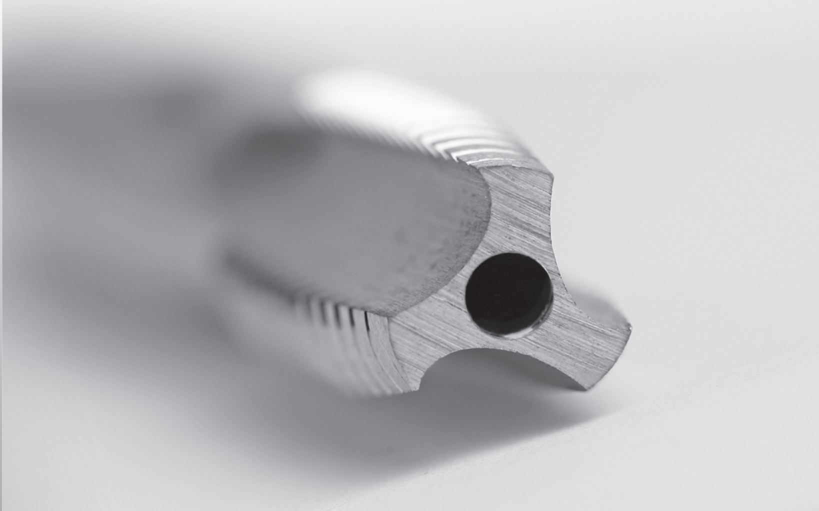
THREADING MANUAL

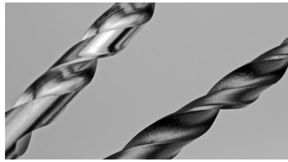
Precision is in the Detail.
Since 1889.



THREADING MANUAL

GSR

CONTENT



GENERAL INFORMATION

All information and notes have been compiled by the authors carefully. Editorial errors or omissions can not be excluded completely. We can therefore accept no liability for any errors. Correction notices are always welcome and are gladly taken into consideration. Also excluded are warranty of any kind. Even if we assume that the provided information is accurate, it may include errors or inaccuracies. For damages or losses arising from the use of this information, we do not assume any liability.

COPYRIGHT

12 x SAFETY PRECAUTIONS FOR TAPPING

- **1** Please wear goggles and work gloves!
- **2** Check the tools before use for damage or wear
- **3** Use the tools according their utilization and not for other purposes!
- **4** Do not lengthen the levers of the tool holder with pipes or other objects!
- **5** Always use cutting oil!
- **6** Chuck tools and workpieces firmly and save!
- **7** Clean all tools after use and remove chips with appropriate tools, not with your bare hands!
- **8** Pay close attention to the correct determination of thread type and thread size!
- **9** Do not recut a thread if you don‘t have solid data about thread type and thread size!
- **10** Please choose the correct speeds for the tools and workpieces according to the tables in the appendix!
- **11** Please choose the correct core hole drill sizes and bolt diameter according to the tables in the appendix!
- **12** Follow the instructions in this manual exactly!

SHORTCUTS

ISO THREAD TYPES
FLANK ANGLE 60°

→ **M**	Metric ISO-thread
→ **MF**	Metric ISO-fine thread
→ **TR**	Metric ISO-trapezoidal thread
→ **PG**	PG Conduit pipe thread
→ **RD**	RD Round thread

AMERICAN THREADS IN INCHES
FLANK ANGLE 60°

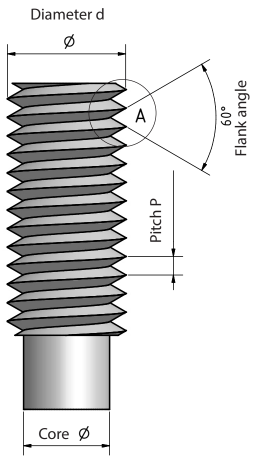
→ **UNC**	UNC Unified National Coarse
→ **UNF**	Unified National Fine
→ **UNEF**	Unified National Extra Fine
→ **UN-8**	Unified National 8-pitch series
→ **UN-12**	Unified National 12-pitch series
→ **UN-16**	Unified National 16-pitch series
→ **UNS**	Special Threads of American National Form
→ **NPT**	National Taper Pipe 1:16
→ **NPTF**	National Taper Pipe Dryseal 1:16
→ **NPS**	National Standard Straight Pipe

BRITISH THREADS IN INCHES
FLANK ANGLE 55°

→ **BSW**	British Standard Whitworth Coarse
→ **BSF**	British Standard Fine
→ **BSP**	British Standard Pipe
→ **BSPT**	British Standard Pipe Taper
→ **BA**	British Standard Association

HISTORY OF THE THREAD

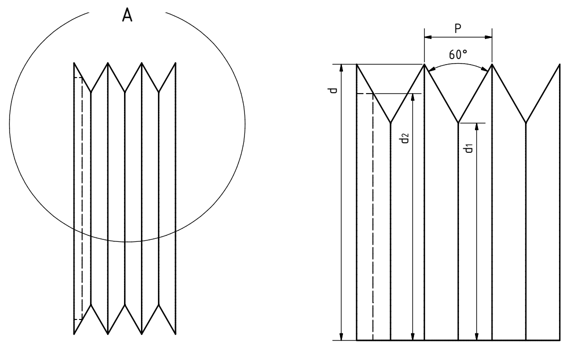
Even in ancient times, the principle of the thread was known. The „Archimedes screw“ is a world-famous example. But records of wine and oil presses are mentioned in the literature. The oldest known notes about tools for threading are from the 16th Century by Leonardo da Vinci. Only in the early phase of industrialization in the mid-19th century came the Englishman Joseph Whitworth on the idea to standardize threads. Until then, all the threads were unique. Thread diameter, core diameter, thread angle and pitch were individually depending on the type of application. The standardization has made the Withworth thread well known in Europe. It is based on the English inch unit and is still in use today. Only by strict standardisation is the worldwide exchange of screws and nuts possible.



THREAD SPECIFICATION

Threads are divided into fixing and moving threads. According to the profile, we divide the threads in point, trapezoidal, flat, round and saw-tooth thread. Here we are only interested in the fastening thread with a pointed profile. The shape of the thread is crucial determined by five dimensions: outer diameter > d, core diameter > D1, flank diameter> d2, flank angle > 60 ° and pitch> P.

The flank diameter is the diameter of thought, in which the thread and the threaded hole have the same width. (> See drawing)



INTERNAL THREAD

WHICH TOOLS DO YOU NEED?

CORE HOLE TWIST DRILLS

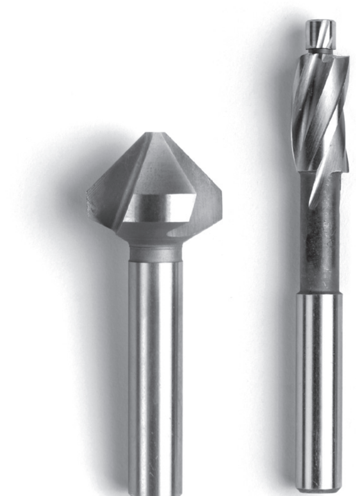
Core hole twist drills have a side rake angle (also called twist angle) of 27°, a point angle of 118° or 135° and a cylindrical shank. The finish "Type N" is suitable for normal chipping materials. A distinction is made between roll forged and fully ground twist drills. When producing the roll forged drill the blank is heated and formed into a spiral. When producing the fully ground drill the spiral is groundout of the fully hardened material. Fully ground twist drills have a blank surface where rollforged drills are burnished and black.

Core hole twist drills

COUNTERSINKS

Countersinks are tools for drilling flat and profiled landings. They are also used for deburring.

Countersinks are differntiated between countersinking and deburring with three axial-radial reliefed ground cutting edges. Counterbores for sinking until a diameter of 5 mm have two main cutting edges. They are right-hand cutting and have a fixed pilot pin for guiding in the through hole or in the thread core hole.



Countersinks

TAPS

THERE ARE HAND TAPS AND MACHINE TAPS

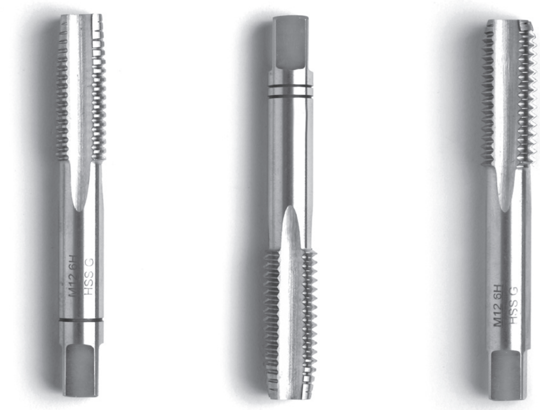
HAND TAP

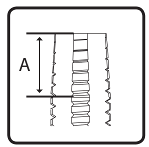
The three-piece set for metric ISO-threads M1 to M68 contains taper, plug and bottoming. Both taper and plug have undersize. The sizes up to M7 have an reinforced shank and three flutes. The sizes from M7 to M68 have a reduced shank and four flutes. The hand tap set for fine threads (MF) just consists of taper and bottoming.

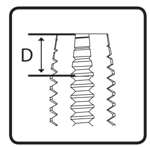
MACHINE TAP

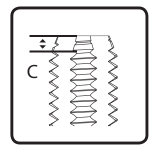
The machine tap for metric ISO threads is suitable for the machine use for cutting inner threads. The version of DIN 371 has a reinforced shank (up to M10) and the version of DIN 376 has a reduced shank.

Machine Tap









TAPER (NO.1)
Marked with one ring, long tap point, Form A / 6 – 9 pitch chamfer

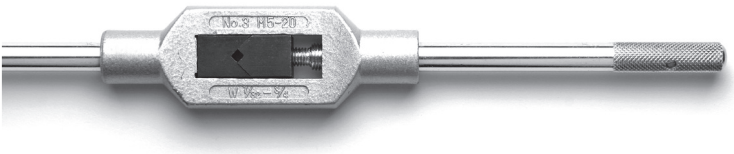
PLUG (NO.2)
Marked with two rings, medium tap point, Form D / 3,5 – 5 pitch chamfer

BOTTOMING (NO.3)
Marking: without ring Short tap point Form C / 2 – 3 pitch chamfer

Hand Tap

AD JUSTABLE TAP WRENCH

The adjustable tap wrench with hardened clamping jaws made from steel has knurled steel handles which are unscrewable on one side. It is suitable for taps with square shank and tap extensions. The body is made from zinc die-cast according to DIN 1743.



TOOLHOLDERS WITH SWITCHABLE

Toolholders with switchable ratchet are designed for mounting taps with square shank in the hardened two jaw chuck.
The body is made entirely of steel. Clockwise and anticlockwise rotation can be switched with a slider. The toolholder with ratchet can be provided in two sizes: for taps M3 – M10 and for taps M5 – M12. It has a sliding T-handle with grooves on both ends for engaging the locking clip

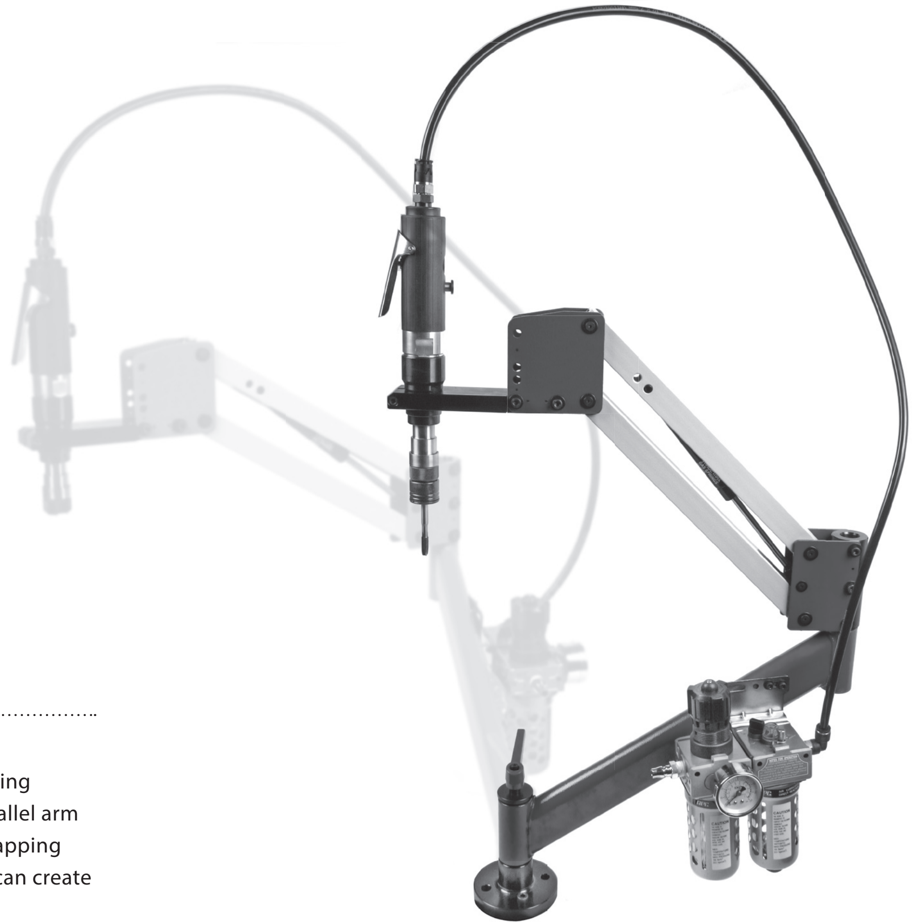
TAPPING CHUCK FOR MACHINE TAPS

The tapping chucks are characterized by a double clamping system. The shank is fixed and centered by turning the lower lock ring. In the rear part the square shank is safely fixed by tightening the allen screws. The chucking range is suitable for taps from M3 to M12 in the version without attached morse taper and from M3 to M12 plus M12 to M24 in the version with fixed morse taper.

▸ HINT!

TAPPING MACHINE

If you often cut threads we recommend to use our tapping machine. It consists of an air-driven spindle drive, a parallel arm which can be screwed on to a workbench and several tapping adapters for the different square shank sizes. Thus you can create threads with great precision quickly and easily.



WAY OF WORKING

HOW DOES THE INTERNAL THREADS WORKS?

The core hole is drilled with a core hole drill bit. Choose the drill diameter from the table > on page 44 - 55!
Basically, the hole diameter is equal to the thread diameter less the pitch. Important: The depth for the core hole drilling of blind holes must be extended by the tap-point length. We recommend to lower the core hole to the thread diameter. Mount the tap in the adjustable tap wrench or for smaller sizes in the tool holder. Take care that the screwable arm of the tap wrench is fixed. Attach the tap vertically to the core hole drilling. Turn the tap wrench clockwise under light pressure into the drilling. After each half turn the chip has to be broken by turning back. Please do not forget to use cutting oil.

HOW DOES THE MACHINE TAPS WORKS?

The shank is fixed and centered by turning the lower lock ring. In the rear part the square shank is safely fixed by tightening the allen screws. First, attach the machine tap into the chuck and then the chuck into the machine, when selecting the machine ensure that the machine features clockwise and anti-clockwise rotation. From the given cutting speed (> see table on page 56) the rotation can be read off from another table (> See tables on pages 54 and 55).

Or you calculate yourself

$$\text{(rotational) speed} = \frac{\text{cutting speed} \times 1000}{\text{diameter} \times 3{,}14}$$

$$n = \frac{vc \times 1000}{d \times \pi} = \text{rpm}$$

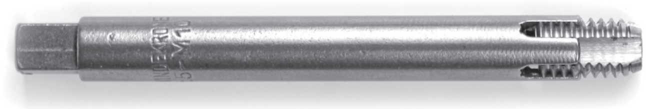
HINT!

THREADED CROWN

As broken taps can be removed only with great effort and you also want to avoid that the workpiece gets damaged you should try to unscrew the broken part of the tap again. Therefor is a special tool: the threaded crown. To remove the broken tap you put the threaded crown into the the grooves of the fragment. If it is not possible to insert the threaded crown you can help with light hammer blows. Then the threaded crown is moved with a tap wrench so that the fragment of the tap in the workpiece looses.

IMPORTANT: small fragments must be removed before as these make it harder to unscrew the tap or possibly damage the thread crown. To remove the tap it must be rotated in the opposite direction of the thread. At smaller sizes it is recommended to be very carefully.

Broken Tap



Threaded crown with fragment

POSSIBLE MISTAKES WHEN THREADING AND THEIR CAUSES

THREAD TOO TIGHT
Tap does not cut according to the pitch, tolerance does not match, too strongly restricted guidance.

OVERSIZED THREAD
Tap point not centered caused by faulty regrinding, runout of the spindle or the tool holder, offset from the tap to the hole, wrong lubricant, inaccurate machine or device, chip congestion in the grooves, faulty or inadequate workholding.

POOR THREAD SURFACE
Cutting design of tap unsuitable Core hole is too small.

THREAD BREAKAGE
Wrong feed, axial backlash, chamfer too long (wrong tap), pitch offset.

LOW LIFE
Cutting speed too high, wrong rake angle, additional surface treatment or coating of the tap required, lubrication wrong or inadequate.

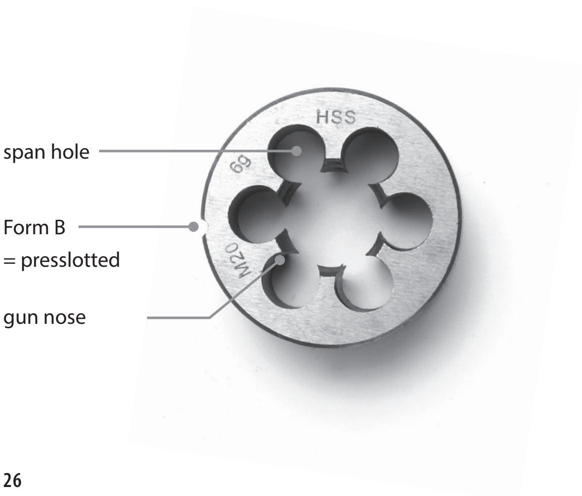
TOOL BREAK-OUTS
Geometry of the tap unsuitable, emergence of the tap due to overloading of the teeth, getting stuck when returning.

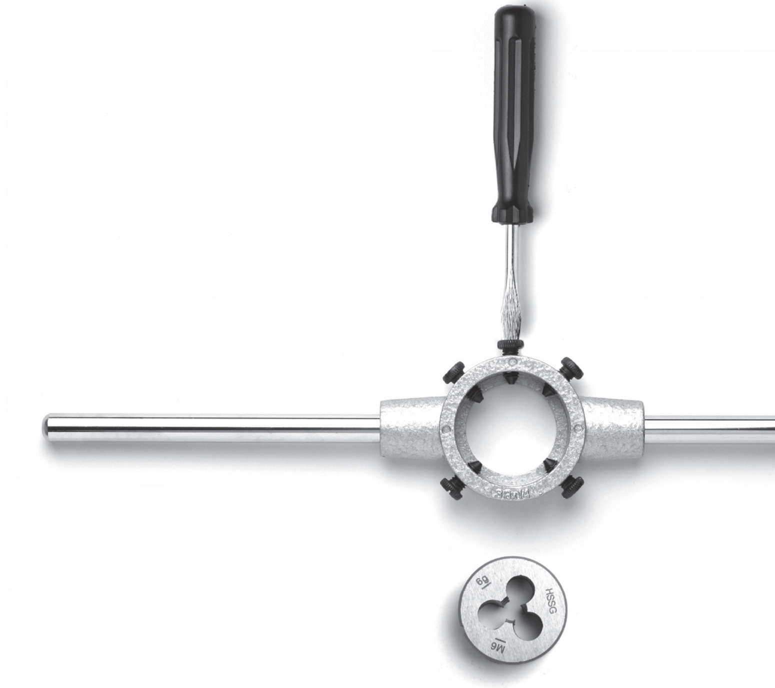
BREAKING OF THE TAP
Hole too small, worn tap, wrong rake angle, chamfer too short (wrong tap). Cutting speed too high, chamfer too long.

EXTERNAL THREAD

WHICH TOOLS DO YOU NEED?

ROUND DIE EN 22568 (PREVIOUSLY = DIN 223)
For cutting external threads according to the ISO standards of metric coarse threads M1 to M68 and metric fine threads M1 to M56 preslotted (Form B) round dies are used. Round dies with an outer diameter of d = 16 mm or d = 20 mm have three chip holes. Larger sizes have four or more chip holes. The round dies can be used from both sides as the cutting parts are on both sides:
The round dies are preslotted and can be used with deviant thread tolerances.





ROUND DIE HOLDER
Round die holders for round dies with the outer diameters of d = 16 mm and d = 20 mm have four locking screws. The larger round die holders have five sharpened locking screws.
The handles are unscrewable on both sides. They are made from steel with a polished and zinc coated surface. The body is manufactured by zinc die-casting according to DIN 1743.

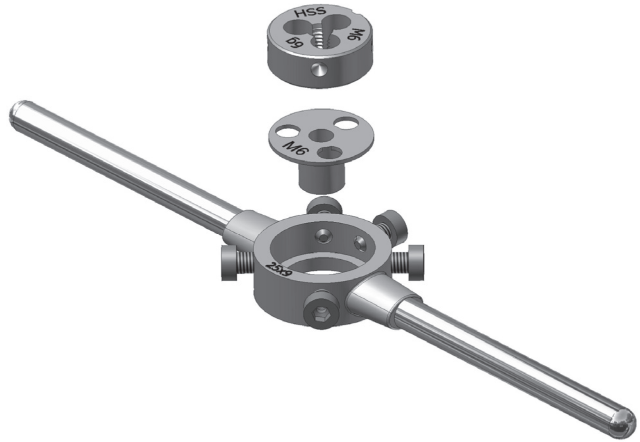
PRODUCTION OF EXTERNAL THREADS

The core hole is drilled with a twist drill. You can find the required twist drill diameter in the table. Important: The core hole for blind holes must be drilled to the tap point deeper than the required thread. We recommend to lower the core hole to the thread diameter.

Attach the tap into the adjustable tap wrench or into the tool-holder with ratchet for lower sizes. Pay attention that the screw thread of the arm of the adjustable tap wrench is fixed properly. Apply the tap vertically to the drilling. Rotate the mounted tap clockwise into the drilling. After each half-turn the chip must be broken by rotating back again.

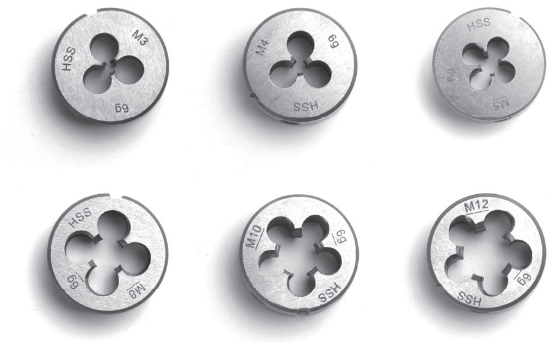
HINT!

For easier cutting there are die guides. The guides are fastened together with the round dies in the round die holder. The guide tube has exactly the same diameter as the bolt on which the thread is going to be cut. Therefore the cutting runs plump-line and the flanks are cut accurately. The round die guides are made from aluminium and produced in the die-casting process. They have chip holes such as round dies to take away the chippings.



▸ TIPP!

COMBINATION ROUND DIE ACCORDING TO FACTORY STANDARD (SIMILAR TO DIN EN 22568)
Round dies with the same outer diameter of d = 25mm for the sizes M3, M4, M5, M6, M8, M10 and M12 are called combination round dies. Their outer diameter differs from the DIN EN standard. Thus, the user needs only one die holder size 25×9 mm for the sizes M3 to M12.

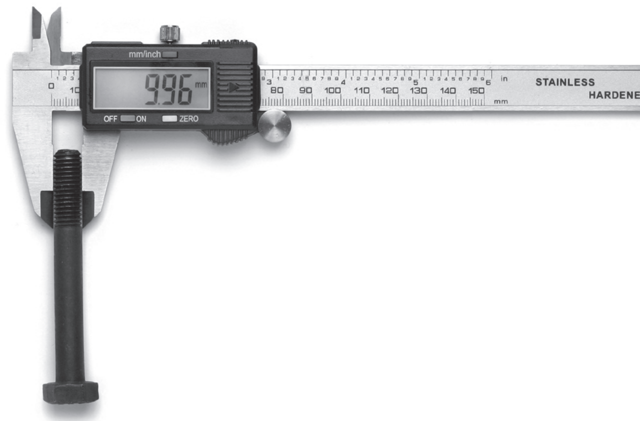


THREAD IDENTIFICATION

WHICH TOOLS TO YOU NEED?

PITCH GAUGE

Pitch gauges are suitable for internal and external measurements of the pitch of a thread. They work under the light gap method. The gauge is placed on the thread and it will be tested whether the pitch of the thread matches together with the gauge. Each sheet represents one pitch of a thread. Several gauge sheets are summarized in a fanlike fixture. There are different combination of sheets for metric threads and inch threads from 6 sheets up to 58 sheets in just one tool.



CALIPER

The calipers have cross-tips, depth gauge and a locking screw. The precision mechanics is made of stainless steel and hardened. There are analog models and measurement tools with digital display. They have the advantage that you can switch between inch and metric units.

HOW IS IT FUNCTIONING?

To identify an unknown thread two information are necessary: the pitch and the outer diameter for a bolt thread and the inner diameter of a nut thread. The pitch of a thread is the distance from one flank to the other in mm for metric systems or the number of pitches per inch for inch threads.

First you measure the diameter of the thread with a caliper. The digital caliper offers inch and metric units. The diameter will show you whether it is a metric or an inch thread. You continue with the pitch gauge. Please test the single sheets until one of them fits precisely into the thread. Then you can read the pitch of the thread on the gauge which is printed onto it. Now you can identify the thread type from the table.

It is difficult to use the thread gauge in an internal thread without damaging the workpiece or without usage of expensive measuring instruments. Nevertheless it is possible to get usable results by roughly measuring and trying.

THE STEPS ARE AS FOLLOWS:

With the caliper you measure the diameter of the core hole of the internal thread. In the tables on page 44ff you find the corresponding nominal size to the core hole diameter. With the nominal size and the core hole diameter you can calculate the pitch for metric threads according to the formula:

Core hole diameter = Nominal size - Pitch

If there is more than one result you have to experiment carefully with suitable pitch gauges, taps or screws.

THREAD REPAIR

WHICH TOOLS DO YOU NEED?

SPECIAL - TWIST DRILL

The twist drill DIN 338 (> see page 12) drills out the broken thread and creates at the same time the core hole for the use of the special tap.

SCREW TAP

With the screw tap the thread for the thread insert is cut. The size does not match to the usual thread sizes.

THREAD INSERTS

Thread inserts made of stainless steel ensure a very high corrosion resistance and heat resistance. The profile is rhombic. The wire is rolled to an elastic spring. A lag pin is located at the bottom end. While installing the screw insert the spring gets tension and holds the inserts into the external thread. Therefore the thread insert is longer when installed than in the original state. There are different sizes which are oriented to the thread diameter.

Thread inserts

INSTALLATION HANDLE

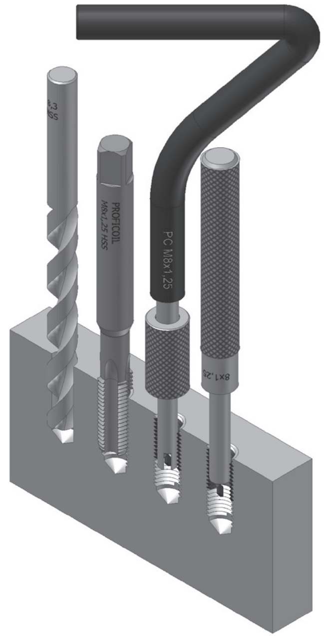
With the installation handle the thread inserts are screwed in.

BREAK TOOL

With the break tool the lag pin is chipped off.

Thread repair inserts are used to repair or to reinforce a thread while maintaining the initial diameter. Primary by aluminium, magnesium, titanium, copper and steel.

Installation handle and break tool



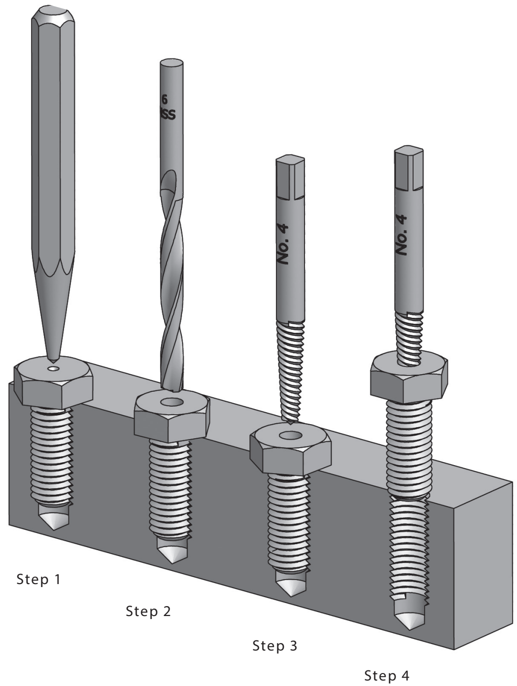
FUNCTIONING

First, we drill out the damaged thread. Therefor the appropriate twist drill has to be used. Then the hole is cleaned. After that a thread is cut into the new core hole with the screw tap. With the installation tool the thread insert is screwed in and with the break tool the lag pin is chipped off. The thread insert if fixed now. The insert can be shortened with a wire cutter to the desired length.

▸ HINT!

SCREW EXTRACTOR

Screw extractors allow the unscrewing of broken screws.
First a centered hole is drilled into the screw, after the center was professionally center punched with a center punch. Then the screw extrator is screwed in anti-clockwise in the hole. You can use an adjustable tap wrench or a toolholder Without ratchet as holding tool.



METRIC THREAD

M	Pitch in mm	max. core hole size	Drill ø	Tap ø
M 1	0,25	0,785	0,75	0,97
M 1,2	0,25	0,985	0,95	1,17
M 1,4	0,3	1,142	1,10	1,36
M 1,6	0,35	1,312	1,25	1,54
M 1,7	0,35	1,346	1,30	1,66
M 1,8	0,35	1,484	1,45	1,74
M 2	0,4	1,679	1,60	1,94
M 2,2	0,45	1,813	1,75	2,13
M 2,3	0,4	1,941	1,90	2,25
M 2,5	0,45	2,115	2,05	2,43
M 2,6	0,45	2,155	2,10	2,54
M 3	0,5	2,559	2,50	2,92
M 4	0,7	3,422	3,30	3,91
M 5	0,8	4,334	4,20	4,9
M 6	1,0	5,153	5,00	5,88
M 7	1,0	6,153	6,00	6,88
M 8	1,25	6,912	6,80	7,87
M 9	1,25	7,912	7,80	8,87
M 10	1,5	8,676	8,50	9,95
M 11	1,5	9,676	9,50	10,85
M 12	1,75	10,441	10,20	11,83
M 14	2,0	12,210	12,00	13,82

M	Pitch in mm	max. core hole size	Drill ø	Tap ø
M 16	2,0	14,210	14,00	15,82
M 18	2,5	15,744	15,50	17,79
M 20	2,5	17,744	17,50	19,79
M 22	2,5	19,744	19,50	21,79
M 24	3,0	21,252	21,00	23,77
M 27	3,0	24,252	24,00	26,77
M 30	3,5	26,771	26,50	29,73
M 33	3,5	29,771	29,50	32,73
M 36	4,0	32,270	32,00	35,7
M 39	4,0	35,270	35,00	38,7
M 42	4,5	37,799	37,50	41,69
M 45	4,5	40,799	40,50	44,69
M 48	5,0	43,297	43,00	47,66
M 52	5,0	47,297	47,00	51,66
M 56	5,5	50,796	50,50	55,63
M 60	5,5	54,796	54,50	59,62
M 64	6,0	58,305	58,00	63,61
M 68	6,0	62,305	62,00	67,61

METRIC-FINE THREAD

M	Pitch in mm	max. core hole size	Drill ø	Tap ø
M 2,5	0,35	2,201	2,15	2,46
M 3	0,35	2,721	2,65	2,94
M 3,5	0,35	3,221	3,15	3,45
M 4	0,5	3,599	3,50	3,93
M 4,5	0,5	4,099	4,00	4,45
M 5	0,5	4,599	4,5	4,93
M 6	0,75	5,378	5,20	5,91
M 7	0,75	6,378	6,20	6,91
M 8	0,75	7,378	7,20	7,91
M 8	1	7,153	7,00	7,88
M 9	0,75	8,378	8,20	8,91
M 9	1	8,153	8,00	8,88
M 10	0,75	9,378	9,20	9,91
M 10	1	9,153	9,00	9,88
M 10	1,25	8,912	8,80	9,87
M 11	0,75	10,378	10,20	10,90
M 11	1	10,153	10,00	10,88
M 12	1	11,153	11,00	11,88
M 12	1,25	10,912	10,80	11,87
M 12	1,5	10,676	10,50	11,85
M 14	1	13,153	13,00	13,88
M 14	1,25	12,912	12,80	13,87

M	Pitch in mm	max. core hole size	Drill ø	Tap ø
M 14	1,5	12,676	12,50	13,85
M 15	1	14,153	14,00	14,88
M 15	1,5	13,676	13,50	14,85
M 16	1	15,153	15,00	15,88
M 16	1,5	14,676	14,50	15,85
M 18	1	17,153	17,00	17,88
M 18	1,5	16,676	16,50	17,86
M 18	2	16,210	16,00	17,82
M 20	1	19,153	19,00	19,88
M 20	1,5	18,676	18,50	19,85
M 20	2	18,210	18,00	19,82
M 22	1	21,153	21,00	21,88
M 22	1,5	20,676	20,50	21,85
M 22	2	20,210	20,00	21,82
M 24	1	23,153	23,00	23,88
M 24	1,5	22,676	22,50	23,85
M 24	2	22,210	22,00	23,82
M 27	1	26,153	26,00	26,88
M 27	1,5	25,676	25,50	26,85
M 27	2	25,210	25,00	26,82
M 30	1	29,153	29,00	29,88
M 30	1,5	28,676	28,50	29,85

METRIC-FINE THREAD

M	Pitch in mm	max. core hole size	Drill ø	Tap ø
M 30	2	28,210	28,00	29,82
M 33	1,5	31,676	31,50	32,85
M 33	2	31,210	31,00	32,82
M 33	3	30,252	30,00	32,76
M 36	1,5	34,676	34,50	35,85
M 36	2	34,210	34,00	35,82
M 36	3	33,252	33,00	35,76
M 39	1,5	37,676	37,50	38,85
M 39	2	37,210	37,00	38,82
M 39	3	36,252	36,00	38,76
M 42	1,5	40,676	40,50	41,85
M 42	2	40,210	40,00	41,82
M 42	3	39,252	39,00	41,76
M 42	4	38,270	38,00	41,72
M 45	1,5	43,676	43,50	44,85
M 45	2	43,210	43,00	44,82
M 45	3	42,252	42,00	44,76
M 45	4	41,270	41,00	44,72
M 52	1,5	50,676	50,50	51,85
M 52	2	50,210	50,00	51,82
M 52	3	49,252	49,00	51,76
M 52	4	48,270	48,00	51,70

ZOLLGEWINDE

Nominal ø	Inch	BSW	UNC	UNF	UNEF	BSF	Core ø	Bolt ø	Outside ø
Inch	Decimal	Pitch/“	Pitch/“	Pitch/“	Pitch/“	Pitch/“	mm	mm	mm
Nr. 0	0,0598	—	—	80	—	—	1,20	1,49	1,520
Nr. 1	0,0728	—	64	72	—	—	1,50	1,79	1,850
Nr. 2	0,0858	—	56	64	—	—	1,80	2,10	2,180
Nr. 3	0,0992	—	48	56	—	—	2,10	2,41	2,520
Nr. 4	0,1122	—	40	48	—	—	2,40	2,77	2,850
Nr. 5	0,1248	—	40	44	—	—	2,60	3,09	3,170
Nr. 6	0,1378	—	32	40	—	—	2,90	3,41	3,500
Nr. 8	0,1638	—	32	36	—	—	3,50	4,02	4,160
Nr. 10	0,1902	—	24	32	—	—	4,00	4,71	4,830
Nr. 12	0,2161	—	24	28	32	—	4,60	5,37	5,490
1/16"	0,0625	60	—	—	—	—	1,20	1,55	1,587
3/32"	0,0937	48	—	—	—	—	1,90	2,30	2,381
1/8"	0,1250	40	—	—	—	—	2,60	3,09	3,175
5/32"	0,1563	32	—	—	—	—	3,20	3,88	3,969
3/16"	0,1875	24	—	—	—	32	3,80	4,61	4,762
7/32"	0,2187	24	—	—	—	28	4,60	5,43	5,556
1/4"	0,2500	20	20	28	32	26	5,10	6,17	6,350
5/16"	0,3125	18	18	24	32	22	6,50	7,76	7,938
3/8"	0,3750	16	16	24	32	20	7,90	9,30	9,525
7/16"	0,4375	14	14	20	28	18	9,30	10,90	11,113
1/2"	0,5000	12	13	20	28	16	10,50	12,44	12,700
9/16"	0,5625	—	12	18	24	16	12,30	13,90	14,288
5/8"	0,6250	11	11	18	24	14	13,50	14,82	15,876

Nominal ø	Inch	BSW	UNC	UNF	UNEF	BSF	Core ø	Bolt ø	Outside ø
Inch	Decimal	Pitch/“	Pitch/“	Pitch/“	Pitch/“	Pitch/“	mm	mm	mm
11/16"	0,6875	—	—	—	24	14	16,50	17,05	17,463
3/4"	0,7500	10	10	16	20	12	16,50	18,76	19,051
13/16"	0,8125	—	—	—	20	12	19,50	20,33	20,638
7/8"	0,8750	9	9	14	20	11	19,50	21,90	22,226
15/16"	0,9375	—	—	—	20	11	22,50	23,49	23,813
1"	1,0000	8	8	12	20	10	22,00	25,08	25,400
1 1/16"	1,0625	—	—	—	18	—	25,50	26,63	26,988
1 1/8"	1,1250	7	7	12	18	9	25,00	28,11	28,576
1 3/16"	1,1875	—	—	—	18	—	28,70	29,75	30,163
1 1/4"	1,2500	7	7	12	18	9	28,00	31,35	31,751
1 5/16"	1,3125	—	—	—	18	—	32,00	32,90	33,338
1 3/8"	1,3750	6	6	12	18	8	30,50	34,49	34,926
1 7/16"	1,4375	—	—	—	18	—	35,00	36,20	36,512
1 1/2"	1,5000	6	6	12	18	8	33,50	37,67	38,101
1 5/8"	1,6250	5	5	—	18	8	35,50	41,00	41,277
1 3/4"	1,7500	5	5	—	18	7	39,00	44,00	44,452
1 7/8"	1,8750	4,5	4,5	—	18	—	41,50	47,22	47,627
2 "	2,0000	4,5	4,5	—	18	7	44,50	50,30	50,800
2 1/4"	2,2500	4	4,5	—	—	—	50,80	56,75	57,152
2 1/2"	2,5000	4	4	—	—	—	57,15	63,05	63,502
2 3/4"	2,7500	3,5	4	—	—	—	62,00	69,25	69,853
3"	3,0000	3,5	4	—	—	—	68,95	75,75	76,203

PIPE THREAD

R ø	Inch	Pitch	Core-ø	Bolt-ø	Outside-ø
Inch	Decimal	Inch	mm	mm	mm
1/16"	0,3041	28	6,80	7,62	7,723
1/8"	0,3830	28	8,80	9,62	9,728
1/4"	0,5180	19	11,80	13,03	13,157
3/8"	0,6560	19	15,30	16,54	16,662
1/2"	0,8250	14	19,00	20,81	20,955
5/8"	0,9020	14	21,00	22,77	22,911
3/4"	1,0410	14	24,50	26,30	26,441
7/8"	1,1890	14	28,30	30,06	30,201
1"	1,3090	11	30,50	33,07	33,249
1 1/8"	1,4920	11	35,50	37,72	37,897
1 1/4"	1,6500	11	39,50	41,73	41,910
1 3/8"	1,7450	11	42,00	44,14	44,323
1 1/2"	1,8820	11	45,00	47,62	47,803
1 3/4"	1,7500	11	51,00	53,57	53,746
2 "	2,3470	11	57,00	59,43	59,614
2 1/4"	2,2500	11	63,30	65,49	65,710
2 1/2"	2,5000	11	72,80	74,97	75,184
2 3/4"	2,7500	11	79,00	81,32	81,534
3"	3,0000	11	85,50	87,67	87,884
3 1/4"	3,2500	11	91,60	93,546	93,980
3 1/2"	3,5000	11	98,00	99,896	100,330
3 3/4"	3,7500	11	104,00	106,246	106,680
4"	4,0000	11	110,50	112,596	113,030

ROTATIONAL SPEED / CUTTING SPEED

Drilling ø	1	2	3	4	5	6	7	8	9	10	11	12	13
U/Min	**Cutting Speed**												
100	0,3	0,6	0,9	1,3	1,6	1,9	2,3	2,5	2,8	3,1	3,5	3,8	4,1
200	0,6	1,3	1,9	2,5	3,1	3,8	4,6	5,0	5,7	6,3	6,9	7,5	8,2
300	0,9	1,9	2,8	3,8	4,7	5,7	6,9	7,5	8,5	9,4	10,4	11,3	12,3
400	1,3	2,5	3,8	5,0	6,3	7,5	9,2	10,1	11,3	12,6	13,8	15,1	16,3
500	1,6	3,1	4,7	6,3	7,9	9,4	11,5	12,6	14,1	15,7	17,3	18,9	20,4
600	1,9	3,8	5,7	7,5	9,4	11,3	13,8	15,1	17,0	18,9	20,7	22,6	24,5
700	2,2	4,4	6,6	8,8	11,0	13,2	16,1	17,6	19,8	22,0	24,2	26,4	28,6
800	2,5	5,0	7,5	10,1	12,6	15,1	18,3	20,1	22,6	25,1	27,6	30,2	32,7
900	2,8	5,7	8,5	11,3	14,1	17,0	19,8	22,6	25,5	28,3	31,1	33,9	36,8
1000	3,1	6,3	9,4	12,6	15,7	18,9	22,0	25,1	28,3	31,4	34,6	37,7	40,8
1100	3,5	6,9	10,4	13,8	17,3	20,7	24,2	27,6	31,1	34,6	38,0	41,5	44,9
1200	3,8	7,5	11,3	15,1	18,9	22,6	26,4	30,2	33,9	37,7	41,5	45,2	49,0
1300	4,1	8,2	12,3	16,3	20,4	24,5	28,6	32,7	36,8	40,8	44,9	49,0	53,1
1400	4,4	8,8	13,2	17,6	22,0	26,4	30,8	35,2	39,6	44,0	48,4	52,8	57,2
1500	4,7	9,4	14,1	18,9	23,6	28,3	33,0	37,7	42,4	47,1	51,8	56,6	61,3
1600	5,0	10,1	15,1	20,1	25,1	30,2	35,2	40,2	45,2	50,3	55,3	60,3	65,4
1700	5,3	10,7	16,0	21,4	26,7	32,0	37,4	42,7	48,1	53,4	58,8	64,1	69,4
1800	5,7	11,3	17,0	22,6	28,3	33,9	39,6	45,2	50,9	56,6	62,2	67,9	73,5
1900	6,0	11,9	17,9	23,9	29,8	35,8	41,8	47,8	53,7	59,7	65,7	71,6	77,6
2000	6,3	12,6	18,9	25,1	31,4	37,7	44,0	50,3	56,6	62,8	69,1	75,4	81,7
2100	6,6	13,2	19,8	26,4	33,0	39,6	46,2	52,8	59,4	66,0	72,6	79,2	85,8
2200	6,9	13,8	20,7	27,6	34,6	41,5	48,4	55,3	62,2	69,1	76,0	82,9	89,9
2300	7,2	14,5	21,7	28,9	36,1	43,4	50,6	57,8	65,0	72,3	79,5	86,7	93,9
2400	7,5	15,1	22,6	30,2	37,7	45,2	52,8	60,3	67,9	75,4	82,9	90,5	98,0
2500	7,9	15,7	23,6	31,4	39,3	47,1	55,0	62,8	70,7	78,6	86,4	94,3	102,1

DIAMETER / CUTTING SPEED

Tool ⌀	2	3	4	5	6	7	8	10	12	15	18	20	22
	Rotation speed - Row RPM												
1	637	955	1273	1591	1910	2228	2546	3183	3819	4774	5729	6365	7002
1,6	398	597	796	995	1194	1392	1591	1989	2387	2984	3581	3978	4376
1,8	354	530	707	884	1061	1238	1415	1768	2122	2652	3183	3536	3890
2	318	477	637	796	955	1114	1273	1591	1910	2387	2864	3183	3501
2,2	289	434	579	723	868	1013	1157	1447	1736	2170	2604	2893	3183
2,5	255	382	509	637	764	891	1018	1273	1528	1910	2292	2546	2801
3	212	318	424	530	637	743	849	1061	1273	1591	1910	2122	2334
3,5	182	273	364	455	546	637	727	909	1091	1364	1637	1819	2001
4	159	239	318	398	477	557	637	796	955	1194	1432	1591	1750
5	127	191	255	318	382	446	509	637	764	955	1146	1273	1400
6	106	159	212	265	318	371	424	530	637	796	955	1061	1167
7	91	136	182	227	273	318	364	455	546	682	818	909	1000
8	80	119	159	199	239	278	318	398	477	597	716	796	875
9	71	106	141	177	212	248	283	354	424	530	637	707	778
10	64	95	127	159	191	223	255	318	382	477	573	637	700
11	58	87	116	145	174	203	231	289	347	434	521	579	637
12	53	80	106	133	159	186	212	265	318	398	477	530	583
14	45	68	91	114	136	159	182	227	273	341	409	455	500
16	40	60	80	99	119	139	159	199	239	298	358	398	438
18	35	53	71	88	106	124	141	177	212	265	318	354	389
20	32	48	64	80	1899	111	127	159	191	239	286	318	350
22	29	43	58	72	87	101	116	145	174	217	260	289	318
24	27	40	53	66	80	93	106	133	159	199	239	265	292
27	24	35	47	59	71	83	94	118	141	177	212	236	259
30	21	32	42	53	64	74	85	106	127	159	191	212	233

$$\text{ROTATIONAL SPEED} = \frac{\text{Cutting Speed} \times 1000}{\text{Diameter} \times 3{,}14} = n = \frac{v \times 1000}{d \times \pi} = \text{U/min.}$$

CUTTING SPEED

Material	Example	Cutting Material	Cutting Speed (m/min)		
			Drilling	Reaming	Tapping
Unalloyed carbon steel	St 37	HSS HSS Coated Carbide	25 28 100	10 12 30	10 12 —
Carbon Steel	C 45	HSS HSS Coated Carbide	18 20 60	6 8 20	8 10 —
Stainless Steel	V 2 A	HSS HSS Coated Carbide	8 10 30	4 6 12	5 5 —
Gray cast iron	GG25	HSS HSS Coated Carbide	18 22 60	6 8 20	10 12 —
Aluminium alloyed	AlCuSi	HSS HSS Coated Carbide	40 50 —	20 25 —	15 18 —
Brass	Ms57	HSS HSS Coated Carbide	40 50 —	20 25 —	15 18 —

These are guidelines which can differ in practice.

GSR Gustav Stursberg GmbH

Schmiedestraße 4
42899 Remscheid, Germany

Fon +49 (0) 21 91 - 58 33
Fax +49 (0) 21 91 - 52 769
Mail info@gsr-germany.de
Web www.gsr-germany.de