	230		0.0005	0.0005	0.0025	0.0040	0.0065	0.0080	0.0100	0.0125
Alloyed heat-treatable steels	≤ 32	≤ 301	180		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
	≤ 43	≤ 402	150		0.0005	0.0005	0.0020	0.0030	0.0050	0.0050	0.0065	0.0080
Unalloyed case hardened steels	≤ 25	≤ 255	330		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
Alloyed case hardened steels	≤ 32	≤ 301	180		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
	≤ 43	≤ 402	100		0.0005	0.0005	0.0020	0.0030	0.0050	0.0050	0.0065	0.0080
Nitriding steels	≤ 32	≤ 301										
	≤ 43	≤ 402										
Tool steels	≤ 25	≤ 255	180		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
	≤ 43	≤ 402										
High speed steels	≤ 43	≤ 402										
Spring steels	≤ 38	≤ 354										
Hardened steels	≤ 48	≤ 460	100		0.0005	0.0005	0.0015	0.0025	0.0040	0.0040	0.0050	0.0065
	≤ 66	-										
Stainless steels, sulphured austenitic	≤ 28	≤ 273	115		0.0005	0.0005	0.0020	0.0030	0.0050	0.0050	0.0065	0.0080
	≤ 36	≤ 337	80		0.0005	0.0005	0.0020	0.0030	0.0050	0.0050	0.0065	0.0080
	≤ 46	≤ 435	100		0.0005	0.0005	0.0020	0.0030	0.0050	0.0050	0.0065	0.0080
Cast iron	≤ 23	≤ 242	330		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
	≤ 38	≤ 354	330		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
Spheroidal graphite iron and malleable cast iron	≤ 23	≤ 242	280		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
	≤ 38	≤ 354	230		0.0005	0.0005	0.0040	0.0065	0.0100	0.0125	0.0155	0.0195
Chilled cast iron	≤ 38	≤ 354										
New cast materials GGV	≤ 20	≤ 220										
	≤ 32	≤ 301										
New cast materials ADI	≤ 32	≤ 301										
	≤ 43	≤ 402										
Special alloys	≤ 54	≤ 549	80		0.0005	0.0005	0.0015	0.0025	0.0040	0.0040	0.0050	0.0065
Ti and Ti-alloys	≤ 25	≤ 255	80		0.0005	0.0005	0.0015	0.0020	0.0030	0.0030	0.0040	0.0050
	≤ 43	≤ 402	80		0.0005	0.0005	0.0015	0.0020	0.0030	0.0030	0.0040	0.0050
Aluminium and Al-alloys	-	≤ 120	755		0.0005	0.0010	0.0050	0.0080	0.0125	0.0125	0.0155	0.0195
Al wrought alloys	-	≤ 200	755		0.0005	0.0010	0.0050	0.0080	0.0125	0.0125	0.0155	0.0195
Al cast alloys ≤ 10 % Si	-	≤ 180	540		0.0005	0.0010	0.0050	0.0080	0.0125	0.0125	0.0155	0.0195
≤ 24 % Si	-	≤ 180	540		0.0005	0.0005	0.0040	0.0065	0.0100	0.0100	0.0125	0.0155
Magnesium alloys	-	≤ 120	755		0.0005	0.0005	0.0040	0.0065	0.0100	0.0100	0.0125	0.0155
Copper, low-alloyed	-	≤ 150	655		0.0005	0.0005	0.0030	0.0050	0.0080	0.0080	0.0100	0.0125
Brass, short-chipping	-	≤ 180	655		0.0005	0.0005	0.0030	0.0050	0.0080	0.0080	0.0100	0.0125
long-chipping	-	≤ 180	445		0.0005	0.0005	0.0030	0.0050	0.0080	0.0080	0.0100	0.0125
Bronze, short-chipping	-	≤ 180	330		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
	≤ 25	≤ 255	280		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
Bronze, long-chipping	≤ 25	≤ 255	180		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
	≤ 32	≤ 301	150		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
Duroplastics			215		0.0005	0.0005	0.0025	0.0040	0.0065	0.0065	0.0080	0.0100
Thermoplastics			310		0.0005	0.0005	0.0030	0.0050	0.0080	0.0080	0.0100	0.0125

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