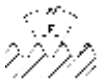
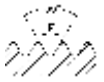
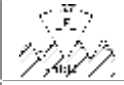
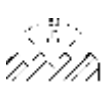
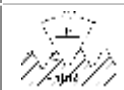
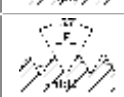
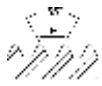
TECHNICAL INFORMATION

1. MATERIALS USED FOR TOOLS PRODUCING

Symbol	Description	Marking acc. to DIN	Destination
HSS	High-speed steel	1.3343 S-6-5-2	General purpose machine dies, hand taps and general purpose machine taps
HSSE (HSCo5)	High-speed steel	1.3243 S-6-5-2-5	High performance machine taps, machine dies, INOX drills
HSSE-PM	High-speed powder steel		High performance machine taps for difficult workable materials, forming taps
VHM	Micrograin solid carbide		High performance machine taps for difficult workable materials, drills, mills

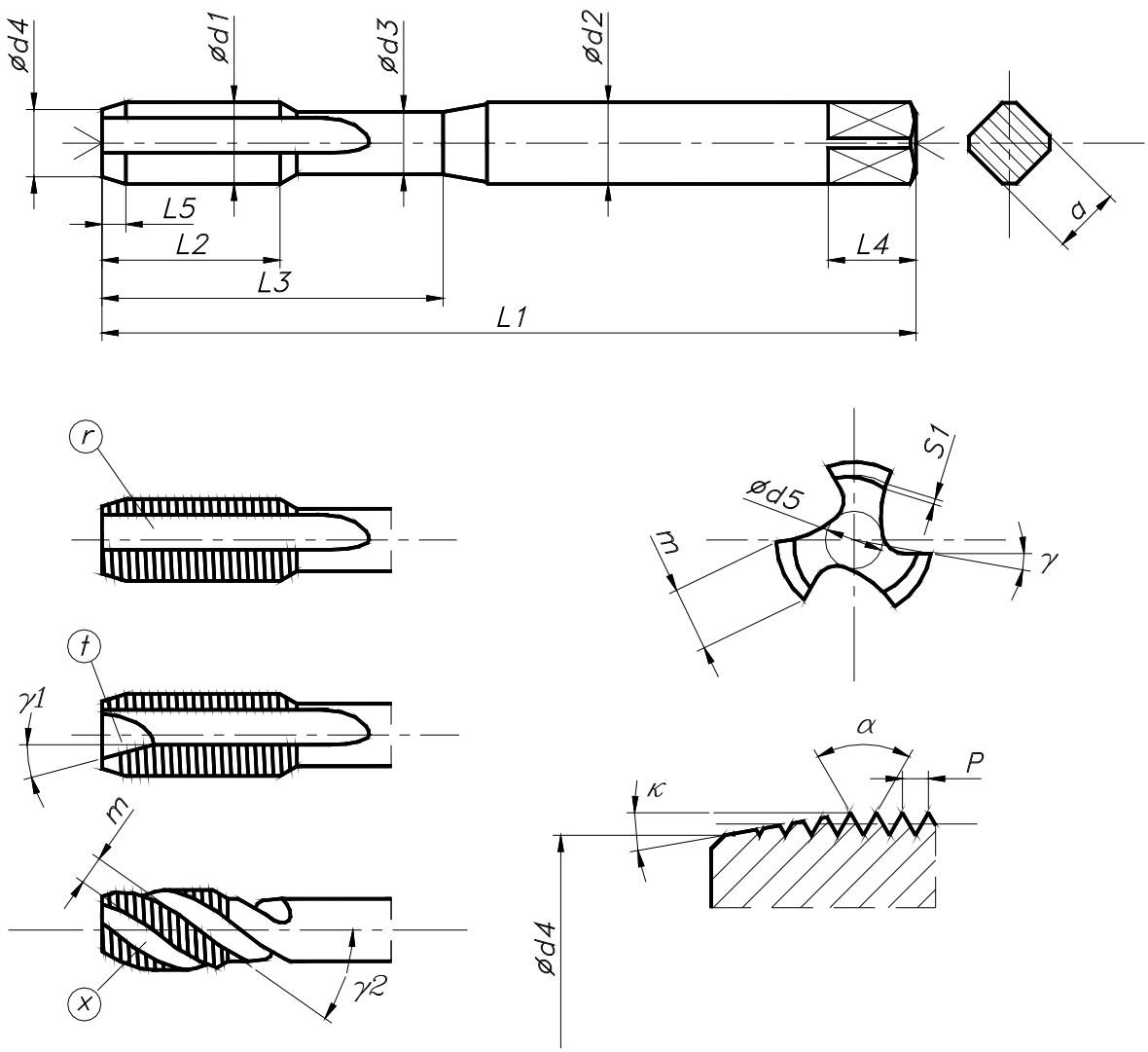
2. THREAD TYPE

CATALOGUE		
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
G		Whitworth pipe thread DIN-ISO 228 (identical with BSP)
Rp		Whitworth internal cylindrical pipe thread PN-ISO 7/1 and DIN EN 10266-1 (identical with BSPP)
Rc		Whitworth internal tapered pipe thread PN-ISO 7/1, DIN EN 10266-2 (identical with BSPT)
BSW		Whitworth thread BS-84:1956 (in the past - W)
BSF		Whitworth fine thread BS-84:1956
Pg		Steel conduit thread DIN-40430 (P)
Tr		Trapezoidal symetric thread DIN-103
NPT		American tapered pipe thread with dryseal material ANSI B-1.20.1
R		Whiworth external tapered pipe thread ISO-7/1 (identical with BSPT)

NON-CATALOGUE made by special order		
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
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
UNEF		American unified extra fine thread ANSI B-1.1
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
EG M		Metric thread for thread inserts V-Coil
EG UNC		American unified thread for thread inserts V-Coil
NPSM (NPS)		American cylindrical pipe thread ANSI B 1.20.1
NPTF		American tapered pipe thread without dryseal material ANSI B 1.20.4

3. TAPS

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



L1	- total length	*S1*	- relief of chamfer
L2	- thread length	*P*	- pitch of thread
L3	- useful length	α	- angle of thread
L4	- length of driving square	γ	- rake angle
L5	- chamfer length	γ1	- spiral point angle
a	- size of square	γ2	- angle of spiral flutes
∅*d1*	- thread diameter	κ	- chamfer angle
∅*d2*	- shank diameter	*r*	- straight flute
∅*d3*	- neck diameter	*x*	- spiral flute
∅*d4*	- (chamfer) point diameter	*t*	- spiral point
∅*d5*	- web (core) diameter	*z*	- number of lands
m	- width of land		

3.2. 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
ISO-529	Short hand and machine taps for metric coarse threads, metric fine threads, UNC, UNF, BSW, BSF as well as other kinds of threads not provided by the standard, excluding the pipe threads G, Rp, 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 threads Norm is also suitable for UNF and BSF threads
DIN-5157	Short hand taps and machine taps for pipe threads G, Rp
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

3.3. Kinds of chamfers and flutes

Chamfers of hand taps

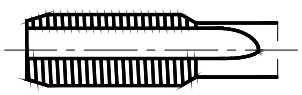
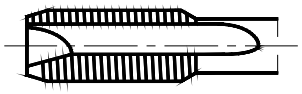
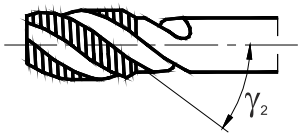
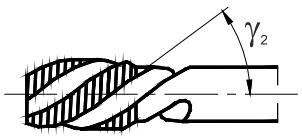
Tap in set	Metric coarse threads, BSW, UNC		Metric fine threads BSF, UNF, UNEF		Pipe threads G, Pg		Flutes
	L5 - length of chamfer in threads					κ - chamfer angle	
	L5	κ	*L5*	κ	*L5*	κ	
Nr 1 taper tap	8P	5°	8P	5°	5P	7°	Straight
Nr 2 second tap	4P	10°	-	-	-	-	
Nr 3 finishing tap	2P	20°	2P	20°	2P	20°	

Chamfers of machine taps according to DIN-2197

Kind of chamfer -symbol	Chamfer length presented in the quantity of the thread coils	Chamfer angle ~	Kind of flutes	Usage
A	(6÷8)P	5°	Straight	Short through holes
B	(3,5÷5,5)P	8°	Straight with spiral point	Different length through holes in materials forming medium and long chips
C	(2÷3)P	15°	Straight or spiral	Blind holes, through holes in materials forming short chips
D	(3,5÷5)P	8°		Through holes, blind holes with long thread runout
E	(1,5÷2)P	23°		Blind holes with a very short thread runout. Used for brass

Apart from above there are also used chamfers (12÷16)P for nut taps and 24P for trapezoidal taps.

Flutes of machine taps according to DIN-2197

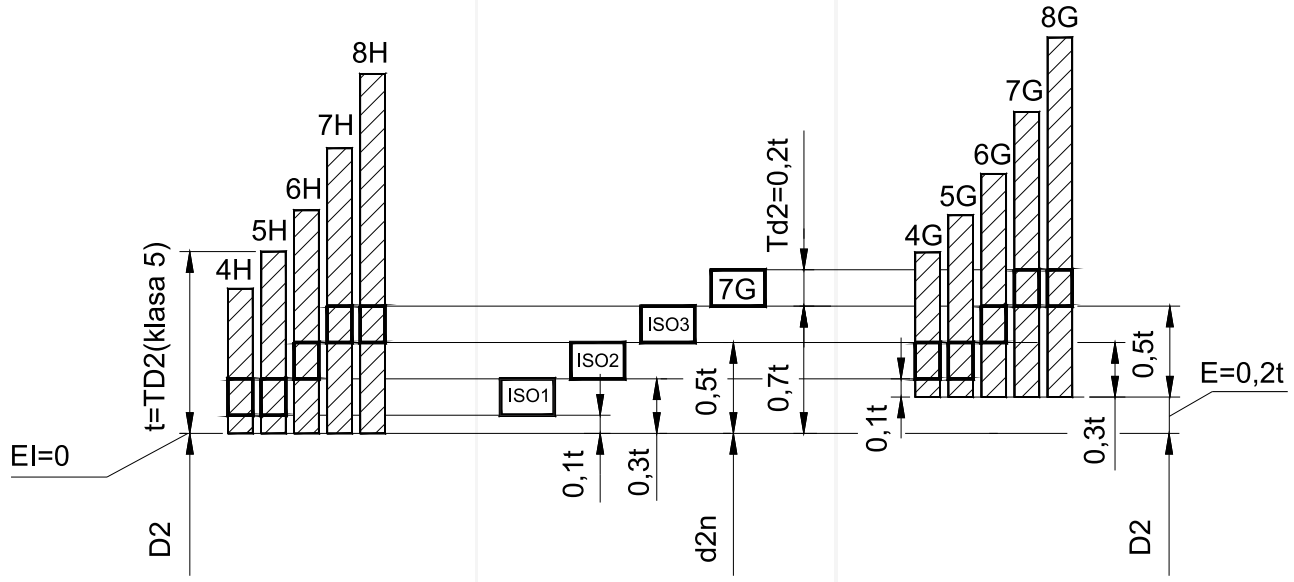
Kinds of flutes			Chamfer	Usage	
				Hole	Chip
Straight			A, D	Through	Short, medium
			C, E	Blind	
Straight with spiral point			B	Through	Medium, long
Right hand spiral flutes			C, E	Blind	Medium, long
	R15	$10^\circ \le \gamma_2 \le 20^\circ$			
	R25	$20^\circ < \gamma_2 \le 30^\circ$			
	R40	$30^\circ < \gamma_2 \le 40^\circ$			
	R45	$40^\circ < \gamma_2 < 50^\circ$			
Left hand spiral flute			D	Through *- for RH thread*	Medium, long
	L15	$10^\circ \le \gamma_2 \le 20^\circ$			
	L40	$30^\circ < \gamma_2 \le 40^\circ$	C	Blind *- for LH thread*	

Because according to the standard, the spiral lead of flute should be the normal number of the R20 series, the real angle γ_2 is variable depending on thread diameter. Its value made approximated to the full grades, including the spiral lead, is stamped on the tap shank.

3.4. Taps classes and inner thread's tolerance zone

Taps offered in our catalogue are produced in the basic class destined for the most common use of inner thread: for metric thread - 6H, for unified threads UNC, UNF - 2B, for Whitworth threads BSW, BSF - „normal". Producing in other classes can be done by order.
Taps classes (i.e. working part tolerance zones) for metric thread are unified by international and domestic standards. The determined tap class allows to obtain the threads of two or three tolerance zones (see picture and table below).

Internal thread Tolerance H limits	Tap tolerance limits	Internal thread Tolerance G limits



Tolerance class of the tap according to standard:			Tolerance range of the internal thread				
PN - 72 / M - 57800	PN - 92 / M - 57800	DIN 802					
1A	ISO1	4H	4H	5H	-	-	-
2A	**ISO2**	**6H**	4G	5G	6H	-	-
3A	ISO3	6G	-	-	6G	7H	8H
-	-	7G*	-	-	-	7G	8G

*) Polish Standard following the international standard ISO, provides only three classes of taps, whereas the standard DIN 802 introduces additionally the fourth class 7G for "loose" threads. Furthermore, the standard 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.

3.5. High performance machine taps HSSE

Using of machine taps of general purpose made of the molybdenum steel class HSS, provides good results of work with conventional machines with the standard cutting speed and it is technically and economically justified in many cases of unitary or short and medium serial cutting. There are cases, where using the tool of the higher purchase price results in a significant lowering of producing costs, because of significant increase of cutting speed, tool durability as well as decrease of labour consumption and cost of servicing the work stand.
Such possibilities are given by using the high performance machine taps.

Basic features of high performance machine taps	
Blade material	High speed steel HSSE, high speed powder steel HSSE-PM and solid carbide VHM characterised with thermal and abrasion resistance
Heat treatment	High hardness with preserving good ductility
Surface treatment	Using the super hard coatings made of titanium nitride TiN, titanium carbonitride TiCN, titanium-aluminium nitride TiAlN or aluminium-chromium nitide AlCrN and passivation OX
Working part geometry	Adopting to each material group with various workability

Super hard coatings properties

Symbol	Kind of coating (oerlikon balzers coating)	Name	Color	Hardness HV 0,05	Max temp. usage	Usage
TiN	BALINIT A	Titanium nitride	Gold	2300	600	Universal
TiCN	BALINIT B	Titanium carbonitride	Blue grey	3000	400	Difficult workable, hard grinding materials
TiAlN	BALINIT FUTURA NANO	Titanium-aluminium nitride	Grey violet	3300	900	As the above ones, dry machining
HL	BALINIT HARDLUBE	TiAlN + WC/C	Dark grey	3000	800	Difficult workable, hard grinding materials

Material groups and the range of application	
Group	**Destination**
500	For common structural steels Rm ≤ 500 MPa
800	For carbon constructional steels, free-cutting steels, low-alloy steels with tensile strength 600 MPa ≤ Rm ≤ 800 MPa
800 Az	Type 800 for through holes in soft materials Rm ≤ 500 MPa
1300	For constructional steels, alloyed steels with tensile strength 700 MPa ≤ Rm ≤ 1300 MPa
INOX	For high-alloy steels, stainless and acid resistant steels with tensile strength Rm ≤ 1000 MPa
FAN	For tool steels and difficult workable steels with tensile strength 800 MPa ≤ Rm ≤ 1200 MPa and for heat-treatable steels up to 38HRC
Ti	For titanium and their alloys
Ni	For nickel and their alloys
1400	For difficult workable steels, acid resistant steels with tensile strength 1000 MPa ≤ Rm ≤ 1400 MPa and for heat-treatable steels up to 44HRC
HRC	For hardened steels, number next to symbol indicate material hardness HRC scale
GG	For grey cast iron and spheroidal cast iron
GAL	For aluminium alloys Si max. 10%
AL	For soft aluminium and soft synthetics
Ms	For brass and short-chipping bronze
S-NC	For synchro tapping on CNC machines with the function of "rigid tapping" for wide range of materials
NC	For productive cutting of wide range materials, forming middle and long chips with tensile strenght Rm <1200 MPa
WGN	Forming taps for machining materials with a high adhesion
WGN	Forming taps for plastic materials with ductility $A_5 \geq 10\%$
WGN	Forming taps for machining materials with reduced toughness

3.6. 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 for hole type and material being cutted according to the table in catalogue.
Cutting 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 damaged teeth.
Chip packing in flutes occured.	You should use tap with another flute geometry. There could 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 feed while tapping. You should check parameters of CNC machine (program). Check lead screw for backlash. You should use holder with compensation.
Problem: Tapping oversized threads (no-go 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.

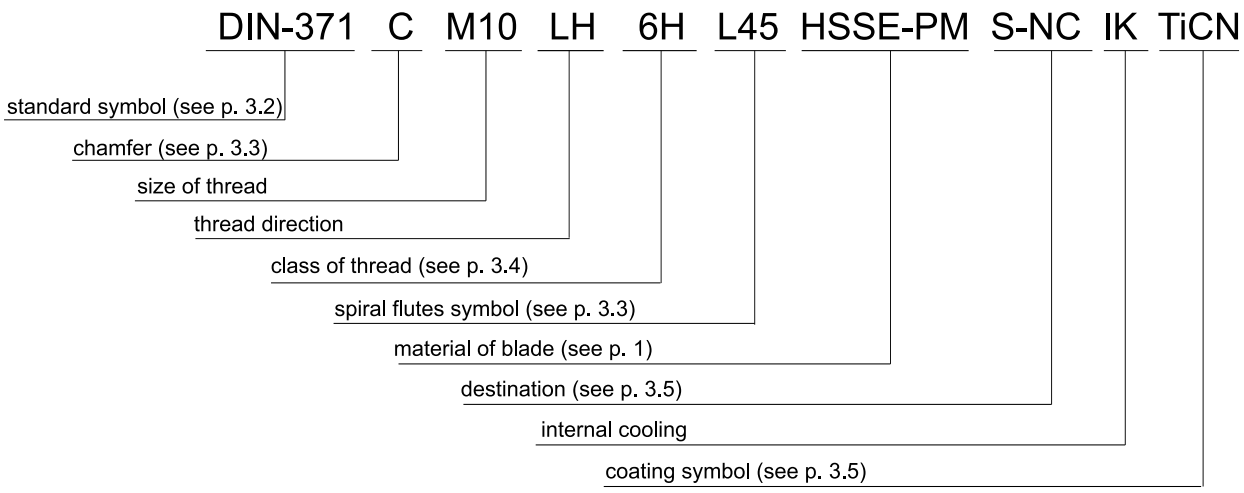
Problem: Torn and rough threads	
You used improper tap for material and thread application.	You should use tap suitable for the hole type and material being cutted according to the table from catalogue.
Tap drill was too small.	You should use correct size of drill. Please check recommended size drill 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.

3.7. Marking and stamping of high performance machine taps

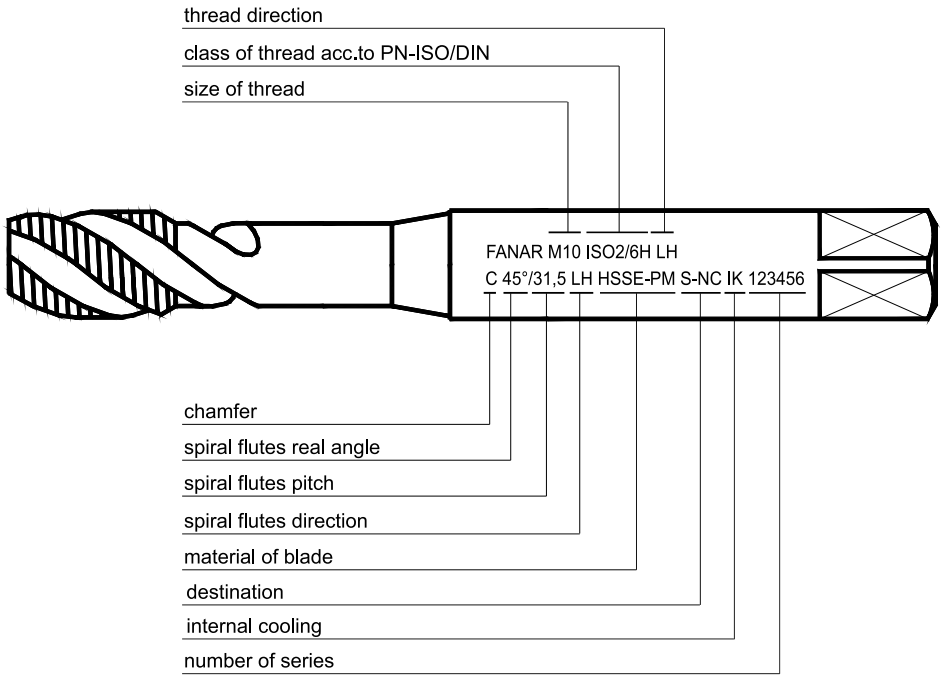
Example:

machine tap according to the standard DIN-371 for the left thread M10 class 6H with spiral flutes 45° (for blind hole) for tapping on CNC machines, TiCN coated, with internal cooling.

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

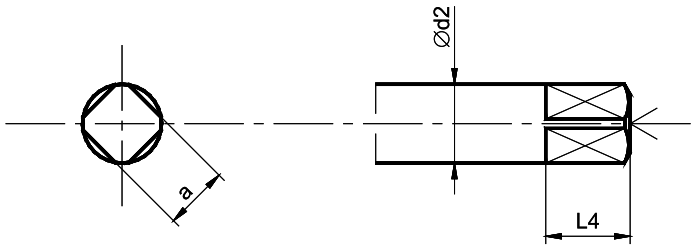


Stamping: on the shank of tap



3.8. Connecting dimensions of taps acc. to ISO and DIN

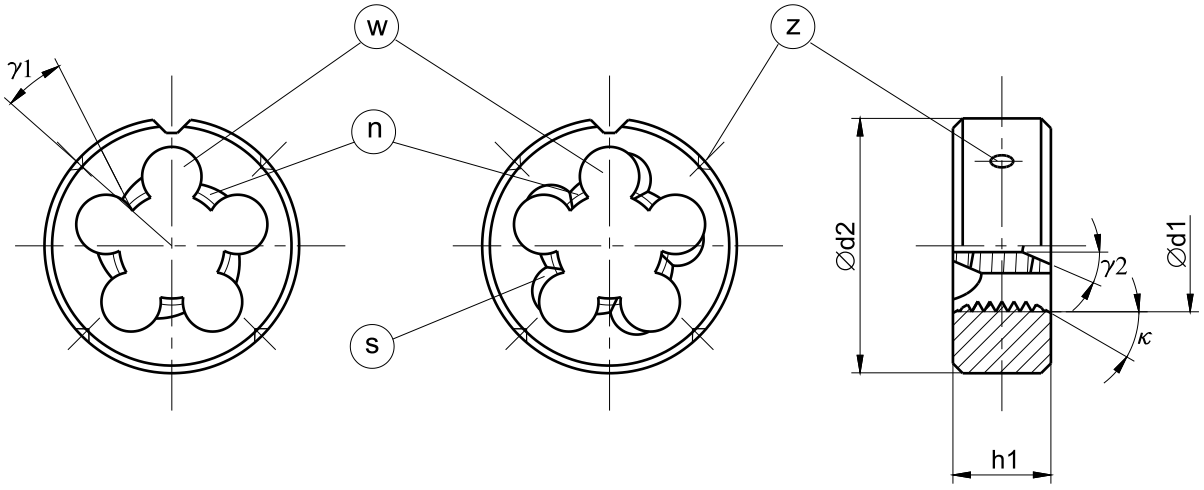
The below table shows shank diameters and square dimensions differences for taps according to standard ISO-529, DIN-352, DIN-371, DIN-376. These differences should be taken into consideration when choosing the tap holders.



Size of thread	ISO-529			DIN-352			DIN-371			DIN-376		
	Ød2(h9)	L4	a(h11)	Ød2(h9)	L4	a(h12)	Ød2(h9)	L4	a(h12)	Ød2(h9)	L4	a(h12)
M2							2,8	5	2,1			
M2,5							2,8	5	2,1			
M3	3,15	5	2,5	3,5	6	2,7	3,5	6	2,7	2,2	5	1,8
M3,5	3,55	5	2,8	4	6	3	4	6	3	2,5	5	2,1
M4	4	6	3,15	4,5	6	3,4	4,5	6	3,4	2,8	5	2,1
M4,5	4,5	6	3,55	6	8	4,9	6	8	4,9	3,5	6	2,7
M5	5	7	4	6	8	4,9	6	8	4,9	3,5	6	2,7
M6	6,3	8	5	6	8	4,9	6	8	4,9	4,5	6	3,4
M7	7,1	8	5,6	6	8	4,9	7	8	5,5	5,5	7	4,3
M8	8	9	6,3	6	8	4,9	8	9	6,2	6	8	4,9
M9	9	10	7,1	7	8	5,5	9	10	7	7	8	5,5
M10	10	11	8	7	8	5,5	10	11	8	7	8	5,5
M11	8	9	6,3	8	9	6,2				8	9	6,2
M12	9	10	7,1	9	10	7				9	10	7
M14	11,2	12	9	11	12	9				11	12	9
M16	12,5	13	10	12	12	9				12	12	9
M18	14	14	11,2	14	14	11				14	14	11
M20	14	14	11,2	16	15	12				16	15	12
M22	16	16	12,5	18	17	14,5				18	17	14,5
M24	18	18	14	18	17	14,5				18	17	14,5
M27	20	20	16	20	19	16				20	19	16
M30	20	20	16	22	21	18				22	21	18
M33	22,4	22	18	25	23	20				25	23	20
M36	25	24	20	28	25	22				28	25	22
M39	28	26	22,4	32	27	24				32	27	24
M42	28	26	22,4	32	27	24				32	27	24
M45	31,5	28	25	36	32	29				36	32	29
M48	31,5	28	25	36	32	29				36	32	29
M52	35,5	31	28	40	35	32				40	35	32

4. DIES

4.1. Die construction elements



∅d1 - nominal thread diameter
∅d2 - outside diameter
h1 - die thickness
κ - chamfer angle
$\gamma 1$ - rake angle
$\gamma 2$ - spiral face inclination
w - chip hole
n - chamfer
s - spiral face
z - hole for fixing screw

4.2. 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 and 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

4.3. Tolerances of the thread being cuted

Dies presented in the catalogue are destined for cutting the most often occuring basic tolerances for the given kind of thread: for metric thread 6g, for threads UNC, UNF etc. 2A. We can produce the dies destined for the other tolerance zone if demanded, e.g. for metric threads: 4h for tight threads, 6e for threads under the thin galvanic coatings.

4.4. Variants of execution and their usage

Kind of work	Destination	Execution of thread	Blade geometry properties	Symbol of execution variant	Die material	Usage
Machine	High performance	Cutted	Without spiral face	800	HSS	Constructional steel, cast steel up to Rm ≤ 800 MPa
			With spiral face	800 SPN	HSS	Steels as above, higher thread quality, for work with automatic lathe
		Lapped	Without spiral face	Ms	HSS	Brass, short chipping bronze
			With spiral face	INOX	HSSE	Stainless steels, cast aluminium, spheroidal cast iron

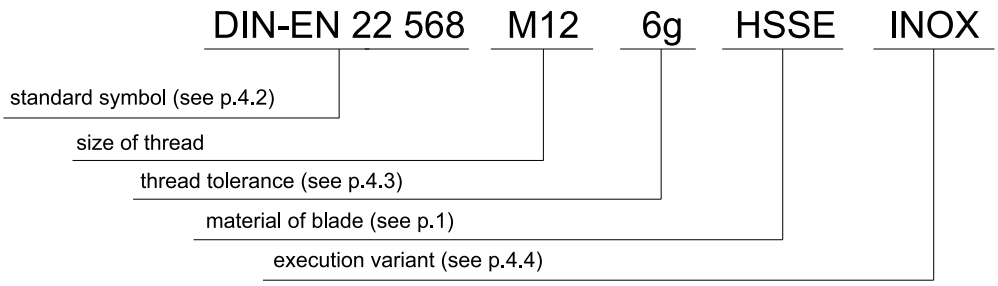
4.5. Technological recommendations for machine dies

Machining material	Cutting speed [m/min]	Cutting fluid
Carbon constructional steels	4 ÷ 8	Oil
Free - cutting steels	8 ÷ 12	Oil
Carburizing steels	4 ÷ 8	Oil, special oil
Heat - treatable steels	3 ÷ 6	Oil
INOX steels	2 ÷ 4	Special oil
Grey cast iron	3 ÷ 8	Oil, kerosene
Short chipping bronze	15 ÷ 25	Oil, special oil
Long chipping brass	10 ÷ 16	Oil
Long chipping bronze	5 ÷ 8	Oil, emulsion
Short chipping bronze	7 ÷ 11	Oil, emulsion
Cooper	11 ÷ 15	Oil, special emulsion
Long chipping aluminium	12 ÷ 18	Special oil, kerosene
Cast aluminium	8 ÷ 12	Special oil, kerosene

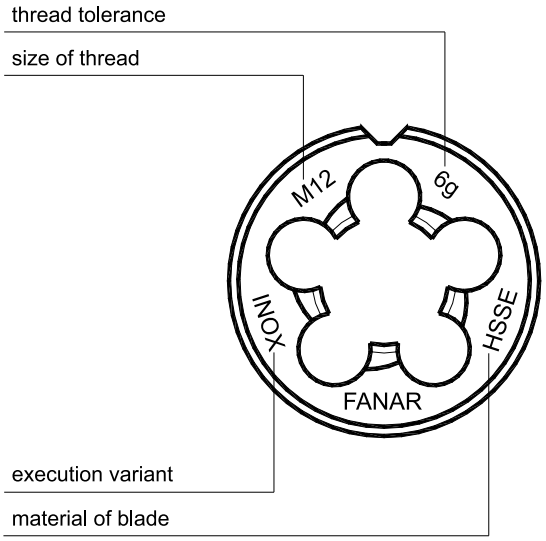
4.6. Marking and stamping of dies

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

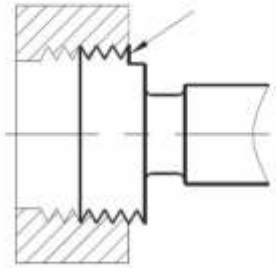
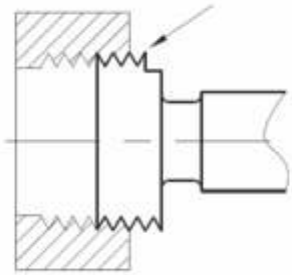
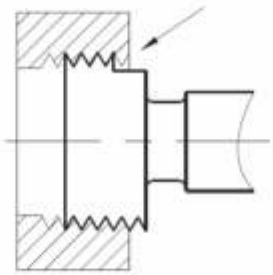


Stamping: on die



5. GAUGES FOR TAPER THREADS

5.1. 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

5.2. Gauges R, Rc/Rp

5.2.1. Standards

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)

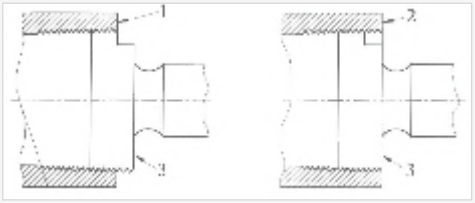
5.2.2. Design of gauges

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 (D_2) 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 (D_2) 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 (d_1) and pitch diameter (d_2) 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.
Gauge No. 6 	**Parallel modified thread form check ring gauge** This check ring gauge is provided to check the dimensions of the taper full form threaded plug gauges (gauge Nos. 1 and 2) when manufacturing the plug gauges and for checking the plug gauges for wear

5.2.3. Use of gauges and checking of threads

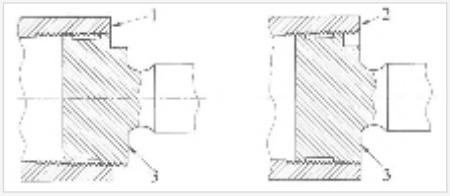
Checking of internal taper (Rc) and internal parallel (Rp) threads

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

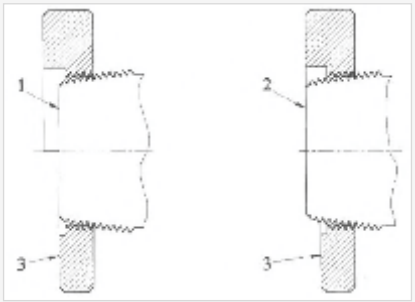
Note 1 : If a workpiece is rejected by gauge No. 2 but accepted by gauge No. 1, then this may indicate a lack of accomodation lenght.

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 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.

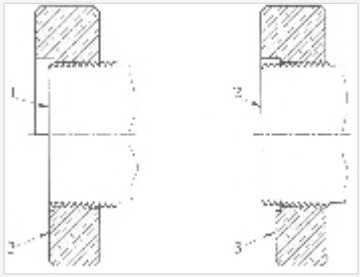
Checking of external taper (R) threads

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.

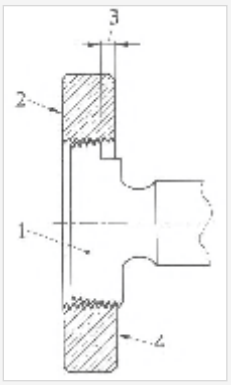


Key:
1 - end face of work piece flush with tolerance step on gauge,
2 - end face of work piece flush with face of gauge
3 - gauge No. 4

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)

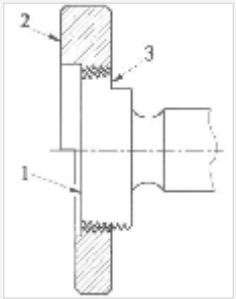
The pitch diameter of taper threaded plug gauges may be checked with the parallel modified thread form check ring gauge (gauge No. 6). The major diameter of taper threaded plug gauges shall be checked by direct measurment.



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.



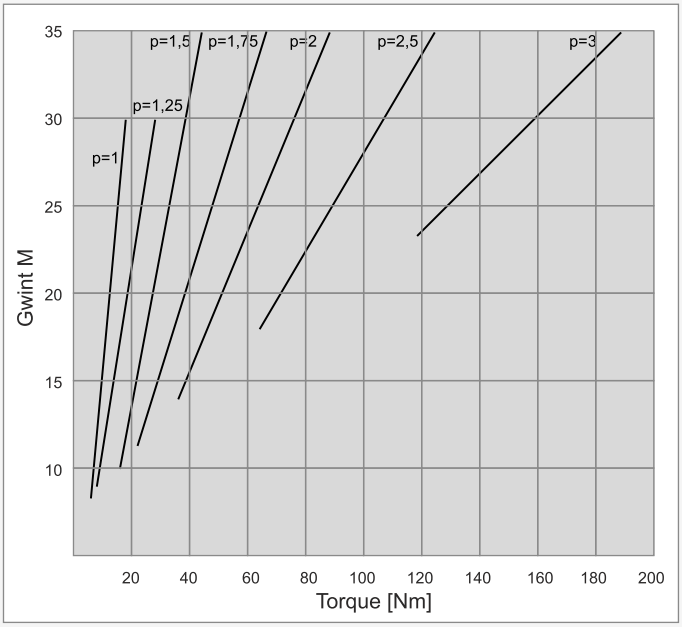
Key:
1 - gauges No 5
2 - gauges No 3
3 - distance from face of step on plug gauge to face of ring gauge shall be l_{14}
(see PN-EN 10226-3:2005 table 16)
4 - this face marked to indicate position of gauge plane

6. TOOLHOLDER

6.1. Quick-change adapters with safety clutch for taps

RECOMMENDED TORQUE VALUES
FOR TAPPED MATERIALS WITH RM=1000 MPA

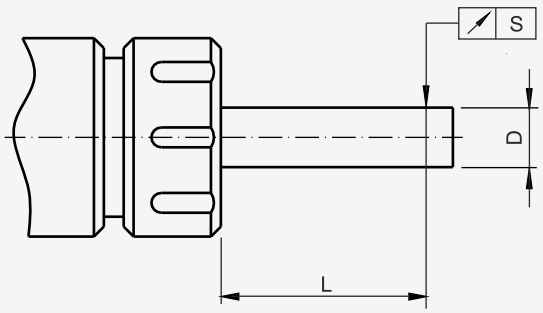
Thread M	Torque [Nm]
3	0,5
4	1,2
5	2
6	4
8	8
10	16
12	22
14	36
16	40
18	63
20	70
22	80
24	125
27	140
30	220
33	240



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

6.2. 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

6.3. Toolholders balance

Definition of unbalance

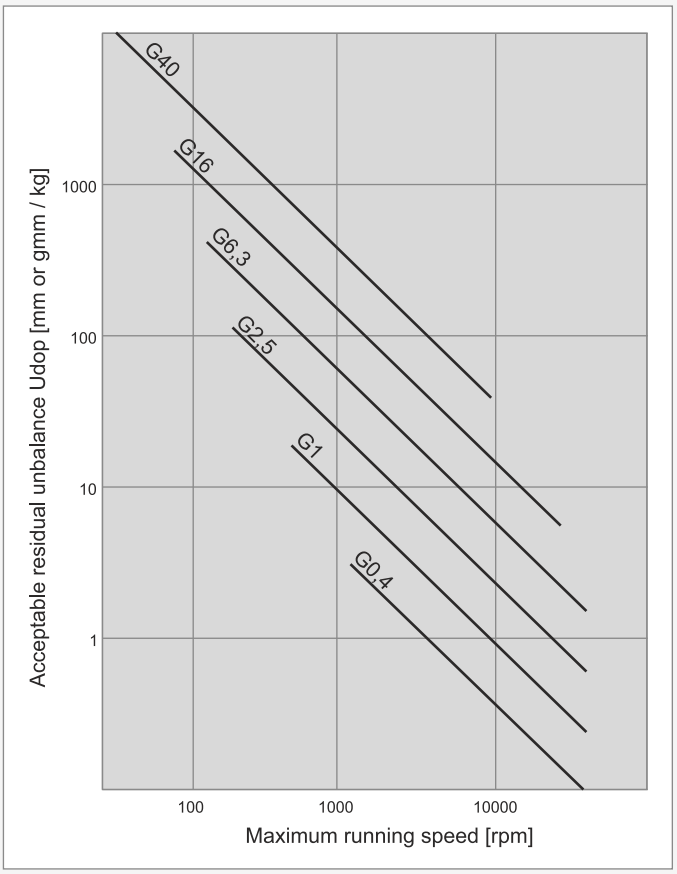
Unbalance is a displacement of the center of gravity of the rotating mass from the axis of rotation. The rotating mass includes: machine spindle, toolholder, intermediate components (collets), other additional elements of toolholders (nuts) and tool The reason of unbalance is geometric asymmetry, tolerance 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.

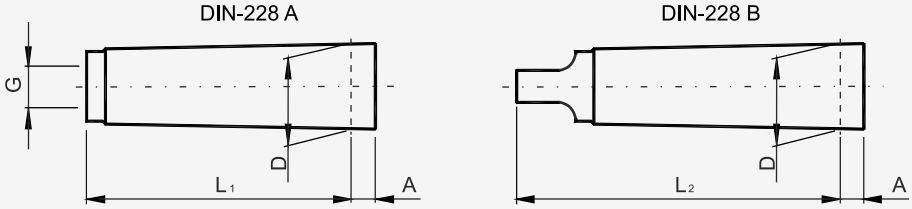
Balance accuracy classes

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.



6.4. Toolholders shanks

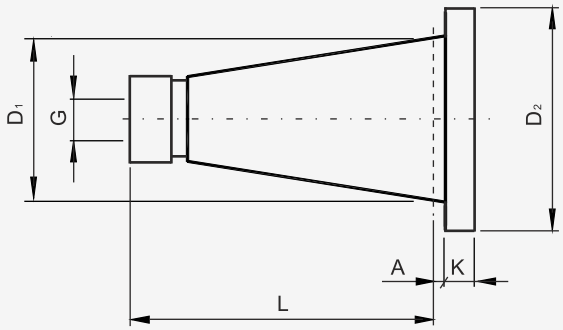
MORSE DIN-228



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.

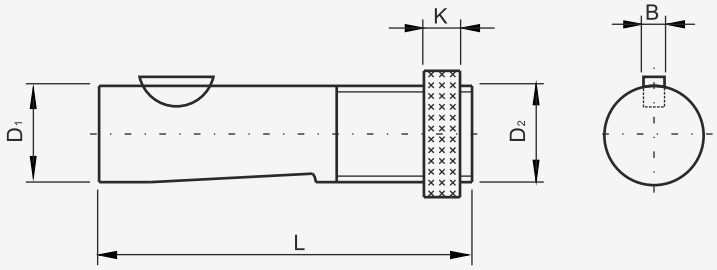
DIN DIN-2080



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.

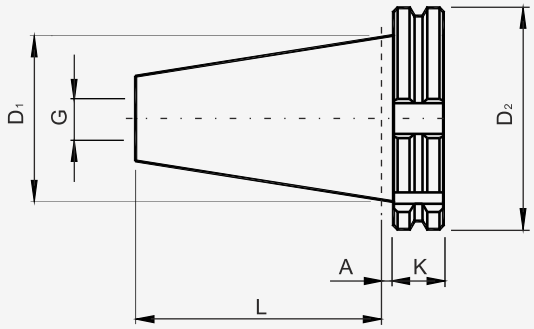
TR DIN-6327



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 DIN-69871 A

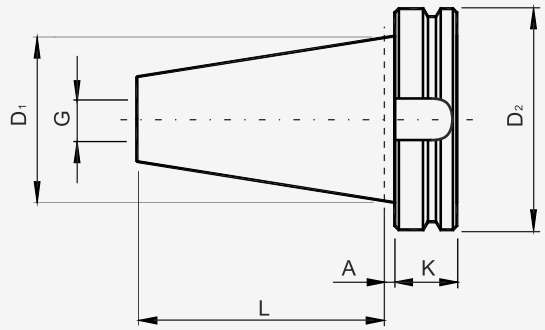


Taper	D 1	D 2	L	A	K	G
ISO30	31,75	50,00	47,80	3,2	15,9	M12
ISO40	44,45	63,55	68,40	3,2	15,9	M16
ISO50	69,85	97,50	101,75	3,2	15,9	M24

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

MAS BT JIS B6339

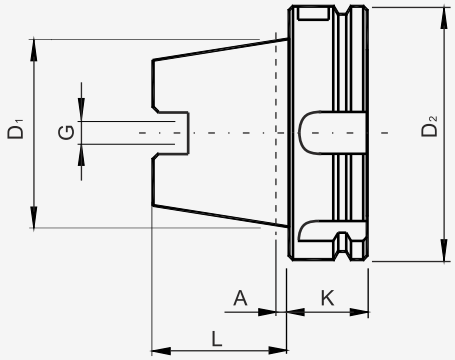


Taper	D 1	D 2	L	A	K	G
BT30	31,75	46	48,4	2	22	M12
BT40	44,45	63	65,4	2	27	M16
BT50	69,85	100	101,8	3	38	M24

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

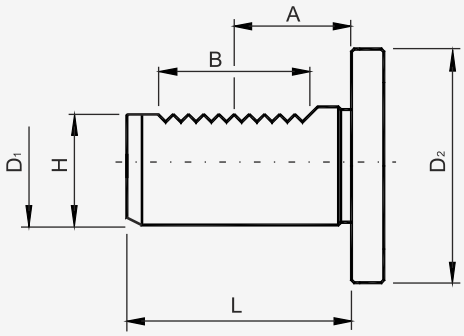
HSK DIN-69893 A



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 DIN-69880

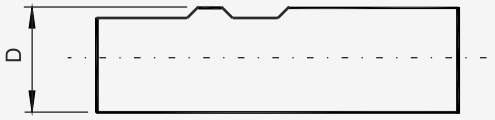


Shank	D 1	D 2	H	L	A	B
VDI20	20	50	18	40	21,7	24
VDI25	25	58	23,5	48	21,7	24
VDI30	30	68	27	55	29,7	40
VDI40	40	83	36	63	29,7	40
VDI50	50	98	45	78	35,7	48

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

CYLINDRICAL 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

7. INFORMATION TABLES

RECOMMENDED HOLE'S DIAMETERS FOR TAPPING WITH TAP

M (6H)		MF (6H)		G		UNC (2B)		UNF (2B)		BSW (normal)	
THREAD	Ø d	THREAD	Ø d	THREAD	Ø d	THREAD	Ø d	THREAD	Ø d	THREAD	Ø d
2	1,60	4 x 0,5	3,50	G-1/16"	6,70	No 5 - 40	2,60	No 5 - 44	2,70	1/8 - 40	2,50
2,5	2,05	5 x 0,5	4,50	G-1/8"	8,80	No 6 - 32	2,70	No 6 - 40	3,00	3/16 - 24	3,60
2,6	2,15	6 x 0,75	5,20	G-1/4"	11,80	No 8 - 32	3,50	No 8 - 36	3,50	1/4 - 20	5,10
3	2,50	8 x 0,75	7,20	G-3/8"	15,25	No 10 - 24	3,80	No 10 - 32	4,10	5/16 - 18	6,50
3,5	2,90	8 x 1	7,00	G-1/2"	19,00	No 12 - 24	4,50	No 12 - 28	4,65	3/8 - 16	7,90
4	3,30	9 x 1	8,00	G-5/8"	21,00	1/4 - 20	5,10	1/4 - 28	5,50	7/16 - 14	9,25
4,5	3,80	10 x 1	9,00	G-3/4"	24,50	5/16 - 18	6,50	5/16 - 24	6,90	1/2 - 12	10,50
5	4,20	10 x 1,25	8,80	G-7/8"	28,25	3/8 - 16	7,90	3/8 - 24	8,50	9/16 - 12	12,00
6	5,00	12 x 1	11,00	G-1"	30,75	7/16 - 14	9,30	7/16 - 20	9,90	5/8 - 11	13,50
7	6,00	12 x 1,25	10,80	G-1.1/8"	35,50	1/2 - 13	10,70	1/2 - 20	11,50	11/16 - 11	15,00
8	6,80	12 x 1,5	10,50	G-1.1/4"	39,50	9/16 - 12	12,30	9/16 - 18	13,00	3/4 - 10	16,50
9	7,80	14 x 1,25	12,80	G-1.3/8"	42,00	5/8 - 11	13,50	5/8 - 18	14,50	7/8 - 9	19,25
10	8,50	14 x 1,5	12,50	G-1.1/2"	45,00	3/4 - 10	16,50	3/4 - 16	17,50	1 - 8	22,00
11	9,50	16 x 1	15,00	G-1.3/4"	51,00	7/8 - 9	19,50	7/8 - 14	20,50	1.1/8 - 7	24,75
12	10,20	16 x 1,5	14,50	G-2"	57,00	1 - 8	22,25	1 - 12	23,30	1.1/4 - 7	28,00
14	12,00	18 x 1	17,00			1.1/8 - 7	25,00	1.1/8 - 12	25,50	1.1/2 - 6	33,50
16	14,00	18 x 1,5	16,50			1.1/4 - 7	28,00	1.1/4 - 12	29,50	1.3/4 - 5	39,00
18	15,50	18 x 2	16,00			1.3/8 - 6	30,70	1.3/8 - 12	32,50	2 - 4.1/2	44,50
20	17,50	20 x 1	19,00			1.1/2 - 6	34,00	1.1/2 - 12	36,00		
22	19,50	20 x 1,5	18,50			1.3/4 - 5	39,50				
24	21,00	20 x 2	18,00			2 - 4.1/2	45,00				
27	24,00	22 x 1	21,00								
30	26,50	22 x 1,5	20,50								
33	29,50	22 x 2	20,00								
36	32,00	24 x 1	23,00								
39	35,00	24 x 1,5	22,50								
42	37,50	24 x 2	22,00								
45	40,50	27 x 1,5	25,50								
48	43,00	27 x 2	25,00								
52	47,00	30 x 1,5	28,50								
56	50,50	30 x 2	28,00								
60	54,50	30 x 3	27,00								
64	58,00	33 x 1,5	31,50								
68	62,00	33 x 2	31,00								
		33 x 3	30,00								
		36 x 1,5	34,50								
		36 x 2	34,00								
		36 x 3	33,00								
		39 x 1,5	37,50								
		42 x 1,5	40,50								
		42 x 2	40,00								
		42 x 3	39,00								
		45 x 2	43,00								
		45 x 3	42,00								
		48 x 2	46,00								
		48 x 3	45,00								
		48 x 4	44,00								
		52 x 2	50,00								
		52 x 3	49,00								
		52 x 4	48,00								

RECOMMENDED HOLE'S DIAMETERS FOR TAPPING WITH FORMING TAP

M (6HX)		MF (6HX)		G (-X)		UNC (2BX)		UNF (2BX)	
THREAD	Ø d	THREAD	Ø d	THREAD	Ø d	THREAD	Ø d	THREAD	Ø d
2	1,83	M 8 x 1	7,55	G-1/8"	9,2	No 5-40	2,9	No 5-44	2,9
2,2	2,00	M 10 x 1	9,5	G-1/4"	12,4	No 6-32	3,15	No 6-40	3,2
2,5	2,30	M 10 x 1,25	9,4	G-3/8"	15,9	No 8-32	3,8	No 8-36	3,85
3	2,80	M 12 x 1	11,5	G-1/2"	19,9	No 10-24	4,3	No 10-32	4,45
3,5	3,25	M 12 x 1,25	11,4	G-5/8"	21,9	No 12-24	5	No 12-28	5,1
4	3,70	M 12 x 1,5	11,3	G-3/4"	25,4	1/4-20	5,75	1/4-28	5,95
5	4,65	M 16 x 1,5	15,3			5/16-18	7,3	5/16-24	7,45
6	5,55	M 18 x 1,5	17,3			3/8-16	8,8	3/8-24	9
8	7,40	M 20 x 1,5	19,3			7/16-14	10,3	7/16-20	10,5
10	9,30					1/2-13	11,8	1/2-20	12,1
12	11,20					5/8-11	14,8	5/8-18	15,25
14	13,00							3/4-16	18,3
16	15,00							1-12	24,45

RELATIONSHIPS OF PERIPHERIAL SPEED AND ROTATIONAL SPEED & TOOL DIAMETER

$\varnothing d_1$ [mm]	$V = \pi d_1 n / 1000$ [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				

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

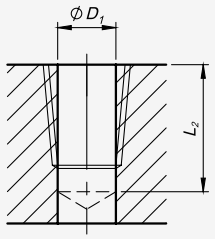
Nominal size		2B / 3B	2B	3B
UNC	UNF	min	max	max
No 5 - 40		2,764	2,847	2,827
	No 5 - 44	2,799	2,880	2,860
No 6 - 32		2,990	3,084	3,058
	No 6 - 40	3,094	3,180	3,157
No 8 - 32		3,650	3,746	3,721
	No 8 - 36	3,708	3,800	3,777
No 10 - 24		4,138	4,247	4,219
	No 10 - 32	4,310	4,409	4,384
No 12 - 24		4,798	4,910	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

INITIAL HOLE DIAMETERS FOR TAPERED PIPE THREAD RC, NPT

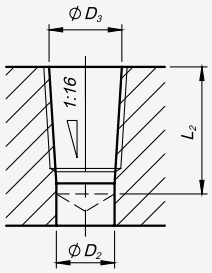
A. Cylindrical hole without the use of a reamer



	Ø nom.	P (tpi)	D_1	L_2
Rc	1/16	28	6,15	11,1
	1/8	28	8,15	11,1
	1/4	19	10,85	16,3
	3/8	19	14,3	16,7
	1/2	14	17,8	22,3
	3/4	14	23,2	23,6
	1	11	29,2	28,3

	Ø nom.	P (tpi)	D_1	L_2
NPT	1/16	27	6,15	11,8
	1/8	27	8,5	11,9
	1/4	18	11	17,4
	3/8	18	14,4	17,7
	1/2	14	17,8	23,1
	3/4	14	23,15	23,6
	1	111/2	29,05	28,4
	1 1/4	11 1/2	37,8	28,9
	1 1/2	11 1/2	43,85	28,9
	2	11 1/2	55,85	29,3

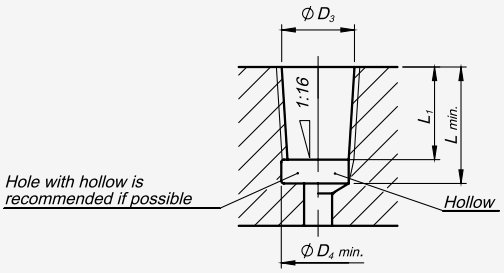
B. Cylindrical hole reamed tapered reamer



	Ø nom.	P (tpi)	D_2	D_3 (JS11)	L_2
Rc	1/16	28	6,1	6,56	11,1
	1/8	28	8,1	8,57	11,1
	1/4	19	10,75	11,45	16,3
	3/8	19	14,25	14,95	16,7
	1/2	14	17,7	18,63	22,3
	3/4	14	23,1	24,12	23,6
	1	11	29,1	30,29	28,3

	Ø nom.	P (tpi)	D_2	D_3 (+0,05)	L_2
NPT	1/16	27	5,95	6,39	11,8
	1/8	27	8,3	8,74	11,9
	1/4	18	10,75	11,36	17,4
	3/8	18	14,15	14,80	17,7
	1/2	14	17,45	18,32	23,1
	3/4	14	22,8	23,67	23,6
	1	11 1/2	28,65	29,69	28,4
	1 1/4	11 1/2	37,35	38,45	28,9
	1 1/2	11 1/2	43,45	44,52	28,9
	2	11 1/2	55,45	56,56	29,3

C. Initial hole recommended for blind holes



	Ø nom.	P (tpi)	D_3 (JS11)	L_1 min.	L min.	D_4 min.
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	$13,0^{+0,5}$
	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	$26,0^{+0,5}$
	1	11	30,29	14,5	25,4	$32,8^{+0,5}$

	Ø nom.	P (tpi)	D_3 (+0,05)	L_1	L min.	D_4 min.
NPT	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	14,80	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

Standard taps are suitable for hole shapes from A to C, as far as possible, avoid A shape.
For blind holes, fig C, for which it is not possible to achieve given L depth, special taps are required.

FANAR fills

Date:..... Representative:..... Inq. nr .....

FORM OF TOOL SELECTION

Date: ..... TAP ☐ FORMING TAP ☐ DIE ☐

CUSTOMER'S DATA

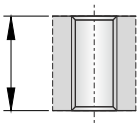
Name and company address:

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

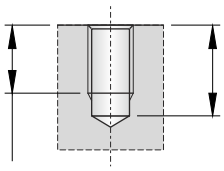
1. Kind of thread

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

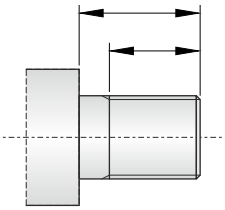
1.3. Character of threaded hole / threaded bar:



Through ☐



Blind ☐



Bar ☐

Other ☐

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

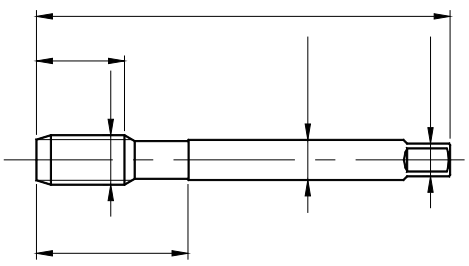
3.4. Type of threaded hole/threaded bar: Drilled☐ Casted☐ Reamed☐ Other:

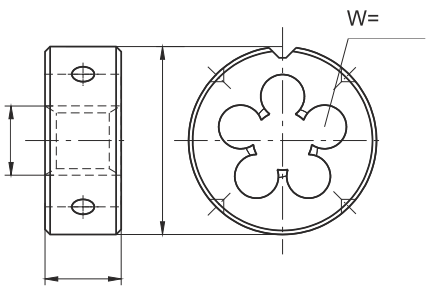
4. Tool

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

4.2. Vitality: .....

4.3. Expected sizes of tool:





5. Notes