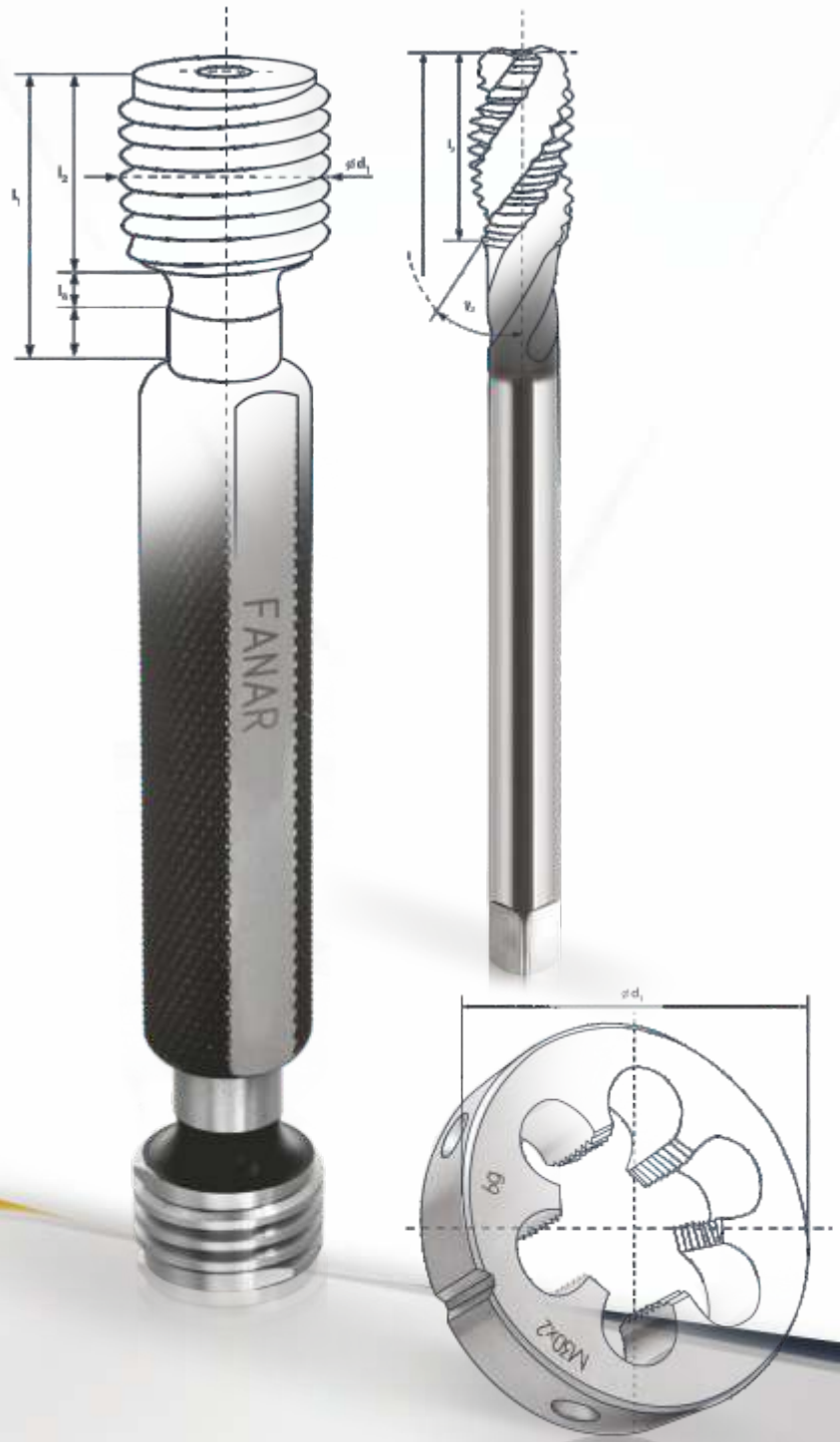
Technical Information



TECHNICAL INFORMATION

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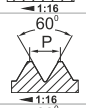
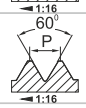
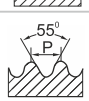
CATALOGUE PAGES 223-277

1. THREAD TYPE

M		Metric thread ISO DIN-13
MF		Metric fine thread ISO DIN-13 (symbol used only in catalogues for distinguish from metric coarse thread)
UNC		American unified coarse thread ANSI B-1.1
UNF		American unified fine thread ANSI B-1.1
UNEF		American unified extra fine thread ANSI B-1.1
G		Whitworth pipe thread DIN-ISO 228 (identical with BSP)
Rp		Whitworth internal cylindrical pipe thread PN-ISO 7/1 and DIN EN 10226-1 (identical with BSPP)
Rc		Whitworth internal tapered pipe thread PN-ISO 7/1, DIN EN 10226-2 (identical with BSPT)
NPT		American tapered pipe thread with dryseal material ANSI B-1.20.1
NPTF		American tapered pipe thread without dryseal material ANSI B 1.20.4
BSW		Whitworth thread BS-84:1956 (in the past - W)
BSF		Whitworth fine thread BS-84:2007
EG M		Metric thread for thread inserts V-Coil
EG UNC		Metric thread for thread inserts V-Coil
Pg		Steel conduit thread DIN-40430 (P)
Tr		Trapezoidal symetric thread DIN-103
R		Whiworth external tapered pipe thread ISO-7/1 (identical with BSPT)
W80		Cylindrical Whitworth thread for caps for gas cylinders PN-60/M-69225 and DIN 477
Rd		Cylindrical round thread PN-84/M-02035 and DIN 405

Rw		Bicycle thread PN-65/S-46001
FG		Bicycle thread DIN 79012
BSC		Bicycle thread BS 811
Ven		Valve thread PN-68/S-83200
Vg		Valve thread DIN 7756
E		Edison electrical thread PN-82/E-02500
UN		American unified thread ANSI B-1.1 (with preferential piches: 4, 6, 8, 12, 16, 20, 28, 32 of threads per inch)
UNS		American unified special thread ANSI B-1.1
Whit. S		Special Whitworth thread BS 84
S		Trapezoidal non-symetric thread
W		Cylindrical Whitworth thread for gas cylinder valves PN-60/M-69224 and DIN 477
W		Tapered Whitworth thread for gas cylinder valves PN-82/M-69223 and DIN 477
NPSM (NPS)		American cylindrical pipe thread ANSI B 1.20.1

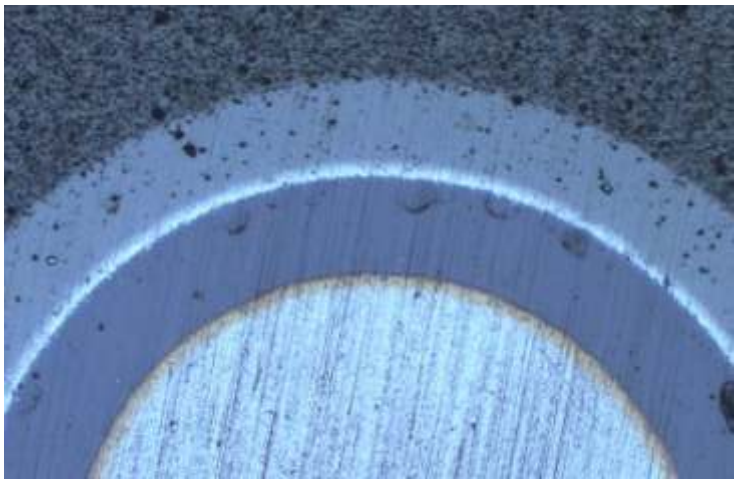
2. MATERIALS USED FOR PRODUCTION OF TOOLS

Symbol	Name	Description
HSS	High-speed steel	Standard material for general purpose cutting tools
HSSE (HSCo5)	High-speed steel	Material with high heat resistance, cobalt content allows to increase the hardening temperature and improves the stability of cutting edges.
HSSE-PM	High-speed powder steel	This homogeneously structured material for tools, obtained with the use of powder metallurgy, has the high-hardness and high-temperature resistance properties, which ensure that the tools made with it are characterized by high stability of cutting edges.
VHM	Micrograin cemented carbide	The homogeneously structured material for tools, obtained with the use of powder metallurgy from the tungsten carbide, features high abrasion resistance and hardness. In comparison with the high-speed steel it is more brittle and usually used with the PVD coatings

3. PVD COATINGS USED FOR TOOLS

HL COATING

Coating	TiAlN + WC/C
Structure	Multilayer nanocomposite
Hardness	3000 $HV_{0,05}$
Max. working temp.	800°C
Coefficient of friction	0,15
Color of coating	Dark Grey 



High performance properties of the HL coating have been achieved by application of the advanced nanocomposite structure. TiAlN layer, with its high hardness and temperature resistance, provides a stable, resistant to abrasion base of the coating. The top WC/C layer consists of tungsten carbide nanocrystallites surrounded by a carbon ply features excellent tribological properties. Hard WC separations provide abrasion resistance, while maintaining excellent the sliding properties of carbon. By combining advantages of two layers, the HL coating is ideal for processing of a wide variety of materials, it improves chips evacuation, reduces cutting forces and protects cutting edges from the impact of high temperatures. The HL-coated tools can work with the minimum quantity of lubrication (MQL). The coating is designed for processing materials from the Groups P, M, K, N, S.

PVD COATINGS USED FOR TOOLS

TN2 COATING

Coating	TiAlN + TiN
Structure	Double-layer nanostructure
Hardness	3500 $HV_{0,05}$
Max. working temp	800°C
Coefficient of friction	0,3
Color of coating	Gold 

The double-layer coating TN2, manufactured with a dropless method and treated with the surface fine finish processes, features very good resistance to abrasion, high thermal resistance and low coefficient of friction. Due to reduction of friction, the tool's life is considerably longer, and the quality of the surface processed by the tool is improved. By combining the extremely hard TiAlN layer with the malleable TiN layer, we have obtained a smart, self-adjusting structure of the tool's surface, which accommodates itself to the processing related stresses, thus improving the tool's resistance to breaks. Tn2 is intended, in particular, for the tools for processing of the Group P materials (for Rm < 1000 MPa), and the materials from Groups M, K, N.

TC COATING

Coating	TiN + TiCN
Structure	Multilayer
Hardness	3700 $HV_{0,05}$
Max. working temp	400°C
Coefficient of friction	0,2
Color of coating	Anthracite 

TC is a multilayer, general purpose coating. It features a very high hardness, good durability and low coefficient of friction. The basic TiN layer provides high adhesion to a tool and considerable resistance to dynamic loads. The top TiCN/TiC layer, with its high hardness and low coefficient of friction, ensures a very good resistance to abrasion. Combination of the above properties allows for protection of the edges from the processed material buildup, and from chipping. Due to the relatively low temperature resistance, proper cooling of the tool should be applied. The coating is intended mainly for the tools for processing of materials from the Groups P (in particular of high strength Rm > 1000 MPa) K, N, H.

PVD COATINGS USED FOR TOOLS

AT COATING

Coating	AlTiN
Structure	Gradient
Hardness	3700 $HV_{0,05}$
Max. working temp.	900°C
Coefficient of friction	0,3
Color of coating	Purplish-Grey 

The AT Coating, with the increased Aluminum (Al) content, features high hardness and temperature resistance. The released from the coating, during processing, aluminum oxides serve as additional lubrication of a tool, and at the same they create a thermal barrier, preventing the coating from being worn out, even in the most extreme conditions. Chemical composition and the nanogradient structure ensure high hardness of the coating. As a result, the high resistance to abrasion is achieved, which directly translates into the tool's longer life. The coating may be used for tools exposed to high temperatures, and is suitable for work both, with coolant and without it. The coating is designed for processing materials from the Groups P, M, K, N, S.

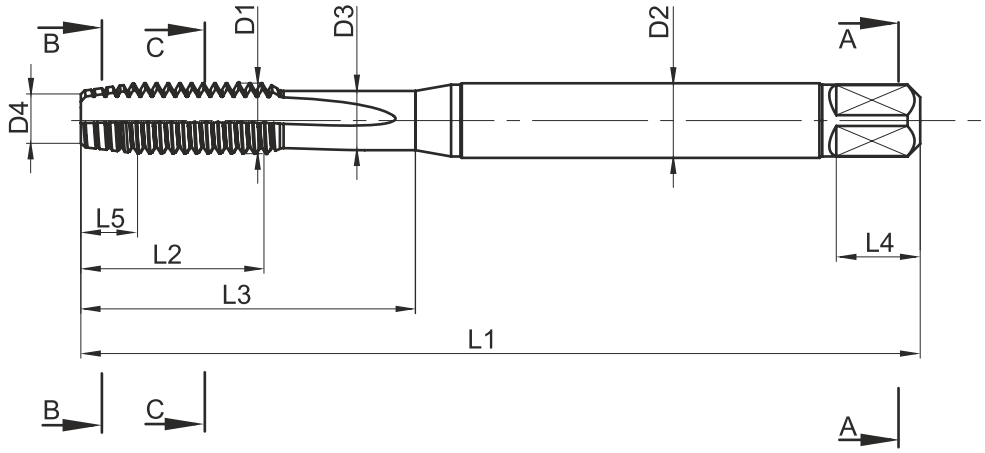
TIB_2 COATING

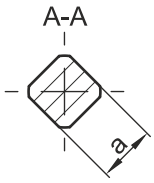
Coating	TiB_2
Structure	Monolayer
Hardness	4000 $HV_{0,05}$
Max. working temp.	900°C
Color of coating	Silver 

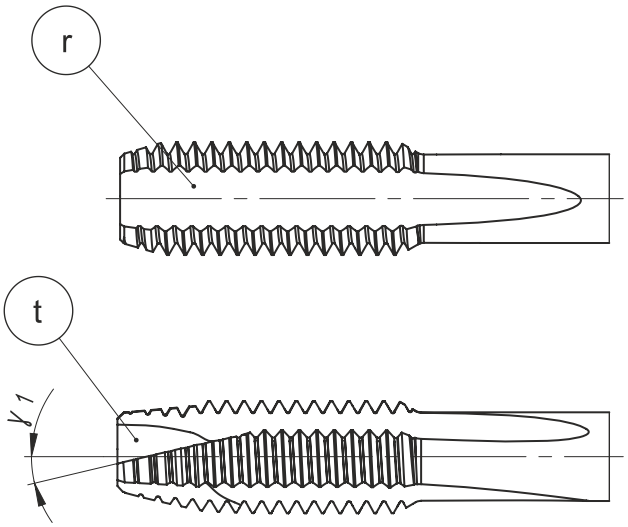
The material of coating, the TB (titanium diboride), is a ceramic material with outstanding properties with regard to its hardness and resistance to abrasion. With its carefully prepared composition (no affinity with aluminum), the material provides high chemical stability and prevents the processed material buildup on cutting edges. The dropless method of manufacturing the coating allows to obtain a very smooth finish, which in turn translates into a very good quality the workpieces' surfaces. The coating is designed for processing materials form the Group N, mainly aluminum alloys (Si<12%) and unalloyed titanium.

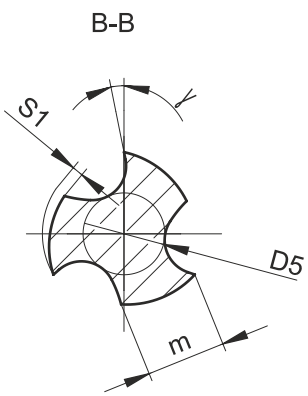
4. TAPS

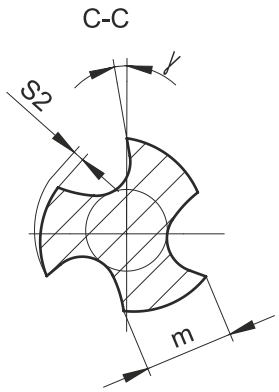
4.1. Tap construction elements (on example of DIN-371)

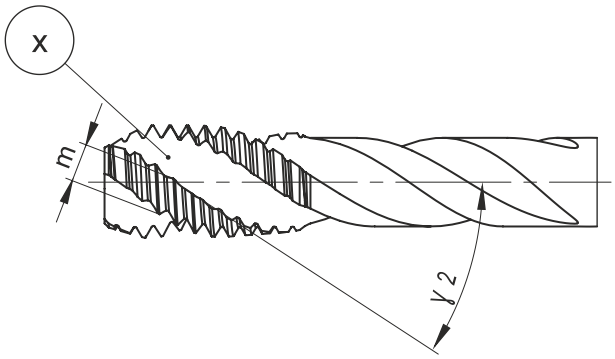


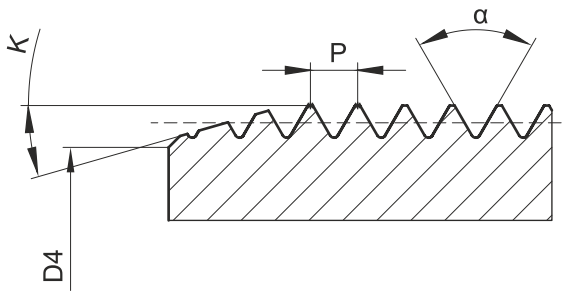












L1 - total length
L2 - thread length
L3 - useful length
L4 - length of driving square
L5 - chamfer length
a - size of square
⌀d1 - thread diameter
⌀d2 - shank diameter
⌀d3 - neck diameter
⌀d4 - (chamfer) point diameter
⌀d5 - web (core) diameter
m - width of land

S1 - relief of chamfer
S2 - relief of thread
P - pitch of thread
α - angle of thread
γ - rake angle
$\gamma 1$ - spiral point angle
$\gamma 2$ - angle of spiral flutes
κ - chamfer angle
r - straight flute
x - spiral flute
t - spiral point
z - number of lands

4.2. Dimension standards

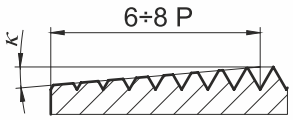
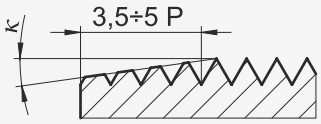
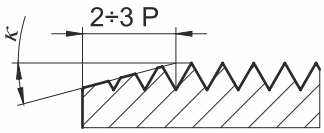
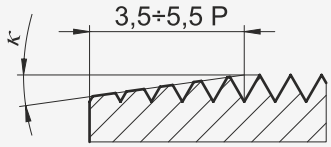
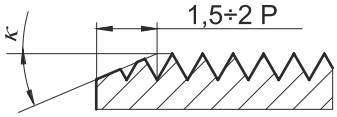
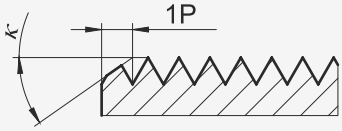
Dimension standards assign proper taps outer dimensions (total length, thread length, shank diameter and size of square) of nominal threads dimensions.

Symbols	Description
DIN-371	Machine taps with reinforced shank for metric coarse and fine threads M3 ÷ M10 and for the threads UNC, UNF, BSW, BSF within the range of nominal diameters 1/8" ÷ 3/8"
DIN-376	Machine taps with reduced shank diameter for metric coarse threads and for the threads UNC and BSW
DIN-374	Machine taps with reduced shank diameter for metric fine threads and for the threads UNF i BSF
DIN-5156	Machine taps with reduced shank diameter for the threads G, Rp and Rc
ISO-2284	Short hand and machine taps for pipe threads G, Rp and Rc
DIN-352	Short hand taps for metric coarse threads Norm is also suitable for UNC and BSW threads
DIN-2181	Short hand taps for metric fine threadsNorm is also suitable for UNF and BSF threads
DIN-5157	Short hand taps and machine taps for pipe threads G, Rp

4.2. Groups of Tools by Applications

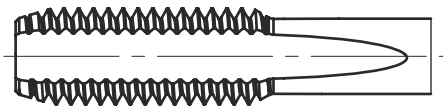
MASTERTAP P M K N S	Group of machine taps intended for high performance thread cutting in a wide range of materials, such as **steel, stainless steel, cast iron, non-ferrous metals and heat-resistant alloys, and titanium alloys.** The thread cutting may be carried out in modern, highly efficient machining centers with high cutting speeds, on the older types of CNC machines, and on the conventional machines with slightly lower processing parameters.
800X P M K N	Innovative variety of machine tap 800, designed also for **processing of stainless steel**. The innovative manufacturing technologies may even double durability and processing performance we had so far. All these features make the 800X tap the best choice for small and medium size production series, while still offering favorable price to quality ratio.
800 P K N	For structural, free machining and low alloy steels with the tensile strength of 600 MPa ≤ Rm ≤ 800 Mpa
FAN-1200 P	For tool and difficult to process steels with the tensile strength of 800 MPa ≤ Rm ≤ 1200 MPa, and for heat treated steels up to 38 HRC
1400 P	For difficult to process and heat resistant steels with the tensile strength of 1200 MPa ≤ Rm ≤ 1400 MPa, and for heat treated steels up to 44 HRC
INOX P M	For high alloy steel, stainless and acid resistant steels with a tensile strength of Rm ≤ 1000 MPa
GG K	For processing of grey and nodular cast iron
GAL N	For cast aluminum alloys with the Si content of max. 10%
HRC H	For materials, which have been hardened. The number next to the symbol indicates the maximum hardness of the material to be processed, in the HRC scale
S-NC P M K N S	For synchronized tapping on CNC machines with the "rigid tapping" function for a wide range of materials with the high cutting speeds
Ms N	For brass and short chip bronze

4.3. Types of machine tap chamfers

Symbol	Sketch	Chamfer length presented in the quantity of the thread coils	Angle
A		6 ÷ 8 P	5°
B		3,5 ÷ 5,5 P	8°
C		2 ÷ 3 P	17°
D		3,5 ÷ 5 P	8°
E		1,5 ÷ 2 P	23°
F		1 P	35°

4.4. Types of Machine Tap Chip Flutes

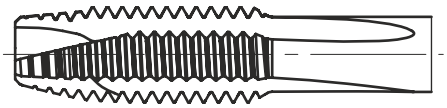
Straight Flutes



In combination with the chamfer A or D applied for the through holes and with the chamfer E or F for the blind holes. Tap with the chamfer C can be used for both types of holes.

It is recommended for materials giving a short chip. The grooves evacuate only some of the chips, which slowly move along the axis. The tap should not be used for deep blind holes or materials giving a long chip. The length of threads, which can be made - up to ca 1.5xD

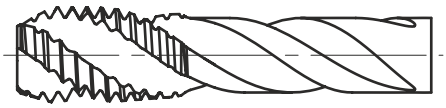
Straight Flutes with Spiral Point



Designed for through holes, with thread along the full length of the hole.

Used together with the chamfer B, it is recommended for materials giving a long chip. The spiral point moves tightly squashed chips in the direction of feed, and prevents the grooves from clogging. Coolant reaches the working zone freely. The length of threads, which can be made - up to ca 2xD.

Spiral flutes

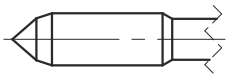
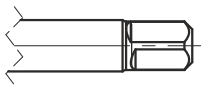
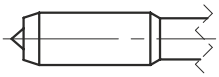
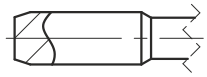
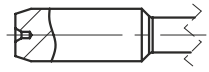
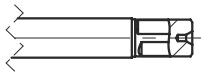


Together with the chamfer C and E used for the blind holes.

It is recommended for materials giving a long chip. Spiral flutes provide good chip evacuation in the direction from the hole toward the shank. Depending on the hole diameter, it is possible to make threads of up to 3xD.

Machine tap with spiral flutes should not be used for the through holes.

4.6. Types of the high performance machine tap center holes, depending on the diameter of the thread, chamfer and the applied standards

Working Part		Shank
Solid cone	① 	 ⑤ Phase
Stepped cone	② 	
Chamfer E (without center hole)	③ 	
Internal center hole	④ 	 ⑥ Internal center hole

	External thread diameter (mm)	Type of center hole on cutting segment side			Type of center hole on shank side
		Chamfers A, C, D,	Chamfer B	Chamfer E	
DIN-371	≤7,2	①	①	③	⑤
	7,2≤8,2	②	①	③	⑤
	8,2<10,2	②	②	③	⑤
DIN-374 DIN-376 DIN-5156	≤7,2	①	①	③	⑤
	>7,2	④	④	③	⑥

Length of full solid cones for selected types of thread (Length of stepped cone Lnak=1.8 mm)

M		MF	
M1	0,6	M2,5 x 0,35	1,9
M1,2	0,8	M2,6 x 0,35	1,9
M1,4	1,0	M3 x 0,35	1,3
M1,6	1,1	M 3,5 x 0,35	1,6
M1,7	1,1	M4 x 0,5	1,8
M1,8	1,3	M5 x 0,5	2,3
M2	1,4	M6 x 0,75	2,6
M2,5	1,8	M7 x ,75	3,1
M2,6	1,8		
M3	1,3		
M3,5	1,5		
M4	1,7		
M4,5	1,9		
M5	2,1		
M6	2,5		
M7	3,0		
UNC		**UNF**	
No 4-40	2,0	No 4-48	2,1
No 5-40	1,3	No 5-44	1,4
No 6-32	1,4	No 6-40	1,5
No 8-32	1,8	No 8-36	1,8
No 10-24	2,0	No 10-32	2,1
No 12-24	2,3	No 12-28	2,3
1/4-20	2,6	1/4 - 28	2,8
5/16-18	3,3	5/16 - 24	3,5
BSW		**BSF**	
1/8 - 40	1,25	1/4 - 26	2,65
3/16 - 24	1,8	5/16 - 22	3,4
1/4 - 20	2,55		
5/16 - 18	3,25		

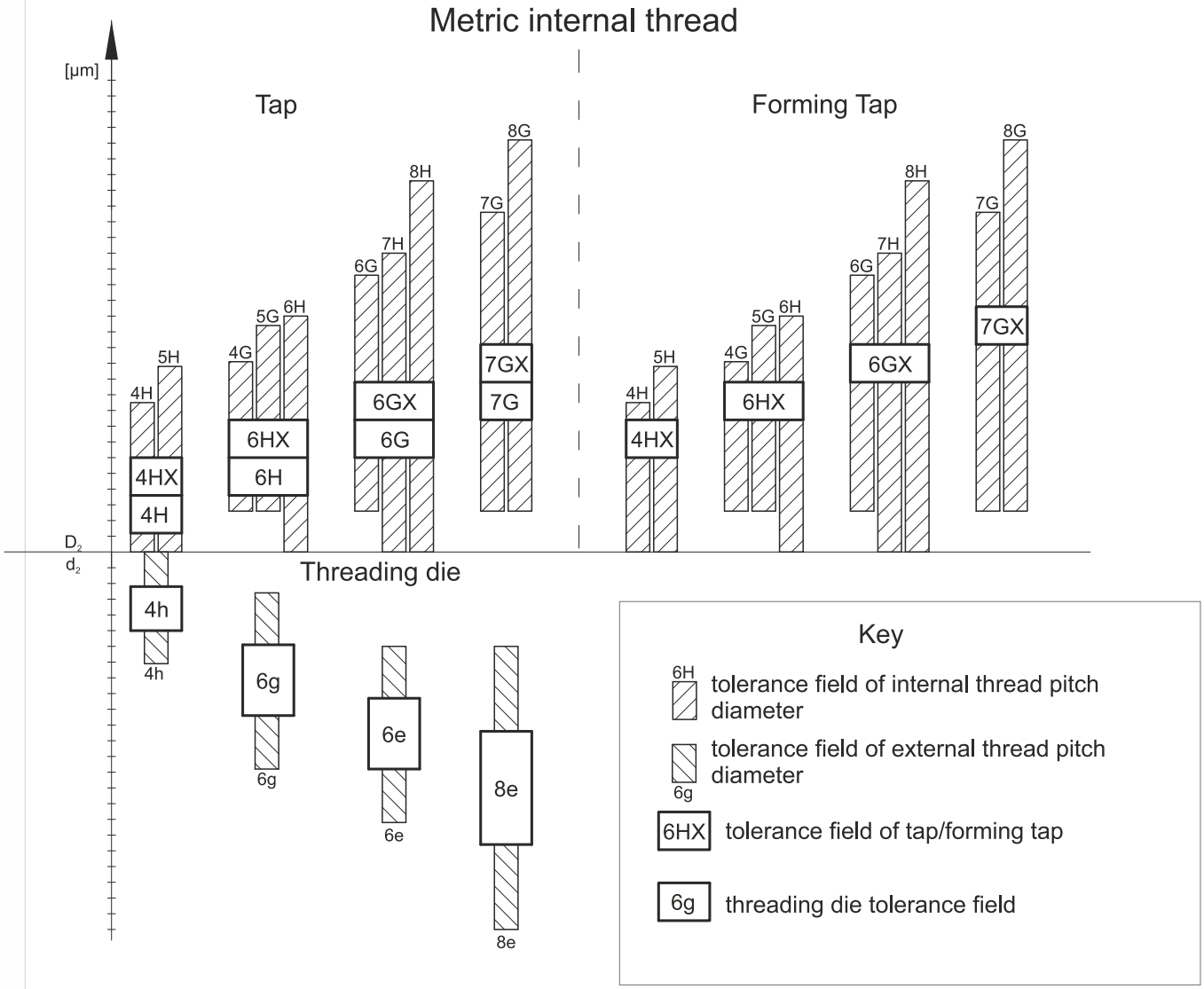
4.7. Application of Tools with Internal Channels for Supplying a Coolant IK/IKR

IK - Central cooling channel is recommended for the blind holes, facilitates chip evacuation of chips toward the shank, improves lubrication and cooling conditions, extends tool life

IKR - Central cooling channel divided into several radial channels, which supply coolant into each of the chip flutes separately. The solution is recommended for tapping of the through holes, facilitates evacuation of chips in the direction of feed, improve lubrication and cooling conditions, extends tool life.

4.8. Classes of Machine Taps

The machine taps presented in our catalog are made in the basic class, intended for the most commonly used internal thread tolerances, appropriate for the particular thread types: for metric thread 6H, for unified thread UNC, UNF - 2B, for Whitworth thread BSW, BSF - "normal." Per individual request we can manufacture the taps in other classes.Tap classes (ie. the tolerance field of a working segment) for metric threads are unified by international and national standards. A particular class of the tap threads allow for two or three fields of tolerance (see drawing and table below.)

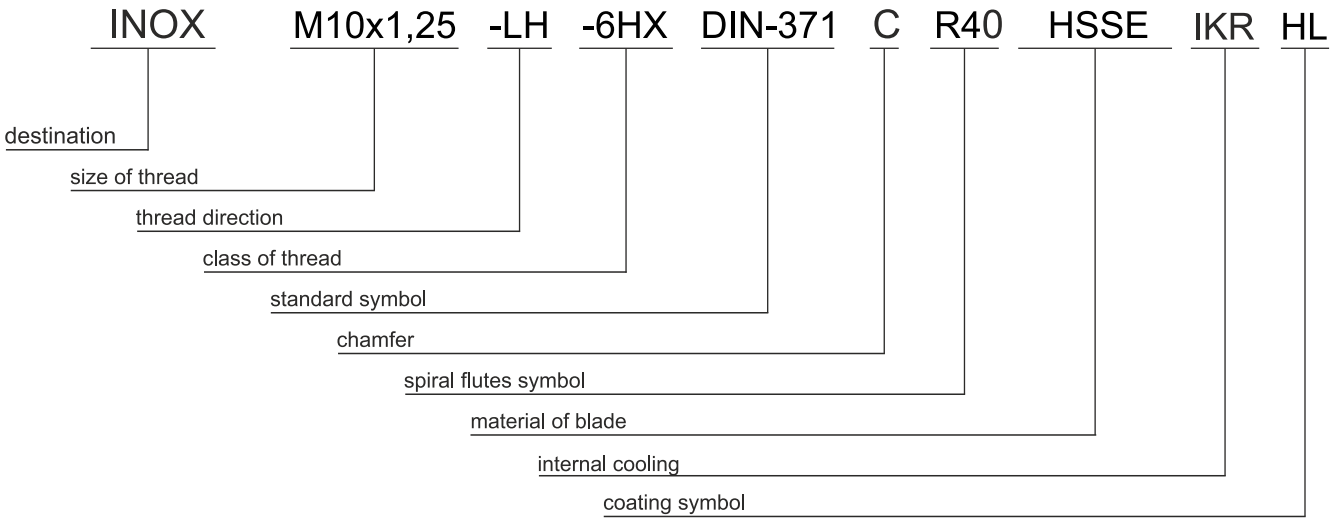


According to DIN 802	Tolerance field of internal thread				
4H	4H	5H	-	-	-
6H	4G	5G	6H	-	-
6G	-	-	6G	7H	8H
7G*	-	-	-	7G	8G

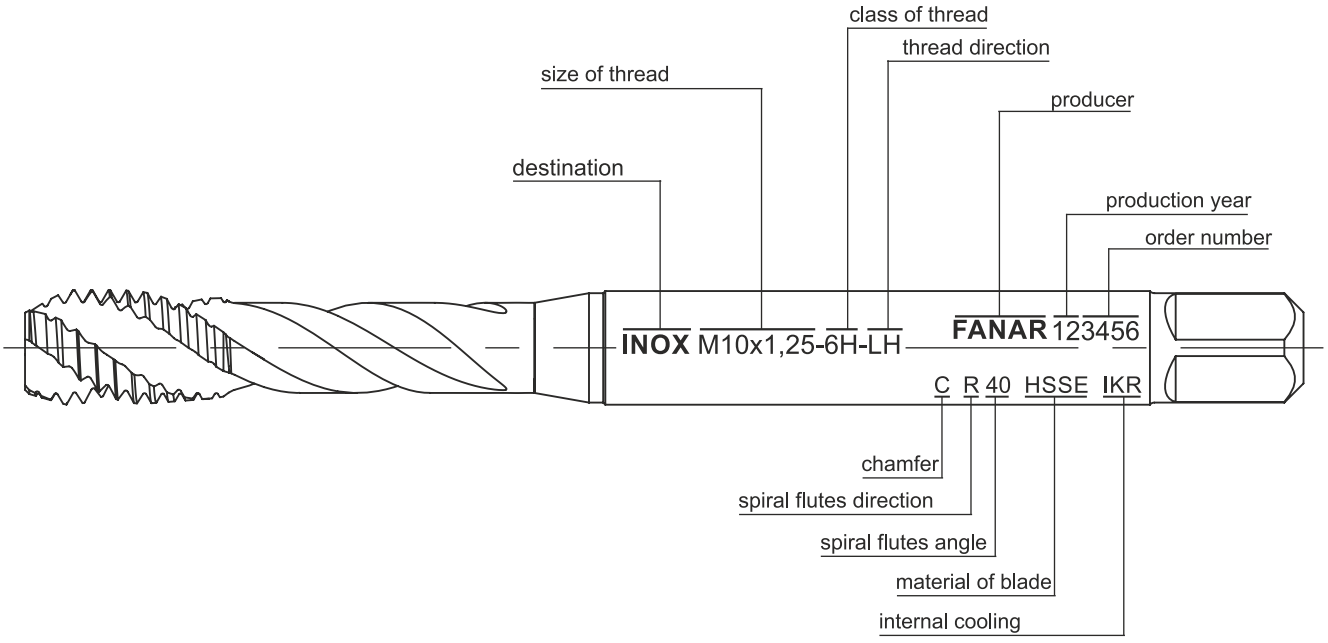
*DIN 802 provides the possibility of correction the tap tolerance comparing to the standard demands in case when it is required by the particular machining conditions, e.g. the sort of machining material. In such situation the symbol of the tap's class with the sign "X", e.g. 6HX, 6GX is obligatory.

4.9. Marking and stamping of high performance machine taps

Marking



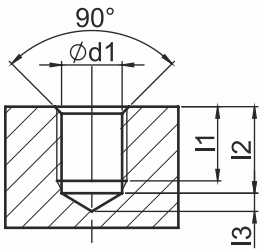
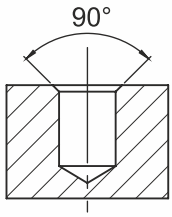
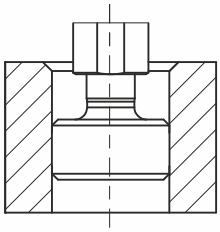
Stamping

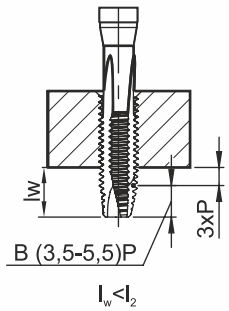
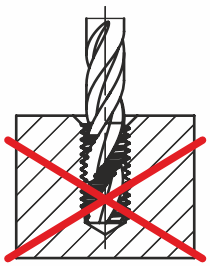
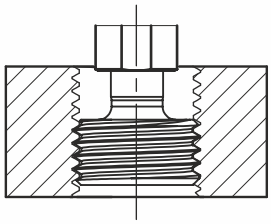


4.10. Recommendations for Processing with Machine Taps

Tapping is usually one of the last operations in the process of machining a workpiece. An error occurring in the process of tapping may result in additional costs associated not only with the damaged tap, but often with the workpiece material, as well as with the machining processes preceding the tapping. In order to avoid such problems, we encourage you to read and apply the below recommendations regarding the tapping process.

4.11. Threading process

Operation	Recommendations
10 **Drilling**  ∅d1 - recommended diameter for tapping l1 - depth of thread l2 - depth of tapping hole l3 - length of point	- The diameter of the drill (see chapter 6, page 141) should be consistent with the recommended value, presented on the catalog page of a tool being used. - In the case of materials with Rm > 1200 MPa, the hole diameter should be possibly close to the upper limit of its tolerance. - In the case of a blind hole, to achieve the required usable length of a thread ,the depth of the drilled hole should take into account the length of the point of the drill, length of the tap's cone (Table on page 231) and the chamfer.
20 **Chamfering of the Hole's Edge**  	- In order to facilitate insertion of the tap into the hole and to reduce resistance in the beginning of its work, the edges of the drilled hole should be chamfered with a deburring tool with the tip angle of 90º (Section 6, page 152)
30 **Validation of the tapping hole** 	- When notching thread with a tap, the minor diameter depends on the diameter of the drilled hole. Correctness of the drilled holes should be checked with a smooth gauge for tapping holes (Section 7, page 162), according to the recommendations included in the technical section referring to gauges

Operation	Recommendations
40 **Tapping** 	- When tapping the through holes using a tap with the spiral point, special attention must be paid when removing the tap from the hole. For the proper thread cut and the chip evacuation, the removal of the tap from the tap hole should include the entire length of the spiral point + ca 3 thread pitches
	- When tapping blind holes, there should be no collision between the tap face and the bottom of the hole - In the case of the numerically controlled machines with synchronous tapping cycle, it is recommended to use the tap grip with the minimal axial compensation (Section 8, page 179) - Applied machining speeds should take into account how the workpiece and the tap have been fixed, type of the processed material, type and condition of the machine, and conditions of the tap lubrication
50 **Validation of the Thread** 	- Upon completion of tapping, it should be checked with a tapping gauge (Section 7, page 164), in accordance with the recommendations included in the technical section referring to gauges.

4.11. Troubleshooting guide for tapping

Problem: Tapping oversized threads (no-go gauge is too loose)	
You used improper tap for material and thread application.	You should use a suitable tap hole type and material being cutted according to the table in catalogue.
Cuutting speed was too high.	You should reduce cutting speed. You should use more coolant/lubrication.
There was cold welding on the flanks of the tap.	You should change your tool for new one. You should use coated tap. You should use more coolant/lubrication. You should remove damagedd teeth.
Chip packing in flutes occured.	You should use tap with another flute geometry. There couldd be necessity of using set of taps.
Grinding burr occured.	Remove it with fiber brush.
Incorect fixturing or positioning of part .	You should use tap holders with axial and parallel compensation. Try presicely fix cutted element.
Inconsistent feed of tap.	You should control the feedd while tapping. You should check parameters of CNC machine (program) Check lead screw for backlash. You should use holdder with compensation.
Problem: Tapping oversized threads (nogo gauge is loose)	
The tolerance of used tap was too high comparing with required class of the thread.	You should check marking on the tap and revise if it is suitable for making required class of thread. If you have any problems contact our Technical Representative.
Inapropriate reconditioning of a tap..	While reconditioning it is required that all ground surfaces maintain the original geometry put on by the manufacturer. For instructive information please contact our Representative.
Problem: Tapping undersized threads (go gauge doesn't enter part way into hole).	
The chosen tap has not suitable geometry for multiple regrinds.	You should limit the number of tap regrinds. Try to use another tap.
A part of tap surface wasn't renewed while resharpening.	Try to grind the tap again. You should use a new tap.
You used inapropriate tap for the tread being made and material being cutted.	You should use tap suitable for the hole type and material being cutted according to the table from catalogue.
The used tap has too small nominal size (tolerance).	You should check marking on the tap and revise if it is suitable for making required class of thread. If you have any problems contact our Technical Representative.
Problem: Tapping bellmouthed hole (first few threads are oversized)	
The tolerance of used tap was too high comparing with required class of the thread.	You should check marking on the tap and revise if it is suitable for making required class of thread. If you have any problems contact our Technical Representative.
Inapropriate reconditioning of a tap.	While reconditioning it is required that all ground surfaces maintain the original geometry put on by the manufacturer. For instructive information please contact our Representative.
Problem: Too low tap life	
All reasons stated in next table "torn and rough threads".	Please read the table "torn and rough threads"
The tap lost its hardness by excess hear during regrinding.	You should change the specification of the grinding wheel. You should use coolant while grinding.
The loss of surface treatment occured after regrinding.	Retreat surface of tap. You should check suitability of surface treatment for material being tapped.
Work hardened drill hole and hole chamfer.	You sholud frequently change or regrind tap drill. You should check proper drilling speed and feed. Please anneal part before tapping.

Problem: Damage of cutting part	
You used improper tap for material and thread application.	You should use tap suitable for the hole type and material being cutted according to the table from catalogue.
Tap drill was too small.	You should use correct size of drill. Please check recommended size drill in catalogue (note that there are different sizes for taps and for forming taps). If you have any problems contact our Technical Representative.
The tap hole wasn't deep enough.	You should check the actual drill depth (the drill could have slipped back into holder).
Tap drill hole was missing.	Please make sure that the tap drill hole is present (that's common problem in multiple spindle applications on transfer lines).
Chips packing in flutes occured.	Try to use tap with different flute geometry (angle). There could be necessity of using set of taps.
Cold welding on the flanks of the tap (loading).	You should use a new tap. You should use coated tap. You should use more coolant/lubrication. You should remove damaged teeth.
Overload of the chamfer teeth occured.	Use tap with longer chamfer. You should use tap with increased number of flutes to provide more chamfered teeth.
Inorrect fixturing or positiong of part.	You should use tap holders with axial and parallel compensation. Try presicely fix cutted element.
The tap was hitting the bottom of the hole.	You should use tap holders with length compensation and with torque overload system.
Tapping hard or high tensile materials.	You should check if yor tap is properly selected. High performance taps HSSE-PM and VHM may be more suitable than HSSE taps.

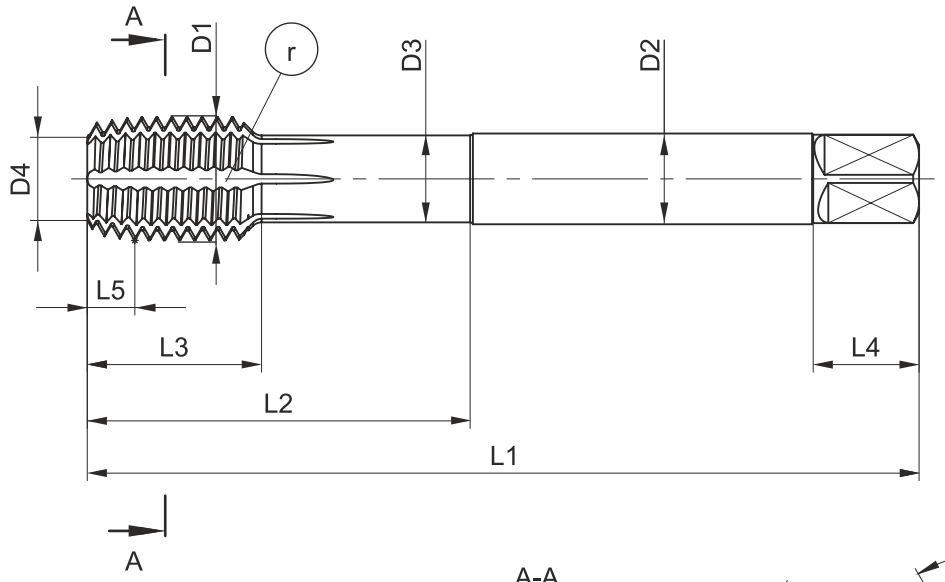
Problem: Torn and rough threads	
You used improper tap for material and thread application.	You should use tap suitable for the hole type and material being cutted according to the table from catalogue.
Cutting speed was too fast or too slow.	Please select proper cutting speed. Improve coolant selection to assist the effects of tap speed.
There was cold welding on the flanks of the tap.	You should use a new tap. You should use coated tap. You should use more coolant/lubrication. You should remove damaged teeth.
Chip packing in flutes occured.	Try to use tap with different flute geometry (angle). There could be necessity of using set of taps.
Grinding burr occured.	Remove it with fiber brush.
Tap drill was too small.	You should use correct size of drill. Please check recommended size drill in catalogue (note that there are different sizes for taps and for forming taps). If you have any problems contact our Technical Representative.
There wasn't proper cooling or lubrication while tapping.	Select properly lubricant according to the notes from the catalogue. Use adequate amounts of coolant/lubrication.
Tool overloading occured due to coarse pitch, hard materials or short chamfers.	There could be necessity of using set of taps.

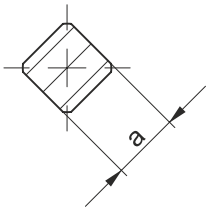
4.12. Regeneration - rake angle information

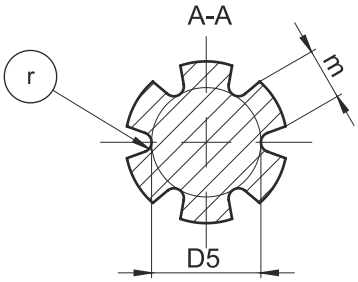
Material group	Material	Designation	γ_p [°]
P	Steel	800	10 – 13
		FAN-1200	7 – 10
		1400	5 – 7
M	Stainless steel	INOX	10 – 13
K	Cast iron	GG	4 – 6
N	Non-ferrous materials	GAL	7 – 9
			10 – 13
			4 – 6
S	heat-resistant alloys, titanium alloys	1400	5 – 7
H	Hard materials	HRC50	-5 – -4

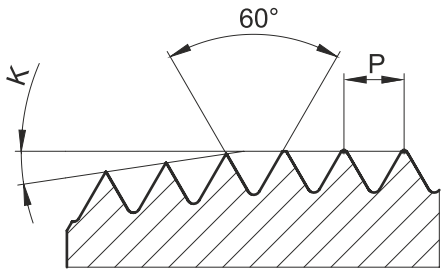
5. FORMING TAPS

5.1. Forming tap construction elements





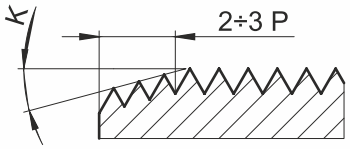
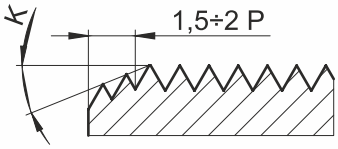




L1- total length
L2 - thread length
L3 - useful length
L4 - length of driving square
L5 - chamfer length
∅ D1 - thread diameter
∅ D2 - shank diameter
∅ D3 - neck diameter
∅ D4 - (chamfer) point diameter
∅ D5 - web (core) diameter

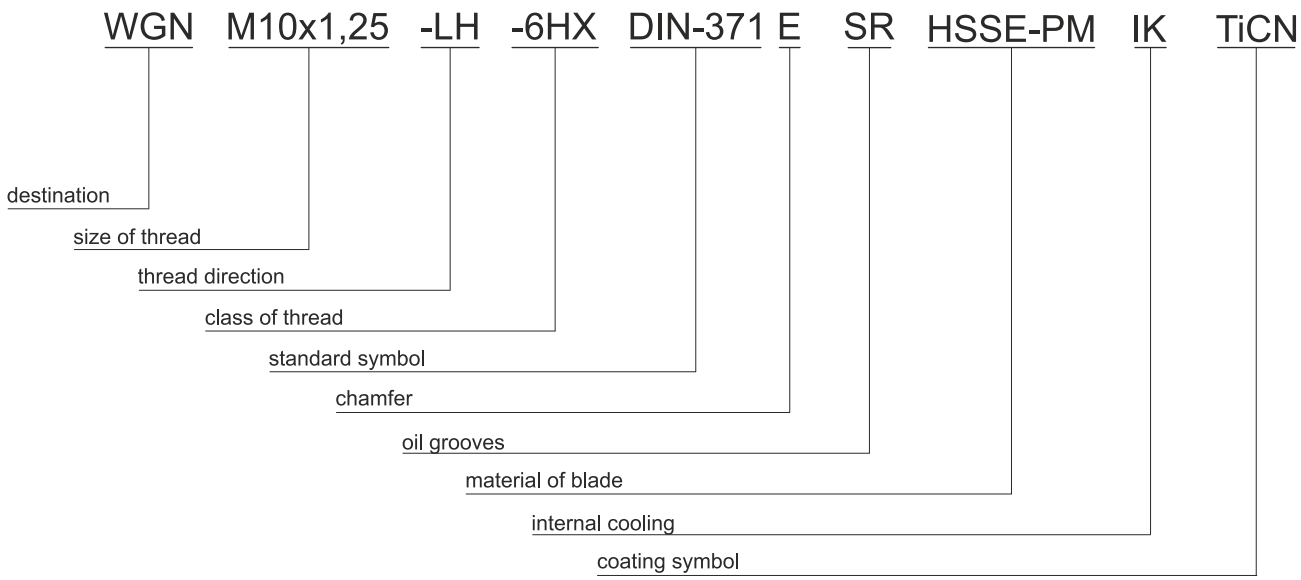
r - straight flute
κ - chamfer angle
α - angle of thread
P - pitch of thread
m - width of land
a - size of square

5.2. Types of forming tap chamfers

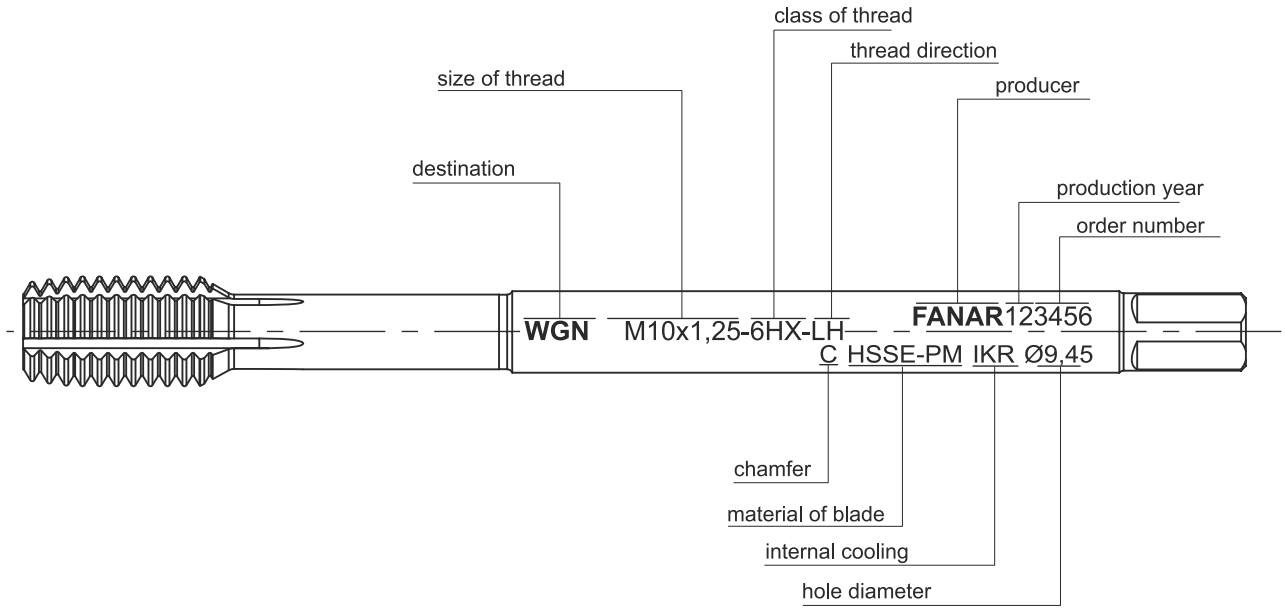
Symbol	Sketch	Chamfer length presented in the quantity of the thread coils	Angle
C		2 ÷ 3 P	15°
E		1,5 ÷ 2 P	23°

5.3. Marking and stamping of forming taps

Marking



Stamping



5.4. Difference Between Cut and Formed Thread

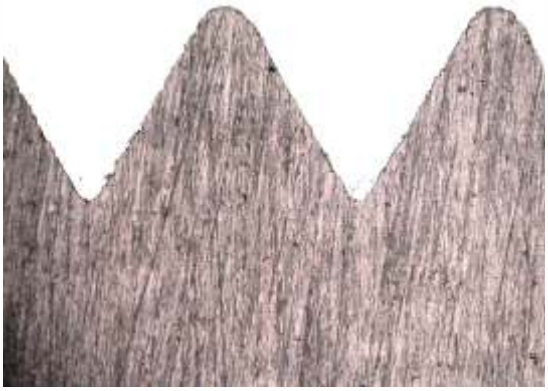
Cold forming is a chip free method of processing, where the workpiece material is being imprinted, the thread is being formed by plastic deformation, without the need for the material evacuation. The material formed is cold, and its fibers are not being broken.

Cut Thread

Cold formed Thread

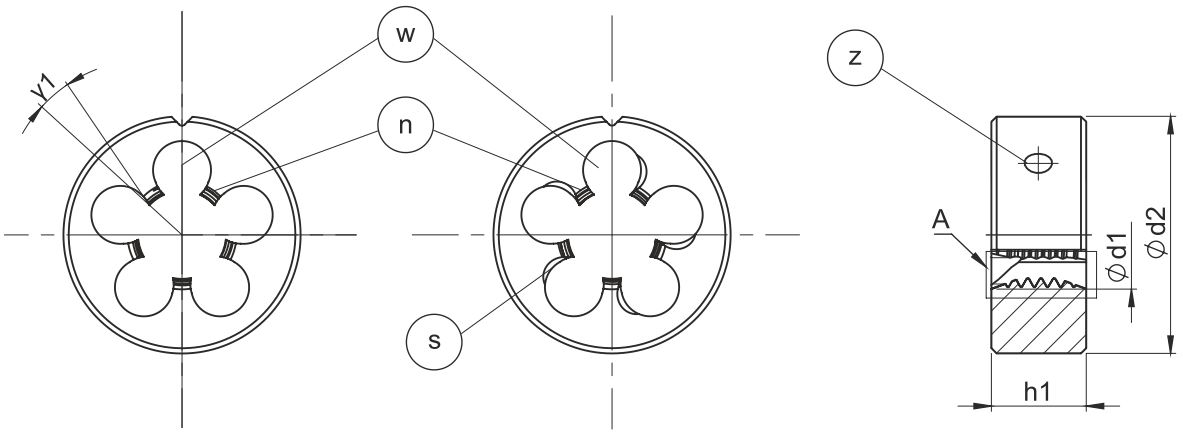
Advantages of Forming threads	Disadvantages of Forming threads
→ chip free processing	→ much greater forming torques in comparison to cutting
→ one tool for both, through and blind holes	→ incomplete formation of a thread top
→ possibility to tap deep holes 4xD	→ thread load carrying capacity amounts to about 80% of the load carrying capacity of the cut thread, but its strength is much greater
→ high durability of thread, especially on side surfaces of a thread pitch	→ application range limited to plastic materials
→ smoother thread surface	→ greater tolerance in the process of threading
→ no errors in pitch or form of thread	→ method not recommended for food and pharmaceutical industry
→ the ability to tap with significantly higher processing parameters, because the processing performance of most materials increases with speed, it has no negative impact on the tool life	
→ high rigidity of the tool reduces risk of its damage	

5.5. Thread forming Troubleshooting

Problem	Solution
Incomplete form of thread	
	Reduce the drill diameter for tapping hole or apply the drill diameter according to the selection Table for forming taps page 270.
Overdone form of thread, too small minor diameter	
	Increase the drill diameter for tapping hole or apply the drill diameter according to the selection Table for forming taps page 270.
Poor quality of thread surface, yanked off material from surface of thread	
	- Improve lubrication: Use forming taps with oil grooves - Increase amount of coolant/lubricant - Use oil for lubricant - Use coated forming tap
Tool breaks	
	- Increase tapping hole diameter - Increased amount of coolant/lubricant - Apply cover coating preventing sticking of material being processed - Check compliance of workpiece with recommendations regarding its plasticity and hardness

6. DIES

6.1. Die construction elements



⌀d1 - nominal thread diameter
⌀d2 - outside diameter
h1 - die thickness
κ - chamfer angle
γ1- rake angle
γ2 - spiral face inclination
w - chip hole
n - chamfer
s - spiral face
z - hole for fixing screw

6.2. Dimension standards

Dimension standards assign proper series of dies outer dimensions (diameters, thickness) to nominal standards as well as determine the dimensions connected with dies fixing in the holder (position, size of holes for fixing screws and V-grooves).

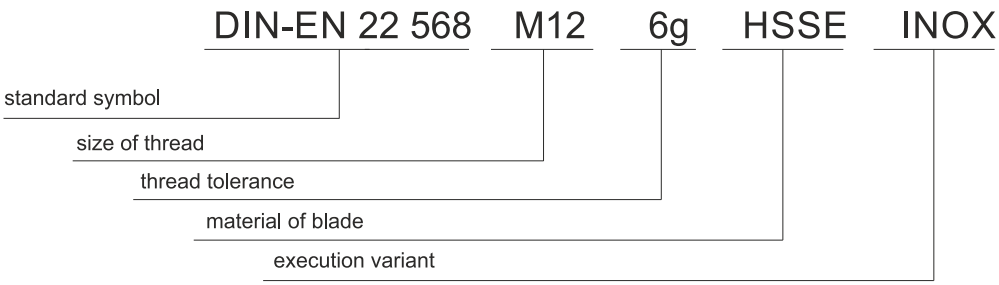
Symbol	Standards	Destination
DIN	EN 22 568 (in the past DIN 223) PN-92/M-58070 ISO 2568	Round dies for metric coarse M and MF fine threads, UNC, UNF, BSW, BSF as well as other threads, excluding the pipe threads G and R
DIN	EN 24 231 (in the past DIN 5158) PN-92/M-58161 ISO 4231	Round dies for pipe threads G
DIN	EN 24 230 (in the past DIN 5159) PN-92/M-58160 ISO 4230	Round dies for tapered pipe threads R

6.3. Marking and stamping of dies

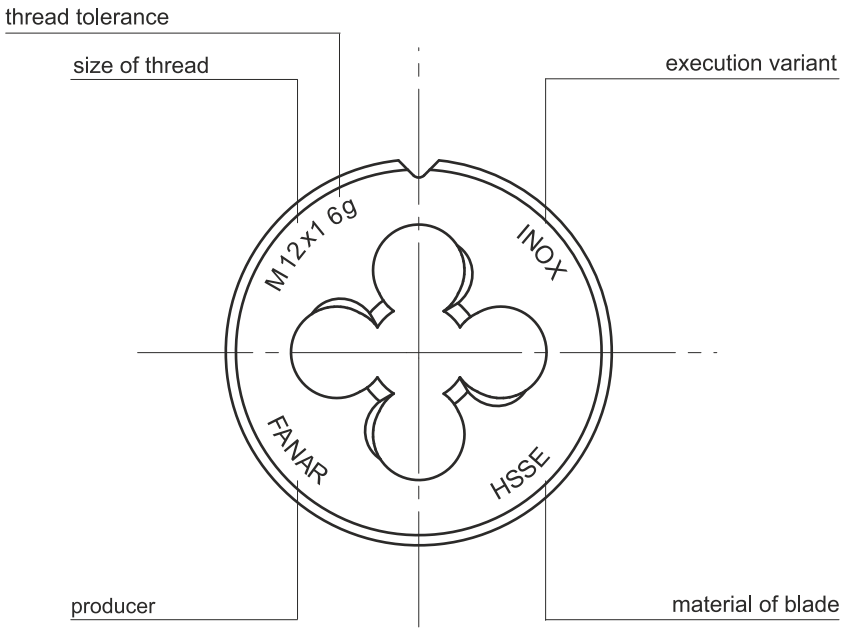
Marking

Example: high performance machine die acc. to DIN-EN 22 568 for the thread M12, thread tolerance 6g, for stainless steel

Marking: given in orders, invoices, specifikations, on the packages



Stamping



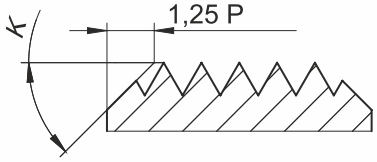
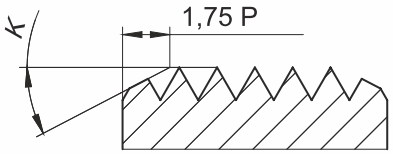
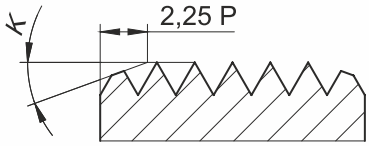
6.4. Cut Thread Tolerances

The threading dies presented in our catalog are designed for cutting the most common and basic for a given type of thread tolerances: for metric thread 6g, for threads UNC, UNF, etc., 2A. On individual request we can manufacture threading dies for other, than the above mentioned, fields of tolerance, e.g. for the metric threads: 4h for tight threads, 6e for threads to be covered with thin galvanized coating.

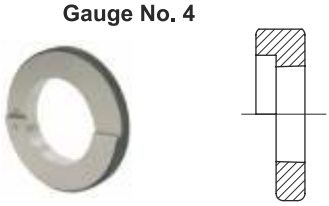
6.5. Groups of Tools by Applications

800 P N	For processing of structural steel and cast steel with Rm≤800MPa
800 SPN P N	For processing of structural steel and cast steel with Rm≤800MPa. Better cut thread quality can be achieved, for use on automatic lathes.
Ms N	For processing of brass and short chip bronze.
INOX P M K N	For processing of stainless steel, cast aluminum and nodular cast iron.

6.6. Chamfer

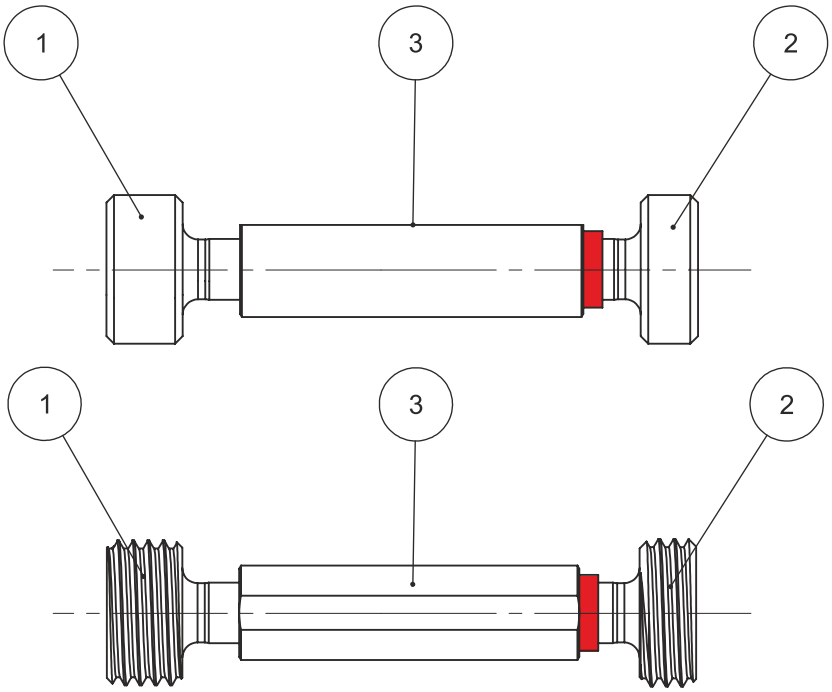
Length	Application	Sketch	Angle
1,25 P	Ms		45°
1,75 P	800		27,5°
2,25 P	INOX		20°

7.2.2 Gauges R, Rc/Rp

Gauge No. 1 	**Taper full form threaded plug gauge.** This gauge is a 1:16 taper full form threaded plug gauge and is suitable for checking the major diameter (D) and pitch diameter (D2) at the gauge plane of internal parallel (Rp) threads and internal taper (Rc) threads.
Gauge No. 2 	**Taper full form threaded plug gauge with relief.** This gauge is a 1:16 taper full form threaded plug gauge with relief of threads and is suitable for checking the major diameter (D) and pitch diameter (D2) at the gauge plane, and the accomodation [1]lenght of inernal parallel (Rp) threads and internal taper (Rc) threads. *[1]Accomodation lenght: distance from the face of an internally threaded workpiece to the first obstruction which the externally threaded workpiece will encounter on assembly.*
Gauge No. 3 	**Parallel full form threaded ring gauge.** This gauge is parallel full form threaded ring gauge and is suitable for checking the minor diameter (d1) and pitch diameter (d2) at the gauge plane of taper external (R) threads.
Gauge No. 4 	**Taper plane ring gauge.** This gauge is a 1:16 taper plain ring gauge and is suitable for checking the major diameter (d) and the related useful thread lenght on taper external (R) threads.
Gauge No. 5 	**Taper modified thread form check plug gauge** This check plug gauge is used to check the dimensions of the parallel threaded ring gauge (gauge No. 3) when manufacturing the ring gauge and for checking the ring gauge for wear.

7. GAUGES

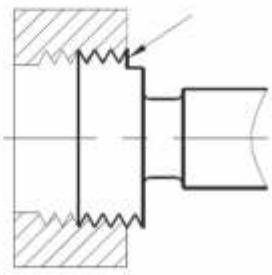
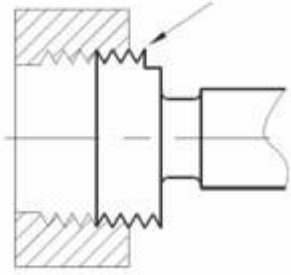
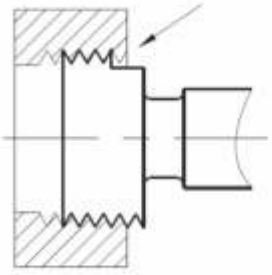
7.1. Gauges construction elements



1 - go plug gauge
2 - no go plug gauge
3 - handle

7.2. Types of gauges

7.2.1 Gauges NPT

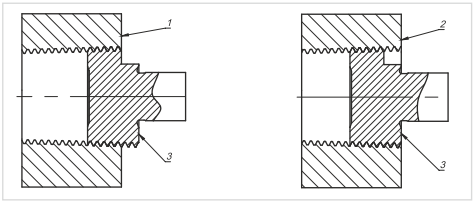
Flattening equal with workpiece plane	Flattening one thread turn above workpiece plane	Flattening one thread turn below workpiece plane
		
The base depth	Minimal tapping depth	Maximum tapping depth

Pipe threads where pressure tight joint are made on the threads according to PN-EN 10226-1, PN-EN 10226-2 (ISO7-1:2000).
Verification by means of limit gauges according to PN-EN 10226-3 (ISO-7-2:2000)

7.4. Use of gauges and checking of threads

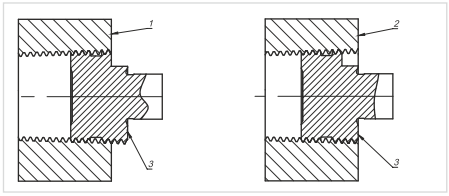
Checking of internal taper (Rc) and internal parallel (Rp) threads

Stage 1: The taper threaded plug gauge (gauge No. 1) is screwed hand tight into the internal thread. The internal thread is within the permissible tolerance if the end face of the threaded workpiece lies between the step faces, or flush with one of the step faces on the gauge.



Key:
1 - end face of work piece flush with tolerance step on gauge,
2 - end face of work piece flush with face of gauge
3 - gauge No. 1

Stage 2: The taper threaded plug gauge with relief (gauge No 2) is screwed hand tight into the internal thread. The internal thread is within the permissible tolerances if the end face of the threaded workpiece lies between the step faces, or flush with one of the step faces on the gauge.



Key:
1 - end face of work piece flush with tolerance step on gauge,
2 - end face of work piece flush with face of gauge
3 - gauge No. 2

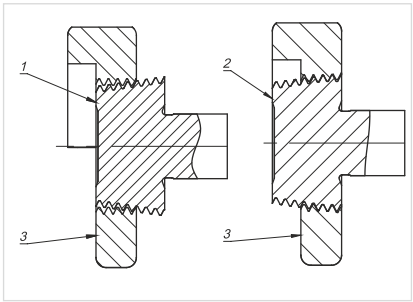
Note 1 : If a workpiece is rejected by gauge No. 2 but accepted by gauge No. 1, then this may indicate a lack of accomodation lenght.

Note 2 : A variation in the relative position of the gauge steps of gauge Nos. 1 and 2 in excess of 0,5P but not greater than 1P is permissible when the manufacturer and purchaser agree that the use of a thread sealant sealant during assembly of the workpiece will compensate for the increased differnce in the gaugin results.

Note 3 : In the case of Rp threads, if the depth of chamfer at the pitch diameter of the threads is more or less than 0,5P, then the gauging result will be slightly affected.

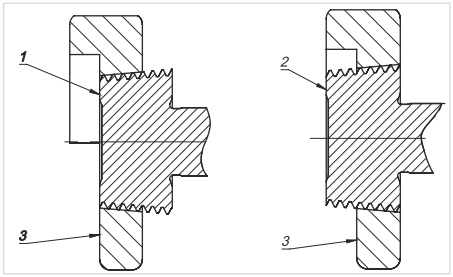
Checking of external taper (R) threads

Stage 1: The threaded ring gauge (gauge No. 3) is screwed hand-tight onto the external thread. The external thread is within the permissible tolerance if the end face of the workpiece lies between the step faces, or flush with one of the step faces on the gauge.



Key:
1 - end face of work piece flush with tolerance step on gauge,
2 - end face of work piece flush with face of gauge
3 - gauge No. 3

Stage 2: The taper plain ring gauge (gauge No. 4) is positioned hand tight over the external thread. The external thread is within the permissible tolerances if the end face of the threaded workpiece lies betwee the step faces, or flush with one of the step faces of the gauge and the roots of all threads within the area covered by the gauge are fully formed.

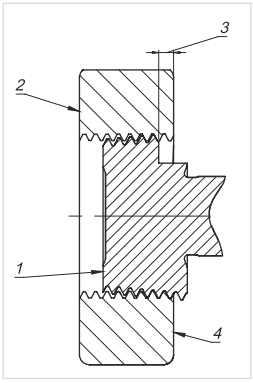


Key:
1 - end face of work piece flush with tolerance step on gauge,
2 - end face of work piece flush with face of gauge
3 - gauge No. 4

Note: A variation in the relative positions of the gauge steps of gauge Nos. 3 and 4 in excess of 0,5P but no greater than 1P is permissible when the manufacturer and purchaser agree that the use of a thread sealant during the assembly of the workpiece will compensate for the increased differnce in the gauging results.

Checking of taper plug gauges wear (gauge Nos. 1 and 2)

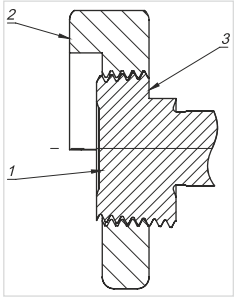
The pitch diameter of taper threaded plug gauges may be checked with the parallel modified thread form check ring gauge (gauge No. 6). The major diameter of taper threaded plug gauges shall be checked by direct measurment.



Key:
1 - gauges No 1 and 2,
2 - gauges No 6,
3 - distance from face of step on plug gauge to face of ring gauge shall be l_{13}
(see PN-EN 10226-3:2005 table 16)
4 - this face marked to indicate position of gauge plane

Checking of parallel ring gauges wear (gauge No 3)

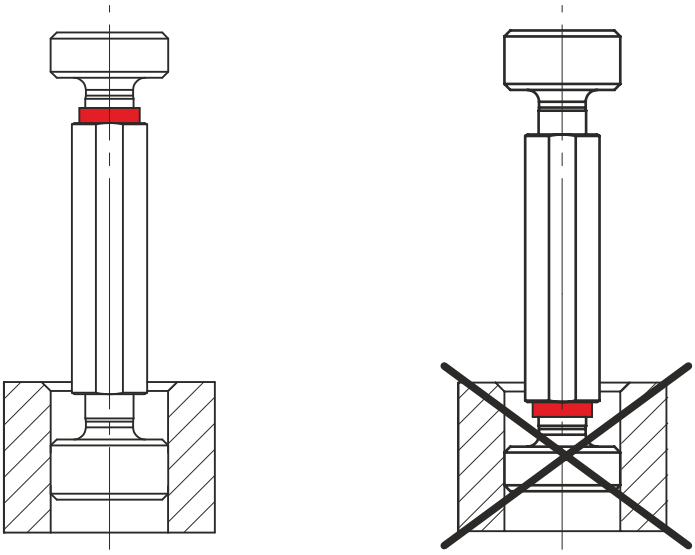
Parallel full form threaded ring gauges shall be checked by using the taper modified thread form check plug gauges at the pitch diameter. The minor diameter shall be checked by direct measurment.



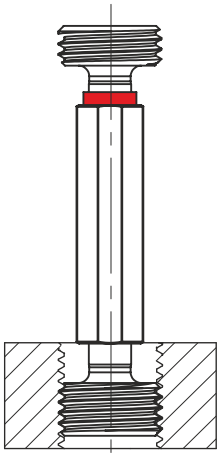
Key:
1 - gauges No 5
2 - gauges No 3
3 - distance from face of step on plug gauge to face of ring gauge shall be l_{14}
(see PN-EN 10226-3:2005 table 16)
4 - this face marked to indicate position of gauge plane

7.3. Validation of Holes

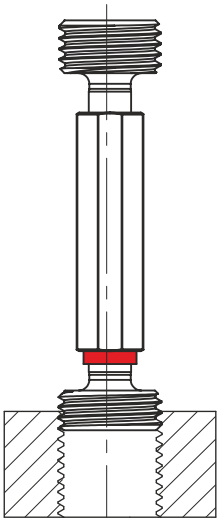
For checking of the through holes and blind holes, there are used go/no go plug gauges. The go gauge should be inserted into a hole with its own weight or with just a little push. The gauge must not be pushed with excessive force, as it could be jammed. The no go gauge should not let itself to be inserted into a hole.



Checking Internal Cylindrical Threads



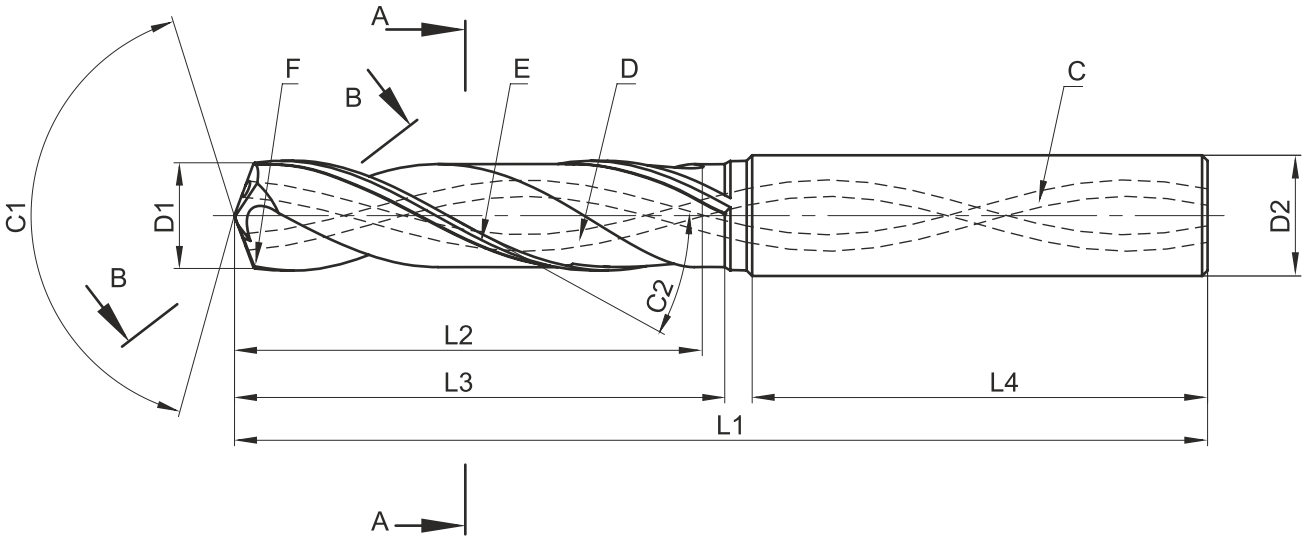
For checking of the internal threads, there are used go and no go thread gauges. **With the go thread gauge** you check the virtual internal thread dimension by checking the bottom dimension of pitch diameter. The go gauge, when manually screwed in, should with no special effort let itself to be screwed in for the whole length of the thread. The thread does not meet requirements, when it proves impossible to screw the gauge in.



With the no go thread gauge you check whether the pitch diameter exceeds the upper limit dimension. The no go gauge, when manually screwed in, should with no special effort go in **no further than two thread pitches**. If the gauge can be screwed in further than the two pitches, it means the thread does not meet requirements.

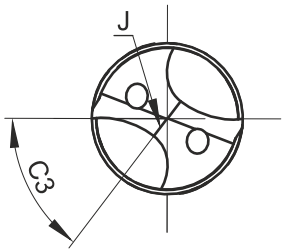
8. TWIST DRILLS

8.1. Nomenclature of Twist Drills

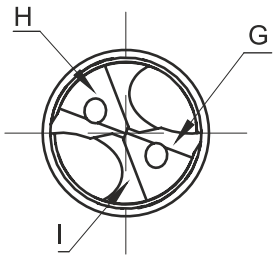


C - channel supplying coolant
D - chip flute
E - margin
F - rake face
G - primary clearance surface
H - secondary clearance surface
I - chamfer
J - chamfer edge

with no web thining

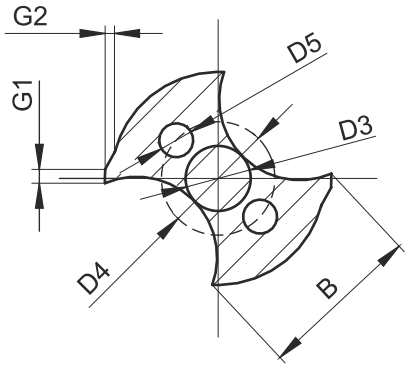


with web thining



L1 - total length
L2 - chip flutes length
L3 - margin length
L4 - shank length
D1 - working part diameter
D2 - shank diameter
D3 - core diameter
D4 - spacing of cooling channels
D5 - diameter of cooling channels
C1 - point angle
C2 - Helix angle
C3 - chisel angle
C4 - clearance angle
C5 - angle of primary clearance surface
C6 - angle of secondary clearance
G1 - margin width
G2 - lowering of margin
B - blade width

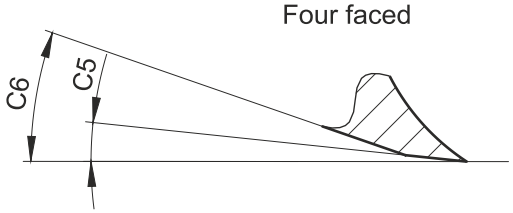
A-A



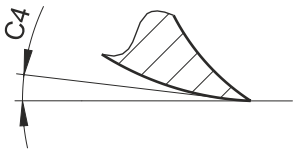
B-B

Types of Drill Clearance Surfaces

Four faced



Conical (eccentric)



8.2. Cooling and Lubrication Conditions

Application of Coolant:

- It is recommended when the drilling depth is at least twice greater than the diameter
- It is a must with depths five times greater than the drill diameter
- With application of external cooling, the coolant should be fed not only with the appropriate pressure, but also in the proper manner.

Methods of Coolant Supply:

Internal:

- Should be applied always, when the depth of the hole is at least three times greater than the diameter.
- Internal cooling is always recommended to avoid blocking of chips.

External:

- To improve chip evacuation, at least one coolant nozzle (two, if the drill bit is fixed) should be directed close to the axis of the tool.
- External cooling helps to avoid the formation of buildup on the edges, due to lowering the edges' temperature.
- External cooling is allowed for materials, which give short chips.

8.3. Problems and Troubleshooting

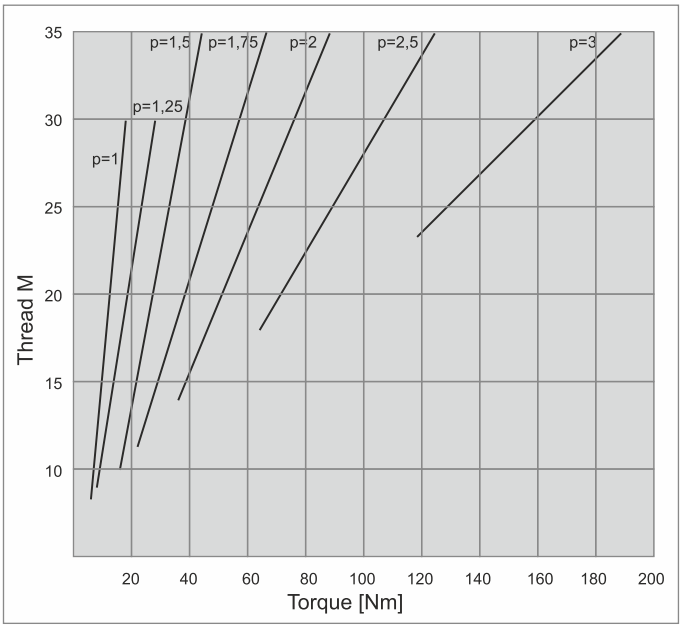
Problem: Buildup on edges	
Too low cutting speed	Increase cutting speed
Too high temperature of tool's edges	Apply cooling
Too great negative rake angle	Sharpen the cutting edge
Wear of coating	Coating on the edge
Too little oil in coolant	Increase amount of oil in coolant
Problem: Chipping off corners	
Excessive runout.	Use grip with better mounting precision
Excessive feed.	Decrease feed.
Insufficient amount of coolant (thermal cracking)	Check coolant pressure
Low rigidity of tool holding system	Check rigidity of tool's mount in the grip
Problem: Chipping off corners	
Excessive runout.	Use grip with better mounting precision
Excessive feed.	Decrease feed.
Discontinuous cutting process	Check coolant pressure
Low rigidity of tool holding system	Check rigidity of tool's mount in the grip

Problem: Excessive wear of the cutting edge	
Excessive runout	Use grip with better mounting precision
Excessive feed	Decrease feed.
Discontinuous cutting process	Check coolant pressure
Low rigidity of tool holding system	Check rigidity of tool's mount in the grip
Problem: Chipping on cutting edge	
Excessive runout	Use grip with better mounting precision
Unstable cutting conditions	Check cutting parameters
Critical tool wear	Change tool more often
Too hard material	Select tool suitable for workpiece material
Problem: Wear on the lands	
Excessive runout	Use grip with better mounting precision
Low coolant pressure	Use pure oil or emulsion with more oil content
Too high cutting speed	Decrease cutting speed
Buildup formed by workpiece material	Select tool suitable for workpiece material
Problem: Wear of the chisel edge	
Too low cutting speed	Increase cutting speed
Excessive feed	Decrease feed
Too small chisel	Check dimensions
Problem: Plastic deformation	
Too high cutting speed	Decrease cutting speed
Excessive feed	Decrease feed
Poor coolant supply	Check coolant pressure and setting of nozzles
Too low rigidity of tool holding system	Use VHM drill bit
Problem: Abrasion of coating from the edge	
Too much friction	Apply coolant with greater content of oil or additives
Remove at an angle	Decrease feeding speed at removal
Buildup formed by workpiece material	Reduce number of tool's regenerations
Problem: Chip block	
Too low cutting speed	Increase cutting speed
Excessive feed	Decrease feed
Too small chip flutes	Select tool with proper geometry
Poor rinsing off chips	Apply internal cooling

9.2. Quick-change adapters with safety clutch for taps

RECOMMENDED TORQUE VALUES FOR TAPPED MATERIALS WITH RM=1000 MPA

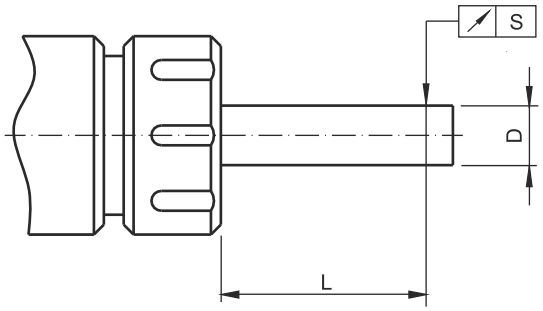
Thread M	Torque [Nm]
3	0,5
4	1,2
5	2
6	4
8	8
10	16
12	22
14	36
16	40
18	63
20	70
22	80
24	125
27	140
30	220
33	240



The values given are approximate and may be different depending on specific operating conditions

9.3. ER collets mounting

SHANK RUNOUT MOUNTED IN THE ER COLLET



D	L	S
1-1,6	6	0,015
1,6-3	10	0,015
3-6	16	0,015
6-10	25	0,015
10-18	40	0,020
18-26	50	0,020
26-40	60	0,020

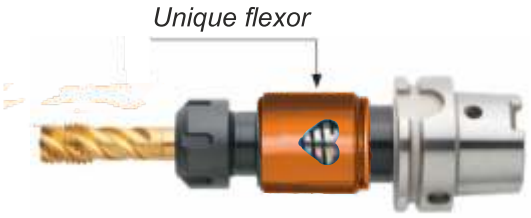
9. TAP HOLDERS

9.1. Tap holders „SOFT SYNCHRO”

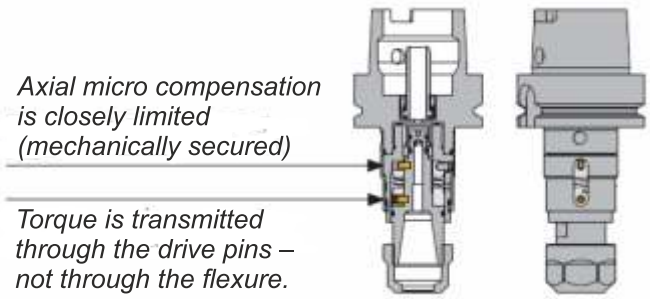
MASTERSYNC

Rule of action

At the heart of MasterSYNC is a precisely machined flexure which provides axial and radial compensation for the unavoidable discrepancy between the machine feed advance and the actual tap pitch. By compensating for this error, the thrust forces acting on the tap are dramatically reduced. The result is the longest possible tap life, 100 % improvement or more, and much better quality threads.



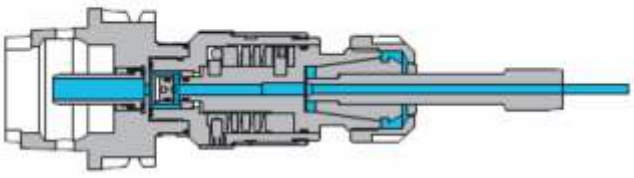
By limiting the axial compensation travel, and torsional forces acting on the flexure, millions of holes can be tapped without causing the MasterSYNC holder to fatigue, take a set, or wear out.



High Pressure Internal Coolant and MQL (Minimum Quantity Lubrication)

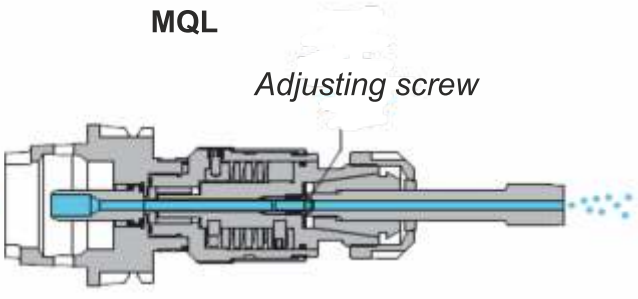
High pressure internal coolant system may be used at pressures up to 80 bar without affecting the axial compensation. Fanar can provide tools ready for Minimum Quantity Lubrication through the spindle. Our system provides direct flow of air and lubricant to the back of the tap.

IK



High Pressure Internal Coolant with increased flow rates

MQL



Minimum Quantity Lubrication Available for 1 channel or Multi channel systems

9.4. Toolholders balance

Definition of unbalance

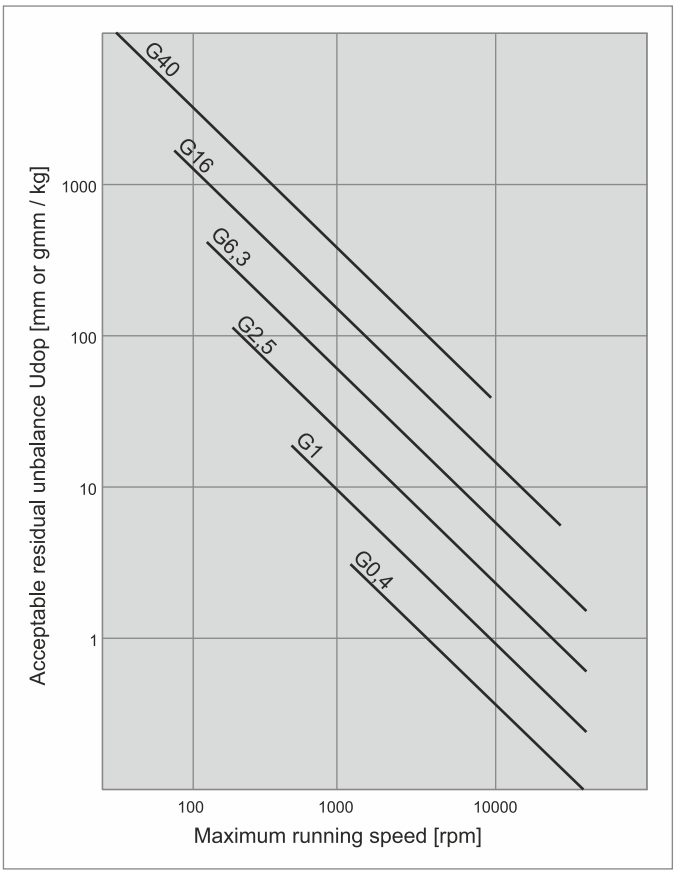
Unbalance is a displacement of the center of gravity of the rotating mass from the axis of rotation. The rotating mass includes: machine spindle, toolholder, intermediate components (collets), other additional elements of toolholders (nuts) and tool The reason of unbalance is geometric asymmetry, tolerance of, mounting errors, etc. Unbalance causes vibration of the setup, which reduce tool life and decrease quality of machining.To limit to an acceptable level of unbalance minimize clearances on the spindle and set suitable tools and toolholders. For most demanding applications it may be necessary not only balancing the toolholders, but also the tools.

Balancing

Balancing is to reduce the unbalance by moving the center of rotating mass in the direction of the axis. This is done by ensuring the proper geometry and adding additional weight or removing.
This target can only be achieved to some degree, as will always be residual unbalance.

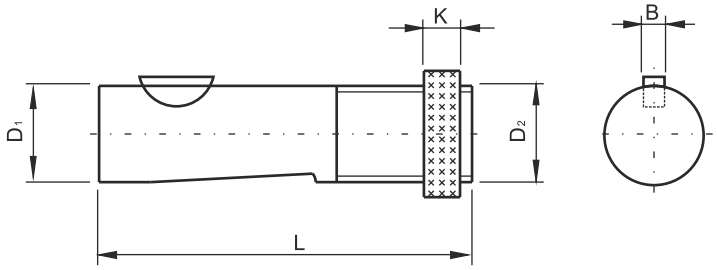
Balance accuracy classes

From an economic perspective it is not profitable too much tightening of requirements for rotating mass balance. In order to achieve a compromise between the technical and economic aspects, norm ISO 1940 introduced balance accuracy classes. It identifies the types of applications for each class, and so:
- G6,3 class is designed for machine parts and general use machines
- G2,5 class is designed for high speed machine parts.



9.5. Toolholders shanks

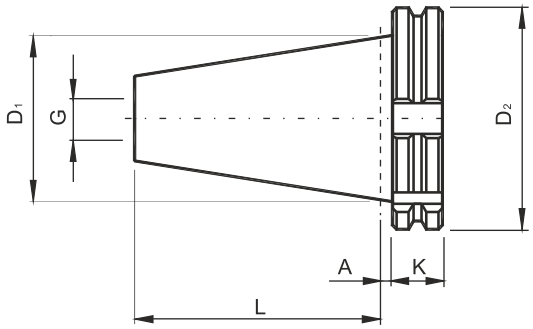
TR wg DIN-6327



Shank	D_1	D_2	L	B	K
TR20	20	TR20x1,5	88	5	12
TR28	28	TR28x2	95	6	12
TR36	36	TR36x2	118	8	14
TR48	48	TR48x2	144	10	18

Features:
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Precision grinded shank in g5 tolerance.

ISO wg DIN-69871 A

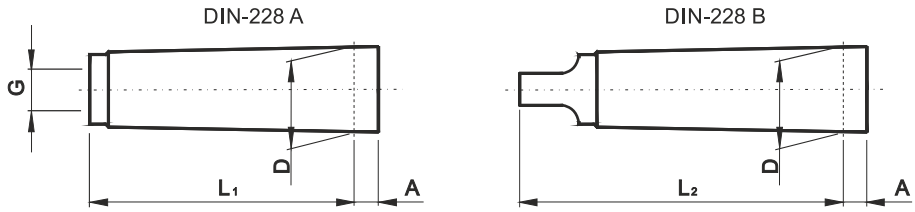


Tapper	D_1	D_2	L	A	K	G
ISO30	31,75	50,00	47,80	3,2	15,9	M12
ISO40	44,45	63,55	68,40	3,2	15,9	M16
ISO50	69,85	97,50	101,75	3,2	15,9	M24

Versions:
- DIN-69871 A - shank without internal cooling
- DIN-69871 AD - with a central hole
- DIN-69871 AD+B - with a central hole and the holes in the flange

Features:
- Toolholders for machines with automatic tool changing
- For toolholder mounting in the machine are used pull studs
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Surface of taper precision grinded in AT3 class.
- Tool sockets made of 0,007 mm maximum runouts.
- Body balanced in G6,3/8000rpm class in standard version

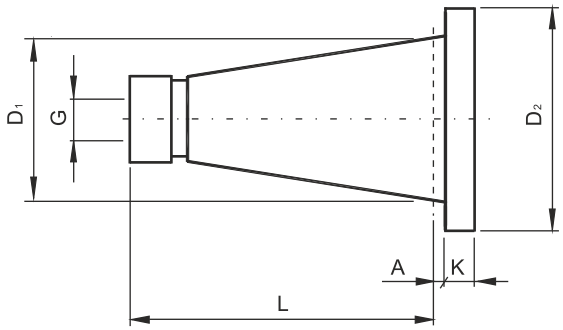
MORSE'A wg DIN-228



Taper	D	A	L_1	L_2	G
MK1	12,065	3,5	53,5	62,0	M6
MK2	17,780	5,0	64,0	75,0	M10
MK3	23,825	5,0	81,0	94,0	M12
MK4	31,267	6,5	102,5	117,5	M16
MK5	44,399	6,5	129,5	149,5	M20

Features:
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Connecting surfaces precision grinded in AT3 class.

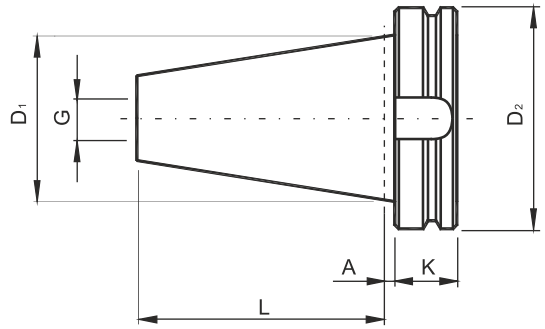
DIN wg DIN-2080



Taper	D_1	D_2	L	A	K	G
DIN30	31,75	50,0	68,4	1,6	8	M12
DIN40	44,45	63,0	93,4	1,6	10	M16
DIN50	69,85	97,5	126,8	3,2	12	M24

Features:
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Surface of taper precision grinded in AT3 class.
- Tool sockets made of 0,007 mm maximum runouts.

MAS BT wg JIS B6339

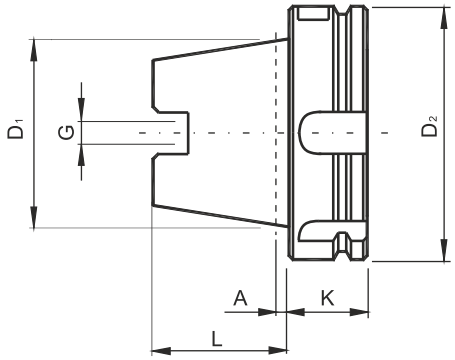


Taper	D_1	D_2	L	A	K	G
BT30	31,75	46	48,4	2	22	M12
BT40	44,45	63	65,4	2	27	M16
BT50	69,85	100	101,8	3	38	M24

Versions:
- shank without internal cooling
- with a central hole
- with a central hole and the holes in the flange

Features:
- Toolholders for machines with automatic tool changing
- For toolholder mounting in the machine are used pull studs
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Surface of taper precision grinded in AT3 class.
- Tool sockets made of 0,007 mm maximum runouts.
- Maximum running speed 10 000 rpm in standard version

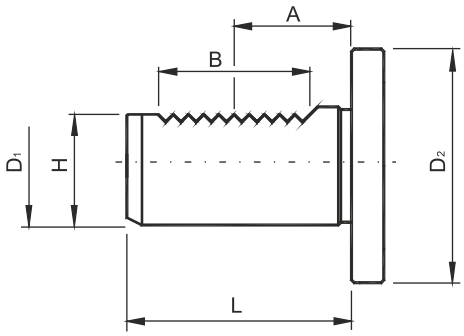
HSK wg DIN-69893 A



Taper	D_1	D_2	L	A	K	G
HSK40	30	40	20	4,0	20	M12x1
HSK50	38	50	25	5,0	26	M16x1
HSK63	48	63	32	6,3	26	M18x1
HSK80	60	80	40	8,0	26	M20x1,5
HSK100	75	100	50	10,0	29	M24x1,5

Features:
- Toolholders for machines with automatic tool changing
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Surface of taper precision grinded in AT3 class.
- Tool sockets made of 0,007 mm maximum runouts.
- Body balanced in G6,3/8000rpm class in standard version
- Shank design provides axial positioning accuracy, high rigidity, high torque transfer at high speeds

VDI wg DIN-69880

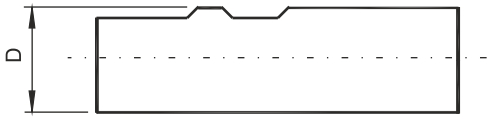


Shank	D_1	D_2	H	L	A	B
VDI20	20	50	18	40	21,7	24
VDI25	25	58	23,5	48	21,7	24
VDI30	30	68	27	55	29,7	40
VDI40	40	83	36	63	29,7	40
VDI50	50	98	45	78	35,7	48

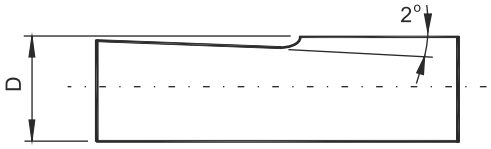
Features:
- Toolholders are made of chrome-manganese steel, carburized and hardened to 58HRC
- Cylindrical surface of shank is grinded in h6 tolerance

CYLINDRICAL wg DIN-1835

DIN-1835 B



DIN-1835 E



Weldon Shank	D
W20	20
W25	25
W32	32
W40	40
W50	50

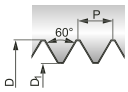
Versions:
- DIN-1835 A - straight cylindrical shank
- DIN-1835 B - WELDON: cylindrical shank with flats parallel to the axis of the cylinder
- DIN-1835 E - WHISTLE-NOTCH: cylindrical shank with 2 degrees of flattening

Features:
- Toolholders made of nickel-chromium-molybdenum steel, carburized and hardened to 58HRC.
- Cylindrical surface of shank is grinded in h6 tolerance

10. INFORMATION TABLE

10.1. Recommended Hole Diameters for Taps

ISO Metric Threads



M ISO Metric coarse thread DIN 13

Nom. size D mm	P mm	D_1 (6H) min. mm	max. mm	mm
M 1	0,25	0,729	0,785	0,75
1,1	0,25	0,829	0,885	0,85
1,2	0,25	0,929	0,985	0,95
1,4	0,3	1,075	1,142	1,1
1,6	0,35	1,221	1,321	1,25
1,7	0,35	1,321	1,421	1,35
1,8	0,35	1,421	1,521	1,45
2	0,4	1,567	1,679	1,6
2,2	0,45	1,713	1,838	1,75
2,3	0,4	1,867	1,979	1,9
2,5	0,45	2,013	2,138	2,05
2,6	0,45	2,113	2,238	2,15
3	0,5	2,459	2,599	2,5
3,5	0,6	2,850	3,010	2,9
4	0,7	3,242	3,422	3,3
4,5	0,75	3,688	3,878	3,7
5	0,8	4,134	4,334	4,2
5,5	0,9	4,526	4,750	4,6
6	1	4,917	5,153	5
7	1	5,917	6,153	6
8	1,25	6,647	6,912	6,8
9	1,25	7,647	7,912	7,8
10	1,5	8,376	8,676	8,5
11	1,5	9,376	9,676	9,5
12	1,75	10,106	10,441	10,2
14	2	11,835	12,210	12
16	2	13,835	14,210	14
18	2,5	15,294	15,744	15,5
20	2,5	17,294	17,744	17,5
22	2,5	19,294	19,744	19,5
24	3	20,752	21,252	21
27	3	23,752	24,252	24
30	3,5	26,211	26,771	26,5
33	3,5	29,211	29,771	29,5
36	4	31,670	32,270	32
39	4	34,670	35,270	35
42	4,5	37,129	37,799	37,5
45	4,5	40,129	40,799	40,5
48	5	42,587	43,297	43
52	5	46,587	47,297	47
56	5,5	50,046	50,796	50,5
60	5,5	54,046	54,796	54,5
64	6	57,505	58,305	58
68	6	61,505	62,305	62

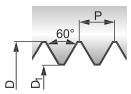
MF ISO Metric fine thread DIN 13

Nom. size D mm	x	P mm	D_1 (6H) min. mm	max. mm	mm
M 2,5	x	0,35	2,121	2,221	2,15
2,6	x	0,35	2,221	2,321	2,25
3	x	0,35	2,621	2,721	2,65
3,5	x	0,35	3,121	3,221	3,15
4	x	0,35	3,621	3,721	3,65
4	x	0,5	3,459	3,599	3,5
5	x	0,5	4,459	4,599	4,5
6	x	0,5	5,459	5,599	5,5
6	x	0,75	5,188	5,378	5,2
7	x	0,75	6,188	6,378	6,2
8	x	0,75	7,188	7,378	7,2
8	x	1	6,917	7,153	7
9	x	0,75	8,188	8,378	8,2
9	x	1	7,917	8,153	8
10	x	0,75	9,188	9,378	9,2
10	x	1	8,917	9,153	9
10	x	1,25	8,647	8,912	8,8
11	x	1	9,917	10,153	10
12	x	1	10,917	11,153	11
12	x	1,25	10,647	10,912	10,8
12	x	1,5	10,376	10,676	10,5
14	x	1	12,917	13,153	13
14	x	1,25	12,647	12,912	12,8
14	x	1,5	12,376	12,676	12,5
15	x	1	13,917	14,153	14
16	x	1	14,917	15,153	15
16	x	1,5	14,376	14,676	14,5
18	x	1	16,917	17,153	17
18	x	1,5	16,376	16,676	16,5
18	x	2	15,835	16,210	16
20	x	1	18,917	19,153	19
20	x	1,5	18,376	18,676	18,5
20	x	2	17,835	18,210	18
22	x	1	20,917	21,153	21
22	x	1,5	20,376	20,676	20,5
22	x	2	19,835	20,210	20
24	x	1	22,917	23,153	23
24	x	1,5	22,376	22,676	22,5
24	x	2	21,835	22,210	22
25	x	1,5	23,376	23,676	23,5
26	x	1,5	24,376	24,676	24,5
27	x	1,5	25,376	25,676	25,5
27	x	2	24,835	25,210	25
28	x	1,5	26,376	26,676	26,5
28	x	2	25,835	26,210	26
30	x	1,5	28,376	28,676	28,5
30	x	2	27,835	28,210	28
32	x	1,5	30,376	30,676	30,5
32	x	2	29,835	30,210	30
33	x	1,5	31,376	31,676	31,5
33	x	2	30,835	31,210	31
34	x	1,5	32,376	32,676	32,5

Nom. size D mm	x	P mm	D_1 (6H) min. mm	max. mm	mm
M 35	x	1,5	33,376	33,676	33,5
36	x	1,5	34,376	34,676	34,5
36	x	2	33,835	34,210	34
36	x	3	32,752	33,252	33
38	x	1,5	36,376	36,676	36,5
39	x	1,5	37,376	37,676	37,5
39	x	2	36,835	37,210	37
39	x	3	35,752	36,252	36
40	x	1,5	38,376	38,676	38,5
40	x	2	37,835	38,210	38
42	x	1,5	40,376	40,676	40,5
42	x	2	39,835	40,210	40
42	x	3	38,752	39,252	39
45	x	1,5	43,376	43,676	43,5
45	x	2	42,835	43,210	43
45	x	3	41,752	42,252	42
48	x	1,5	46,376	46,676	46,5
48	x	2	45,835	46,210	46
48	x	3	44,752	45,252	45
50	x	1,5	48,376	48,676	48,5
50	x	2	47,835	48,210	48
52	x	1,5	50,376	50,676	50,5
52	x	2	49,835	50,210	50
52	x	3	48,752	49,252	49
56	x	3	52,752	53,252	53
56	x	4	51,670	52,270	52
60	x	4	55,670	56,270	56
64	x	3	60,752	61,252	61
64	x	4	59,670	60,270	60
68	x	4	63,670	64,270	64
70	x	3	66,752	67,252	67
70	x	4	65,670	66,270	66
72	x	3	68,752	69,252	69
72	x	4	67,670	68,270	68
72	x	6	65,505	66,305	66
76	x	3	72,752	73,252	73
76	x	4	71,670	72,270	72
76	x	6	69,505	70,305	70
80	x	4	75,670	76,270	76
80	x	6	73,505	74,305	74
85	x	3	81,752	82,252	82
85	x	4	80,670	81,270	81
90	x	3	86,752	87,252	87
90	x	4	85,670	86,270	86
90	x	6	83,505	84,305	84
95	x	6	88,505	89,305	89
100	x	4	95,670	96,270	96
100	x	6	93,505	94,305	94
110	x	6	103,505	104,305	104
115	x	3	111,752	112,252	112
120	x	4	115,670	116,270	116
120	x	6	113,505	114,305	114

10.1. Thread Hole Preparatory Diameters

Unified Threads



UNC Unified coarse thread ANSI/ASME B1.1

Nom. size D inch - Gg/1" (tpi)	D_1 (2B) min. mm	D_1 (2B) max. mm	mm
Nr. 1 - 64	1,425	1,582	1,55
Nr. 2 - 56	1,694	1,872	1,85
Nr. 3 - 48	1,941	2,146	2,1
Nr. 4 - 40	2,156	2,385	2,35
Nr. 5 - 40	2,487	2,697	2,65
Nr. 6 - 32	2,647	2,896	2,85
Nr. 8 - 32	3,307	3,528	3,5
Nr. 10 - 24	3,680	3,949	3,9
Nr. 12 - 24	4,341	4,590	4,5
1/4 - 20	4,976	5,268	5,1
5/16 - 18	6,411	6,734	6,6
3/8 - 16	7,805	8,164	8
7/16 - 14	9,149	9,550	9,4
1/2 - 13	10,584	11,016	10,8
9/16 - 12	11,996	12,456	12,2
5/8 - 11	13,376	13,868	13,5
3/4 - 10	16,299	16,833	16,5
7/8 - 9	19,169	19,748	19,5
1" - 8	21,963	22,598	22,25
1 1/8 - 7	24,648	25,349	25
1 1/4 - 7	27,823	28,524	28
1 3/8 - 6	30,343	31,120	30,75
1 1/2 - 6	33,518	34,295	34
1 3/4 - 5	38,951	39,814	39,5
2" - 4 1/2	44,689	45,598	45

UNF Unified coarse thread ANSI/ASME B1.1

Nom. size D inch - Gg/1" (tpi)	D_1 (2B) min. mm	D_1 (2B) max. mm	mm
Nr. 2 - 64	1,755	1,913	1,85
Nr. 3 - 56	2,024	2,197	2,15
Nr. 4 - 48	2,271	2,459	2,4
Nr. 5 - 44	2,550	2,741	2,7
Nr. 6 - 40	2,817	3,012	2,95
Nr. 8 - 36	3,401	3,597	3,5
Nr. 10 - 32	3,967	4,168	4,1
Nr. 12 - 28	4,503	4,716	4,6
1/4 - 28	5,367	5,580	5,5
5/16 - 24	6,792	7,038	6,9
3/8 - 24	8,379	8,626	8,5
7/16 - 20	9,738	10,030	9,9
1/2 - 20	11,326	11,618	11,5
9/16 - 18	12,761	13,084	12,9
5/8 - 18	14,348	14,671	14,5
3/4 - 16	17,330	17,689	17,5
7/8 - 14	20,262	20,663	20,4
1" - 12	23,109	23,569	23,25
1 1/8 - 12	26,284	26,744	26,5
1 1/4 - 12	29,459	29,919	29,5
1 3/8 - 12	32,634	33,094	32,75
1 1/2 - 12	35,809	36,269	36

UN-8

Nom. size D inch - Gg/1" (tpi)	D_1 (2B) min. mm	D_1 (2B) max. mm	mm
1 1/8 - 8	25,138	25,773	25,4
1 1/4 - 8	28,313	28,948	28,6
1 1/2 - 8	34,663	35,298	35
1 3/4 - 8	41,013	41,648	41,3
2" - 8	47,363	47,998	47,7

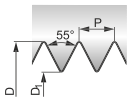
UNEF

Nom. size D inch - Gg/1" (tpi)	D_1 (2B) min. mm	D_1 (2B) max. mm	mm
1/4 - 32	5,491	5,679	5,55
5/16 - 32	7,079	7,267	7,15
3/8 - 32	8,666	8,854	8,7
7/16 - 28	10,130	10,343	10,2
1/2 - 28	11,717	11,930	11,8
9/16 - 24	13,142	13,388	13,2
5/8 - 24	14,729	14,975	14,8
3/4 - 20	17,676	17,968	17,8
7/8 - 20	20,851	21,143	20,95
1" - 20	24,026	24,318	24,15

Cylindrical PipeThreads

G

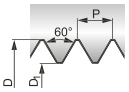
Whitworth pipe thread DIN EN ISO 228



Nom. size D - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
G 1/16 - 28	6,561	6,843	6,8
1/8 - 28	8,566	8,848	8,8
1/4 - 19	11,445	11,890	11,8
3/8 - 19	14,950	15,395	15,25
1/2 - 14	18,631	19,172	19
5/8 - 14	20,587	21,128	21
3/4 - 14	24,117	24,658	24,5
7/8 - 14	27,877	28,418	28,25
1" - 11	30,291	30,931	30,75
1 1/8 - 11	34,939	35,579	35,5
1 1/4 - 11	38,952	39,592	39,5
1 3/8 - 11	41,365	42,005	41,75
1 1/2 - 11	44,845	45,485	45,25
1 5/8 - 11	49,030	49,670	49,5
1 3/4 - 11	50,788	51,428	51
2" - 11	56,656	57,296	57
2 1/4 - 11	62,752	63,392	63,3
2 1/2 - 11	72,226	72,866	72,8
2 3/4 - 11	78,576	79,216	79,1
3" - 11	84,926	85,566	85,5

NPSM

American Standard straight pipe thread
ANSI/ASME B1.20.1
for mechanical joints (previously NPS)



Nom. size D inch - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
1/8 - 27	9,093	9,246	9,1
1/4 - 18	11,887	12,217	12
3/8 - 18	15,316	15,545	15,5
1/2 - 14	18,974	19,279	19
3/4 - 14	24,333	24,638	24,5
1" - 11 1/2	30,505	30,759	30,5

NPSF

American Standard straight pipe thread
ANSI B1.20.3
dryseal internal straight pipe thread for fuel, combined with external tapered pipe thread NPTF or PTF-SAE-SHORT; Gauge with tapered gauges

Nom. size D inch - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
1/16 - 27	6,304	6,393	6,35
1/8 - 27	8,651	8,740	8,7
1/4 - 18	11,232	11,364	11,3
3/8 - 18	14,671	14,803	14,75
1/2 - 14	18,118	18,288	18,2
3/4 - 14	23,465	23,635	23,5
1" - 11 1/2	29,464	29,670	29,5

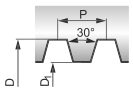
Rp (BSPP)

Cylindrical Whitworth pipe thread DIN EN 10226-1 and ISO 7-1
where pressure-tight joints are made on the threads

Nom. size D - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
Rp 1/16 - 28	6,490	6,632	6,55
1/8 - 28	8,495	8,637	8,6
1/4 - 19	11,341	11,549	11,5
3/8 - 19	14,846	15,054	15
1/2 - 14	18,489	18,773	18,5
3/4 - 14	23,975	24,259	24
1" - 11	30,111	30,471	30,25

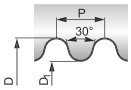
Trapezoidal and Round Threads

Tr ISO Metric trapezoidal coarse thread DIN 103



Nom. size D mm x P mm	D_1 (7H) min. mm	D_1 (7H) max. mm	mm
Tr 8 x 1,5	6,5	6,69	6,6
9 x 2	7	7,236	7,2
10 x 2	8	8,236	8,2
10 x 3	7	7,315	7,25
11 x 3	8	8,315	8,25
12 x 3	9	9,315	9,25
14 x 3	11	11,315	11,25
14 x 4	10	10,375	10,25
16 x 4	12	12,375	12,25
18 x 4	14	14,375	14,25
20 x 4	16	16,375	16,25
22 x 5	17	17,45	17,25
24 x 5	19	19,45	19,25
26 x 5	21	21,45	21,25
28 x 5	23	23,45	23,25
30 x 6	24	24,5	24,25
32 x 6	26	26,5	26,25
34 x 6	28	28,5	28,25
36 x 6	30	30,5	30,25
38 x 7	31	31,56	31,5
40 x 7	33	33,56	33,5
42 x 7	35	35,56	35,5
44 x 7	37	37,56	37,5
46 x 8	38	38,63	38,5
48 x 8	40	40,63	40,5
50 x 8	42	42,63	42,5
52 x 8	44	44,63	44,5

Rd Round thread DIN 405



Nom. size D mm x P/1" (tpi)	D_1 (7H) min. mm	D_1 (7H) max. mm	mm
Rd 8 x 10	5,714	6,164	6
9 x 10	6,714	7,164	7
10 x 10	7,714	8,164	8
11 x 10	8,714	9,164	9
12 x 10	9,714	10,164	10
14 x 8	11,142	11,672	11,5
16 x 8	13,142	13,672	13,5
18 x 8	15,142	15,672	15,5
20 x 8	17,142	17,672	17,5
22 x 8	19,142	19,672	19,5
24 x 8	21,142	21,672	21,5
26 x 8	23,142	23,672	23,5
28 x 8	25,142	25,672	25,5
30 x 8	27,142	27,672	27,5

BSF

Nom. size D - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
BSF 3/16 - 32	3,747	4,006	4
1/4 - 26	5,100	5,398	5,3
5/16 - 22	6,459	6,817	6,8
3/8 - 20	7,899	8,331	8,3
7/16 - 18	9,304	9,764	9,7
1/2 - 16	10,668	11,163	11,1
5/8 - 14	13,553	14,094	14
3/4 - 12	16,337	16,939	16,75
7/8 - 11	19,268	19,909	19,75
1" - 10	22,149	22,835	22,75

BSW

Nom. size D - P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
BSW 1/16 - 60	1,045	1,230	1,15
3/32 - 48	1,704	1,912	1,85
1/8 - 40	2,362	2,591	2,55
5/32 - 32	2,952	3,214	3,2
3/16 - 24	3,406	3,744	3,7
7/32 - 24	4,201	4,539	4,5
1/4 - 20	4,724	5,156	5,1
5/16 - 18	6,129	6,589	6,5
3/8 - 16	7,493	7,988	7,9
7/16 - 14	8,791	9,332	9,25
1/2 - 12	9,987	10,589	10,5
9/16 - 12	11,575	12,177	12
5/8 - 11	12,918	13,559	13,5
3/4 - 10	15,799	16,485	16,4
7/8 - 9	18,613	19,355	19,25
1" - 8	21,336	22,149	22
1 1/8 - 7	23,927	24,831	24,75
1 1/4 - 7	27,102	28,006	27,75
1 3/8 - 6	29,504	30,528	30,5
1 1/2 - 6	32,680	33,703	33,5
1 5/8 - 5	34,769	35,963	35,5
1 3/4 - 5	37,943	39,136	39
1 7/8 - 4 1/	40,396	41,702	41,5
2" - 4 1/	43,571	44,877	44,5

Tapered Pipe Threads

Rc (BSPT)

Tapered Whitworth pipe thread DIN EN 10226-2 and ISO 7-1where pressure-tight joints are made on the threads, taper 1:16

Nom. size D inch - P/1" (tpi)	D_1 mm	t_1 mm	t_4 mm
Rc 1/16 - 28	6,15	11,1	9,5
1/8 - 28	8,15	11,1	9,5
1/4 - 19	10,85	16,3	14
3/8 - 19	14,3	16,7	14,4
1/2 - 14	17,8	22,3	19,1
3/4 - 14	23,2	23,6	20,4
1" - 11	29,2	28,3	24,3

Nom. size D inch - P/1" (tpi)	D_2 mm	D_3 (JS11) mm	t_1 mm	t_4 mm
Rc 1/16 - 28	6,1	6,56	11,1	9,5
1/8 - 28	8,1	8,57	11,1	9,5
1/4 - 19	10,75	11,45	16,3	14
3/8 - 19	14,25	14,95	16,7	14,4
1/2 - 14	17,7	18,63	22,3	19,1
3/4 - 14	23,1	24,12	23,6	20,4
1" - 11	29,1	30,29	28,3	24,3

Nom. size D inch - P/1" (tpi)	D_3 (JS11) mm	b	t min. mm	D_4 min. mm
Rc 1/16 - 28	6,56	5,6	9,9	$7,6^{+0,3}$
1/8 - 28	8,57	5,6	9,9	$9,6^{+0,3}$
1/4 - 19	11,45	8,4	14,6	$13^{+0,5}$
3/8 - 19	14,95	8,8	15	$16,5^{+0,5}$
1/2 - 14	18,63	11,4	20	$20,6^{+0,5}$
3/4 - 14	24,12	12,7	21,3	$26^{+0,5}$
1" - 11	30,29	14,5	25,4	$32,8^{+0,5}$

NPT

American tapered pipe thread ANSI/ASME B1.20.1 for threads with dryseal material taper 1:16

Nom. size D inch - P/1" (tpi)	D_1 mm	t_1 mm	t_4 mm
1/16 - 27	6,15	11,8	9,7
1/8 - 27	8,5	11,9	9,75
1/4 - 18	11	17,4	14,25
3/8 - 18	14,4	17,7	14,55
1/2 - 14	17,8	23,1	19
3/4 - 14	23,15	23,6	19,5
1" - 11 1/2	29,05	28,4	23,4
1 1/4 - 11 1/2	37,8	28,9	23,9
1 1/2 - 11 1/2	43,85	28,9	23,9
2" - 11 1/2	55,85	29,3	24,35

Nom. size D inch - P/1" (tpi)	D_2 mm	D_3 +0,05 mm	t_1 mm	t_4 mm
1/16 - 27	5,95	6,39	11,8	9,7
1/8 - 27	8,3	8,74	11,9	9,75
1/4 - 18	10,75	11,36	17,4	14,25
3/8 - 18	14,15	14,8	17,7	14,55
1/2 - 14	17,45	18,32	23,1	19
3/4 - 14	22,8	23,67	23,6	19,5
1" - 11 1/2	28,65	29,69	28,4	23,4
1 1/4 - 11 1/2	37,35	38,45	28,9	23,9
1 1/2 - 11 1/2	43,45	44,52	28,9	23,9
2" - 11 1/2	55,45	56,56	29,3	24,35

Nom. size D inch - P/1" (tpi)	D_3 +0,05 mm	b	t min. mm	D_4 min. mm
1/16 - 27	6,39	7	10	7,6
1/8 - 27	8,74	7	10	10
1/4 - 18	11,36	10,2	14,5	13,1
3/8 - 18	14,8	10,6	15	16,5
1/2 - 14	18,32	13,8	19	20,5
3/4 - 14	23,67	14,2	20	25,8
1" - 11 1/2	29,69	17	24	32,2
1 1/4 - 11 1/2	38,45	17,5	24,5	41
1 1/2 - 11 1/2	44,52	17,5	24,5	47,2
2" - 11 1/2	56,56	18	25	59,2

NPTF

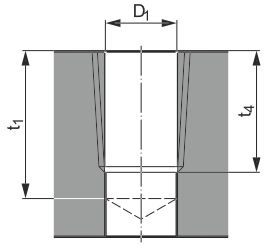
American tapered pipe thread ANSI B1.20.3 for threads without dryseal material taper 1:16

Nom. size D inch - P/1" (tpi)	D_1 mm	t_1 mm	t_4 mm
1/16 - 27	6,1	13	10,65
1/8 - 27	8,45	13	10,7
1/4 - 18	10,9	19,2	15,65
3/8 - 18	14,3	19,5	16
1/2 - 14	17,6	25,4	20,85
3/4 - 14	23	25,9	21,3
1" - 11 1/2	28,75	31,1	25,6
1 1/4 - 11 1/2	37,5	31,7	26,15
1 1/2 - 11 1/2	43,75	31,7	26,15
2" - 11 1/2	55,75	32,1	26,55

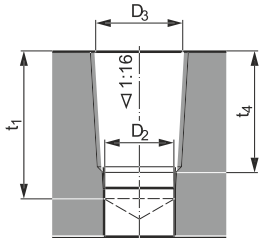
Nom. size D inch - P/1" (tpi)	D_2 mm	D_3 +0,05 mm	t_1 mm	t_4 mm
1/16 - 27	5,95	6,41	13	10,65
1/8 - 27	8,3	8,76	13	10,7
1/4 - 18	10,75	11,4	19,2	15,65
3/8 - 18	14,15	14,84	19,5	16
1/2 - 14	17,45	18,33	25,4	20,85
3/4 - 14	22,8	23,68	25,9	21,3
1" - 11 1/2	28,65	29,72	31,1	25,6
1 1/4 - 11 1/2	37,35	38,48	31,7	26,15
1 1/2 - 11 1/2	43,45	44,55	31,7	26,15
2" - 11 1/2	55,45	56,59	32,1	26,55

Nom. size D inch - P/1" (tpi)	D_3 +0,05 mm	b	t min. mm	D_4 min. mm
1/16 - 27	6,41	8	11	7,4
1/8 - 27	8,76	8	11	9,8
1/4 - 18	11,4	11,6	15,5	12,9
3/8 - 18	14,84	12	16	16,3
1/2 - 14	18,33	15,6	20,5	20,3
3/4 - 14	23,68	16	21,5	25,6
1" - 11 1/2	29,72	19,2	26	32
1 1/4 - 11 1/2	38,48	19,7	26,5	40,8
1 1/2 - 11 1/2	44,55	19,7	26,5	47
2" - 11 1/2	56,59	20,2	27	59

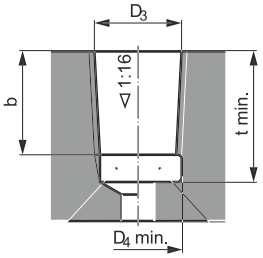
Drill cylindrically without using a reamer



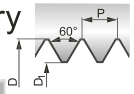
Drill cylindrically and prepare tapered hole with reamer



Recommended preparation of blind holes (minimum length)



Threads for the Aerospace Industry



MJ MJ thread DIN ISO 5855

Nom. size D mm	x P mm	D_1 min. mm	D_1 max. mm	mm
MJ 3	x 0,5	2,513	2,653	2,6
4	x 0,7	3,318	3,498	3,4
5	x 0,8	4,221	4,421	4,3
6	x 1	5,026	5,216	5,1
8	x 1	7,026	7,216	7,1
8	x 1,25	6,782	6,994	6,9
10	x 1,25	8,782	8,994	8,9
10	x 1,5	8,539	8,775	8,6

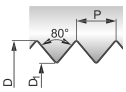
UNJF Unified fine thread ASME B1.15

Nom. size D inch	- P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
Nr. 4	- 48	2,329	2,466	2,4
Nr. 6	- 40	2,888	3,053	3
Nr. 8	- 36	3,480	3,663	3,55
Nr. 10	- 32	4,054	4,255	4,15
1/4	- 28	5,466	5,662	5,55
5/16	- 24	6,906	7,109	7
3/8	- 24	8,494	8,679	8,6

UNJC Unified coarse thread ASME B1.15

Nom. size D inch	- P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
Nr. 4	- 40	2,228	2,393	2,3
Nr. 6	- 32	2,733	2,939	2,85
Nr. 8	- 32	3,393	3,599	3,5
Nr. 10	- 24	3,795	4,064	3,9
1/4	- 20	5,113	5,387	5,25
5/16	- 18	6,563	6,833	6,7
3/8	- 16	7,978	8,255	8,1

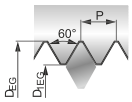
Steel Conduit Threads



Pg Steel conduit thread DIN 40430

Nom. size D mm	P/1" (tpi)	D_1 min. mm	D_1 max. mm	mm
Pg 7	20	11,28	11,43	11,35
9	18	13,86	14,01	13,95
11	18	17,26	17,41	17,35
13,5	18	19,06	19,21	19,15
16	18	21,16	21,31	21,25
21	16	26,78	27,03	26,95
29	16	35,48	35,73	35,6
36	16	45,48	45,73	45,6
42	16	52,48	52,73	52,6
48	16	57,78	58,03	57,9

Helical Coil Threads for Wire Thread Inserts



EG M (STI) ISO Metric coarse thread DIN 8140-2

Nom. size D mm	P mm	D_{EG} min. mm	D_{1EG} min. mm	D_{1EG} max. mm	mm
EG M2,5	0,45	3,084	2,597	2,697	2,65
3	0,5	3,650	3,108	3,220	3,15
4	0,7	4,910	4,152	4,292	4,2
5	0,8	6,040	5,174	5,334	5,25
6	1	7,300	6,217	6,407	6,3
8	1,25	9,624	8,271	8,483	8,4
10	1,5	11,948	10,324	10,560	10,5
12	1,75	14,274	12,379	12,644	12,5
14	2	16,598	14,433	14,733	14,5
16	2	18,598	16,433	16,733	16,5
18	2,5	21,248	18,541	18,896	18,75
20	2,5	23,248	20,541	20,896	20,75

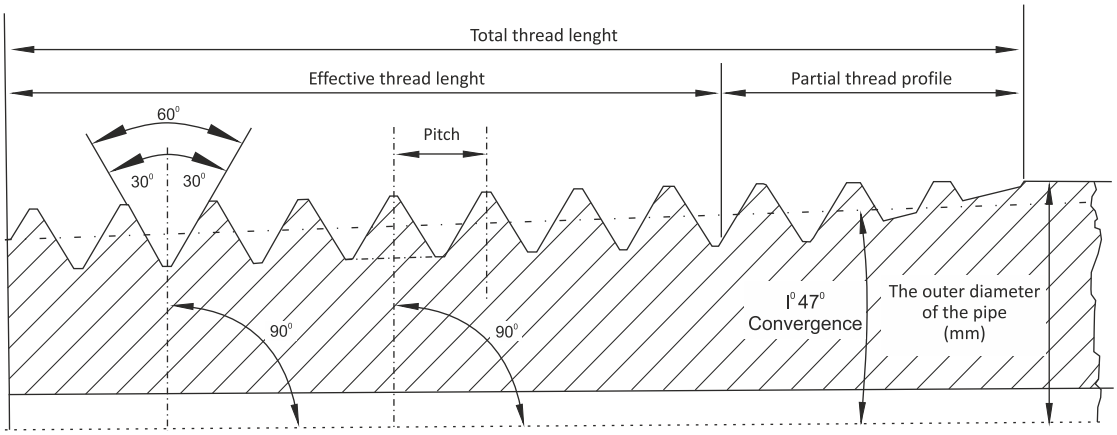
EG UNC (STI) Unified coarse thread ASME B18.29.1

Nom. size D mm	P/1" (tpi)	D_{EG} min. mm	D_{1EG} min. mm	D_{1EG} max. mm	mm
EG Nr. 4	- 40	3,671	2,982	3,178	3,1
Nr. 6	- 32	4,536	3,678	3,879	3,8
Nr. 8	- 32	5,197	4,338	4,523	4,4
Nr. 10	- 24	6,200	5,054	5,283	5,2
1/4	- 20	8,002	6,628	6,872	6,7
5/16	- 18	9,771	8,244	8,490	8,4
3/8	- 16	11,587	9,867	10,126	10
7/16	- 14	13,469	11,506	11,783	11,6
1/2	- 13	15,237	13,121	13,393	13,3
9/16	- 12	17,039	14,747	15,031	14,9
5/8	- 11	18,875	16,376	16,673	16,5
3/4	- 10	22,349	19,598	19,908	19,75

EG UNF (STI) Unified coarse thread ASME B18.29.1

Nom. size D mm	P/1" (tpi)	D_{EG} min. mm	D_{1EG} min. mm	D_{1EG} max. mm	mm
EG Nr. 4	- 48	3,533	2,959	3,119	3
Nr. 6	- 40	4,330	3,642	3,815	3,7
Nr. 8	- 36	5,083	4,318	4,496	4,4
Nr. 10	- 32	5,858	4,999	5,184	5,1
1/4	- 28	7,528	6,545	6,720	6,6
5/16	- 24	9,312	8,166	8,351	8,25
3/8	- 24	10,899	9,753	9,931	9,8
7/16	- 20	12,763	11,389	11,587	11,5
1/2	- 20	14,352	12,978	13,176	13,1
9/16	- 18	16,121	14,594	14,800	14,7
5/8	- 18	17,709	16,182	16,388	16,25
3/4	- 16	21,112	19,392	19,608	19,5

TAPERED TREAD PROFILE EXTERNAL NPT



Thread diameter (inch)	Thread pitch (T.P.I)	Outer diameter of the pipe (mm)	Total thread lenght (mm)
1/16	27	7,950	9,896
1/8	27	10,287	9,967
1/4	18	13,716	15,103
3/8	18	17,145	15,255
1/2	14	21,336	19,850
3/4	14	26,670	20,155
1	11.1/2	33,401	25,006
1.1/4	11.1/2	42,164	25,616
1.1/2	11.1/2	48,260	26,040
2	11.1/2	60,325	26,878
2.1/2	8	73,025	39,908
3	8	88,900	41,496
3.1/2	8	101,600	42,766
4	8	114,300	44,036

10.3. Recommended Hole Diameters for Forming Taps

M

Nom. size D mm	P mm	mm
M 1	0,25	0,9
1,1	0,25	1
1,2	0,25	1,1
1,4	0,3	1,28
1,6	0,35	1,47
1,7	0,35	1,57
1,8	0,35	1,67
2	0,4	1,85
2,2	0,45	2,03
2,3	0,4	2,15
2,5	0,45	2,33
2,6	0,45	2,43
3	0,5	2,8
3,5	0,6	3,25
4	0,7	3,7
4,5	0,75	4,2
5	0,8	4,65
5,5	0,9	5,1
6	1	5,6
7	1	6,6
8	1,25	7,45
9	1,25	8,45
10	1,5	9,35
12	1,75	11,25
14	2	13,1
16	2	15,1
18	2,5	16,85
20	2,5	18,85
22	2,5	20,85
24	3	22,65
27	3	25,65
30	3,5	28,4
33	3,5	31,4
36	4	34,15
39	4	37,15
42	4,5	39,9
45	4,5	42,9
48	5	45,65

MF

Nom. size D mm	x	P mm	mm
M 2,5	x	0,35	2,37
2,6	x	0,35	2,47
3	x	0,35	2,88
3,5	x	0,35	3,38
4	x	0,5	3,8
5	x	0,5	4,8
6	x	0,5	5,8
6	x	0,75	5,7
7	x	0,75	6,7
8	x	0,75	7,7
8	x	1	7,6
9	x	0,75	8,7
9	x	1	8,6
10	x	0,75	9,7
10	x	1	9,6
10	x	1,25	9,45
11	x	1	10,6
12	x	1	11,6
12	x	1,25	11,45
12	x	1,5	11,35
14	x	1	13,6
14	x	1,25	13,45
14	x	1,5	13,35
15	x	1	14,6
15	x	1,5	14,35
16	x	1	15,6
16	x	1,5	15,35
18	x	1	17,6
18	x	1,5	17,35
18	x	2	17,1
20	x	1	19,6
20	x	1,5	19,35
20	x	2	19,1
24	x	2	23,1
30	x	2	29,1
36	x	3	34,65
42	x	4	40,15
48	x	3	46,65

UNC

Nom. size D inch	-	P/1" (tpi)	mm
Nr. 4	-	40	2,55
Nr. 5	-	40	2,9
Nr. 6	-	32	3,15
Nr. 8	-	32	3,8
Nr. 10	-	24	4,35
Nr. 12	-	24	5
1/4	-	20	5,75
5/16	-	18	7,3
3/8	-	16	8,8
7/16	-	14	10,25
1/2	-	13	11,8
9/16	-	12	13,3
5/8	-	11	14,8
3/4	-	10	17,85
7/8	-	9	20,9
1"	-	8	23,9

UNF

Nom. size D inch	-	P/1" (tpi)	mm
Nr. 2	-	64	2,02
Nr. 3	-	56	2,32
Nr. 4	-	48	2,62
Nr. 5	-	44	2,92
Nr. 6	-	40	3,22
Nr. 8	-	36	3,85
Nr. 10	-	32	4,45
Nr. 12	-	28	5,1
1/4	-	28	5,95
5/16	-	24	7,45
3/8	-	24	9,05
7/16	-	20	10,55
1/2	-	20	12,15
9/16	-	18	13,65
5/8	-	18	15,25
3/4	-	16	18,35
7/8	-	14	21,4
1"	-	12	24,45

G

Nom. size D	-	P/1" (tpi)	mm
G 1/16	-	28	7,25
1/8	-	28	9,25
1/4	-	19	12,55
3/8	-	19	16,05
1/2	-	14	20,1
5/8	-	14	22,05
3/4	-	14	25,6
7/8	-	14	29,35
1"	-	11	32,15

10.4. Formulas to calculate technological parameters for drilling and tapping

Relationships of peripherial speed andd rotational speed andd tool diameter

Cutting speed Vc [m/min]

$$v_c = \frac{d_1 \times \pi \times n}{1000}$$

Spindle rotation speed [RPM]

$$n = \frac{1000 \times v_c}{d_1 \times \pi}$$

Feeding speed Vf [mm/min]

- when tapping

$$v_f = p \times n$$

- when drilling

$$v_f = f_o \times n$$

$$f_o = \frac{v_f}{n}$$

Torque when tapping M_d [Nm]

$$M_d = \frac{p^2 \times d_1 \times k_c}{8000}$$

Torque when drilling Mc [Nm]

$$M_c = \frac{F_c \times z \times d_1}{4000}$$

Cutting force per one tooth F_c [N]

$$F_c = \frac{d_1 \times f_o \times k_c}{2}$$

Power P [kW]

$$P = \frac{M_{c,d} \times 2 \times \pi \times n}{60000}$$

Key:

d_1 - nominal diameter of tool [mm]

v_c - cutting speed [m/min]

n - spindle rotation speed [RPM]

p - thread pitch [mm]

P - power [kW]

v_f - feeding speed [m/min]

f_o - feed per revolution [RPM]

k_c - specific resistance of workpiece material [MPa]

M_d - torque when tapping [Nm]

z - cutting edges

10.5. Recommended diameter for thread cuting rods

M

THREAD	ø d
M 1	0,96
M 1,1	1,05
M 1,2	1,15
M 1,4	1,35
M 1,6	1,55
M 1,8	1,75
M 2	1,95
M 2,2	2,15
M 2,5	2,42
M 3	2,92
M 3,5	3,41
M 4	3,90
M 4,5	4,40
M 5	4,90
M 6	5,88
M 7	6,88
M 8	7,86
M 9	8,86
M 10	9,85
M 11	10,85
M 12	11,83
M 14	13,82
M 16	15,82
M 18	17,79
M 20	19,79
M 22	21,79
M 24	23,76
M 27	26,76
M 30	29,73
M 33	32,73
M 36	35,70
M 39	38,70
M 42	41,68
M 45	44,68
M 48	47,66
M 52	51,66
M 56	55,65
M 60	59,65
M 64	63,62
M 68	67,62

MF

THREAD	ø d
M3,5x0,5	3,43
M4x0,5	3,92
M4,5x0,5	4,43
M5x0,5	4,92
M5x0,75	4,91
M5,5x0,5	5,43
M5,5x0,75	5,42
M6x0,5	5,92
M6x0,75	5,90
M7x0,75	6,90
M8x0,5	7,92
M8x0,75	7,90
M8x1	7,88
M9x0,75	8,90
M9x1	8,88
M10x0,75	9,90
M10x1	9,88
M10x1,25	9,86
M11x0,75	10,91
M11x1	10,88
M12x1	11,88
M12x1,25	11,86
M12x1,5	11,85
M14x1	13,88
M14x1,5	13,85
M15x1	14,88
M15x1,5	14,85
M16x1	15,88

MF cd.

GWINT	ø d
M16x1,5	15,85
M17x1	16,88
M17x1,5	16,85
M18x1	17,88
M18 x1,5	17,85
M18x2	17,82
M20x1	19,88
M20x1,5	19,85
M20x2	19,82
M22x1	21,88
M22x1,5	21,85
M22x2	21,82
M24x1	23,88
M24x1,5	23,85
M24x2	23,82
M25x1	24,88
M25x1,5	24,85
M25x2	24,82
M26x1,5	25,85
M27x1	26,88
M27x1,5	26,85
M27x2	26,82
M28x1	27,88
M28x1,5	27,85
M28x2	27,82
M30x1	29,88
M30x1,5	29,85
M30x2	29,82
M30x3	29,76
M32x1,5	31,85
M32x2	31,82
M33x1,5	32,85
M33x2	32,82
M33x3	32,76
M35x1,5	34,85
M36x1,5	35,85
M36x2	35,82
M36x3	35,76
M38x1,5	37,85
M39x1,5	38,85
M39x2	38,82
M39x3	38,76
M40x1,5	39,85
M40x2	39,82
M40x3	39,76
M42x1,5	41,85
M42x2	41,82
M42x3	41,76
M45x1,5	44,85
M45x2	44,82
M45x3	44,76
M48x1,5	47,85
M48x2	47,82
M48x3	47,76
M48x4	47,73
M50x1,5	49,85
M50x2	49,82
M50x3	49,76
M52x1,5	51,85
M52x2	51,82
M52x3	51,76
M52x4	51,73
M55x1,5	54,85
M55x2	54,82
M55x3	54,76
M55x4	54,73
M56x1,5	55,85
M56x2	55,82
M56x3	55,76
M56x4	55,73

G

THREAD	ø d
G - 1/8"	9,62
G - 1/4"	13,03
G - 3/8"	16,54
G - 1/2"	20,81
G - 5/8"	22,77
G - 3/4"	26,30
G - 7/8"	30,06
G - 1"	33,07
G - 1.1/8"	37,72
G - 1.1/4"	41,73
G - 1.3/8"	44,14
G - 1.1/2"	47,62
G - 1.3/4"	53,57
G - 2"	59,43
G - 2.1/4"	65,49

BSW

THREAD	ø d
1/8 - 40	3,09
3/16 - 24	4,66
1/4 - 20	6,24
5/16 - 18	7,82
3/8 - 16	9,40
7/16 - 14	10,98
1/2 - 12	12,56
9/16 - 12	14,14
5/8 - 11	15,72
3/4 - 10	18,89
7/8 - 9	22,10
1 - 8	25,27

NPT

GWINT	ø d
1/8"	9,99
1/4"	13,26
3/8"	16,67
1/2"	20,71
3/4"	26,03
1"	32,59

UNC

THREAD	ø d
No 5 - 40	3,09
No 6 - 32	3,41
No 8 - 32	4,07
No 10 - 24	4,71
No 12 - 24	5,37
1/4 - 20	6,22
5/16 - 18	7,80
3/8 - 16	9,37
7/16 - 14	10,95
1/2 - 13	12,52
9/16 - 12	14,10
5/8 - 11	15,68
3/4 - 10	18,84
7/8 - 9	22,00
1 - 8	25,16
1.1/8 - 7	28,31
1.1/4 - 7	31,49
1.3/8 - 6	34,63
1.1/2 - 6	37,80
1.3/4 - 5	44,12
2 - 4.1/2	50,45

UNF

THREAD	ø d
No 5 - 44	3,10
No 6 - 40	3,42
No 8 - 36	4,08
No 10 - 32	4,73
No 12 - 28	5,38
1/4 - 28	6,24
5/16 - 24	7,82
3/8 - 24	9,41
7/16 - 20	10,98
1/2 - 20	12,56
9/16 - 18	14,14
5/8 - 18	15,73
3/4 - 16	18,89
7/8 - 14	22,05
1 - 12	25,21
1.1/8 - 12	28,38
1.1/4 - 12	31,55
1.3/8 - 12	34,73
1.1/2 - 12	37,90

R

THREAD	ø d
R - 1/8"	9,48
R - 1/4"	12,78
R - 3/8"	16,26
R - 1/2"	20,44
R - 3/4"	25,85
R - 1"	32,60

BSF

GWINT	ø d
3/16 - 32	4,76
1/4 - 26	6,25
5/16 - 22	7,83
3/8 - 20	9,41
7/16 - 18	10,99
1/2 - 16	12,57
9/16 -16	14,16
5/8 - 14	15,73
3/4 - 12	18,89
7/8 - 11	22,11
1 - 10	25,28

Pg

THREAD	ø d
Pg 7	12,40
Pg 9	15,10
Pg 11	18,50
Pg 13,5	20,30
Pg 16	22,40
Pg 21	28,15
Pg 29	36,85
Pg 36	46,85
Pg 42	53,85
Pg 48	59,15

10.6. Relationships of peripherial speed andd rotational speed andd tool diameter

Ød$_1$ [mm]	V = π · d$_1$n / 1000 [m/min]														
	2	3	4	5	6	8	10	12	15	18	20	25	30	35	40
3	212	318	424	531	637	849	1061	1273	1592	1910	2122	2653	3183	3714	4244
3,5	182	273	364	455	546	728	909	1091	1364	1637	1819	2274	2728	3183	3638
4	159	239	318	398	477	637	796	955	1194	1432	1592	1989	2387	2785	3183
4,5	141	212	283	354	424	566	707	849	1061	1273	1415	1768	2122	2476	2829
5	127	191	255	318	382	509	637	764	955	1146	1273	1592	1910	2228	2546
6	106	159	212	265	318	424	531	637	796	955	1061	1326	1592	1857	2122
7	91	136	182	227	273	364	455	546	682	819	909	1137	1364	1592	1819
8	80	119	159	199	239	318	398	477	597	716	796	995	1194	1393	1592
9	71	106	141	177	212	283	354	424	531	673	707	884	1061	1238	1415
10	64	95	127	159	191	255	318	382	477	573	637	796	955	1114	1273
11	58	87	116	145	174	231	289	347	434	521	579	723	868	1013	1157
12	53	80	106	133	159	212	265	318	398	477	531	663	796	928	1061
14	45	68	91	114	136	182	227	273	341	409	455	568	682	796	909
16	40	60	80	99	119	159	199	239	298	358	398	497	597	696	796
18	35	53	71	88	106	141	177	212	265	318	354	442	531	619	707
20	32	48	94	80	95	127	159	191	239	286	318	398	477	557	637
22	29	43	58	72	87	116	145	174	217	260	289	362	434	506	579
24	27	40	53	66	80	106	133	159	199	239	265	332	398	464	531
27	24	35	47	59	71	94	118	141	177	212	236	295	354	413	472
30	21	32	42	53	64	85	106	127	159	191	212	265	318	371	424
33	19	29	39	48	58	77	96	116	145	174	193	241	289	338	386
36	18	27	35	44	53	71	88	106	133	159	177	221	265	309	354
39	16	24	33	41	49	65	82	98	122	147	163	204	245	286	326
42	15	23	30	38	45	61	76	91	114	136	152	189	227	265	303
45	14	21	28	35	42	57	71	85	106	127	141	177	212	248	283
48	13	20	27	33	40	53	66	80	99	119	133	166	199	232	265
52	12	18	24	31	37	49	61	73	92	110	122	153	184	214	245

Relationships of resistances Rm, HRC, HB, HV 10

Rm [MPa]	HRC	HB	HV 10	Rm [MPa]	HRC	HB	HV 10	Rm [MPa]	HRC	HB	HV 10
240		71	75	690		204	215	1360	43	402	423
255		76	80	705		209	220	1400	44	413	434
270		81	85	720		214	225	1440	45	424	446
285		86	90	740		219	230	1480	46	435	458
305		90	95	755		223	235	1530	47	449	473
320		95	100	770		228	240	1570	48	460	484
335		100	105	785		233	245	1620	49	472	497
350		105	110	800	22	238	250	1680	50	488	514
370		109	115	820	23	242	255	1730	51	501	527
385		114	120	835	24	247	260	1890	52	517	544
400		119	125	860	25	255	268	1845	53	532	560
415		124	130	870	26	258	272	1910	54	549	578
430		128	135	900	27	266	280	1980	55	567	596
450		133	140	920	28	273	287	2050	56	584	615
465		138	145	940	29	278	293	2140	57	607	639
480		143	150	970	30	287	302		58	622	655
495		147	155	995	31	295	310		59		675
510		152	160	1020	32	301	317		60		698
530		157	165	1050	33	311	327		61		720
545		162	170	1080	34	319	336		62		745
560		166	175	1110	35	328	345		63		773
575		171	180	1140	36	337	355		64		800
595		176	185	1170	37	346	364		65		829
610		181	190	1200	38	354	373		66		864
625		185	195	1230	39	363	382		67		900
640		190	200	1260	40	372	392		68		940
660		195	205	1300	41	383	403				
675		199	210	1330	42	393	413				

10.7. Limit dimensions of pitch diameter - internal thread

ISO metric thread

Nominal size		6H		6G	
M	MF	min	max	min	max
M 2		1,740	1,830	1,759	1,849
M 2,2		1,908	2,003	1,928	2,023
M 2,5		2,208	2,303	2,228	2,323
M 3		2,675	2,775	2,695	2,795
M 3,5		3,110	3,222	3,131	3,243
M 4		3,545	3,663	3,567	3,685
	M 4x0,5	3,675	3,775	3,695	3,795
M 4,5		4,013	4,131	4,035	4,153
M 5		4,480	4,605	4,504	4,629
	M 5x0,5	4,675	4,775	4,695	4,795
M 6		5,350	5,500	5,376	5,526
	M 6x0,75	5,513	5,645	5,535	5,667
M 7		6,350	6,500	6,376	6,526
M 8		7,188	7,348	7,216	7,376
	M 8x0,75	7,513	7,645	7,535	7,667
	M 8x1	7,350	7,500	7,376	7,526
M 9		8,188	8,348	8,216	8,376
M 10		9,026	9,206	9,058	9,238
	M 10x0,75	9,513	9,645	9,535	9,667
	M 10x1	9,350	9,500	9,376	9,526
	M 10x1,25	9,188	9,348	9,216	9,376
M 12		10,863	11,063	10,897	11,097
	M 12x1	11,350	11,510	11,376	11,536
	M 12x1,25	11,188	11,368	11,216	11,396
	M 12x1,5	11,026	11,216	11,058	11,248
M 14		12,701	12,913	12,739	12,951
	M 14x1,5	13,026	13,216	13,058	13,248
M 16		14,701	14,913	14,739	14,951
	M 16x1,5	15,026	15,216	15,058	15,248
M 18		16,376	16,600	16,418	16,642
	M 18x1,5	17,026	17,216	17,058	17,248
M 20		18,376	18,600	18,418	18,642
	M 20x1,5	19,026	19,216	19,058	19,248
	M 20x2	18,701	18,913	18,739	18,951
M 22		20,376	20,600	20,418	20,642
	M 22x1,5	21,026	21,216	21,058	21,248
M 24		22,051	22,316	22,099	22,364
	M 24x1,5	23,026	23,226	23,058	23,258
	M 24x2	22,701	22,925	22,739	22,963
	M 26x1,5	25,026	25,226	25,058	25,258
M 27		25,051	25,316	25,099	25,364
	M 27x1,5	26,026	26,226	26,058	26,258
	M 27x2	25,701	25,925	25,739	25,963
	M 28x1,5	27,026	27,226	27,058	27,258
M 30		27,727	28,007	27,780	28,060
	M 30x1,5	29,026	29,226	29,058	29,258
	M 30x2	28,701	28,925	28,739	28,963
	M 32x1,5	31,026	31,226	31,058	31,258
	M 32x2	30,701	30,925	30,739	30,963
M 33		30,727	31,007	30,780	31,060
	M 33x1,5	32,026	32,226	32,058	32,258
	M 33x2	31,701	31,925	31,739	31,963
M 36		33,402	33,702	33,462	33,762
	M 36x1,5	35,026	35,226	35,058	35,258
	M 36x2	34,701	34,925	34,739	34,963
	M 36x3	34,051	34,316	34,099	34,364
M 39		36,402	36,702	36,462	36,762
	M 39x1,5	38,026	38,226	38,058	38,258
	M 39x2	37,701	37,925	37,739	37,963
	M 39x3	37,051	37,316	37,099	37,364
	M 40x1,5	39,026	39,226	39,058	39,258
M 42		39,077	39,392	39,140	39,455
	M 42x1,5	41,026	41,226	41,058	41,258
	M 42x2	40,701	40,925	40,739	40,963
	M 42x3	40,051	40,316	40,099	40,364
M 45		42,077	42,392	42,140	42,455
	M 45x1,5	44,026	44,226	44,058	44,258
	M 45x2	43,701	43,925	43,739	43,963
	M 45x3	43,051	43,316	43,099	43,364
M 48		44,752	45,087	44,823	45,158
	M 48x1,5	47,026	47,238	47,058	47,270
	M 48x2	46,701	46,937	46,739	46,975
	M 48x3	46,051	46,331	46,099	46,379
M 52		48,752	49,087	48,823	49,158
	M 52x2	50,701	50,937	50,739	50,975
	M 52x3	50,051	50,331	50,099	50,379

American unified thread UNC and UNF

Nominal size		2B / 3B	2B	3B
UNC	UNF	min	max	max
No 5 - 40		2,764	2,847	2,827
	No 5 - 44	2,799	2,880	2,860
No 6 - 32		2,990	3,084	3,058
	No 6 - 40	3,094	3,180	3,157
No 8 - 32		3,650	3,746	3,721
	No 8 - 36	3,708	3,800	3,777
No 10 - 24		4,138	4,247	4,219
	No 10 - 32	4,310	4,409	4,384
No 12 - 24		4,798	4,910	4,882
	No 12 - 28	4,897	5,004	4,976
1/4 - 20		5,524	5,648	5,616
	1/4 - 28	5,761	5,870	5,842
5/16 - 18		7,021	7,155	7,120
	5/16 - 24	7,249	7,371	7,341
3/8 - 16		8,494	8,639	8,603
	3/8 - 24	8,837	8,961	8,931
7/16 - 14		9,934	10,089	10,051
	7/16 - 20	10,287	10,424	10,391
1/2 - 13		11,430	11,595	11,552
	1/2 - 20	11,874	12,017	11,981
9/16 - 12		12,913	13,086	13,043
	9/16 - 18	13,371	13,520	13,482
5/8 - 11		14,376	14,559	14,514
	5/8 - 18	14,958	15,110	15,072
3/4 - 10		17,399	17,595	17,544
	3/4 - 16	18,019	18,184	18,143
7/8 - 9		20,391	20,599	20,546
	7/8 - 14	21,026	21,224	21,181
1 - 8		23,338	23,561	23,505
	1 - 12	24,026	21,224	24,171
1.1/8 - 7		26,218	26,457	26,398
	1.1/8 - 12	27,201	21,224	27,351
1.1/4 - 7		29,393	29,637	29,576
	1.1/4 - 12	30,376	24,219	30,528
1.3/8 - 6		32,174	32,438	32,372
	1.3/8 - 12	33,551	27,399	33,706
1.1/2 - 6		35,349	35,616	35,550
	1.1/2 - 12	36,726	36,937	36,886
1.3/4 - 5		41,151	41,445	41,372
2 - 4.1/2		47,135	47,450	47,371

Whitworth pipe thread G

Nominal size	min	max
G-1/16”	7,142	7,249
G-1/8”	9,147	9,254
G-1/4”	12,301	12,426
G-3/8”	15,806	15,931
G-1/2”	19,793	19,935
G-5/8”	21,749	21,891
G-3/4”	25,279	25,421
G-7/8”	29,039	29,181
G-1”	31,770	31,950
G-1.1/8”	36,418	36,598
G-1.1/4”	40,431	40,611
G-1.3/8”	42,844	43,024
G-1.1/2”	46,324	46,504
G-1.3/4”	52,267	52,447
G-2”	58,135	58,315

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FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: ..... TAP ☐ FORMING TAP ☐

CUSTOMER'S DATA

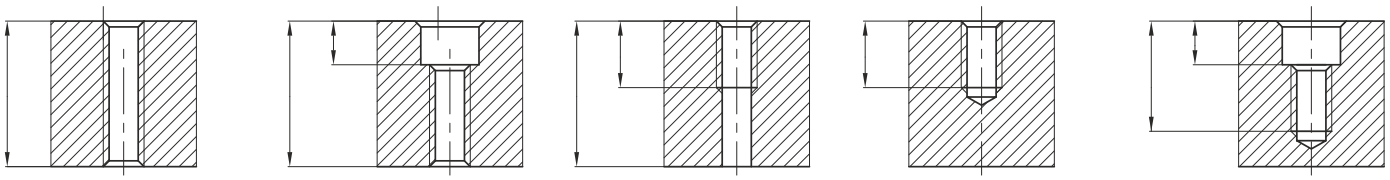
Name and company address: .....

Contact person: .....tel.....

1. Kind of thread

1.1. Size: ..... 1.2. Tolerance: .....

1.3. Character of threaded hole / threaded bar:



☐ ☐ ☐ ☐ ☐

2. Machine and character of threading

2.1. Type of machine: .....

2.2. Method of threading: horizontal ☐ vertical ☐ 2.3. Forced feed: yes ☐ no ☐

2.4. Type of holder / handle: .....

Axial float: yes ☐ no ☐
Radial float: yes ☐ no ☐
Friction clutch: yes ☐ no ☐

2.5. Cutting speed: .....m/min, ...V.p.m.

2.6. Lubrification: hand ☐ automat ☐ Lubricant: .....

3. Working material

3.1.Type of element: .....

3.2. Material (symbol): .....

3.3. Hardness: .....HB .....HRC; Extension strength Rm.....N/mm^2

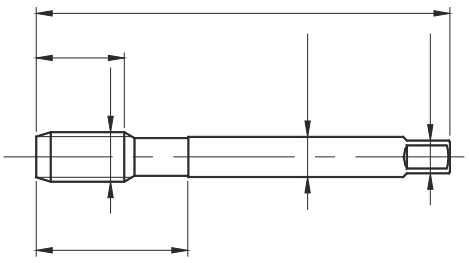
3.4. Type of threaded hole/threaded bar: Drilled☐ Casted☐ Reamed ☐ Other: .....

4. Tool

4.1. Nowadays used tool (type): .....

4.2. Vitality: .....

4.3. Expected sizes of tool:



5. Notes

FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: .....

SCREWING DIES

CUSTOMER'S DATA

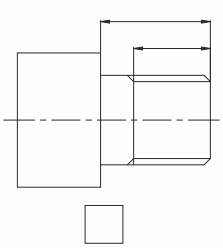
Name and company address: .....

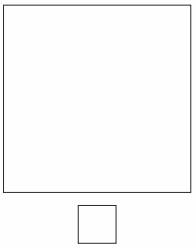
Contact person: .....tel.....

1. Kind of thread

1.1. Size: ..... 1.2. Tolerance: .....

1.3. Character of threaded hole / threaded bar:





2. Machine and character of threading

2.1. Type of machine: .....

2.2. Method of threading: horizontal ☐ vertical ☐ 2.3. Forced feed: yes ☐ no ☐

2.4. Type of holder / handle: .....

Axial float: yes ☐ no ☐
Radial float: yes ☐ no ☐
Friction clutch: yes ☐ no ☐

2.5. Cutting speed: .....m/min, ...V.p.m.

2.6. Lubrification: hand ☐ automat ☐ Lubricant: .....

3. Working material

3.1.Type of element: .....

3.2. Material (symbol): .....

3.3. Hardness: .....HB .....HRC; Extension strength Rm.....N/mm^2

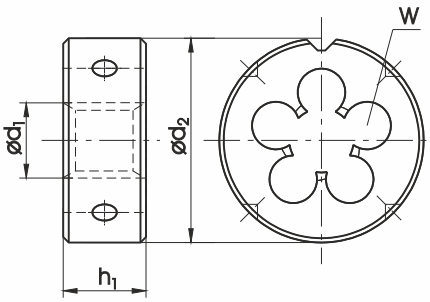
3.4. Type of threaded hole/threaded bar: Drilled☐ Casted☐ Reamed☐ Other: .....

4. Tool

4.1. Nowadays used tool (type): .....

4.2. Vitality: .....

4.3. Expected sizes of tool:



5. Notes

FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: .....

Special drill

CUSTOMER'S DATA

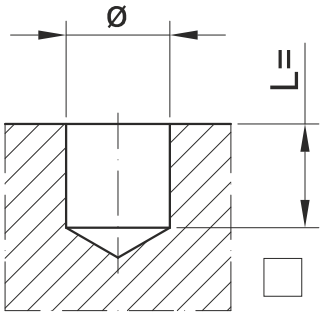
Name and company address: .....

Contact person: .....tel.....

1. Sketch of the machined part:

1.1. Name of detail:..... 1.2. Workpiece material:.....

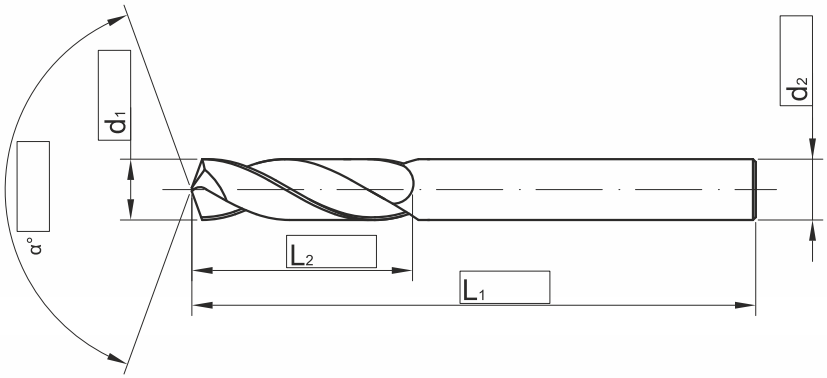
1.3. Hardness:



2. Tool:

2.1. Nr. drawing tool:.....

2.2. Suggest material: 2.3. Suggest material PVD:.....



3. Execution:

3.1. Flutes:	Right spiral	☐	Left spiral	☐	Straight	☐	Spiral angle: .....
3.2. Rotation direction:	Right hand	☐	Left hand	☐			
3.3. Cooling:	External	☐	Internal	☐	Non-cooling	☐	
3.4. Shank:	DIN-6535-HA	☐	DIN-6535-HB	☐	DIN-65350HE	☐	

4. Machine:

4.1.Type of machine: .....

4.2. Type of spindle: .....

4.3. Power[kW]: .....

4.4. Max. rotating speed[RPM]: .....

5. Notes

FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: ..... **Special drill 1 step**

CUSTOMER'S DATA

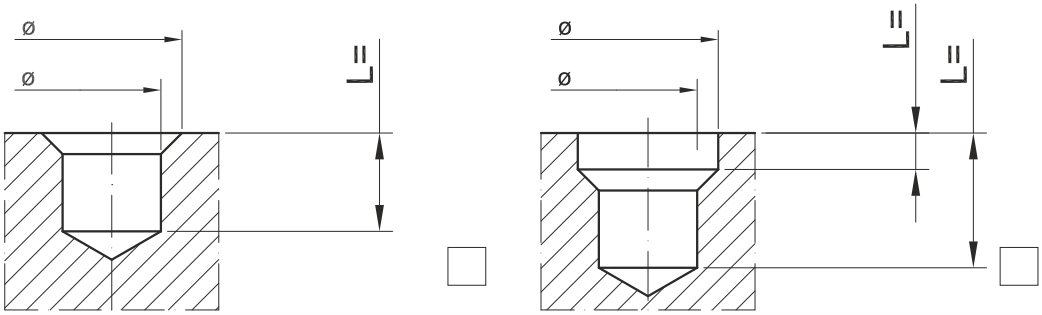
Name and company address: .....

Contact person: .....tel.....

1. Sketch of the machined part:

1.1. Name of detail:..... 1.2. Workpiece material:.....

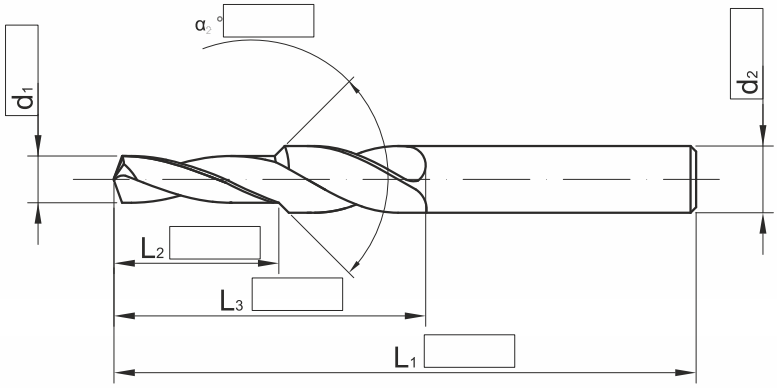
1.3. Hardness:



2. Tool:

2.1. Nr. drawing tool:.....

2.2. Suggest material: 2.3. Suggest material PVD:.....



3. Execution:

3.1. Flutes:	Right spiral	☐	Left spiral	☐	Straight	☐	Spiral angle: .....
3.2. Rotation direction:	Right hand	☐	Left hand	☐			
3.3. Cooling:	External	☐	Internal	☐	Non-cooling	☐	
3.4. Shank:	DIN-6535-HA	☐	DIN-6535-HB	☐	DIN-65350HE	☐	

4. Machine:

4.1.Type of machine: .....

4.2. Type of spindle: .....

4.3. Power[kW]: .....

4.4. Max. rotating speed[RPM]: .....

5. Notes

FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: ..... **Special drill 2 steps**

CUSTOMER'S DATA

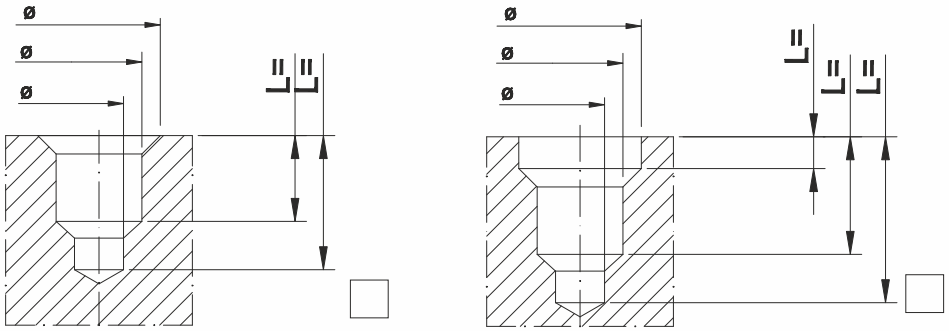
Name and company address: .....

Contact person: .....tel.....

1. Sketch of the machined part:

1.1. Name of detail:..... 1.2. Workpiece material:.....

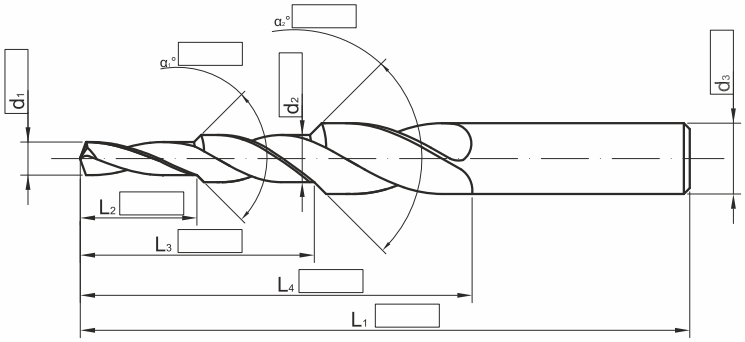
1.3. Hardness:



2. Tool:

2.1. Nr. drawing tool:.....

2.2. Suggest material: 2.3. Suggest material PVD:.....



3. Execution:

3.1. Flutes:	Right spiral	☐	Left spiral	☐	Straight	☐	Spiral angle: .....
3.2. Rotation direction:	Right hand	☐	Left hand	☐			
3.3. Cooling:	External	☐	Internal	☐	Non-cooling	☐	
3.4. Shank:	DIN-6535-HA	☐	DIN-6535-HB	☐	DIN-65350HE	☐	

4. Machine:

4.1.Type of machine: .....

4.2. Type of spindle: .....

4.3. Power[kW]: .....

4.4. Max. rotating speed[RPM]: .....

5. Notes

FORM OF TOOL SELECTION

FANAR fills
Date:..... Representative:..... Inq. nr .....

Date: ..... **Special drill**

CUSTOMER'S DATA

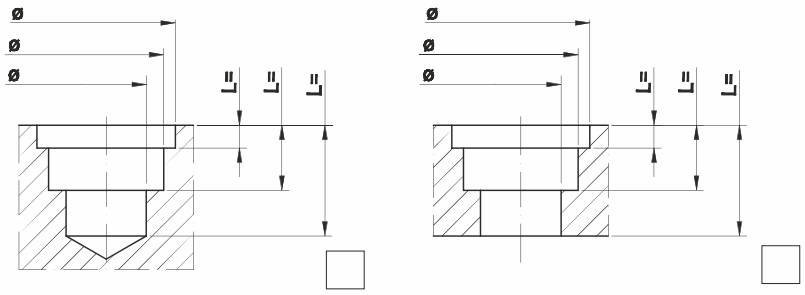
Name and company address: .....

Contact person: .....tel.....

1. Sketch of the machined part:

1.1. Name of detail:..... 1.2. Workpiece material:.....

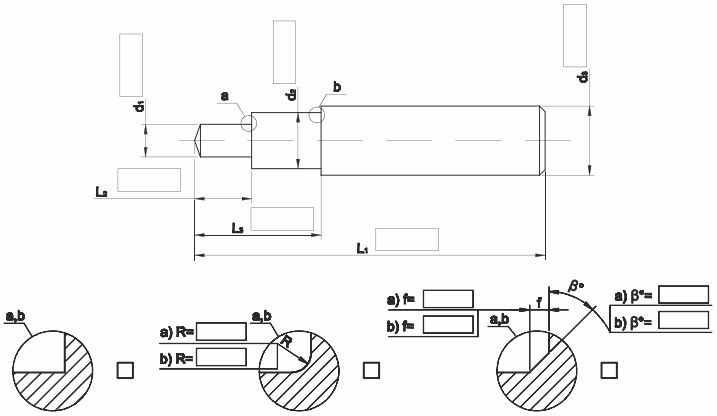
1.3. Hardness:



2. Tool:

2.1. Nr. drawing tool:.....

2.2. Suggest material: 2.3. Suggest material PVD:.....



3. Execution:

3.1. Flutes:	Right spiral	☐	Left spiral	☐	Straight	☐	Spiral angle: .....
3.2. Rotation direction:	Right hand	☐	Left hand	☐			
3.3. Cooling:	External	☐	Internal	☐	Non-cooling	☐	
3.4. Shank:	DIN-6535-HA	☐	DIN-6535-HB	☐	DIN-65350HE	☐	

4. Machine:

4.1.Type of machine: .....

4.2. Type of spindle: .....

4.3. Power[kW]: .....

4.4. Max. rotating speed[RPM]: .....

5. Notes