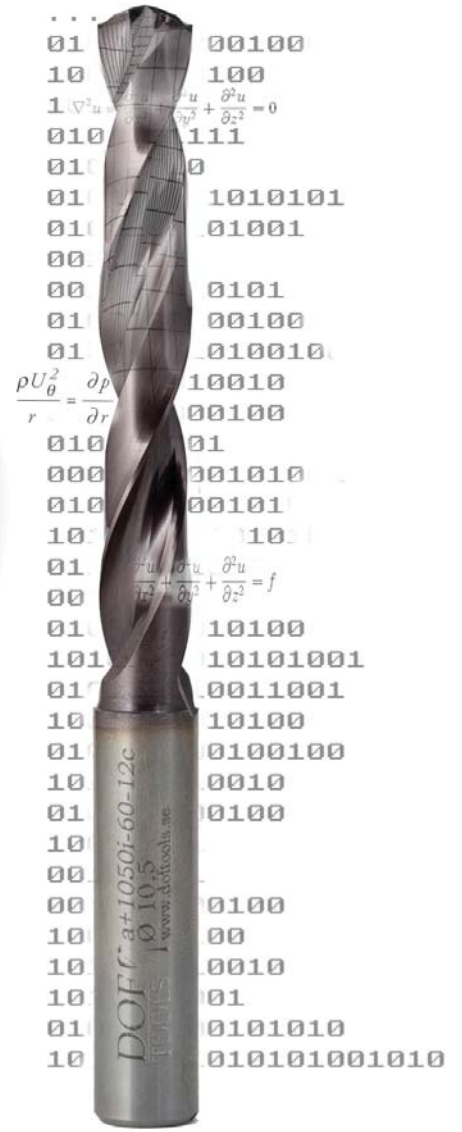

DOF
TOOLS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www.dofkools.se

Content

DOF Tools AB

DOF Tools develops, manufactures and sells cutting tools made from solid carbide. The company and our innovations are sprung from several years of research and practical experiences in machining and heat generation.

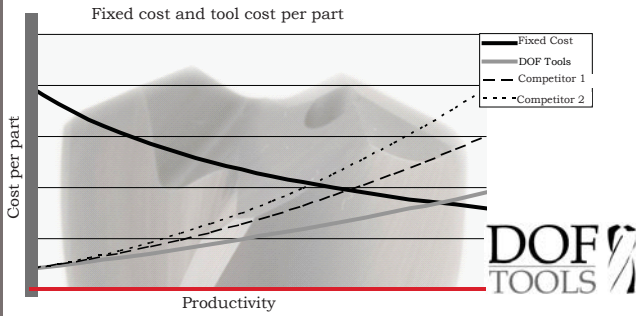
The products in this catalogue are results from a long process of development, evaluation and improvement where basic research and calculations has been combined with extensive testing and measurment.
DOF Tools is unique, swedish research at its best.

We incorporate a sigificant technology level in our tools and they are designed to withstand high productivity.

High productivity

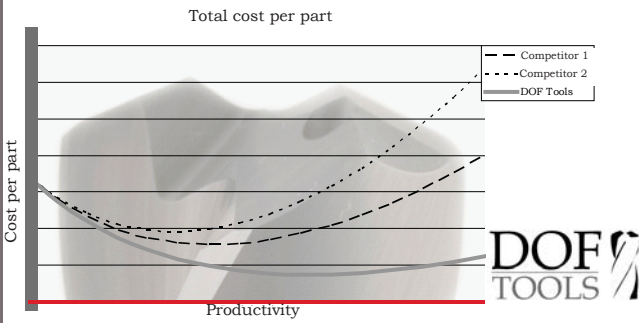
DOF Tools can withstand high productivity

Demonstrated in the chart bellow are the fixed cost per part and tool cost per part as a function of productivity. The fixed costs per part decrease and the tool cost per part increase when productivity increase. Different tools withstand high productivity in various degree. See the chart bellow.



Lower manufacturing cost and higher productivity

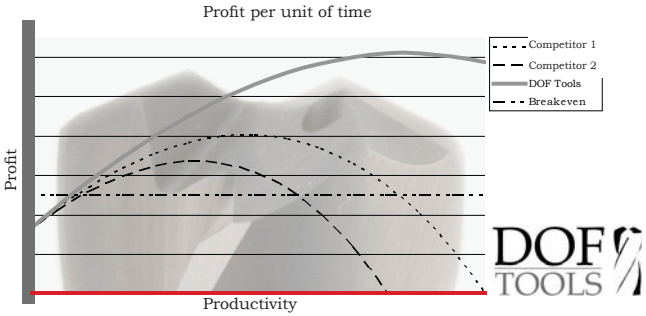
Since DOF Tools can withstand high productivity to a greater degree, the result is more parts produced at a lower cost. See the chart bellow.



High productivity

Greater profit per part and more parts

When the profit is calulated the effect is double, lower cost per part and higher productivity. See the chart bellow.



Implementation

In the following pages there are methodology, rule of thumb, formulas and arithmetical example, for adaptation to specific case. Cutting parameters can be found on page 47.

Profitability calculations

In this case profitability calculations describes how tool cost can be evaluated with regards to productivity and overall production economy.

When profitability is calculated two basis for evaluation is possible.

One: Minimize the total manufacturing cost per part.

Two: Maximize profit per unit of time

Minimize the total manufacturing cost per part

This approach is easy to calculate and is well defined in literature.

The general idea is to find a minimum of the sum of fixed cost per part and tool cost per part. Included in the fixed costs are all the costs which are influated by the number of parts produced per unit of time (machine cost, mantime, over head etc.) but not costs specificly tied to a specific part (raw material etc)

The fixed cost per part decrease and tool cost increase with increased productivity. This can be represented by one curve wich decrease and one curve which increase with increased productivity. It is possible to mathematicaly determine a minimum of the sum of the two curves. For an exact determination use the formulas on page 9 and forward. It is also possible to use the following rules of thumb

Rules of thumb

- It is the cost per produced hole which is determining, not the fixed cost or the tool cost alone.

- High machine cost requires high productivity and vice versa

- High man cost requires high productivity and vice versa

- High overhead (rent, cost for development, quality controll , programming etc.) requires high productivity and vice versa

- Greater tool ability to withstand high productivity enables higher productivity.

- Greater added value enables higher productivity.

Maximize profit per unit of time

The general idea with this approach is that increased productivity enables less margin. Which means focus on profit in euro instead of profit in %. Otherwise it is the same basis for calculation and the same rules of thumb.

Example 1: 10 parts per hour are produced with a margin of 10 euro (100 euro profit in one hour)

Example 2: 15 of the same parts per are produced but with a margin of 8 euro (120 euro profit in one hour)

If the reduction in margin per part (A) and increased productivety (B) cancel each other out (AxB=1) it gives the same profit per hour.

It is harder to do calculations with this approach and requires more testing but gives a more accurate result if the goal is maximize the profit per unit of time.

Formulas and methodology

Theese are the formulas for comparing two known setups and see which gives the lowest total production cost per part and greatest profit per hour. Setup in this case could be either two different tools or the same tool brand but with different productivety and toollife. The basis for the following calculations is that the productivity and the toollife is known for two setups and compares them to each other.

(It is theoreticaly possible to interpolate results to find the theoretical, optimal setup but to little research has been made as to its practical limitations)

The following parameters must be known and are the same for both setups.

K_{mc}:	Machine cost per hour	[Euro]
K_{mt}:	Man cost per hour	[Euro]
K_{oh}:	Overhead cost per hour	[Euro]
Ld:	Total hole depth per part	[mm]
X%:	Drilling operations in total	[%]

Fixed cost per hour, is per effective production hour. Disturbance, quality problems etc in the production increase the fixed cost per hour.

The following parameters must be known but are diffrent for both setups.

K_{v1}, K_{v2}:	Tool cost per toollife.	[Euro]
V_{f1}, V_{f2}:	Feed	[mm/min]
V_{l1}, V_{l2}:	Toollife	[m]

First the number of toollife per hour is calculated for both setups (N_{v1} and N_{v2}).

$$N_{v1} = \frac{V_{f1} \times 60}{V_{l1} \times 1000}$$

$$N_{v2} = \frac{V_{f2} \times 60}{V_{l2} \times 1000}$$

Then the number of parts produced per hour is calculated for both setups (N_{a1} and N_{a2}).

$$N_{a1} = \frac{V_{f1} \times 60 \times X\%}{Ld \times 100}$$

$$N_{a2} = \frac{V_{f2} \times 60 \times X\%}{Ld \times 100}$$

It is now possible to calculate the total production cost per part for both setups (K_{tot1} and K_{tot2}).

$$K_{tot1} = \frac{K_{mc} + K_{mt} + K_{oh}}{N_{a1}} + \frac{K_{v1} \times N_{v1}}{N_{a1}}$$

$$K_{tot2} = \frac{K_{mc} + K_{mt} + K_{oh}}{N_{a2}} + \frac{K_{v2} \times N_{v2}}{N_{a2}}$$

The setup which gives the lowest K_{tot} is the best setup if the goal is to minimize the total production cost per part.

Profit calculations

When the total production cost per part for both setups (K_{tot1} and K_{tot2}) is known there is a possibility to proceed and calculate profit per hour (P_{h1} and P_{h2}) and profit per tool (P_{v1} tool P_{v2}).

Then the following parameter must be known.

P_{a1}	Value added per part setup 1 [Euro]
$P_{a2}=P_{a1}+K_{tot1}-K_{tot2}$	Value added per part setup 2 [Euro]

Profit per hour (P_{h1} and P_{h2}) [Euro].

$$P_{h1} = P_{a1} \times N_{a1}$$
$$P_{h2} = P_{a2} \times N_{a2}$$

Profit per tool (P_{v1} and P_{v2}) [Euro]

$$P_{v1} = \frac{P_{h1}}{N_{v1}}$$

$$P_{v2} = \frac{P_{h2}}{N_{v2}}$$

The setup which gives the highest P_h is the best if the goal is to maximize the profit per hour.

Arithmetical example

Common parameters

K_{mc}:	Machine cost per hour	[Euro]	Ex 60
K_{mt}:	Man cost per hour	[Euro]	Ex 30
K_{oh}:	Overhead cost per hour	[Euro]	Ex 30
Ld:	Total hole depth per part	[mm]	Ex 1000
X%:	Drilling operations in total	[%]	Ex 95 %

Unique parameters for each setup

			Ex set.1	Ex set2
K_{v1}, K_{v2}:	Tool cost per toollife.	[Euro]	40	45
V_{f1}, V_{f2}:	Feed	[mm/min]	780	1560
V_{l1}, V_{l2}:	Toolife	[m]	50	45

Toollifes per hour.

$N_{v1}= (V_{f1} \times 60)/(V_{l1} \times 1000)$ $N_{v1}=(780 \times 60)/(50 \times 1000)$

$N_{v1}=0,936$

$N_{v2}= (V_{f2} \times 60)/(V_{l2} \times 1000)$ $N_{v2}= (1560 \times 60)/(45 \times 1000)$

$N_{v2}=2,08$

Number of parts produced per hour.

$N_{a1}=(V_{f1} \times 60)/Ld \times X\%/100$ $N_{a1}=(780 \times 60)/1000 \times 95/100$

$N_{a1}=44,46$

$N_{a2}=(V_{f2} \times 60)/Ld \times X\%/100$ $N_{a2}=(1560 \times 60)/1000 \times 95/100$

$N_{a2}=88,92$

Total production cost per part

K_{tot1}= (K_{mc} + K_{mt} + K_{oh})/N_{a1} + (K_{v1} x N_{v1})/N_{a1}
K_{tot1}= (60+30+30)/44,46+(40 x 0,936)/44,46
K_{tot1}=3,541 Euro

K_{tot2}= (K_{mc} + K_{mt} + K_{oh})/N_{a2} + (K_{v2} x N_{v2})/N_{a2}
K_{tot2}=(60+30+30)/88,92 + (45 x 2,08)/88,92
K_{tot2}=2,403 Euro

In this example setup 2 is better than setup 1 the total production cost has been reduced with 1,138 euro per part (32,17%)

Profit calculations.

P_{a1}: Value added per part setup 1 Ex P_{a1}=0,5 Euro
P_{a2}=P_{a1}+K_{tot1}-K_{tot2} P_{a2}=0,5+3,541-2,403**P_{a2}= 1,638 Euro**

Profit per hour (Ph1 and Ph2)

P_{h1}= P_{a1} x N_{a1}	P_{h1}=0,5 x 44,46	**P_{h1}= 22,230 Euro**
P_{h2}= P_{a2} x N_{a2}	P_{h2}=1,638 x 88,92	**P_{h2}=145,651 Euro**

Profit per tool (Pv1 and Pv2)

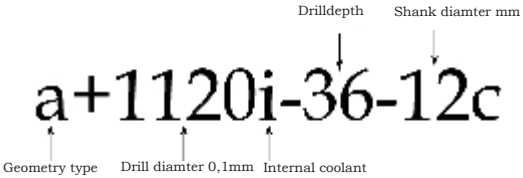
P_{v1}=P_{h1}/N_{v1}	P_{v1}=22,33/0,936	**P_{v1}=23,857 Euro**
P_{v2}=P_{h2}/N_{v2}	P_{v2}=145,651/2,08	**P_{v2}=70,025 Euro**

In this example setup 2 is better than setup 1, the profit per hour has increased with 123,41 euro and the profit per tool has increased with 46,168 euro.

In this example setup 2 has lower total production cost per part and greater profit per hour, how ever in some cases the setup with the highest profit per hour dosen´t necessarly have the lowest total production cost. The setup with the highest Ph should therefore always be selected.

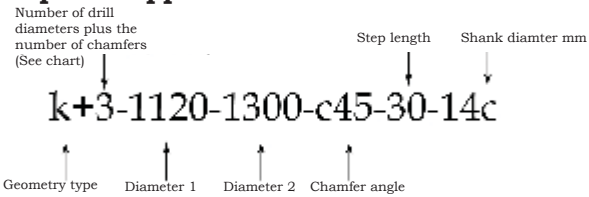
In this example the breaking point is Ktot2=3,791 euro which gives P_{h1}=P_{h2}

Ex standard tool

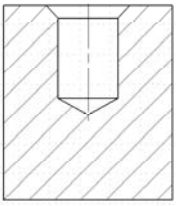


The example is a drill for aluminium with diameter 11,2 mm, drill depth 36 mm and shank diamter 12 mm

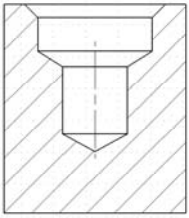
Ex Tools for special applications



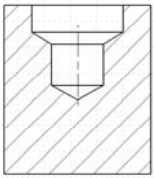
The example is a tool for special application, has two drilling diameters (11,2mm and 13,0mm), Steplength 30mm, chamfer angle 45 degrees and shank diameter 14mm.



k+2-...



k+4-...



k+3-...

Drilling

DOF k+ (++)	Drill for specific material groups (see next page)
DOF p+	Drill for specific material groups (see next page)
DOF a+	Drill for specific material groups (see next page)
DOF SX	Drill with split point for extra low axial force
DOF CB	Centre drill with 145° point angle

All geometries are design for high productivity in the form of increased feed.

Drill-reaming

DOF brbs:	Drill ream with negative helix ream cut for H7 tolerance

Tools for special application

Semistandard: Adaptation for specific diameter etc.

DOF brb:	Drill with four land margins based on optional base geometry
Step tools:	Based on optional base geometry
Mills:	End mills and ball nose mills tailord for specific materials
Profile tools:	Tools with high accuracy profiles, concave radius or side milling cutters with gear teeth profile

Geometry selection

This is an overview of which geometries are suited for which materials. The chart should be interpreted as following

- ○ Not recommended
- ◐ Recommended in certain apllications
- ● Recommended

For brbs (drill reaming) the feed should be reduced with 30-60% to maintain high hole quality.

		Drill geometry				
ISO	Material group	p+	k+ (++)	a+	sx	brbs
P	1	●	◐	○	○	○
	2	●	◐	○	○	○
	3	●	◐	○	○	○
	4	●	◐	○	○	○
	5	●	●	○	◐	●
	6	●	●	○	◐	●
	7	●	●	○	◐	●
M	8	●	◐	○	◐	◐
	9	●	◐	○	◐	◐
	10	●	◐	○	○	○
K	11	◐	●	○	●	●
	12	◐	●	○	●	●
	13	◐	●	○	●	●
N	14	◐	◐	●	○	◐
	15	◐	◐	●	○	◐
S	16	●	●	○	◐	◐
	17	◐	●	○	◐	◐
	18	●	◐	○	◐	◐
H	19	◐	●	○	◐	●
	20	○	●	○	◐	●

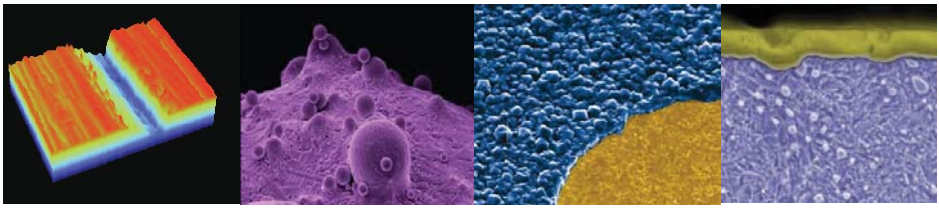
Preparation before coating

To increase the coatings adhesion and to strengthen the cutting edges all tools are subjected to a separate process.

Primateria

In colaboration with DOF Tools techical partner Primateria all tools above 3 X D are treated with PrimaCoat® after the normal coating.

PrimaCoat® is used for coated tools to give the lowest possible friction, and to reduce the risk for microscopic wear. The process removes all loose material and smothen edges and surfaces without penetrating the coating.



Primateria AB is an independant company, partially owned by Uppsala Universitets Utveckling AB.

Primateria

Surface treatment

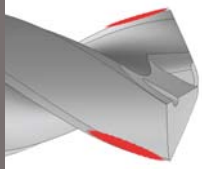
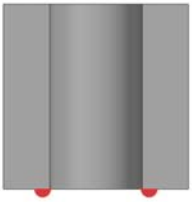
Low friction enables high removal rate

The friction force which occurs when the chip is formed and transported, is reduced by increasing the surface finish with PrimaCoat®.

Increased toollife through high surface controll

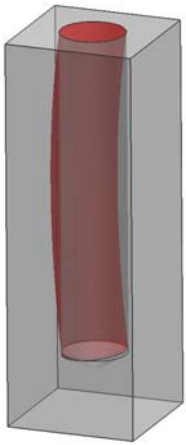
By removing all loose material and by decreasing microscopic defects a surface which is much less sensitive for wear is produced.

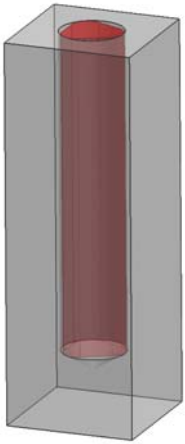
DOF TOOLS Troubleshooting

	Problem	Cause	Solution
	Excessive wear in centre of drill	-Chisel runout -Unsuitable cutting parameters	-Check the runout, tool and workpiece clamping -Reduce the feed
	Build up edge/chipping on the cutting edges	-Unsuitable process temperature	-Increase the cutting speed -Increase coolant concentration.
	Excessive wear on the cutting corners	-To high process temperature -Instabillity	-Reduce the cutting speed -Check the runout, tool and workpiece clamping -Increase coolant preassure
	Excessive wear on the land margins	-Instabillity -Poor centrering (long tools)	-Check the runout, tool and workpiece clamping -Predrill with DOF CB
	Exit burrs	-Corner wear to large -Wrong drill geometry	-Regrind drill

Troubleshooting

Problem	Cause	Solution
Drill breakage	-Poor transport of the chip	-Change feed to optimize chip formation
	-Instabillity	-Check the runout, tool and workpiece clamping
Hole not straight	-Poor centrering (long tools)	-Predrill with DOF CB
	-Poor fixturing of the workpiece	
Hole not round	-Poor centrering (long tools)	-Predrill with DOF CB
		-Reduce the feed at the entrance





Standard tools

The following charts are standard tools. Webshop with current stock levels will be intoduced on www.doftools.se during 2008.

Design criteria

All geometries are design to withstand high productivity. In order to achive this the entire production process has been optimized.

Carbide quality

DOF Tools only use carbide with the highest strength of material.

Grinding process

The most robust and accurate grinding machines available is used. The grinding process is adapted to give high repeatability even at narrow tolerances. Each drill geometry is optimized with regards to maching materail.

Preparation before coating

To increase the coatings adhesion and to strengthen the cutting edges all tools are subjected to a separate process.

Coating

Coting is selected to enhance each geometrys qualities.

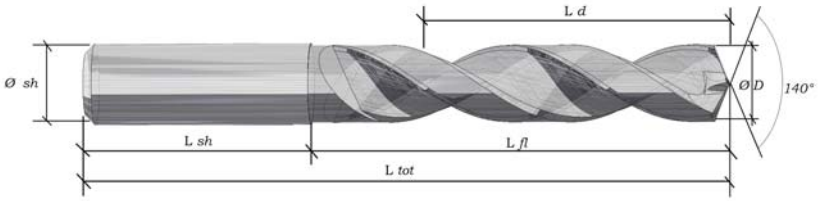
Surface treatment

After coating the drills are subjected to a unique process in co-laboration with DOF Tools technical partner Primateria to reduce friction and increase chip transportation.

Geometry specific qualities

To increase heat transfer and thereby increase toollife DOF k+ has a unique corner geometry. The centre is designed to produce low axail forces.

DOF k+(++)



2,5 X D External coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
12001	++300-9-6c	3	6	36	19	9	58
12002	++310-9-6c	3,1	6	36	19	9	58
12003	++320-9-6c	3,2	6	36	19	9	58
12004	++330-9-6c	3,3	6	36	19	9	58
12005	++340-9-6c	3,4	6	36	19	9	58
12006	++350-9-6c	3,5	6	36	19	9	58
12007	++360-9-6c	3,6	6	36	19	9	58
12008	++370-9-6c	3,7	6	36	19	9	58
12009	++380-11-6c	3,8	6	36	20	11	58
12010	++390-11-6c	3,9	6	36	20	11	58
12011	++400-11-6c	4	6	36	20	11	58
12012	++410-11-6c	4,1	6	36	20	11	58
12013	++420-12-6c	4,2	6	36	20	12	58
12014	++450-12-6c	4,5	6	36	20	12	58
12015	++480-15-6c	4,8	6	36	25	15	62
12016	++500-15-6c	5	6	36	25	15	62
12017	++510-15-6c	5,1	6	36	25	15	62
12018	++520-15-6c	5,2	6	36	25	15	62
12019	++550-15-6c	5,5	6	36	25	15	62
12020	++580-15-6c	5,8	6	36	25	15	62
12021	++600-15-6c	6	6	36	25	15	62
12022	++650-20-8c	6,5	8	36	33	20	70
12023	++680-20-8c	6,8	8	36	33	20	70
12024	++690-20-8c	6,9	8	36	33	20	70
12025	++700-20-8c	7	8	36	33	20	70
12026	++750-20-8c	7,5	8	36	33	20	70
12027	++780-20-8c	7,8	8	36	33	20	70
12028	++800-20-8c	8	8	36	33	20	70
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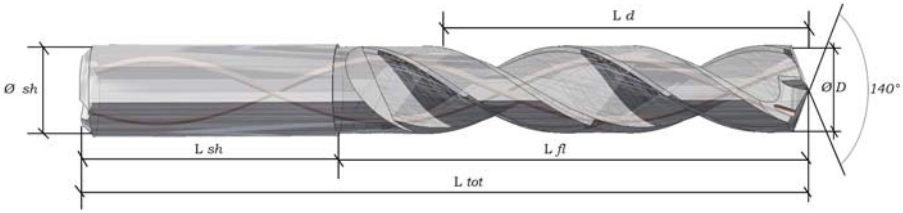
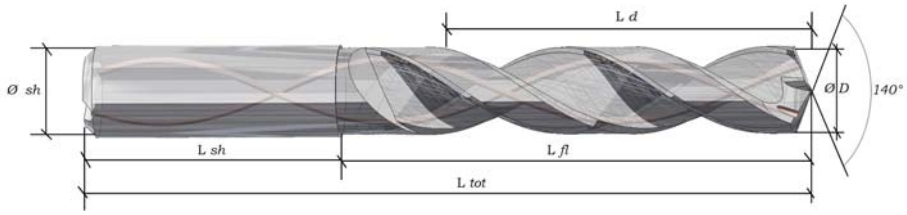
12035	++1020-30-12c	10,2	12	45	49	30	95
12036	++1050-30-12c	10,5	12	45	49	30	95
12037	++1080-30-12c	10,8	12	45	49	30	95
12038	++1100-30-12c	11	12	45	49	30	95
12039	++1150-30-12c	11,5	12	45	49	30	95
12040	++1180-30-12c	11,8	12	45	49	30	95
12041	++1200-30-12c	12	12	45	49	30	95
12042	++1250-35-14c	12,5	14	45	56	35	102
12043	++1270-35-14c	12,7	14	45	56	35	102
12044	++1300-35-14c	13	14	45	56	35	102
12045	++1350-35-14c	13,5	14	45	56	35	102
12046	++1400-35-14c	14	14	45	56	35	102
12047	++1450-40-16c	14,5	16	48	61	40	110
12048	++1500-40-16c	15	16	48	61	40	110
12049	++1550-40-16c	15,5	16	48	61	40	110
12050	++1600-40-16c	16	16	48	61	40	110
12051	++1650-45-18c	16,5	18	48	71	45	120
12052	++1700-45-18c	17	18	48	71	45	120
12053	++1750-45-18c	17,5	18	48	71	45	120
12054	++1800-45-18c	18	18	48	71	45	120



3 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
13001	++380i-14-6c	3,8	6	36	21	14	58
13002	++400i-14-6c	4	6	36	21	14	58
13003	++420i-14-6c	4,2	6	36	21	14	58
13004	++450i-14-6c	4,5	6	36	21	14	58
13005	++500i-18-6c	5	6	36	27	18	64
13006	++510i-18-6c	5,1	6	36	27	18	64
13007	++520i-18-6c	5,2	6	36	27	18	64
13008	++550i-18-6c	5,5	6	36	27	18	64
13009	++580i-18-6c	5,8	6	36	27	18	64
13010	++600i-18-6c	6	6	36	27	18	64
13011	++650i-24-8c	6,5	8	36	36	24	73
13012	++680i-24-8c	6,8	8	36	36	24	73
13013	++690i-24-8c	6,9	8	36	36	24	73
13014	++700i-24-8c	7	8	36	36	24	73
13015	++750i-24-8c	7,5	8	36	36	24	73
13016	++780i-24-8c	7,8	8	36	36	24	73
13017	++800i-24-8c	8	8	36	36	24	73
13018	++850i-30-10c	8,5	10	40	45	30	86
13019	++880i-30-10c	8,8	10	40	45	30	86
13020	++900i-30-10c	9	10	40	45	30	86
13021	++950i-30-10c	9,5	10	40	45	30	86
13022	++980i-30-10c	9,8	10	40	45	30	86
13023	++1000i-30-10c	10	10	40	45	30	86
13024	++1020i-36-12c	10,2	12	45	52	36	98
13025	++1050i-36-12c	10,5	12	45	52	36	98
13026	++1100i-36-12c	11	12	45	52	36	98
13027	++1150i-36-12c	11,5	12	45	52	36	98
13028	++1200i-36-12c	12	12	45	52	36	98
13029	++1250i-42-14c	12,5	14	45	61	42	107
13030	++1300i-42-14c	13	14	45	61	42	107
13031	++1350i-42-14c	13,5	14	45	61	42	107
13032	++1400i-42-14c	14	14	45	61	42	107
13033	++1450i-48-16c	14,5	16	48	69	48	118
13034	++1500i-48-16c	15	16	48	69	48	118
13035	++1550i-48-16c	15,5	16	48	69	48	118
13036	++1600i-48-16c	16	16	48	69	48	118
13037	++1700i-54-18c	17	18	48	79	54	128
13038	++1800i-54-18c	18	18	48	79	54	128

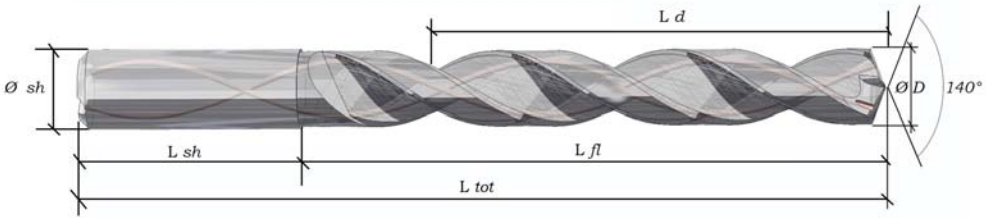
DOF k+(++)



5 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
15001	++380i-23-6c	3,8	6	36	32	23	70
15002	++400i-23-6c	4	6	36	32	23	70
15003	++420i-23-6c	4,2	6	36	32	23	70
15004	++450i-23-6c	4,5	6	36	32	23	70
15005	++500i-30-6c	5	6	36	38	30	75
15006	++510i-30-6c	5,1	6	36	38	30	75
15007	++520i-30-6c	5,2	6	36	38	30	75
15008	++550i-30-6c	5,5	6	36	38	30	75
15009	++580-30-6c	5,8	6	36	38	30	75
15010	++600i-30-6c	6	6	36	38	30	75
15011	++650i-40-8c	6,5	8	36	52	40	89
15012	++680i-40-8c	6,8	8	36	52	40	89
15013	++690i-40-8c	6,9	8	36	52	40	89
15014	++700i-40-8c	7	8	36	52	40	89
15015	++750i-40-8c	7,5	8	36	52	40	89
15016	++780i-40-8c	7,8	8	36	52	40	89
15017	++800i-40-8c	8	8	36	52	40	89
15018	++850i-50-10c	8,5	10	40	62	50	103
15019	++880i-50-10c	8,8	10	40	62	50	103
15020	++900i-50-10c	9	10	40	62	50	103
15021	++950i-50-10c	9,5	10	40	62	50	103
15022	++980i-50-10c	9,8	10	40	62	50	103
15023	++1000i-50-10c	10	10	40	62	50	103
15024	++1020i-60-12c	10,2	12	45	78	60	124
15025	++1050i-60-12c	10,5	12	45	78	60	124
15026	++1100i-60-12c	11	12	45	78	60	124
15027	++1150i-60-12c	11,5	12	45	78	60	124
15028	++1180i-60-12c	11,8	12	45	78	60	124
15029	++1200i-60-12c	12	12	45	78	60	124
15030	++1250i-70-14c	12,5	14	45	91	70	137
15031	++1270i-70-14c	12,7	14	45	91	70	137
15032	++1300i-70-14c	13	14	45	91	70	137
15033	++1350i-70-14c	13,5	14	45	91	70	137
15034	++1400i-70-14c	14	14	45	91	70	137
15035	++1450i-80-16c	14,5	16	48	104	80	153
15036	++1500i-80-16c	15	16	48	104	80	153
15037	++1550i-80-16c	15,5	16	48	104	80	153
15038	++1600i-80-16c	16	16	48	104	80	153
15039	++1650i-90-18c	16,5	18	48	116	90	165
15040	++1700i-90-18c	17	18	48	116	90	165
15041	++1750i-90-18c	17,5	18	48	116	90	165
15042	++1800i-90-18c	18	18	48	116	90	165

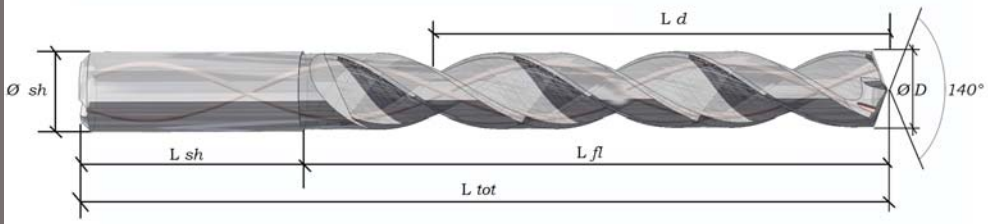
DOF k+(++)



7 X D Internal coolant

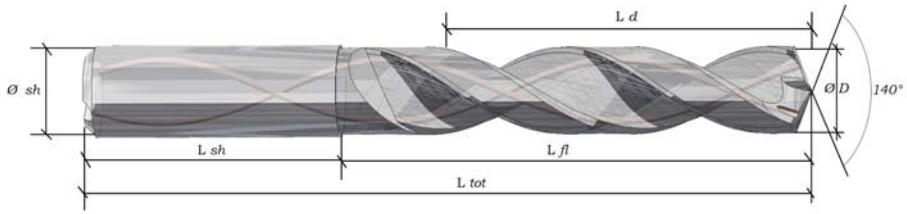
Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
17001	++380i-33-6c	3,8	6	36	40	33	77
17002	++400i-33-6c	4	6	36	40	33	77
17003	++420i-33-6c	4,2	6	36	40	33	77
17004	++450i-33-6c	4,5	6	36	40	33	77
17005	++500i-42-6c	5	6	36	51	42	88
17006	++510i-42-6c	5,1	6	36	51	42	88
17007	++520i-42-6c	5,2	6	36	51	42	88
17008	++550i-42-6c	5,5	6	36	51	42	88
17009	++580i-42-6c	5,8	6	36	51	42	88
17010	++600i-42-6c	6	6	36	51	42	88
17011	++650i-56-8c	6,5	8	36	68	56	105
17012	++680i-56-8c	6,8	8	36	68	56	105
17013	++690i-56-8c	6,9	8	36	68	56	105
17014	++700i-56-8c	7	8	36	68	56	105
17015	++750i-56-8c	7,5	8	36	68	56	105
17016	++780i-56-8c	7,8	8	36	68	56	105
17017	++800i-56-8c	8	8	36	68	56	105
17018	++850i-70-10c	8,5	10	40	85	70	126
17019	++880i-70-10c	8,8	10	40	85	70	126
17020	++900i-70-10c	9	10	40	85	70	126
17021	++950i-70-10c	9,5	10	40	85	70	126
17022	++980i-70-10c	9,8	10	40	85	70	126
17023	++1000i-70-10c	10	10	40	85	70	126
17024	++1020i-84-12c	10,2	12	45	102	84	148
17025	++1050i-84-12c	10,5	12	45	102	84	148
17026	++1100i-84-12c	11	12	45	102	84	148
17027	++1150i-84-12c	11,5	12	45	102	84	148
17028	++1200i-84-12c	12	12	45	102	84	148
17029	++1250i-98-14c	12,5	14	45	119	98	165
17030	++1300i-98-14c	13	14	45	119	98	165
17031	++1350i-98-14c	13,5	14	45	119	98	165
17032	++1400i-98-14c	14	14	45	119	98	165
17033	++1450i-112-16c	14,5	16	48	136	112	185
17034	++1500i-112-16c	15	16	48	136	112	185
17035	++1550i-112-16c	15,5	16	48	136	112	185
17036	++1600i-112-16c	16	16	48	136	112	185
17037	++1700i-126-18c	17	18	48	151	126	200
17038	++1800i-126-18c	18	18	48	151	126	200

DOF k+(++)



10 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
11001	++500i-60-6c	5	6	36	68	60	105
11002	++510i-60-6c	5,1	6	36	68	60	105
11003	++520i-60-6c	5,2	6	36	68	60	105
11004	++550i-60-6c	5,5	6	36	68	60	105
11005	++580i-60-6c	5,8	6	36	69	60	106
11006	++600i-60-6c	6	6	36	69	60	106
11007	++650i-80-8c	6,5	8	36	90	80	127
11008	++680i-80-8c	6,8	8	36	90	80	127
11009	++690i-80-8c	6,9	8	36	90	80	127
11010	++700i-80-8c	7	8	36	91	80	128
11011	++750i-80-8c	7,5	8	36	91	80	128
11012	++780i-80-8c	7,8	8	36	92	80	129
11013	++800i-80-8c	8	8	36	92	80	129
11014	++850i-100-10c	8,5	10	40	113	100	154
11015	++880i-100-10c	8,8	10	40	113	100	154
11016	++900i-100-10c	9	10	40	114	100	155
11017	++950i-100-10c	9,5	10	40	114	100	155
11018	++980i-100-10c	9,8	10	40	115	100	156
11019	++1000i-100-10c	10	10	40	115	100	156
11020	++1020i-120-12c	10,2	12	45	135	120	181
11021	++1050i-120-12c	10,5	12	45	136	120	182
11022	++1100i-120-12c	11	12	45	137	120	183
11023	++1150i-120-12c	11,5	12	45	137	120	183
11024	++1200i-120-12c	12	12	45	138	120	184
11025	++1250i-140-14c	12,5	14	45	157	140	203
11026	++1300i-140-14c	13	14	45	157	140	203
11027	++1350i-140-14c	13,5	14	45	157	140	203
11028	++1400i-140-14c	14	14	45	157	140	203



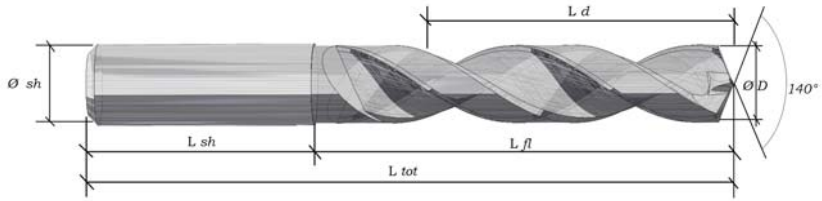
3 X D Internal coolant
For form tapping ISO

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
13901	++M4-371i-12-6c	**3,71**	**6**	36	19	12	58
13902	++M5-466i-15-6c	**4,66**	**6**	36	26	15	64
13903	++M6-556i-18-6c	**5,56**	**6**	36	27	18	64
13904	++M8-350i-24-8c	**7,41**	**8**	36	36	24	73
13905	++M10-931i-30-10c	**9,31**	**10**	40	45	30	86
13906	++M12-1121i-36-12c	**11,21**	**12**	45	52	36	98
13907	++M16-1511i-48-16c	**15,11**	**16**	48	69	48	118

13990	**sats M4 tom M10 formg 3xDi**
	Ingående artiklar: 13901, 13902, 13903, 13904, 13905

Geometry specific qualities

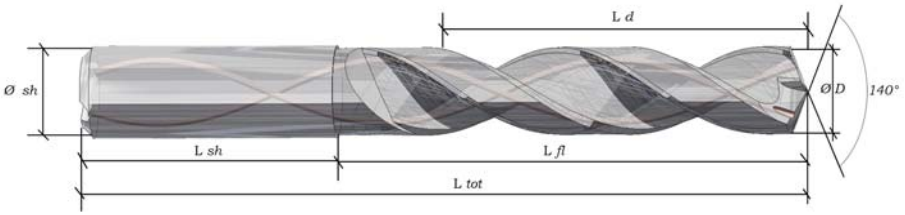
DOF p+ geometry has been optimized for chip breaking and chip formation in ductile materials. Four land margins ensures high hole quality even in theese materials.



2,5 X D External coolant

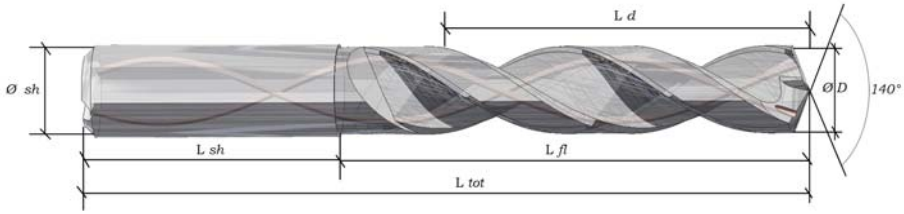
Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
182001p	p+300-9-6c	3	6	36	19	9	58
182002p	p+310-9-6c	3,1	6	36	19	9	58
182003p	p+320-9-6c	3,2	6	36	19	9	58
182004p	p+330-9-6c	3,3	6	36	19	9	58
182005p	p+340-9-6c	3,4	6	36	19	9	58
182006p	p+350-9-6c	3,5	6	36	19	9	58
182007p	p+360-9-6c	3,6	6	36	19	9	58
182008p	p+370-9-6c	3,7	6	36	19	9	58
182009p	p+380-11-6c	3,8	6	36	20	11	58
182010p	p+390-11-6c	3,9	6	36	20	11	58
182011p	p+400-11-6c	4	6	36	20	11	58
182012p	p+410-11-6c	4,1	6	36	20	11	58
182013p	p+420-12-6c	4,2	6	36	20	12	58
182014p	p+450-12-6c	4,5	6	36	20	12	58
182015p	p+480-15-6c	4,8	6	36	25	15	62
182016p	p+500-15-6c	5	6	36	25	15	62
182017p	p+510-15-6c	5,1	6	36	25	15	62
182018p	p+520-15-6c	5,2	6	36	25	15	62
182019p	p+550-15-6c	5,5	6	36	25	15	62
182020p	p+580-15-6c	5,8	6	36	25	15	62
182021p	p+600-15-6c	6	6	36	25	15	62
182022p	p+650-20-8c	6,5	8	36	33	20	70
182023p	p+680-20-8c	6,8	8	36	33	20	70
182024p	p+690-20-8c	6,9	8	36	33	20	70
182025p	p+700-20-8c	7	8	36	33	20	70
182026p	p+750-20-8c	7,5	8	36	33	20	70
182027p	p+780-20-8c	7,8	8	36	33	20	70
182028p	p+800-20-8c	8	8	36	33	20	70
182029p	p+850-25-10c	8,5	10	40	41	25	82
182030p	p+880-25-10c	8,8	10	40	41	25	82
182031p	p+900-25-10c	9	10	40	41	25	82
182032p	p+950-25-10c	9,5	10	40	41	25	82
182033p	p+980-25-10c	9,8	10	40	41	25	82
182034p	p+1000-25-10c	10	10	40	41	25	82
182035p	p+1020-30-12c	10,2	12	45	49	30	95
182036p	p+1050-30-12c	10,5	12	45	49	30	95
182037p	p+1080-30-12c	10,8	12	45	49	30	95
182038p	p+1100-30-12c	11	12	45	49	30	95
182039p	p+1150-30-12c	11,5	12	45	49	30	95
182040p	p+1180-30-12c	11,8	12	45	49	30	95
182041p	p+1200-30-12c	12	12	45	49	30	95
182042p	p+1250-35-14c	12,5	14	45	56	35	102
182043p	p+1270-35-14c	12,7	14	45	56	35	102
182044p	p+1300-35-14c	13	14	45	56	35	102
182045p	p+1350-35-14c	13,5	14	45	56	35	102
182046p	p+1400-35-14c	14	14	45	56	35	102
182047p	p+1450-40-16c	14,5	16	48	61	40	110
182048p	p+1500-40-16c	15	16	48	61	40	110
182049p	p+1550-40-16c	15,5	16	48	61	40	110
182050p	p+1600-40-16c	16	16	48	61	40	110
182051p	p+1650-45-18c	16,5	18	48	71	45	120
182052p	p+1700-45-18c	17	18	48	71	45	120
182053p	p+1750-45-18c	17,5	18	48	71	45	120
182054p	p+1800-45-18c	18	18	48	71	45	120

DOF p+



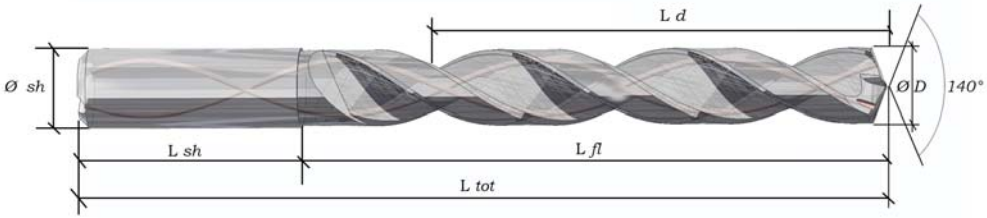
3 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
183009P	p+380i-12-4c	3,8	4	36	18	12	55
183010P	p+400i-12-4c	4	4	36	18	12	55
183011P	p+420i-15-6c	4,2	6	36	21	15	58
183012P	p+450i-15-6c	4,5	6	36	21	15	58
183013P	p+480i-15-6c	4,8	6	36	21	15	58
183014P	p+500i-15-6c	5	6	36	21	15	58
183015P	p+510i-18-6c	5,1	6	36	27	18	64
183016P	p+520i-18-6c	5,2	6	36	27	18	64
183008P	p+550i-18-6c	5,5	6	36	27	18	64
183018P	p+580i-18-6c	5,8	6	36	27	18	64
183019P	p+600i-18-6c	6	8	36	36	24	73
183020P	p+650i-24-8c	6,5	8	36	36	24	73
183021P	p+680i-24-8c	6,8	8	36	36	24	73
183022P	p+690i-24-8c	6,9	8	36	36	24	73
183023P	p+700i-24-8c	7	8	36	36	24	73
183024P	p+750i-24-8c	7,5	8	36	36	24	73
183025P	p+780i-24-8c	7,8	8	36	36	24	73
183026P	p+800i-24-8c	8	10	40	45	30	86
183027P	p+850i-30-10c	8,5	10	40	45	30	86
183056P	p+880i-30-10c	8,8	10	40	45	30	86
183029P	p+900i-30-10c	9	10	40	45	30	86
183030P	p+950i-30-10c	9,5	10	40	45	30	86
183031P	p+980i-30-10c	9,8	10	40	45	30	86
183032P	p+1000i-30-10c	10	10	45	52	36	98
183033P	p+1020i-36-12c	10,2	12	45	52	36	98
183034P	p+1050i-36-12c	10,5	12	45	52	36	98
183035P	p+1080i-36-12c	10,8	12	45	52	36	98
183036P	p+1100i-36-12c	11	12	45	52	36	98
183037P	p+1150i-36-12c	11,5	12	45	52	36	98
183038P	p+1180i-36-12c	11,8	12	45	52	36	98
183039P	p+1200i-36-12c	12	12	45	52	36	98
183040P	p+1250i-42-14c	12,5	14	45	61	42	107
183041P	p+1270i-42-14c	12,7	14	45	61	42	107
183042P	p+1300i-42-14c	13	14	45	61	42	107
183057P	p+1350i-42-14c	13,5	14	45	61	42	107
183044P	p+1400i-42-14c	14	14	45	61	42	107
183045P	p+1450i-48-16c	14,5	16	48	69	48	118
183046P	p+1500i-48-16c	15	16	48	69	48	118
183047P	p+1550i-48-16c	15,5	16	48	69	48	118
183048P	p+1600i-48-16c	16	16	48	69	48	118
183052P	p+1700i-48-18c	17	18	48	79	54	128
183054P	p+1800i-48-18c	18	18	48	79	54	128



5 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
185009p	p+380i-21-4c	3,8	4	36	27	21	64
185010p	p+400i-21-4c	4	4	36	27	21	64
185011p	p+420i-25-6c	4,2	6	36	32	25	70
185012p	p+450i-25-6c	4,5	6	36	32	25	70
185013p	p+480i-25-6c	4,8	6	36	32	25	70
185014p	p+500i-25-6c	5	6	36	32	25	70
185015p	p+510i-30-6c	5,1	6	36	38	30	75
185016p	p+520i-30-6c	5,2	6	36	38	30	75
185017p	p+550i-30-6c	5,5	6	36	38	30	75
185018p	p+580i-30-6c	5,8	6	36	38	30	75
185019p	p+600i-30-6c	6	8	36	52	40	89
185020p	p+650i-40-8c	6,5	8	36	52	40	89
185053p	p+680i-40-8c	6,8	8	36	52	40	89
185022p	p+690i-40-8c	6,9	8	36	52	40	89
185023p	p+700i-40-8c	7	8	36	52	40	89
185024p	p+750i-40-8c	7,5	8	36	52	40	89
185025p	p+780i-40-8c	7,8	8	36	52	40	89
185026p	p+800i-40-8c	8	8	36	52	40	89
185027p	p+850i-50-10c	8,5	10	40	62	50	103
185028p	p+880i-50-10c	8,8	10	40	62	50	103
185029p	p+900i-50-10c	9	10	40	62	50	103
185021p	p+950i-50-10c	9,5	10	40	62	50	103
185031p	p+980i-50-10c	9,8	10	40	62	50	103
185032p	p+1000i-50-10c	10	10	40	62	50	103
185033p	p+1020i-60-12c	10,2	12	45	78	60	124
185034p	p+1050i-60-12c	10,5	12	45	78	60	124
185035p	p+1080i-60-12c	10,8	12	45	78	60	124
185036p	p+1100i-60-12c	11	12	45	78	60	124
185037p	p+1150i-60-12c	11,5	12	45	78	60	124
185038p	p+1180i-60-12c	11,8	12	45	78	60	124
185039p	p+1200i-60-12c	12	12	45	78	60	124
185040p	p+1250i-70-14c	12,5	14	45	91	70	137
185041p	p+1270i-70-14c	12,7	14	45	91	70	137
185054p	p+1300i-70-14c	13	14	45	91	70	137
185043p	p+1350i-70-14c	13,5	14	45	91	70	137
185044p	p+1400i-70-14c	14	14	45	91	70	137
185045p	p+1450i-80-16c	14,5	16	48	104	80	153
185046p	p+1500i-80-16c	15	16	48	104	80	153
185047p	p+1550i-80-16c	15,5	16	48	104	80	153
185048p	p+1600i-80-16c	16	16	48	104	80	153
185049p	p+1650i-90-18c	16,5	18	48	116	90	165
185050p	p+1700i-90-18c	17	18	48	116	90	165
185051p	p+1750i-90-18c	17,5	18	48	116	90	165
185042p	p+1800i-90-18c	18	18	48	116	90	165

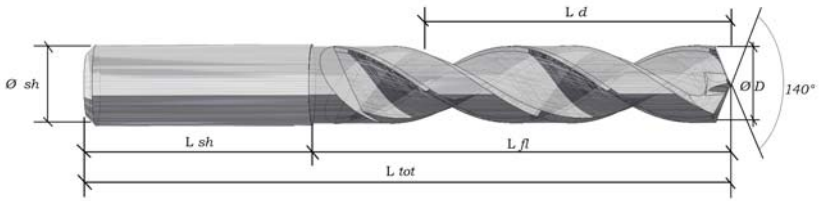


7 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
187001p	p+380i-33-6c	3,8	4	36	40	33	77
187002p	p+400i-33-6c	4	4	36	40	33	77
187003p	p+420i-33-6c	4,2	6	36	40	33	77
187004p	p+450i-33-6c	4,5	6	36	40	33	77
187005p	p+500i-42-6c	5	6	36	51	42	88
187006p	p+510i-42-6c	5,1	6	36	51	42	88
187007p	p+520i-42-6c	5,2	6	36	51	42	88
187008p	p+550i-42-6c	5,5	6	36	51	42	88
187009p	p+580i-42-6c	5,8	6	36	51	42	88
187010p	p+600i-42-6c	6	6	36	51	42	88
187011p	p+650i-56-8c	6,5	8	36	68	56	105
187012p	p+680i-56-8c	6,8	8	36	68	56	105
187013p	p+690i-56-8c	6,9	8	36	68	56	105
187014p	p+700i-56-8c	7	8	36	68	56	105
187015p	p+750i-56-8c	7,5	8	36	68	56	105
187016p	p+780i-56-8c	7,8	8	36	68	56	105
187017p	p+800i-56-8c	8	8	36	68	56	105
187018p	p+850i-70-10c	8,5	10	40	85	70	126
187019p	p+880i-70-10c	8,8	10	40	85	70	126
187020p	p+900i-70-10c	9	10	40	85	70	126
187021p	p+950i-70-10c	9,5	10	40	85	70	126
187022p	p+980i-70-10c	9,8	10	40	85	70	126
187023p	p+1000i-70-10c	10	10	40	85	70	126
187024p	p+1020i-84-12c	10,2	12	45	102	84	148
187025p	p+1050i-84-12c	10,5	12	45	102	84	148
187026p	p+1100i-84-12c	11	12	45	102	84	148
187027p	p+1150i-84-12c	11,5	12	45	102	84	148
187028p	p+1200i-84-12c	12	12	45	102	84	148
187029p	p+1250i-98-14c	12,5	14	45	119	98	165
187030p	p+1300i-98-14c	13	14	45	119	98	165
187031p	p+1350i-98-14c	13,5	14	45	119	98	165
187032p	p+1400i-98-14c	14	14	45	119	98	165
187033p	p+1450i-112-16c	14,5	16	48	136	112	185
187034p	p+1500i-112-16c	15	16	48	136	112	185
187035p	p+1550i-112-16c	15,5	16	48	136	112	185
187036p	p+1600i-112-16c	16	16	48	136	112	185
187037p	p+1700i-126-18c	17	18	48	151	126	200
187038p	p+1800i-126-18c	18	18	48	151	126	200

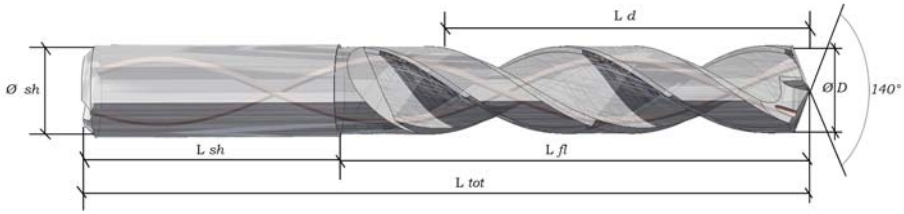
Geometry specific qualities

DOF a+ geometry has been optimized for chip breaking and chip formation in aluminium and enable excaptional high feed. A concave corner geometry reduces exit burrs.



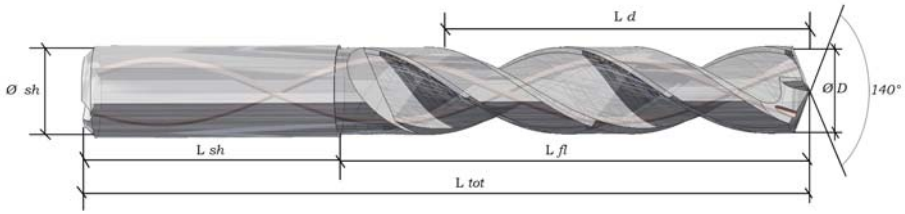
2,5 X D External coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
162001p	a+300-9-6c	3	6	36	19	9	58
162002p	a+310-9-6c	3,1	6	36	19	9	58
162003p	a+320-9-6c	3,2	6	36	19	9	58
162004p	a+330-9-6c	3,3	6	36	19	9	58
162005p	a+340-9-6c	3,4	6	36	19	9	58
162006p	a+350-9-6c	3,5	6	36	19	9	58
162007p	a+360-9-6c	3,6	6	36	19	9	58
162008p	a+370-9-6c	3,7	6	36	19	9	58
162009p	a+380-11-6c	3,8	6	36	20	11	58
162010p	a+390-11-6c	3,9	6	36	20	11	58
162011p	a+400-11-6c	4	6	36	20	11	58
162012p	a+410-11-6c	4,1	6	36	20	11	58
162013p	a+420-12-6c	4,2	6	36	20	12	58
162014p	a+450-12-6c	4,5	6	36	20	12	58
162015p	a+480-15-6c	4,8	6	36	25	15	62
162016p	a+500-15-6c	5	6	36	25	15	62
162017p	a+510-15-6c	5,1	6	36	25	15	62
162018p	a+520-15-6c	5,2	6	36	25	15	62
162019p	a+550-15-6c	5,5	6	36	25	15	62
162020p	a+580-15-6c	5,8	6	36	25	15	62
162021p	a+600-15-6c	6	6	36	25	15	62
162022p	a+650-20-8c	6,5	8	36	33	20	70
162023p	a+680-20-8c	6,8	8	36	33	20	70
162024p	a+690-20-8c	6,9	8	36	33	20	70
162025p	a+700-20-8c	7	8	36	33	20	70
162026p	a+750-20-8c	7,5	8	36	33	20	70
162027p	a+780-20-8c	7,8	8	36	33	20	70
162028p	a+800-20-8c	8	8	36	33	20	70
162029p	a+850-25-10c	8,5	10	40	41	25	82
162030p	a+880-25-10c	8,8	10	40	41	25	82
162031p	a+900-25-10c	9	10	40	41	25	82
162032p	a+950-25-10c	9,5	10	40	41	25	82
162033p	a+980-25-10c	9,8	10	40	41	25	82
162034p	a+1000-25-10c	10	10	40	41	25	82
162035p	a+1020-30-12c	10,2	12	45	49	30	95
162036p	a+1050-30-12c	10,5	12	45	49	30	95
162037p	a+1080-30-12c	10,8	12	45	49	30	95
162038p	a+1100-30-12c	11	12	45	49	30	95
162039p	a+1150-30-12c	11,5	12	45	49	30	95
162040p	a+1180-30-12c	11,8	12	45	49	30	95
162041p	a+1200-30-12c	12	12	45	49	30	95
162042p	a+1250-35-14c	12,5	14	45	56	35	102
162043p	a+1270-35-14c	12,7	14	45	56	35	102
162044p	a+1300-35-14c	13	14	45	56	35	102
162045p	a+1350-35-14c	13,5	14	45	56	35	102
162046p	a+1400-35-14c	14	14	45	56	35	102
162047p	a+1450-40-16c	14,5	16	48	61	40	110
162048p	a+1500-40-16c	15	16	48	61	40	110
162049p	a+1550-40-16c	15,5	16	48	61	40	110
162050p	a+1600-40-16c	16	16	48	61	40	110
162051p	a+1650-45-18c	16,5	18	48	71	45	120
162052p	a+1700-45-18c	17	18	48	71	45	120
162053p	a+1750-45-18c	17,5	18	48	71	45	120
162054p	a+1800-45-18c	18	18	48	71	45	120



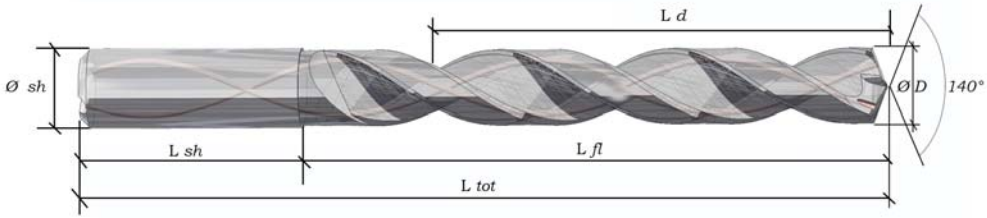
3 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
163001p	a+300i-12-4c	3	4	36	17	11	54
163002p	a+310i-12-4c	3,1	4	36	17	11	54
163003p	a+320i-12-4c	3,2	4	36	17	11	54
163004p	a+330i-12-4c	3,3	4	36	17	11	54
163005p	a+340i-12-4c	3,4	4	36	17	11	54
163006p	a+350i-12-4c	3,5	4	36	17	11	54
163007p	a+360i-12-4c	3,6	4	36	17	11	54
163008p	a+370i-12-4c	3,7	4	36	17	11	54
163009p	a+380i-12-4c	3,8	4	36	21	14	58
163010p	a+400i-12-4c	4	4	36	21	14	58
163011p	a+420i-15-6c	4,2	6	36	21	14	58
163012p	a+450i-15-6c	4,5	6	36	21	14	58
163013p	a+480i-15-6c	4,8	6	36	21	14	58
163014p	a+500i-15-6c	5	6	36	27	18	64
163015p	a+510i-18-6c	5,1	6	36	27	18	64
163016p	a+520i-18-6c	5,2	6	36	27	18	64
163017p	a+550i-18-6c	5,5	6	36	27	18	64
163018p	a+580i-18-6c	5,8	6	36	27	18	64
163019p	a+600i-18-6c	6	6	36	27	18	64
163020p	a+650i-24-8c	6,5	8	36	36	24	73
163021p	a+680i-24-8c	6,8	8	36	36	24	73
163022p	a+690i-24-8c	6,9	8	36	36	24	73
163023p	a+700i-24-8c	7	8	36	36	24	73
163024p	a+750i-24-8c	7,5	8	36	36	24	73
163025p	a+780i-24-8c	7,8	8	36	36	24	73
163026p	a+800i-24-8c	8	8	36	36	24	73
163027p	a+850i-30-10c	8,5	10	40	45	30	86
163028p	a+880i-30-10c	8,8	10	40	45	30	86
163029p	a+900i-30-10c	9	10	40	45	30	86
163030p	a+950i-30-10c	9,5	10	40	45	30	86
163031p	a+980i-30-10c	9,8	10	40	45	30	86
163032p	a+1000i-30-10c	10	10	40	45	30	86
163033p	a+1020i-36-12c	10,2	12	45	52	36	98
163034p	a+1050i-36-12c	10,5	12	45	52	36	98
163035p	a+1080i-36-12c	10,8	12	45	52	36	98
163036p	a+1100i-36-12c	11	12	45	52	36	98
163037p	a+1150i-36-12c	11,5	12	45	52	36	98
163038p	a+1180i-36-12c	11,8	12	45	52	36	98
163039p	a+1200i-36-12c	12	12	45	52	36	98
163040p	a+1250i-42-14c	12,5	14	45	61	42	107
163041p	a+1270i-42-14c	12,7	14	45	61	42	107
163042p	a+1300i-42-14c	13	14	45	61	42	107
163043p	a+1350i-42-14c	13,5	14	45	61	42	107
163044p	a+1400i-42-14c	14	14	45	61	42	107
163045p	a+1450i-48-16c	14,5	16	48	69	48	118
163046p	a+1500i-48-16c	15	16	48	69	48	118
163047p	a+1550i-48-16c	15,5	16	48	69	48	118
163048p	a+1600i-48-16c	16	16	48	69	48	118
163049p	a+1650i-54-18c	16,5	18	48	79	54	128
163052p	a+1700i-54-18c	17	18	48	79	54	128
163053p	a+1750i-54-18c	17,5	18	48	79	54	128
163054p	a+1800i-54-18c	18	18	48	79	54	128



5 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
165001p	a+300i-18-4c	3	4	36	24	18	62
165002p	a+310i-18-4c	3,1	4	36	24	18	62
165003p	a+320i-18-4c	3,2	4	36	24	18	62
165004p	a+330i-18-4c	3,3	4	36	24	18	62
165005p	a+340i-18-4c	3,4	4	36	24	18	62
165006p	a+350i-18-4c	3,5	4	36	24	18	62
165007p	a+360i-18-4c	3,6	4	36	24	18	62
165008p	a+370i-18-4c	3,7	4	36	24	18	62
165009p	a+380i-21-4c	3,8	4	36	27	21	65
165010p	a+400i-21-4c	4	4	36	27	21	65
165011p	a+420i-25-6c	4,2	6	36	32	25	70
165012p	a+450i-25-6c	4,5	6	36	32	25	70
165013p	a+480i-25-6c	4,8	6	36	32	25	70
165014p	a+500i-25-6c	5	6	36	32	25	70
165015p	a+510i-30-6c	5,1	6	36	38	30	75
165016p	a+520i-30-6c	5,2	6	36	38	30	75
165017p	a+550i-30-6c	5,5	6	36	38	30	75
165018p	a+580i-30-6c	5,8	6	36	38	30	75
165019p	a+600i-30-6c	6	6	36	38	30	75
165020p	a+650i-40-8c	6,5	8	36	52	40	89
165021p	a+680i-40-8c	6,8	8	36	52	40	89
165022p	a+690i-40-8c	6,9	8	36	52	40	89
165023p	a+700i-40-8c	7	8	36	52	40	89
165024p	a+750i-40-8c	7,5	8	36	52	40	89
165025p	a+780i-40-8c	7,8	8	36	52	40	89
165026p	a+800i-40-8c	8	8	36	52	40	89
165027p	a+850i-50-10c	8,5	10	40	62	50	103
165028p	a+880i-50-10c	8,8	10	40	62	50	103
165029p	a+900i-50-10c	9	10	40	62	50	103
165030p	a+950i-50-10c	9,5	10	40	62	50	103
165031p	a+980i-50-10c	9,8	10	40	62	50	103
165032p	a+1000i-50-10c	10	10	40	62	50	103
165033p	a+1020i-60-12c	10,2	12	45	78	60	124
165034p	a+1050i-60-12c	10,5	12	45	78	60	124
165035p	a+1080i-60-12c	10,8	12	45	78	60	124
165036p	a+1100i-60-12c	11	12	45	78	60	124
165037p	a+1150i-60-12c	11,5	12	45	78	60	124
165038p	a+1180i-60-12c	11,8	12	45	78	60	124
165039p	a+1200i-60-12c	12	12	45	78	60	124
165040p	a+1250i-70-14c	12,5	14	45	91	70	137
165041p	a+1270i-70-14c	12,7	14	45	91	70	137
165042p	a+1300i-70-14c	13	14	45	91	70	137
165043p	a+1350i-70-14c	13,5	14	45	91	70	137
165044p	a+1400i-70-14c	14	14	45	91	70	137
165045p	a+1450i-80-16c	14,5	16	48	104	80	153
165046p	a+1500i-80-16c	15	16	48	104	80	153
165047p	a+1550i-80-16c	15,5	16	48	104	80	153
165048p	a+1600i-80-16c	16	16	48	104	80	153
165049p	a+1650i-90-18c	16,5	18	48	116	90	165
165050p	a+1700i-90-18c	17	18	48	116	90	165
165051p	a+1750i-90-18c	17,5	18	48	116	90	165
165052p	a+1800i-90-18c	18	18	48	116	90	165

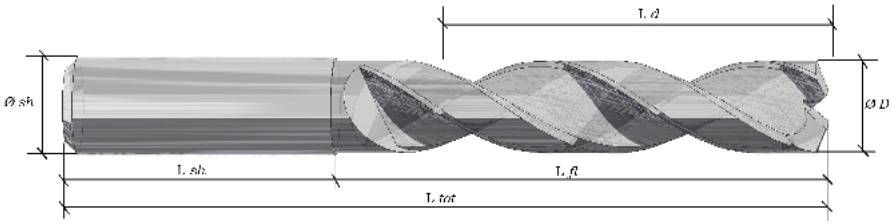


7 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
167001p	a+380i-33-6c	3,8	6	36	40	33	77
167002p	a+400i-33-6c	4	6	36	40	33	77
167003p	a+420i-33-6c	4,2	6	36	40	33	77
167004p	a+450i-33-6c	4,5	6	36	40	33	77
167005p	a+500i-42-6c	5	6	36	51	42	88
167006p	a+510i-42-6c	5,1	6	36	51	42	88
167007p	a+520i-42-6c	5,2	6	36	51	42	88
167008p	a+550i-42-6c	5,5	6	36	51	42	88
167009p	a+580i-42-6c	5,8	6	36	51	42	88
167010p	a+600i-42-6c	6	6	36	51	42	88
167011p	a+650i-56-8c	6,5	8	36	68	56	105
167012p	a+680i-56-8c	6,8	8	36	68	56	105
167013p	a+690i-56-8c	6,9	8	36	68	56	105
167014p	a+700i-56-8c	7	8	36	68	56	105
167015p	a+750i-56-8c	7,5	8	36	68	56	105
167016p	a+780i-56-8c	7,8	8	36	68	56	105
167017p	a+800i-56-8c	8	8	36	68	56	105
167018p	a+850i-70-10c	8,5	10	40	85	70	126
167019p	a+880i-70-10c	8,8	10	40	85	70	126
167020p	a+900i-70-10c	9	10	40	85	70	126
167021p	a+950i-70-10c	9,5	10	40	85	70	126
167022p	a+980i-70-10c	9,8	10	40	85	70	126
167023p	a+1000i-70-10c	10	10	40	85	70	126
167024p	a+1020i-84-12c	10,2	12	45	102	84	148
167025p	a+1050i-84-12c	10,5	12	45	102	84	148
167026p	a+1100i-84-12c	11	12	45	102	84	148
167027p	a+1150i-84-12c	11,5	12	45	102	84	148
167028p	a+1200i-84-12c	12	12	45	102	84	148
167029p	a+1250i-98-14c	12,5	14	45	119	98	165
167030p	a+1300i-98-14c	13	14	45	119	98	165
167031p	a+1350i-98-14c	13,5	14	45	119	98	165
167032p	a+1400i-98-14c	14	14	45	119	98	165
167033p	a+1450i-112-16c	14,5	16	48	136	112	185
167034p	a+1500i-112-16c	15	16	48	136	112	185
167035p	a+1550i-112-16c	15,5	16	48	136	112	185
167036p	a+1600i-112-16c	16	16	48	136	112	185
167037p	a+1700i-126-18c	17	18	48	151	126	200
167038p	a+1800i-126-18c	18	18	48	151	126	200

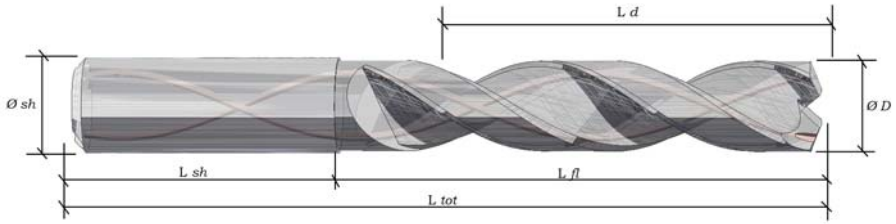
Geometry specific qualities

DOF SX geometry has been optimized for extra low axial force. SX has two points on equal distance from centre which eliminates the centres influence on the axial force.



2 X D External coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
32001	sx600-12-6c	6	6	36	18	12	55
32002	sx650-16-8c	6,5	8	36	27	16	64
32003	sx680-16-8c	6,8	8	36	27	16	64
32004	sx690-16-8c	6,9	8	36	27	16	64
32005	sx700-16-8c	7	8	36	27	16	64
32006	sx750-16-8c	7,5	8	36	27	16	64
32007	sx780-16-8c	7,8	8	36	27	16	64
32008	sx800-16-8c	8	8	36	27	16	64
32009	sx850-20-10c	8,5	10	40	33	20	74
32010	sx880-20-10c	8,8	10	40	33	20	74
32011	sx900-20-10c	9	10	40	33	20	74
32012	sx950-20-10c	9,5	10	40	33	20	74
32013	sx980-20-10c	9,8	10	40	33	20	74
32014	sx1000-20-10c	10	10	40	33	20	74
32015	sx1020-24-12c	10,2	12	45	40	24	86
32016	sx1050-24-12c	10,5	12	45	40	24	86
32017	sx1100-24-12c	11	12	45	40	24	86
32018	sx1150-24-12c	11,5	12	45	40	24	86
32019	sx1200-24-12c	12	12	45	40	24	86
32020	sx1250-28-14c	12,5	14	45	46	28	92
32021	sx1300-28-14c	13	14	45	46	28	92
32022	sx1350-28-14c	13,5	14	45	46	28	92
32023	sx1400-28-14c	14	14	45	46	28	92
32024	sx1450-32-16c	14,5	16	48	52	32	101
32025	sx1500-32-16c	15	16	48	52	32	101
32026	sx1550-32-16c	15,5	16	48	52	32	101
32027	sx1600-32-16c	16	16	48	52	32	101
32028	sx1700-36-18c	17	18	48	56	36	105
32029	sx1800-36-18c	18	18	48	56	36	105

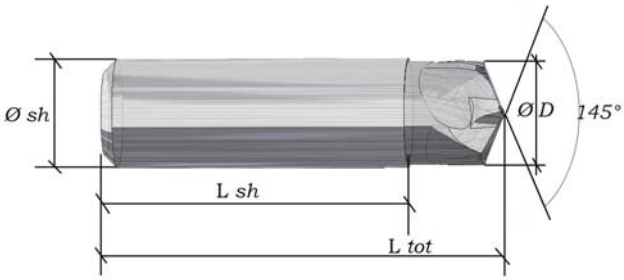


3 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
33001	sx600i-18-6c	6	6	36	27	18	64
33002	sx650i-24-8c	6,5	8	36	36	24	73
33003	sx680i-24-8c	6,8	8	36	36	24	73
33004	sx690i-24-8c	6,9	8	36	36	24	73
33005	sx700i-24-8c	7	8	36	36	24	73
33006	sx750i-24-8c	7,5	8	36	36	24	73
33007	sx780i-24-8c	7,8	8	36	36	24	73
33008	sx800i-24-8c	8	8	36	36	24	73
33009	sx850i-30-10c	8,5	10	40	45	30	86
33010	sx880i-30-10c	8,8	10	40	45	30	86
33011	sx900i-30-10c	9	10	40	45	30	86
33012	sx950i-30-10c	9,5	10	40	45	30	86
33013	sx980i-30-10c	9,8	10	40	45	30	86
33014	sx1000i-30-10c	10	10	40	45	30	86
33015	sx1020i-36-12c	10,2	12	45	52	36	98
33016	sx1050i-36-12c	10,5	12	45	52	36	98
33017	sx1100i-36-12c	11	12	45	52	36	98
33018	sx1150i-36-12c	11,5	12	45	52	36	98
33019	sx1200i-36-12c	12	12	45	52	36	98
33020	sx1250i-42-14c	12,5	14	45	61	42	107
33021	sx1300i-42-14c	13	14	45	61	42	107
33022	sx1350i-42-14c	13,5	14	45	61	42	107
33023	sx1400i-42-14c	14	14	45	61	42	107
33024	sx1450i-48-16c	14,5	16	48	69	48	118
33025	sx1500i-48-16c	15	16	48	69	48	118
33026	sx1550i-48-16c	15,5	16	48	69	48	118
33027	sx1600i-48-16c	16	16	48	69	48	118
33028	sx1700i-54-18c	17	18	48	79	54	128
33029	sx1800i-54-18c	18	18	48	79	54	128

Geometry specific qualities

DOF CB is a centre drill with 145° point angle and thereby guiding the next drilling operation by the point.



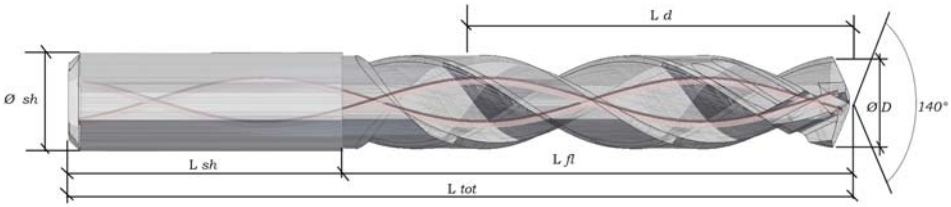
Centre drill 145° Point angle

Art. Nr	Denomination	Ø D	Ø sh	L sh	L tot
90615	cb-600-6c-v145	6	6	36	49
90616	cb-800-8c-v145	8	8	36	51
90617	cb-1000-10c-v145	10	10	40	56
90618	cb-1200-12c-v145	12	12	45	62

DOF brbs

Geometry specific qualities

DOF brbs is a drill ream with a negative helix ream cut. To ensure a robust process extra support points and ground chanels to guide the coolant flow are added. In most materials H7 tolerance is achieved.



3 X D Internal coolant

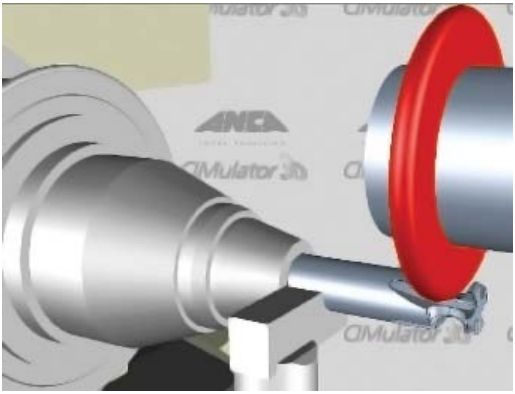
Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
23001	brbs-600i-18-6c	6	6	36	27	18	64
23002	brbs-700i-24-8c	7	8	36	36	24	73
23003	brbs-800i-24-8c	8	8	36	36	24	73
23004	brbs-900i-30-10c	9	10	40	45	30	86
23005	brbs-1000i-30-10c	10	10	40	45	30	86
23006	brbs-1100i-36-12c	11	12	45	52	36	98
23007	brbs-1200i-36-12c	12	12	45	52	36	98
23008	brbs-1300i-42-14c	13	14	45	61	42	107
23009	brbs-1400i-42-14c	14	14	45	61	42	107
23010	brbs-1500i-48-16c	15	16	48	69	48	118
23011	brbs-1600i-48-16c	16	16	48	69	48	118
23012	brbs-1700i-54-18c	17	18	48	79	54	128
23013	brbs-1800i-54-18c	18	18	48	79	54	128

5 X D Internal coolant

Art. Nr	Denomination	Ø D	Ø sh	L sh	L fl	L d	L tot
25001	brbs-600i-30-8c	6	6	36	39	30	75
25002	brbs-700i-40-8c	7	8	36	52	40	89
25003	brbs-800i-40-8c	8	8	36	52	40	89
25004	brbs-900i-50-10c	9	10	40	65	50	103
25005	brbs-1000i-50-10c	10	10	40	65	50	103
25006	brbs-1100i-60-12c	11	12	45	76	60	124
25007	brbs-1200i-60-12c	12	12	45	76	60	124
25008	brbs-1300i-70-14c	13	14	45	89	70	137
25009	brbs-1400i-70-14c	14	14	45	89	70	137
25010	brbs-1500i-80-16c	15	16	48	101	80	153
25011	brbs-1600i-80-16c	16	16	48	101	80	153
25012	brbs-1800i-90-18c	17	18	48	115	90	165
25013	brbs-1800i-90-18c	18	18	48	115	90	165

CIM 3D, simulation of grinding paths

By using CIM 3D as a programming tool simulation and measurment of each geometry is enabled. In tools for special applications this means that each product can be optimized even if the tool is unique.



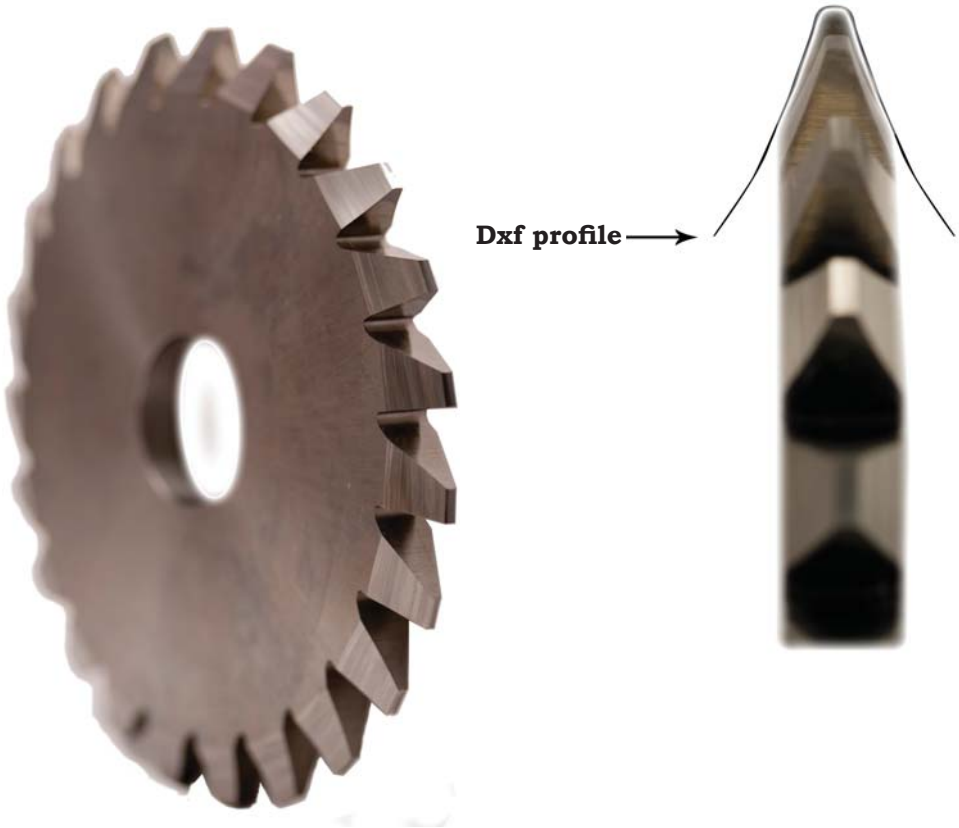
Benefits

-Solution for machining problems
-Adaptaion for specific dimensions
-Combination of multiple tools into one
-Adaptation for specific material

With the same high productivity as for alla our tools.

I-View, high accuracy profiles

To be able to manufacture high accuracy profile tools I-View is used, which is a way to measure and compensate grinding paths to achieve excaptional accuracy. The profiles can be based on spline functions or dxf files.



Material groups

Theese are the material groups according to ISO. For detailed information about which materials belong to respective material group pleasu refer to DOF material groups on page 49 and forward.

ISO	Material group	Description		Hardness [HB]
P	1	Low carbon steel	Very soft <0.25% C	<170
	2		Soft <=0.25% C	170-200
	3		Medium hard >=0.25% C	200-250
	4	Low alloy steel	Medium hard <5% alloy	200-300
	5		Harder <5% alloy	250-350
	6	High alloy steel	Annealed >5% alloy	180-250
	7		Hardened >5% alloy	250-400
M	8	Stainless steel	Ferritic/martensitic	≈200
	9		Martensitic	≈240
	10		Austenitic	≈180
K	11	Nodular cast iron	Ferritic/pearlitic	150-200
	12		Pearlitic	200-300
	13	Grey cast iron, tough cast iron		150-300
N	14	Aluminium		60-130
	15	Brass, copper alloy		70-110
S	16	Super alloy Fe/Ni base	Annealed	180-280
	17		Cured	280-380
	18	Titanium, titanium alloy		
H	19	Hardened steel	Hardness 48-55 HRc	48-55 HRc
	20		Hardness 55-65 HRc	55-65 HRc

Cutting Parameters

The Recomendations in the table below, is to be concidered as starting values in machines with good production parameters, such as:

Internal coolant:	Cutting fluid for good lubrication, (conc. 5-10%) Aprox. 20-40 bar preassure. - if the preassure is higher, both speed and feed can be increased. - if the preassure is lower, both speed and feed should be decreased. - if the concentration is lower, decrease the feed and maintain the speed.
External coolant:	Cutting fluid for good lubrication, (conc. 5-10%) with acurate and rich flow. - if the concentration is lower, decrease the feed and maintain the speed.
Stability:	Work part firmly clamped. Tool holding with shrink fit or hydraulic attachment. - if vibrations occurs, a range of cutting values should be tested to find a minimum. - if the breakout of the drill point causes noice the feed should be reduced by 50% during breakout. - if roundness or positioning of the hole is bad, pre-drill with 145°-150° drill point.

DOF TOOLS Cutting Parameters

As clearly demonstrated in the chart bellow DOF Tools can withstand high productivity in form of increased feed.

For brbs (drill reaming) the feed should be reduced with 30-60% to maintain high hole quality.

		Cutting speed Vc [m/min]		Feedrate [mm/varv] (Drill diameter)				
ISO	Material group	Int. coolnt.	Ext. coolnt.	Ø 3-5	Ø 5.1-8	Ø 8.1-12	Ø 12.1-16	Ø 16.1-20
P	1	200	130	0.25	0.35	0.4	0.45	0.5
	2	160	110	0.25	0.35	0.45	0.55	0.6
	3	130	100	0.25	0.35	0.45	0.6	0.65
	4	120	100	0.3	0.4	0.55	0.65	0.7
	5	110	100	0.3	0.4	0.55	0.65	0.7
	6	100	90	0.3	0.4	0.55	0.65	0.7
	7	85	70	0.25	0.35	0.4	0.45	0.5
M	8	70	60	0.1	0.15	0.2	0.25	0.3
	9	55	50	0.1	0.15	0.2	0.25	0.3
	10	45	40	0.08	0.12	0.16	0.2	0.24
K	11	110	90	0.35	0.5	0.7	0.8	0.9
	12	100	80	0.35	0.5	0.7	0.8	0.9
	13	90	70	0.35	0.5	0.7	0.8	0.9
N	14	350	200	0.4	0.6	1	1	1
	15	300	200	0.4	0.6	1	1	1
S	16	28	25	0.07	0.1	0.12	0.15	0.18
	17	18	15	0.05	0.07	0.08	0.1	0.12
	18	40	30	0.15	0.2	0.25	0.28	0.3
H	19	50	35	0.1	0.12	0.13	0.14	0.15
	20	30	20	0.05	0.07	0.08	0.09	0.1

Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
	A 366 (1012)	0.0030	C 10	040 A 10		AF 34 C 10		C 10
	1008			045 M 10		XC 10		1C 10
				1449 10 CS				
		1.0028	Ust 34-2 (S250G1T)			A 34-2		Fe 330, Fe 330 B FU
		1.0034	RSt 34-2 (S250G2T)	1449 34/20 HR, HS, CR, CS		A 34-2 NE		Fe 330 B FN
		1.0035	St185 (Fe 310-0)	Fe 310-0		A 33	1300	Fe 320
			St 33	1449 15 HR, HS				
	A 570 Gr. 33, 36	1.0036	S235JRG1 (Fe 360 B)	Fe 360 B			1311	FE37BFU
			Ust 37-2	4360-40 B			1312	
		1.0037	S235JR (Fe 360 B)	Fe 360 B			1311	Fe 360 B
			St 37-2	4360-40 B		E 24-2		1449 37/23 HR
	1115	1.0038	GS-CK16	030A04	1A		1325	
	A 570 Gr. 40	1.0044	S275JR (Fe 430 B)	Fe 430 B FN			1412	Fe 430 B
			St 44-2	1449 43/25 HR, HS				Fe 430 B FN
				4360-43 B		E 28-2		
		1.0045	S355JR	4360-50 B		E 36-2	2172	Fe 510 B
	A 570 Gr. 50	1.0050	E295 (Fe 490-2)	Fe 490-2 FN			1550	Fe 490
	A 572 Gr. 50		St 50-2	4360-50 B		A 50-2	2172	
	A 572 Gr. 65	1.0060	E335 (Fe 590-2)	Fe 60-2			1650	Fe 60-2
			St 60-2	4360-55 E; 55 C		A 60-2		Fe 590
		1.0060	St 60-2					Fe 60-2
		1.0070	E360 (Fe 690-2)	Fe 690-2 FN		A 70-2	1655	Fe 70-2
			St 70-2					Fe 690
		1.0112	P235S	1501-164-360B LT20		A 37 AP		Fe 360 C
		1.0114	S235JU;St 37-3 U	4360-40C		E 24-3		Fe 360 C
	A 284 Gr. D	1.0116	S235J2G3 (Fe 360 D 1)	Fe 360 D1 FF		E 24-3	1312	Fe 360 D1 FF
	A 573 Gr. 58		St 37-3	1449 37/23 CR		E 24-4	1313	Fe 360 C FN
	A 570 Gr. 36;C			4360-40 D				Fe 360 D FF
	A 611 Gr. C							Fe 37-2
		1.0130	P265S	1501-164-400B LT 20		A 42 AP		
		1.0143	S275J0; St 44-3 U	4360-43C		E 28-3	1414-01	Fe 430 D
	A 573 Gr. 70	1.0144	S275J2G3 (Fe 430 D 1)	Fe 430 D1 FF		E 28-3	1411, 1412	Fe 430 B, Fe 430 C (FN)
	A 611 Gr. D		St 44-3	4360-43 C; 43 D		E 28-4	1414	Fe 430 D (FF)
		1.0149	S275JOH; RoSt 44-2	4360-43 C			1412-04	Fe 430 C
		1.0226	DX51D; St 02 Z	Z2		GC	1151 10	FeP 02 G
	M 1010	1.0301	C10	040 A 10		AF 34 C 10		C 10
				045 M 10		XC 10		1 C 10
				1449 10 CS				
	A 621 (1008)	1.0330	DC 01	1449 4 CR			1142	FeP 00
			St 2; St 12	1449 3 CS		TC		FeP 01
1	A 619 (1008)	1.0333	Ust 3 (DC03G1)	1449 2 CR; 3 CR		E		FeP 02
			Ust 13					
	A 621 (1008)	1.0334	UstW 23 (DD12G1)			SC		FeP 12
	A 622 (1008)	1.0335	DD13; StW 24	1449 1 HR		3 C		FeP 13
	A 620 (1008)	1.0338	DC04	1449 1 CR; 2 CR		ES	1147	FeP 04
			St4; St 14					
	A 516 Gr. 65; 55	1.0345	P235GH	1501 Gr. 141-360		A 37 CP;AP	1331	FeE235, Fe 360 1 KW; KG
	A 515 Gr. 65; 55		HI	1501 Gr. 161-360; 151-360			1330	Fe 360 2 KW; KG
	A 414 Gr. C			1501 Gr. 161-400; 154-360				
	A 442 Gr. 55			1501 Gr. 164-360; 161-360				
	(M) 1020	1.0402	C22	055 M 15, 070 M 20	2C/2D	AF 42 C 20;	1450	C 20
	M 1023			1449 22 HS, CS		XC 25; 1 C 22		C 21, C 25
	1020	1.0402	C22	050A20	2C/2D	CC20	1450	C20C21
	1020;1023	1.0402	C22	055 M 15;070 M 20	2C	AF 42 C 20;	1450	C 20;
						XC 25;1 C 22		C 21;C 25
		1.0425	P265GH HII	1501 Gr. 161-400;151-400		A 42 CP;AP	1431	Fe 410 1 KW; KG;
				1501 Gr. 164-360;161-400			1430	KT Fe 410 2 KW; KG
				1501 Gr. 164-400;154-400			1432	
	A 27 65-35	1.0443	GS-45	A1		E 23-45 M	1305	
		1.0539	S355NH; StE 335			TSE 355-4	2134-04	Fe 510 B
		1.0545	S355N; StE 355	4360-50E		E 355 R	2334-01	Fe 355 KG
		1.0546	S355NL;TStE 355	4360-50EE		E 355 FP	2135-01	FeE 355 KT
		1.0547	S355JOH	4360-50C		TSE355-3	2172-04	Fe 510 C
		1.0549	S355 NLH;TStE 355				2135	Fe 510 D
		1.0553	S355JO;St 52-3U	4360-50C		E 36-3		Fe 510 C
	A 633 Gr. C	1.0562	P355N	1501 Gr.225-490A LT 20		FeE 355 KG N	2106	FeE 355 KG;KW
	A 588		StE 355			E 355 R/FP;		
						A 510 AP		
		1.0565	P355NH; WStE 355	1501-225-490B LT 20		A 510 AP	2106	FeE 355-2
		1.0566	P355NL1; TStE 355	1501-225-490A LT 50		A 510 FP	2107-01	FeE 355-3
		1.0570	S355J2G3	Fe 510 D1 FF		E 36-3	2132, 2133	17GS
			St 52-3	1449 50/35 HR>HS		E 36-4	2134	17GS1S
				4360-50 D			2174	
	1213	1.0715	9 SMn 28 (1SMn 30)	230 M 07		S 250	1912	CF SMn 28
	1213	1.0715	9 SMn 28	230 M 07		S 250	1912	CF 9 SMn 28
	12 L 13	1.0718	9 SMnPb 28			S 250 Pb	1914	CF 9 SMnPb 28
			(11SmnPb30)					
	1108	1.0721	10 S 20	(210 M 15)		10S20		CF 10 S 20
	1109					10F 2		
	11 L 08	1.0722	10 SPb 20			10PbF 2		CF 10 SPb 20
	11 L 08	1.0722	10 SPb 20			10 PbF 2		CF 10 SPb 20

DOF TOOLS Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
1	1215	1.0736	9 SMn 36 (11SMn37)			S 300		CF 9 Mn 36
	12 L 14	1.0737	9 SMnPb 36 (11SMnPb37)			S 300Pb	1926	CF 9 SMnPb 36
		1.0972	S315MC; OStE 300 TM	1501-40F30		E 315 D		
		1.0976	S355MC; OStE 360 TM	1501-43F35		E 355 D	2642	FeE 355TM
		1.0982	S460MC; OStE 460 TM	1501-50F45				
		1.0984	S500MC; OStE 500 TM			E 490 D	2662	FeE 490 TM
		1.0986	S500MC; OStE 500 TM	1501-60F55		E 490 D		FeE 560 TM
	1010	1.1121	CK 10 (C10E)	040 A 10		XC 10	1265	C 10, 2 C 10 2 C 15
		1.1121	St 37-1	4360 40 A			1300	
	1015	1.1141	CK 15 (C15E)	040 A 15 080 M 15	32C	XC 12 XC 15 XC 18	1370	C 15
	1020 1023	1.1151	C22E CK 22	055 M 15 (070M 20)		2 C 22 XC 18 XC 25	1450	C 20
	D 3	1.2080	X 210 Cr 12	BD 3		Z 200 C 12		
	A36		St 44-2	4360 43 A		NFA 35-501 E 28	1411	
			StE 320-3Z	1 501 160			1421	
	A572-60	1.8900	StE 380	4360 55 E			2145	FeE390KG
2	(M) 1025	1.0406	C 25	070 M 26		1 C 25		C 25
		1.0416	GS-38			20-400 M	1306	
	A 537 Cl.1 A 414 Gr.G A 612	1.0473	P355GH	19 Mn 6		A 52 CP	2101 2102	FeE 355-2
	1035	1.0501	C35	080 A 32, 080 A 35 080 M 36, 1449 40 CS		1 C 35 AF 55 C 35 XC 38	1572 1550	C 35 1 C 35
	1045	1.0503	CF 45 (C45G)	060 A 47 080 M 46		XC 42 H 1 TS	1672	C 43 C 46
	1040	1.0511	C40	080 M 40		1 C 40 AF 60 C 40		C 40
		1.0540	C 50				1674	C 50
	A27 70-36	1.0551	GS-52	A2		280-480 M	1505	
	A148 80-40	1.0553	GS-60	A3		320-560 M	1606	
	A738	1.0577	S355J2G4 (Fe 510 D 2)	Fe 510 D2 FF 1501 Gr. 224-460 1501 Gr. 224-490		A 52 FP	2107	
	1140	1.0726	35 S 20	212 M 36	8M	35 MF 6	1957	
	1146	1.0727	45 S 20 (46S20)			45 MF 4	1973	
	1035 1041	1.1157	40Mn4	150 M 36	15	35 M 5 40 M 5		
	1025	1.1158	C25E CK 25	(070 M 25)		2 C 25 XC 25	C25	F.1120-C 25 K
	1536	1.1166	34Mn5					TO.B
	1330	1.1170	28Mn6	(150 M 28), (150 M 18)		20 M 5, 28 Mn 6		C 28 Mn
	1330	1.1170	28Mn6	150 M 5		20 M 5		
	1330	1.1170	28Mn6		14A	20 M 5		C 28 Mn
		1.1178	C30E; CK 30	080M30		XC 32		C 30
	1035	1.1180	C35R Cm 35	080 A 35		3 C 35 XC 32	1572	
	1035 1038	1.1181	C35E CK 35	080 A 35 (080 M 36)		2 C 35, XC 32 XC 38 H 1	1550 1572	C 35
	1035	1.1181	C35E CK 35	080 A 35 (080 M 36)		XC 38	1572	C 36
	1042	1.1191	GS-Ck 45	080 A 46		XC 45	1660	C 45
	1049 1050	1.1206	C50E CK 50	080 M 50		2 C 50 XC 48 H1; XC 50 H1	1674	C 50
	1050 1055	1.1213	Cf 53 (C53G)	070 M 55		XC 48 H TS	1674	C 53
	4520	1.5423	22Mo4	1503-245-420				16 Mo 5 KG;KW
		1.0050	St50-2					FE50
3	A 516 Gr. 70 A 515 Gr. 70 A 414 Gr.F; G	1.0481	P295GH 17 Mn 4	1501 Gr. 224		A 48 Cp; AP		Fe 510 KG; KT; KW Fe 510-2 KG; KT; KW FeE 295
	1043	1.0503	C 35	060 A 47 080 M 46 1449 50 HS; CS		1 C 45 AF 65 C 45	1672 1650	C 45 1 C 45
	1074	1.0614	C 76 D; 75-2			XC 75		
	1086	1.0616	C 86 D; D 85-2			XC 80	C 85	
	1095	1.0618	C 92 D; D 95-2			XC 90		
	1036 1330	1.1165	30Mn5	120 M 36 (150 M 28)		35 M 5		
	1335	1.1167	36Mn5	150 M 36		40 M 5	2120	
	1040	1.1186	C40E CK 40	060 A 40, 080 A 40 080 M 40		2 C 40 XC 42 H 1		C 40
	1045	1.1191	C45E CK 45	080 M 46 060 A 47		2 C 45 XC 42 H 1 XC 45 XC 48 H 1	1672	C 45 C 46
	1049	1.1201	C45R Cm 45	080 M 46		3 C 45 XC 42 H 1 XC 48 H 1	1660	C 45

Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
		1.7242	18 CrMo 4				18 Cr Mo 4	
	A 387 Gr. 12 Cl	1.7337	16 CrMo 4 4					A 18 CrMo 4 5 KW
		1.7362	12 CrMo 19 5	3606-625		Z 10 CD 5.05		16 CrMo 20 5
	A 572-60		17 MnV 6	436055 E		NFA 35-501 E 36	2142	
	1055	1.0535	C 55	070 M 55		1 C 55 AF 70 C 55	1655	C 55 1 C 55
	1060	1.0601	C 60	060 A 62 1449 HS; CS	43 D	1 C 60 AF 70 C 55		C 60 1 C 60
	107	1.0603	C 67	080 A 67 1449 70 HS		XC 65		C 67
	1074 1075	1.0605	C 75	1449 80 HS				C 75
3	1055	1.1203	C55E CK 55	060 A 57 070 M 55		2 C 55 XC 55 H1		C 55
	1055	1.1209	C55R Cm 55	070 M 55		3 C 55 XC 55 H 1		C 55
	1060 1064	1.1221	C60E CK 60	060 A 62	43D	2 C 60 XC 60 H 1	1665 1678	C 60
	1070	1.1231	CK 67 (C67E)	060 A 67		XC 68	1770	C 70
	1074 1075 1078	1.1248	CK 75 (C75E)	060 A 78		XC 75	774	C 75
	1086	1.1269	CK 85 (C85E)			XC 90		C 90
	1095	1.1274	CK 101 (C101E)			XC 100	1870	C 100
	W 112	1.1663	C125W			Y2 120		
							2223	
		1.0070	St70-2					FE70-2
		1.7238	49 CrMo 4					
		1.7701	51 CrMoV 4					51 CrMoV 4
	A573-81 65	1.0116	St 37-3	4360 40 B		E 24-U	1312	Fe37-3
	A515 65	1.0345	H 1	1 501 161		A 37 CP	1330	
	5120	1.0841	St 52-3	150 M 19		20 MC 5	2172	Fe 52
	9255	1.0904	55 Si 7	250 A 53	45	55 S 7	2085	55Si8
	9254	1.0904	55 Si 7	250 A 53		55 S 7	2090	
	9262	1.0961	60 SiCr 7			60 SC 6		100 Cr 6
	L3	1.2067	100 Cr 6	BL3		Y 100 C 6		100 Cr 6
	L1	1.2108	90 CrSi 5				2092	105 WCR 5
	L2	1.2210	115 CrV 3			100 C 3		107 CrV 3 KU
		1.2241	51 CrV 4					
		1.2311	40 CrMnMo 7					35 cRmO 8 KU
	4135	1.2330	35 CrMo 4	708 A 37		34 CD 4	2234	35 CrMo 4
		1.2419	105 WCr 6			105 WC 13	2140	10 WCr 6
	01	1.2510	100 MnCrW 4	BO 1		8 MO 8	2140	10 WCr 6
	S1	1.2542	45 WCrV 7	BS 1			2710	45 WCrV 8 KU
	S1	1.255	60 WCrV 7			55 WC 20	2710	58 WCr 9 KU
	L6	1.2713	55 NiCrMoV 6			55 NCDV 7		
	L6	1.2721	50 NiCr 13			55 NCV 6	2550	
	O2	1.2842	90 MnCrV 8	BO 2		90 MV 8		
	E 50100	1.3501	100 Cr 2					
	52100	1.3505	100 CR 6	2 S 135 535 A 99	31	100 C 6	2258	100 Cr 6
		1.5024	46 Si 7			45 S 7; Y 46 7;46 Si 7		
4	9255	1.5025	51 Si 7			51 S 7 51 Si 7	2090	48 Si 7 50 Si 7
	9255	1.5026	55 Si 7	251 A 58		55 S 7	2085 2090	55 Si 7
	9260	1.5027	60 Si 7	251 A 60 251 H 60		60 S 7		60 Si 7
	9260 H	1.5028	65 Si 7			60 S 7		
		1.5120	38 MnSi 4					
	A 204 Gr. A 4017	1.5415	16 Mo 3 15 Mo 3	1503-243 B		15 D 3	2912	16 Mo 3 (KG;KW)
	4419	1.5419	20 Mo 4	1503-243-430			-2512	G 20 Mo 5 G 22 Mo 5
	A 350-LF 5	1.5622	14 Ni 6			16 N 6		14 Ni 6 KG;KT
	3415	1.5732	1 NiCr 10			14 NC 11		16 NiCr 11
	3310; 3314	1.5752	14 NiCr 14	655 M 13	36 A	12 NC 15		
		1.6587	17CrNiMo 6	820 A 16		18 NCD 6		14 NiCrMo 13
		1.6657	14 NiCrMo 134					14 NiCrMo 131
	5015	1.7015	15 Cr 3	523 M 15		12 C 3		
	5132	1.7033	34 Cr 4	530 A 32	18 B	32 C 4		34 Cr 4 (KB)
	5140	1.7035	41 Cr 4	530 M 40	18	42 C 4		41 Cr 4
	5140	1.7045	42 Cr 41	530 A 40		42 C 4 TS	2245	41 Cr 4
	5115	1.7131	16 MnCr 5	527 M 17		16 MC 5	2511	16 MnCr 5
		1.7139	16 MnCr 5				2127	
	5155	1.7176	55 Cr 3	527 A 60	48	55 C 3	2253	
	4135; 4137	1.7220	34 CrMo 4	708 Aa 37		35 CD 4	2234	
	4142	1.7223	41 CrMo 4					41 CrMo 4
	4140	1.7225	42 CrMo 4	708 M 0		42 CD 4	2244	
		1.7228	55 NiCrMoV 6 G	823 M 30	33		2512	653 M 31
		1.7262	15 CrMo 5			12 CD 4	2216	
		1.7321	20 CrMo 4				2625	
	ASTM A182 F-12	1.7335	13 CrMo 4	1501-620 Gr 27				14 CRMo 4 5

DOF TOOLS Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
4	A 182-F11;12	1.7335	13 CrMo 4 4	1 501 620 Gr 27		15 CD 4.5	2216	
	ASTM A 182 F.22	1.7380	10 CrMo 9 10	1501-622 Gr 31; 45				
	A 182 f-22	1.7380	10 CrMo 9 10	1501-622		12 CD 9.10	2218	12 CrMo 9.10
		1.7715	14 MoV 6 3	1503-660-440				
	A 355 A	1.8509	41 CrAlMo 7	905 M 39	41 B	40 CAD 6.12	2940	41 CrAlMo 9.10
	A 570.36	1.0038	S 235 JRG 2 (Fe 360 B) RSt 37-2	Fe 360 B FU 1449 27/23 CR 4360-40 B		E 24-2 NE	1312	Fe 360 B FN
	3135	1.5710	36 NiCr 6	640 A 35		35 NC 6		
		1.5755	31 NiCr 14	653 M 31		18 NC 13		
	8620	1.6523	2 NiCrMo 2	805 M 20	362	20 NCD 2	2506	20 NiCrMo 2
	8740	1.6546	40 NiCrMo 22	311-Tyre 7				40 NiCrMo 2 (KB)
	4130	1.7218	25 CrMo 4	CDS 110		25 CD 4	2225	25 CrMo 4 (KB)
		1.7733	24 CrMoV 5 5			20 CDV 6		21 CrMoV 5 11
		1.7755	GS-45 CrMoV 10 4					
		1.8070	21 CrMoV 5 11					35 NiCr 9
5	4142	1.2332	47 CrMo 4	708 M 40	19 A	42 CD 4	2244	42 CrMo 4
	A 128 (A)	1.3401	G-X120 Mn 12			Z 120 M 12	2183	GX 120 Mn 12
	3435	1.5736	36 NiCr 10			30 NC 11		
	9840	1.6511	36 CrNiMo 4	816 M 40	110	40 NCD 3		36 NiCrMo 4 (KB)
	4340	1.6582	35 NiCrMo 6	817 M 40	24	35 NCD 6	2541	35 NiCrMo 6
		1.7361	32 CeMo 12	722 M 24	40 B	30 CD 12	2240	20 CrMo 12
	6150	1.8159	50 CrV 4	735 A 50	47	50 CrV 4	2230	50 CrV 4
		1.8161	58 CrV 4					
		1.8515	32 CrMo 12	722 M 24	40 B	30 CD 12	2240	32 CrMo 12
		1.8523	39 CrMoV 13 9	897 M 39	40 C			36 CrMoV 12
		1.4882	X 50 CrMnNiNbN 21 9			Z 50 CMNNb 21.09		
	3135	1.5710	36 NiCr 6	640 A 35	111 A	35 NC 6		
		1.5864	35 NiCr 18					
			31 NiCrMo 13 4	830 M 31			2534	
6	A 573-81	1.0144	ST 44-3	4360 43 C		E 28-3	1412	
	A 619	1.0347	DCO 3 RSt;RRSt 13	1449 3 CR 1449 2 CR		E		Fep 02
	M 1015 M 1016 M 1017	1.0401	C 15	080 M 15 080 M 15 1449 17 CS		AF 37 C 12 XC 18	1350	C 15 C 16 1 C 15
		1.0570	ST 52-3	4360 50 B		E 36-3	2132	Fe 52 BFN / Fe 52 CFN
	12 L 13	1.0718	9 SMnPb 28			S 250 Pb	1914	CF 9 SMnPb 28
	(12 L 13)	1.0718	9 SMnPb 28			S 250 Pb	1914	CF 9 SMnPb 28
		1.0723	15 S 22 15 S 20	210 A 15 210 M 15			1922	
		1.2083					2314	
	H 11	1.2343	X 38 CrMoV 5 1	BH 11		Z 38 CDV 5		X 37 CrMoV 5 1 KU
	H 13	1.2344	X 40 CRMoV 5 1	BH 13		Z 40 CDV 5	2242	X 40 CrMoV 511 KU
	A 2	1.2363	X 100 CrMoV 5 1	BA 2		Z 100 CDV 5	2260	X 100 CrMoV 51 KU
	D 2	1.2379	X 155 CrMo 12 1	BD 2		Z 160 CDV 12	2310	X 165 CrMoW 12 KU
	HNV 3	1.2379	X 210 Cr 12 G	BD 2		Z 160 CDV 12	2736	
	D 4 (D6)	1.2436	X 210 CrW 12	BD 6		Z 200 CD 12	2312	X 215 CrW 12 1 KU
	H 21	1.2581	X 30 WCrV 9 3	BH 21		Z 30 WCV 9		X 30 WCrV 9 3 KU
		1.2601	X 165 CrMoV 12				2310	
	H 12	1.2606	X 37 CrMoW 5 1	BH 12		Z 35 CWDV 5		X 35 CrMoW 05 KU
	D 3	1.3343	S 6-5-2	BM 2		Z 200 C 12	2715	X 210 Cr 13 KU
	N 08028	1.4563				Z 1 NCDU 31-27-03	2584	
	ASTM A 353	1.5662	X 8 Ni 9	1501-509;510				14 Ni 6 KG;KT
	ASM A 353	1.5662	X 8 Ni 9	502-650		9 Ni		X 10 Ni 9
	2517	1.5680	12 Ni 19	12 Ni 19		Z 18 N 5		
	2515	1.5680	12 NI 19			Z 18 N 5		
7		1.3202	S 12-1-4-5	BT 15				HS 12-1-5-5
		1.3207	S 10-4-3-10	BT 42		Z 130 WKCDV		
	T 15	1.3243	S 6-5-2-5			KCV 06-05-05-04-02	2723	HS 6-5-2-5
		1.3246	S 7-4-2-5			Z 110 WKCDV 07-05-04	7-4-2-5	HS 7-4-2-5
		1.3247	S 2-10-1-8	BM 42		Z 110 DKCWV 09-08-04	2-10-1-8	HS 2-9-1-8 2-9-2-8
	M 42	1.3249	S 2-9-2-8	BM 34				
	T 4	1.3255	S 18-1-2-5	BT 4		Z 80 WKCV 18-05-04-0		
	M 2	1.3343	S 6-5-2	BM 2		Z 85 WDCV	2722	HS 6 5 2
	M 7	1.3348	S 2-9-2			Z 100 DCWV 09-04-02	2782	HS 2 9 2
	T 1	1.3355	S 18-0-1	BT 1		Z 80 WCV 18-4-01		
	630	1.4548				Z 7 CNU 17-04		
	HNV 3	1.4718	X 45 CrSi 9 3	401 S 45	52	Z 45 CS 9		
	422	1.4935	X 20 CrMoWV 12 1					
8	403	1.4000	X 6 Cr 13	403 S 17		Z 6 C 13	2301	X 6 Cr 13
		1.4001	X 6 Cr 14					
	(410 S)	1.4001	X 7 Cr 13	(403 S 7)		Z 8 C 13	2301	
	405	1.4002	X 6 Cr A 12	405 S 17		Z 8 CA 12		X 6 CrAl 13
	405	1.4002	X 6 CrAl 13	405 S 17		Z 6 CA 13	2302	X 6 CrAl 13
	416	1.4005	X 12 CrS 13	416 S 21		Z 11 CF 13	2308	X 12 CrSC 13
	410;CA-15	1.4006	(G-)X 10 Cr 13	410 S 21	56 A	Z 10 C 13	2302	X 12 Cr 13
	430	1.4016	X 8 Cr 17	Z 8 C 17		430 S 15	2320	X 8 Cr 17

Material groups

DOF TOOLS

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
	430	1.4016	X 6 Cr 17	430 S 15	60	Z 8 C 17	2320	X 8 Cr 17
		1.4027	G-X 20 CR 14	420 C 29		Z 20 C 13 M		
		1.4027	G-X 20 CR 14	420 C 29		Z 20 C 13 M		
	420	1.4028	X 30 Cr 13	420 S 45		Z 30 C 13	2304	
		1.4086	G-X 120 Cr 29	452 C 11				
	430 F	1.4104	X 12 CrMoS 17	420 S 37		Z 10 CF 17	2383	
	440 B	1.4112	X 90 CrMoV 18					
	434	1.4113	X 6 CrMo 17	434 S 17		Z 8 CD 17	2325	X 8 CrMo 17
		1.4340	G-X 40 CrNi 27 4					
	S 31500	1.4417	X 2 CrNiM 0 Si 19 5				2376	
	S 31500	1.4417	X 2 CrNoMoSi 18 5 3				2376	
		1.4418	X 4 CrNiMo 16 5			Z 6 CND 16-04-01	2387	
8	XM 8 430 Ti 439	1.4510				Z 4 CT 17		X 6 CrTi 17
	430 Ti	1.4510	X 6 CrTi 17			Z 4 CT 17		
		1.4511	X 6 CrNb 17 (X 6 CrNb 17)			Z 4 CNb 17		X 6 CrNb 17
	409	1.4512	X 6 CrTi 12 (X 2 CrTi 12)	LW 19 409 S 19		Z 3 CT 12		X 6 CrTi 12
		1.4720	X 20 CrMo 13					
	405	1.4724	X 10 CrA 113	403 S 17		Z 10 C 13		X 10 CrA 112
	430	1.4742	X 10 CrA 118	439 S 15	60	Z 10 CAS 18		X 8 Cr 17
	HNV 6	1.4747	X 80 CrNiSi 20	443 S 65	59	Z 80 CSN 20.02		X 80 CrSiNi 20
	446	1.4749	X 18 CrNi 28					
	446	1.4762	X 10 CrA 124			Z 10 CAS 24	2322	X 16 Cr 26
	EV 8	1.4871	X 53 CrMnNiN 21 9	349 S 54		Z 52 CMN 21.09		X 53 CrMnNiN 21 9
	302		X 12 CrNi 18 9	302 S 31		Z 10 CN 18-09	2330	
	429		X 10 CrNi 15					
	420	1.4021	X 20 Cr 13	420 S 37		Z 10 C 13	2303	14210
	420	1.4031	X 40 Cr 13			Z 40 C 14	-2304	
		1.4034	X 46 Cr 13	420 S 45		Z 40 C 14		X 40 Cr 14
	431	1.4057	X 20 CrNi 172	431 S 29	57	Z 15 CN 16.02	2321	X 16 CrNi 16
		1.4125	X 105 CrMo 17			Z 100 CD 17		X 105 CrMo 17
	CA6-NM	1.4313	G-X 4 CrNi 13 4	425 C 11		Z 4 CND 13-04 M	2385	(G)X 6 CrNi 304
9	630	1.4542	X 5 CrNiCuNb 17 4 (X 5 CrNiCuNb 16-4)					
		1.4544		S. 524 S. 526				X 6 CrNiTi 18 11
	348	1.4546	X 5 CrNiNb 18-10	347 S 31 2 S. 130 2 S.143/144/145 S. 525/527				X 6 CRNiNb 18 11
		1.4922	X 20 CrMV 12-1				2317	X 20 CrMoNi 12 01
		1.4923	X 22 CrMoV 12 1					
	304	1.4301	X 5 CrNi 18 9	304 S 15		Z 5 CN 18.09	2332;2333	
	303	1.4305	X 10 CrNiS 18 9	303 S 21	58 M	Z 8 CNF 18-09	2346	
	304 L	1.4306	X 2 CrNi 18 9	304 S 12		Z 2 CrNi 18 10	2352	X 2 CrNi 18 11
	304 L	1.4306	X 2 CrNi 18 10	304 S 11		Z 3 CN 19-11	2352	X 2 CrNi 18 11
	CF-8	1.4308	X 6 CrNi 18 9	304 C 15	58 E	Z 6 CN 18-10 M	2333	
	301	1.4310	X 12 CrNi 17 7	301 S 21		Z 12 CN 17.07	2331	X 2 CrNi 18 07
	304 LN	1.4311	X 2 CrNiN 18 10	304 S 62		Z 2 CN 18.10	2371	X 2 CrNiN 18 10
		1.4312	G-X 10 CrNi 18 8	302 C 25		Z 10 CN 18.9 M		
	305	1.4312	X 8 CrNi 18 12	305 S 19				
		1.4332	X 2 CrNi 18-8					
	304	1.4350	X 5 CrNi 18 9	304 S 15	58 E	Z 6 CN 18.09	2332	X 5 CrNi 18 10
	S 32304	1.4362	X 2 CrNiN 23 4			Z 2 CN 23-04 AZ	2327	
	202	1.4371	X 3 CrMnNiN 188 8 7	284 S 16		Z 8 CMN 18-08-05		
	316	1.4401	X 5 CrNiMo 17 12 2 (X4 CrNiMo 17-12-2)	316 S 13 316 S 17 316 S 19 316 S 31 316 S 33		Z 3 CND 17-11-01 Z 6 CND 17-11 Z 6 CND 17-11-02 Z 7 CND 17-11-02 Z 7 CND 17-12-02	2347	X 5 CrNiMo 17 12
10	316 L	1.4404	X 2 CrNiMo 17 13 2 (X2 CrNiMo 17-12-1) GX 2 CrNiMoN 18-10	316 S 11, 316 S 13 316 S 14, 316S 31; 316 S 42, S.537; 316 C 12, T. 75, S. 161		Z 2 CND 17-12 Z 2 CND 18-13 Z 3 CND 17-11-02 Z 3 CND 17-12-02 FF Z 3 CND 18-12-03 Z 3 CND 19.10 M	2348	X 2 CrNiMo 17 12 G-X 2 CrNiMo 19 11
	316 LN	1.4406	X 2 CrNiMoN 17 12 2 (X2 CrNiMoN 18-10)	316 S 61 316 S 63		Z 2 CND 17-12 AZ		X 2 CrNiMoN 17 12
	CF-8M	1.4408	GX 5 CrNiMoN 7 12 2 GX 6 CrNiMo 18 10	316 C 16 (LT 196) ANC 4 B			2343	
		1.4410	GX 10 CrNiMo 18 9			Z 5 CND 20.12 M	2328	
	316 LN	1.4429	X 2 CrNiMo 17-13-3	316 S 62		Z 2 CND 17-13 AZ	2375	X 2 CrNiMoN 17 13
	316 L	1.4435	X 2 CrNiMo 18 14 3	316 S 11; 316 S 13 316 S 14; 316 S 31 LW 22 LWCF 22		Z 3 CND 17-12-03 Z 3 CND 18-14-03	2375	X 2 CrNiMoN 17 13
	316	1.4436	X 5 CrNiMo 17 13 3 (X 4 CrNiMo 17-13-3)	316 S 19; 316 S 31 316 S 33 LW 23 LWCF 23		Z 6 CND 18-12-03 Z 7 CND 18-12-03	2343	X 5 CrNiMo 17 13 X 8 CrNiMo 17 13
	317 L	1.4438	X 2 CrNiMo 18 16 4 (X 2 CrNiMo 18-15-4)	317 S 12		Z 2 CND 19-15-04 Z 3 CND 19-15-04	2367	X 2 CrNiMo 18 16
	(S 31726)	1.4439	X 2 CrNiMoN 17 13 5			Z 3 CND 18-14-06 AZ		
		1.4440	X 2 CrNiMo 18 13					
	317	1.4449	X 5 CrNiMo 17 13 3	317 S 16				X 5 CrNiMo 18 15

DOF TOOLS Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
	430	1.4016	X 6 Cr 17	430 S 15	60	Z 8 C 17	2320	X 8 Cr 17
		1.4027	G-X 20 CR 14	420 C 29		Z 20 C 13 M		
		1.4027	G-X 20 CR 14	420 C 29		Z 20 C 13 M		
	420	1.4028	X 30 Cr 13	420 S 45		Z 30 C 13	2304	
		1.4086	G-X 120 Cr 29	452 C 11				
	430 F	1.4104	X 12 CrMoS 17	420 S 37		Z 10 CF 17	2383	
	440 B	1.4112	X 90 CrMoV 18					
	434	1.4113	X 6 CrMo 17	434 S 17		Z 8 CD 17	2325	X 8 CrMo 17
		1.4340	G-X 40 CrNi 27 4					
	S 31500	1.4417	X 2 CrNiM 0 Si 19 5				2376	
	S 31500	1.4417	X 2 CrNoMoSi 18 5 3				2376	
		1.4418	X 4 CrNiMo 16 5			Z 6 CND 16-04-01	2387	
8	XM 8 430 Ti 439	1.4510				Z 4 CT 17		X 6 CrTi 17
	430 Ti	1.4510	X 6 CrTi 17			Z 4 CT 17		
		1.4511	X 6 CrNb 17 (X 6 CrNb 17)			Z 4 CNb 17		X 6 CrNb 17
	409	1.4512	X 6 CrTi 12 (X 2 CrTi 12)	LW 19 409 S 19		Z 3 CT 12		X 6 CrTi 12
		1.4720	X 20 CrMo 13					
	405	1.4724	X 10 CrA 113	403 S 17		Z 10 C 13		X 10 CrA 112
	430	1.4742	X 10 CrA 118	439 S 15	60	Z 10 CAS 18		X 8 Cr 17
	HNV 6	1.4747	X 80 CrNiSi 20	443 S 65	59	Z 80 CSN 20.02		X 80 CrSiNi 20
	446	1.4749	X 18 CrNi 28					
	446	1.4762	X 10 CrA 124			Z 10 CAS 24	2322	X 16 Cr 26
	EV 8	1.4871	X 53 CrMnNiN 21 9	349 S 54		Z 52 CMN 21.09		X 53 CrMnNiN 21 9
	302		X 12 CrNi 18 9	302 S 31		Z 10 CN 18-09	2330	
	429		X 10 CrNi 15					
	420	1.4021	X 20 Cr 13	420 S 37		Z 10 C 13	2303	14210
	420	1.4031	X 40 Cr 13			Z 40 C 14	-2304	
		1.4034	X 46 Cr 13	420 S 45		Z 40 C 14		X 40 Cr 14
	431	1.4057	X 20 CrNi 172	431 S 29	57	Z 15 CN 16.02	2321	X 16 CrNi 16
		1.4125	X 105 CrMo 17			Z 100 CD 17		X 105 CrMo 17
	CA6-NM	1.4313	G-X 4 CrNi 13 4	425 C 11		Z 4 CND 13-04 M	2385	(G)X 6 CrNi 304
9	630	1.4542	X 5 CrNiCuNb 17 4 (X 5 CrNiCuNb 16-4)					
		1.4544		S. 524 S. 526				X 6 CrNiTi 18 11
	348	1.4546	X 5 CrNiNb 18-10	347 S 31 2 S. 130 2 S.143/144/145 S. 525/527				X 6 CRNiNb 18 11
		1.4922	X 20 CrMV 12-1				2317	X 20 CrMoNi 12 01
		1.4923	X 22 CrMoV 12 1					
	304	1.4301	X 5 CrNi 18 9	304 S 15		Z 5 CN 18.09	2332;2333	
	303	1.4305	X 10 CrNiS 18 9	303 S 21	58 M	Z 8 CNF 18-09	2346	
	304 L	1.4306	X 2 CrNi 18 9	304 S 12		Z 2 CrNi 18 10	2352	X 2 CrNi 18 11
	304 L	1.4306	X 2 CrNi 18 10	304 S 11		Z 3 CN 19-11	2352	X 2 CrNi 18 11
	CF-8	1.4308	X 6 CrNi 18 9	304 C 15	58 E	Z 6 CN 18-10 M	2333	
	301	1.4310	X 12 CrNi 17 7	301 S 21		Z 12 CN 17.07	2331	X 2 CrNi 18 07
	304 LN	1.4311	X 2 CrNiN 18 10	304 S 62		Z 2 CN 18.10	2371	X 2 CrNiN 18 10
		1.4312	G-X 10 CrNi 18 8	302 C 25		Z 10 CN 18.9 M		
	305	1.4312	X 8 CrNi 18 12	305 S 19				
		1.4332	X 2 CrNi 18-8					
	304	1.4350	X 5 CrNi 18 9	304 S 15	58 E	Z 6 CN 18.09	2332	X 5 CrNi 18 10
	S 32304	1.4362	X 2 CrNiN 23 4			Z 2 CN 23-04 AZ	2327	
	202	1.4371	X 3 CrMnNiN 188 8 7	284 S 16		Z 8 CMN 18-08-05		
	316	1.4401	X 5 CrNiMo 17 12 2 (X4 CrNiMo 17-12-2)	316 S 13 316 S 17 316 S 19 316 S 31 316 S 33		Z 3 CND 17-11-01 Z 6 CND 17-11 Z 6 CND 17-11-02 Z 7 CND 17-11-02 Z 7 CND 17-12-02	2347	X 5 CrNiMo 17 12
10	316 L	1.4404	X 2 CrNiMo 17 13 2 (X2 CrNiMo 17-12-1) GX 2 CrNiMoN 18-10	316 S 11, 316 S 13 316 S 14, 316S 31; 316 S 42, S.537; 316 C 12, T. 75, S. 161		Z 2 CND 17-12 Z 2 CND 18-13 Z 3 CND 17-11-02 Z 3 CND 17-12-02 FF Z 3 CND 18-12-03 Z 3 CND 19.10 M	2348	X 2 CrNiMo 17 12 G-X 2 CrNiMo 19 11
	316 LN	1.4406	X 2 CrNiMoN 17 12 2 (X2 CrNiMoN 18-10)	316 S 61 316 S 63		Z 2 CND 17-12 AZ		X 2 CrNiMoN 17 12
	CF-8M	1.4408	GX 5 CrNiMoN 7 12 2 GX 6 CrNiMo 18 10	316 C 16 (LT 196) ANC 4 B			2343	
		1.4410	GX 10 CrNiMo 18 9			Z 5 CND 20.12 M	2328	
	316 LN	1.4429	X 2 CrNiMo 17-13-3	316 S 62		Z 2 CND 17-13 AZ	2375	X 2 CrNiMoN 17 13
	316 L	1.4435	X 2 CrNiMo 18 14 3	316 S 11; 316 S 13 316 S 14; 316 S 31 LW 22 LWCF 22		Z 3 CND 17-12-03 Z 3 CND 18-14-03	2375	X 2 CrNiMoN 17 13
	316	1.4436	X 5 CrNiMo 17 13 3 (X 4 CrNiMo 17-13-3)	316 S 19; 316 S 31 316 S 33 LW 23 LWCF 23		Z 6 CND 18-12-03 Z 7 CND 18-12-03	2343	X 5 CrNiMo 17 13 X 8 CrNiMo 17 13
	317 L	1.4438	X 2 CrNiMo 18 16 4 (X 2 CrNiMo 18-15-4)	317 S 12		Z 2 CND 19-15-04 Z 3 CND 19-15-04	2367	X 2 CrNiMo 18 16
	(S 31726)	1.4439	X 2 CrNiMoN 17 13 5			Z 3 CND 18-14-06 AZ		
		1.4440	X 2 CrNiMo 18 13					
	317	1.4449	X 5 CrNiMo 17 13 3	317 S 16				X 5 CrNiMo 18 15

Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
	A 220-90001	0.8170	GTS 70-02			Mn 700-2	0856-00	GMN 65
		0.817	GTS 7-02	IP 70-2			0862-00	GMN 70
	1022						0864-00	
13	1518	1.1133	20 Mn 5	120 M 19		20 M 5		
	1035	1.1183	Cf 35 (C 35 G)	080 A 35		XC 38 H 1 TS	2132	G 22 Mn 3
	400 10		GTS 45	P 440/7				20 Mn 7
	70003		GTS 65	P 570/3		MP 60-3	1572	C 36; C 38
	Al 99	3.0205					0852	
	1000	3.0255	Al 99,5	L 31/34/36		A 59050 C	858	
		3.3315	Al Mg 1					
		3.1325	AlCuMg 1					
		3.1655	AlCuSiPb					
		3.2315	AlMgSi 1					
	7050	3.4345	AlZnMgCu 0,5	L 86		AZ 4 GU/9051		
		3.2381	G-AlSi 10 Mg					
		3.2382	GD-AlSi 10 Mg				811-04	
		3.2581	G-AlSi 12					
		3.3561	G-AlMg 5					
	ZE 41	3.5101	G-MgZn 4 SE 1 Zr 1	MAG 5				
	EZ 33	3.5103	MgSE 3 Zn 27 r 1	MAG 6	G-TR 3 Z 2			
	AZ 81	3.5812	G-MgAl 8 Zn 1	NMAG 1				
14	AZ 91	3.5912	G-MgAl 9 Zn 1	MAG 7				
		2.1871	G-AlCu 4 TiMg					
		3.1754	G-AlCu 5 Ni 1,5					
		3.2163	G-AlSi 9 Cu 3					
	4218 B	3.2371	G-AlSi 7 Mg					
	SC 64 D	3.2373	G-AlSi 9 MgWa			A-S 7 G	4251	
		3.2373	G-AlSi 9 Mg					
	QE 22	3.5106	G-MgAg 3 SE 2 Zr 1	MAG 12				
	GD-AlSi 12		G-AlMg 5	LM 5		A-SU 12	4252	
	A 360.2	3.2383	G-AlSi 0 Mg(Cu)	LM 9			4253	
	A 356-72			2789:1973		NF A 32-201		
	356.1			LM 25			4244	
	A 413.2		G-AlSi 12	LM 6			4261	
	A 413.1		G-AlSi 12 (Cu)	LM 20			4260	
	A 413.0		GD-AlSi 12				4247	
	A 380.1		GD-AlSi 8 Cu 3	LM 24			4250	
	C 93200	2.1090	G-CuSn 7 S Pb			U-E 7 Z 5 Pb 4		
	C 83600	2.1096	G-CuSn 5 ZnPb	LG 2				
	C 83600	2.1098	G-CuSn 2 ZnPb					
	C 23000	2.1182	G-CuPb 15 Sn	LB 1		U-Pb 15 E 8		
	C 93800	2.1182	G-CuPb 15 Sn			Uu-Pb 15 E 8		
15		2.0240	CuZn 15					
	C 27200	2.0321	CuZn 37	Cz 108	CuZn 36, CuZn 37			C 2700
	C 27700	2.0321	CuZn 37	Cz 108	CuZn 36, CuZn 37			C 2720
		2.0590	G-CuZn 40 Fe					
	C 86500	2.0592	G-CuZN 35 Al 1	U-Z 36 N 3	HTB 1			
	C 86200	2.0596	G-CuZn 34 Al 2	HTB 1	U-Z 36 N 3			
	C 18200	2.1293	CuCrZr	CC 102	U-Cr 0.8 Zr			
	N 08800	1.4558	X 2 NiCrAlTi 32 20	NA 15				
	N 08031	1.4562	X 1 NiCrMoCu 32 28 7					
	N 08028	1.4563	X 1 NiCrMoCuN 31 27 4				2584	
	N 08330	1.4864	X 12 NiCrSi 36 16	NA 17		Z 12 NCS 35.16		
	330	1.4864	X 12NiCrSi 36 16	NA 17		Z 12 NCS 37.18		
		1.4865	G-X 40 NiCrSi 38 18	330 C 40				XG 50 NICr 39 19
		1.4958	X 5 NiCrAlTi 31 20					
	AMS 5544	LW2.4668	NiCr 19 NbMo			NC 20 K 14		
	Monel 400	2.4360	NiCu 30 Fe	NA 13		NU 30		
	5390A	2.4603				NC 22 FeD		
	Hastelloy C-4	2.4610	NiMo 16 Cr 16 Ti					
16	Nimonic 75	2.4630	NiCr 20 Ti	HR 5,203-4		NC 20 T		
		2.4630	NiCr 20 Ti	HR 5, 203-4		NC 20 T		
	Inconel 690	2.4642	NiCr 29 Fe			Nnc 30 Fe		
	Inconel 625	2.4856	NiCr 22 Mo 9 Nb	NA 21		NC 22 FeDNb		
	5666	2.4856	NiCr 22 Mo 9 Nb			Inconel 625		
	Incoloy 825	2.4858	NiCr 21 Mo	NA 16		NC 21 Fe DU		
	5537 C	LW2.4964	CoCr 20W 15 Ni			KC 20 WN		
	AMS 5772		CoCr 22 W 14 Ni			KC 22 WN		
	Inconel X-750	2.4669	NiCr 15 Fe 7 TiAl			NC 15 TNb A		
	Hastelloy B	2.4685	G-NiMo 28					
	Hastelloy C	2.4810	G-NiMo 30					
	AMS 5399	2.4973	NiCr 19 Co 11 MoTi			NC 19 KDT		
		3.7115	TiAl 5 Sn 2					
		1.4977	X 40 CoCrNi 20 20			Z 42 CNKDWNb		
	Monel k-500	2.4375	NiCu 30 Al	NA 18		NU 30 AT		
	4676	2.4375	NICu 30 Al	3072-76				
		2.4631	NiCr 20 TiAl	Hr 40;601		NC 20 TA		
17	Inconel 718	2.4668	NiCR 19 FeNbMo			Nc 19 Fe Nb		
	Inconel	2.4694	NiCr 16 Fe 7 TiAl					
		2.4955	NiFe 25 Cr 20 NbTi					
	5383	LM2.4668	NiCR 19 FeNbMo	HR 8		NC 19ENb		
	5391	LW2.4670	S-NiCr 13 A 16 MoNb	3146-3		NC 12 AD		
	5660	LW2.4662	NiFe 35 Cr 14 MoTi			ZSNCDT 42		
	R 50250	3.7025	Ti 1	2 TA 1				
18	R 52250	3.7225	Ti 1 Pd	TP 1				
	AMS 5397	LW2.4674	NiCo 15 Cr 10 MoAlTi					
		3.7124	TiCu 2	2 TA 21-24				

DOF TOOLS Material groups

grupp	AISI	w-stoff	DIN	BS	EN	AFNOR	SS	UNI
18	R 54620	3.7145	TiAl 6 Sn 2 Zr 4 Mo 2 Si					
		3.7165	TiAl 6 V 4	TA 10-13; TA 28		T-A 6 V		
		3.7185	TiAl 4 Mo 4 Sn 2	TA 45-51; TA 57				
		3.7195	TiAl 3 V 2.5					
			TiAl 4 Mo 4Sn 4 Si 0.5					
	AMS R 54520		TiAl 5 Sn 2.5	TA 14/17		T-A 5 E		
	AMS R 56400		TiAl 6 V 4	TA 10-13/ TA 28		T-A 6 V		
	AMS R 56401		TiAl 6 V 4 ELI	TA 11				
19	W 1	1.1545	C 105 W 1	BW 1 A		Y 1 105	1880	C 100 KU
	W 210	1.1545	C 105 W 1	BW 2		Y 120	2900	C 120 KU
		1.2762	75 CrMoNiW 6 7					
	440 C	1.4125	X 105 CrMo 17			Z 100 CD 17		
		1.6746	32 NiCrMo 14 5	832 M 31		35 NCD 14		

Material	Mtrl grupp
253MA	10
ARNE	6
ASP23	7
ASP30	7
ASP60	7
CALMAX	6
CORRAX	6
DOMEX240XP	2
DOMEX450XP	3
ELMAX	7
FORMAX	3
HARDOX400	7
HARDOX500	19
HARDOX600	20
Hastelloy C	16
HOLDAX	6
IMPAX	6
Inconel 600	16
Inconel 718	17
Monel 400	16
Nimonic 80A	17
ORVAR	6
RIGOR	6
STAVAX2083	8
SVERKER21	7
VANADIS10	7
VANADIS23	7
VANADIS30	7
VANADIS4	7
VANADIS60	7
Waspaloy	17
WEDLOX900	19
WELDOX1100	19
WELDOX420	6
WELDOX460	6
WELDOX500	6
WELDOX700	7
WELDOX960	19

Nomenclature

Symbol	Description	Unit
f	Feed	[mm/varv]
V_c	Cutting speed	[m/min]
d	Drill diameter	[mm]
V_f	Table feed	[mm/min]
n	Number of revolution	[min^{-1}] (=RPM)
Ld	Drill depth	[mm]
T_c	Process time per hole	[min]
M_z	Torque moment	[Nm]
F_z	Feed force	[N]
P	Power	[kW]
Kc	Specific cutting force	[N/mm^2]

Cuttingspeed

Number of revolutions when the cutting speed is known:

$$n = \frac{V_c \times 1000}{\pi \times d}$$

Cutting speed when the number of revolutions is known:

$$Vc = \frac{n \times \pi \times d}{1000}$$

Feed

Table feed when the feed is knowned:

$$V_f = f \times n$$

Feed when table feed is knowned:

$$f = \frac{V_f}{n}$$

Process time per hole

$$T_c = \frac{Ld}{V_f}$$

Torque moment (estimation)

$$M_Z = \frac{f \times Kc \times D^2 \times 0{,}95}{8 \times 10^3}$$

Power (estimation)

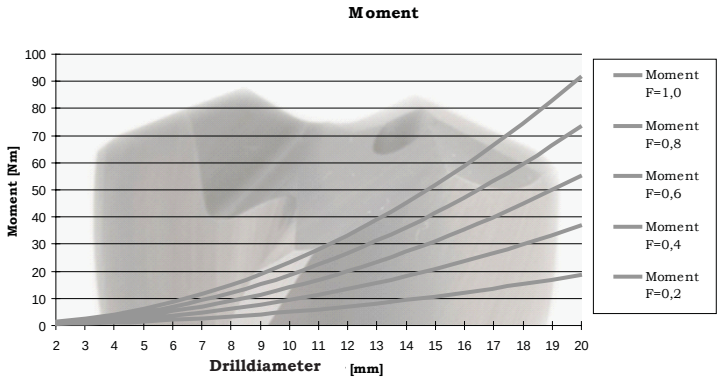
$$P = \frac{M_Z \times \pi \times n}{30}$$

Feed force (estimation)

$$Fz = 0{,}2 \times D \times f \times K_C$$

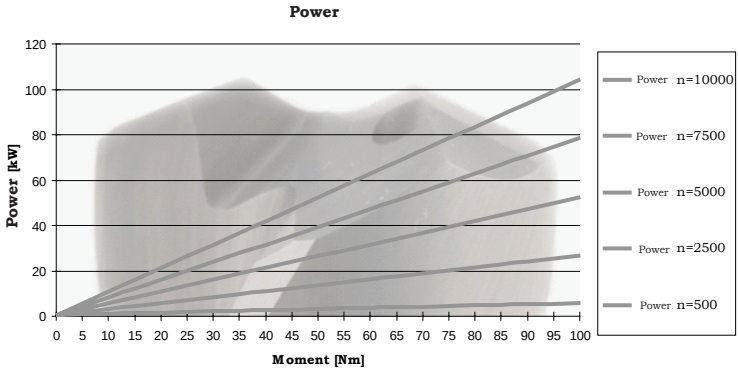
ISO	Material Group	Kc Value
P	1	1800
	2	1950
	3	2100
	4	2200
	5	2300
	6	2600
	7	2800
M	8	2600
	9	2800
	10	3100
K	11	1500
	12	1800
	13	2300
N	14	850
	15	950
S	16	3400
	17	4200
	18	1800
H	19	4000
	20	5000

Torque moment



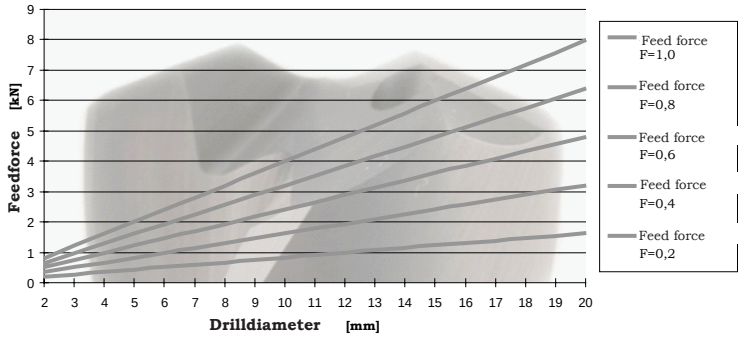
The chart is an estimation and based on 2000 as Kc Value.

Power



The chart is an estimation and based on 2000 as Kc Value.

Feed force



The chart is an estimation and based on 2000 as Kc Value.

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