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National Aerospace University
«Kharkiv Aviation Institute»

JOINTS IN MACHINERY

Manual

Kharkiv «KhAI» 2019

UDC 744:62–112.83(075.8)
J74

Подано геометричні параметри й розміри та класифікацію профілю різей. Розглянуто основні типи нарізних з'єднань, що застосовуються в машинобудуванні. Викладено розрахункові методи геометричних параметрів нарізних з'єднань. У додатку наведено довідкові матеріали й приклади виконання завдань.

Для студентів технічних спеціальностей усіх форм навчання.

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Geometrical parameters and dimensions of a screw thread profile and thread classification are represented. Basic types of threaded joints applied in machinery are mentioned. Calculation methods of threaded joints geometrical parameters are also considered. Reference sources on threaded fastenings and some technological elements are given in appendix.

For students of mechanical specialties for carrying out threaded joints assignment and as reference data on fastenings and some shaft components.

Figs. 31. Tables 23. Bibliogr. : 14 names

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INTRODUCTION

Drawing is one of the oldest and most basic forms of communication.

Before language, cave dwellers communicated by drawing simple figures on the walls of caves.

As the world became more and more complex, the need for drawings increased.

The ability to read and interpret drawings is needed in many occupations.

Drawings can be used to convey simple and complex messages in a clear and precise manner.

Information can be given and ideas expressed using drawings and graphics that would take thousands of words to express.

A drawing is a graphic representation of an idea in the mind of the person creating the drawing.

Object details such as size, shape and locational relationships can be clearly described with drawings.

Drawing is a communicational tool.

Drawing is one of the first communication technologies.

Still the closest thing to a universal language form.

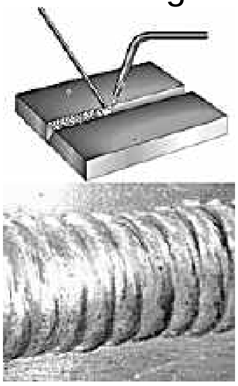
Drawing is one of the first communication technologies and the closest thing to a universal language form.

THREADS AND FASTENERS

A machine element used for holding or joining two or more parts of a machine or structure is known as a fastener. The process of joining the parts is called fastening. The fasteners are of two types: permanent and detachable (removable, temporary).

Permanent joints. Riveting and welding processes are used for fastening permanently (Fig. 1).

Welding



Gluing

Riveting

Fig. 1. Permanent joints

Temporary joints. Screwed fasteners such as bolts, studs and nuts in combination, machine screws, set screws, and keys, cotters, are used for fastening components that require frequent assembly and disassembly (Fig. 2).

Threaded fastener
– bolts
– studs
– screws

Non threaded fasteners
– keys
– pins

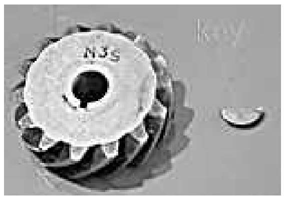


Fig. 2. Temporary (detachable) joints

Screw fastenings threads

Screw threads are vital to industry. They are designed for hundreds of different purposes. The three basic applications are as follows:

1. To hold parts together.
2. To provide for adjustment between parts.
3. To transmit power.

The shape of the helical (spiral shaped) thread is called a thread form. The metric thread form is an international standard. Other thread forms are used in specific applications. Threads are generally cut on a machine called a lathe. On a small-size screw, thread is often cut by means of a tool called a die. A small-size hole is threaded by means of a tool called a tap. Such a hole is called a tapped hole.

Thread elements definitions

Various parts of a screw thread are shown in Fig. 3 and defined below.

Crest: The crest is the outer-most part of a thread.

Root: The root is the inner-most portion of a thread.

Flank: The surface between the crest and the root is called the flank of the thread.

Angle: It is the angle between the flanks, measured on an axial plane.

Depth: The depth is the distance between the crest and the root, measured at right angles to the axis. It is equal to half the difference between the outside diameter and the core diameter.

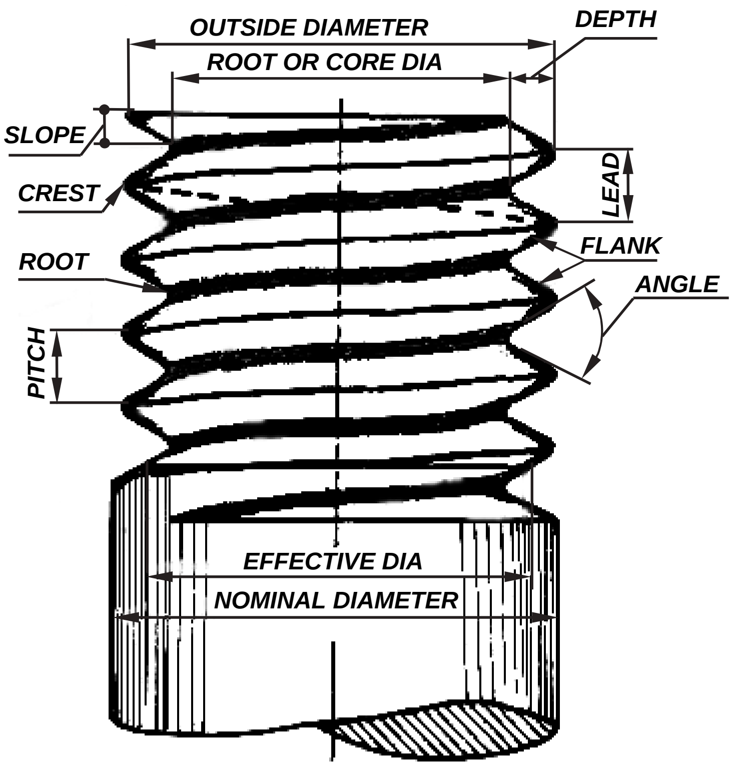


Fig. 3. Parameters of a Screw Thread

Nominal diameter: It is the diameter of the cylindrical piece on which the thread is cut. The screw is specified by this diameter.

Outside or major diameter: It is the diameter at the crest of the thread measured at right angles to the axis of the screw.

Core or minor diameter: It is the diameter at the core or root of the thread. It is the smallest diameter of the screw and is equal to the outside diameter minus twice the depth of the thread.

Effective (pitch) diameter: It is equal to the length of the line, perpendicular to and passing through the axis, and measured between the points where it cuts the flanks of the thread.

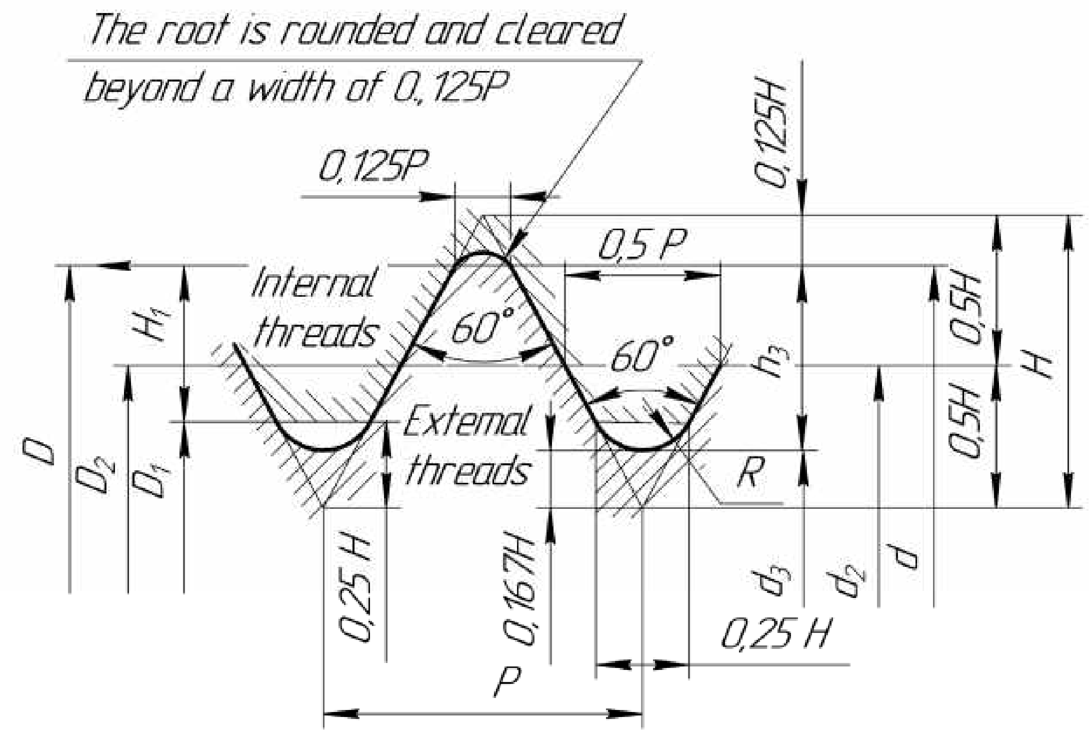
Pitch: It is the distance measured parallel to the axis, between a point on one thread form and a corresponding point on the adjacent thread form, i.e. from crest to crest or root to root. It may also be described as the reciprocal of the number of thread forms per unit length, i. e. p = 1/n.

Lead: It is the distance measured parallel to the axis from a point on a thread to a corresponding point on the same thread after one complete revolution. It can also be described as the distance moved by a nut in the axial direction in one complete revolution. The lead is equal to the pitch in case of single-start threads.

Slope: The slope of a thread is equal to half the lead.

Form: The cross section of thread cut by a plane containing the axis.

Series: The standard number of threads for various diameters.



Internal thread diameters:
D – Major diameter
D_2 – Pitch diameter
D_1 – Minor diameter
H_1 – Effective thread height

External thread diameters:
d – Major diameter
d_2 – Pitch diameter
d_3 – Minor diameter

Fig. 4. Parameters of a screw-nut thread joints

Forms of screw threads

There are two main forms of screw threads: triangular or V thread (Fig. 5, *a*, *b*) and square thread (Fig. 5, *e*). Other forms are either modified forms of a square or triangular thread or a combination of the two forms.

Metric thread (Fig. 5, *a*): This thread is based on metric standard system and recommended for use in many countries where metric standard system is in use. The form of thread is based on triangular or V thread profile. The angle of the thread is 60°. Root of a thread is rounded, while the crests are cut parallel to the axis of the screw.

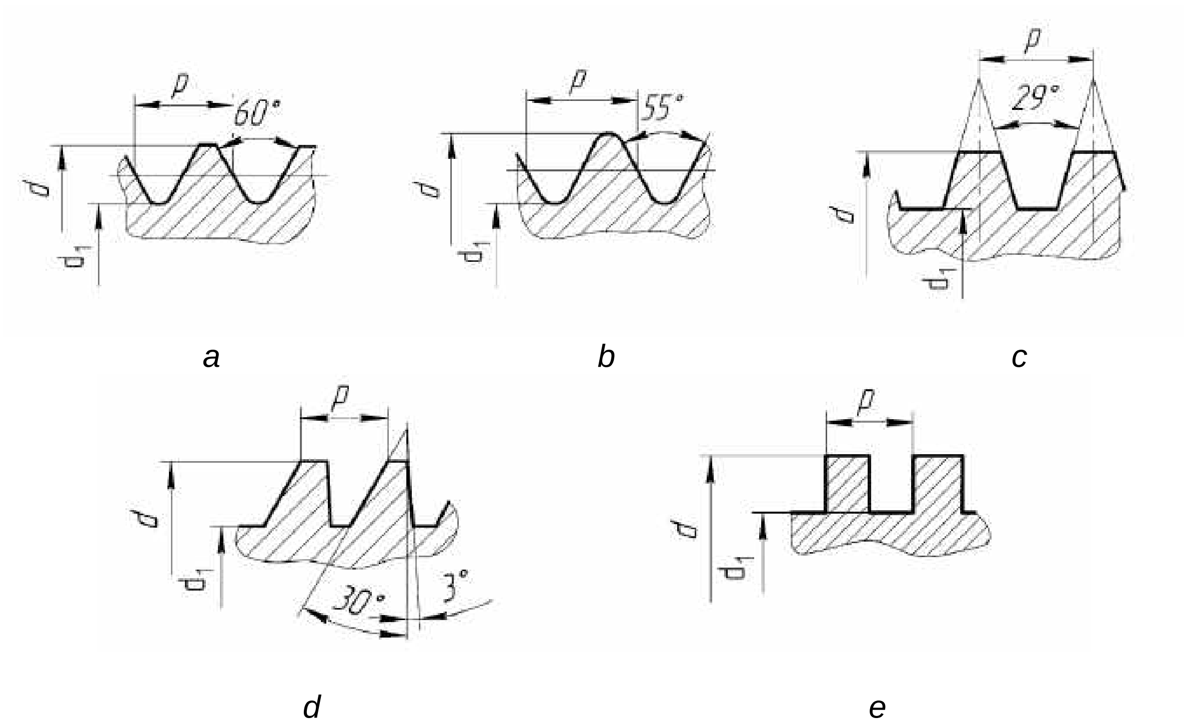


Fig. 5. Thread profiles: *a* – Metric; *b* – Whitworth; *c* – Acme; *d* – Buttress; *e* – Square; *d* – outside diameter; d_1 – root (core) diameter; *P* – pitch

Square thread (Fig. 5, *e*): This thread has its flanks or sides normal to the axis and hence, parallel to each other. It is generally used for transmission of power. It is also used for obtaining larger axial movement of the nut or the screw per revolution. For the same nominal diameter of the screws, the pitch of the square thread is usually greater than that of the triangular thread. The depth and the thickness of the thread are each equal to half the pitch.

Acme thread (Fig. 5, *c*): This thread is a modification of the square thread (Fig. 5, *e*) and is also known as trapezoidal thread. It is easier to cut and is stronger at the root than the square thread. It is particularly used where the nut, which is made in two parts, is required to engage with or disengage from a screw at frequent intervals as in the lead-screw of the lathe. The thread angle is 29°.

Buttress thread (Fig. 5, *d*): This thread is a combination of the triangular and the square threads. One flank of the thread is almost perpendicular to the axis of the screw (inclination angle 4°), while the other flank is inclined to the axis at 30°. Thus the angle between two flanks is 34°. Root and crest of a thread are cut parallel to the axis of the screw. This thread is suitable only when the force acts entirely in one direction form almost perpendicular flank. Its use is commonly made in the screw of a bench-vice.

Knuckle thread: This thread is also a modification of the square thread. It is formed by rounding off the corners of the square thread to such an extent that it has a completely rounded profile. Its section comprises of semi-circles of radius R = 0,25P. This thread can withstand heavy wear and rough usage.

They are used in coupler of railway carriages and thing shells joints like electrical bulbs, etc.

Classification of screw threads

Destination: *fastening* and *sliding* threads.

Fastening threads are used in screwed joints to provide permanent connection between two or more parts in assembly, like between vacuum camera and mounting flange, or between cylinder-cover and engine cylinder, etc. (Fig. 6).

Sliding threads are generally used for transmission of power. They are also used to transform rotational motion into translational one and vice versa like in worm-gearing. They are used in lead-screw of lathe machine, jack screws and vices.

Location: *external* and *internal* threads.

A thread, cut on the outer surface of a screw, is called an external thread, while that cut in a hole, is called an internal thread.

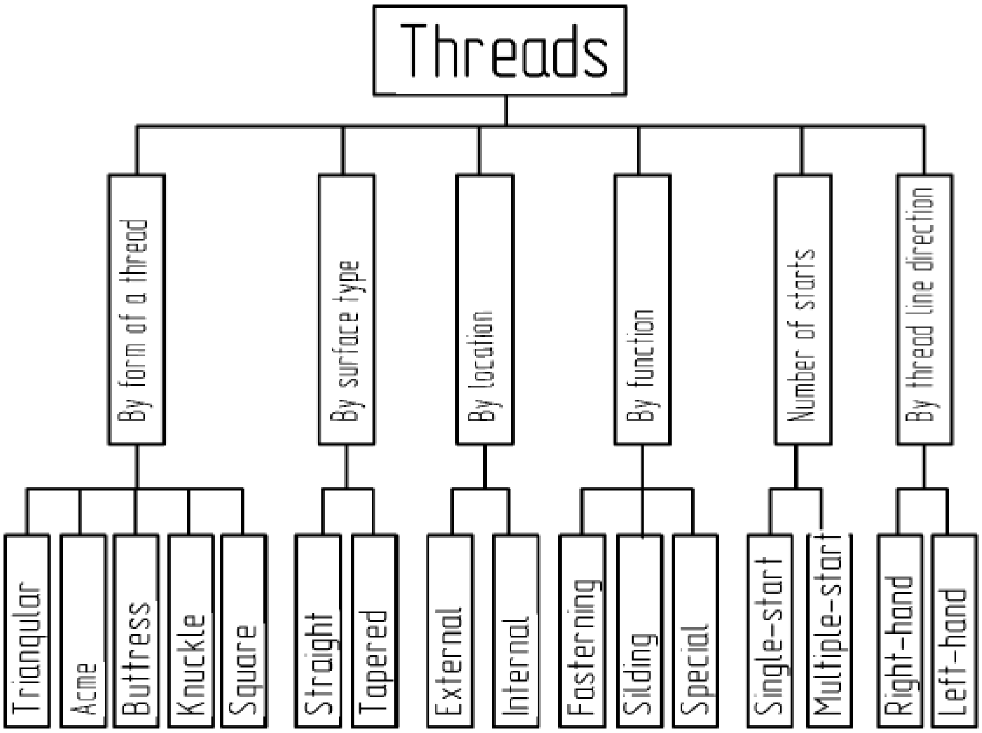


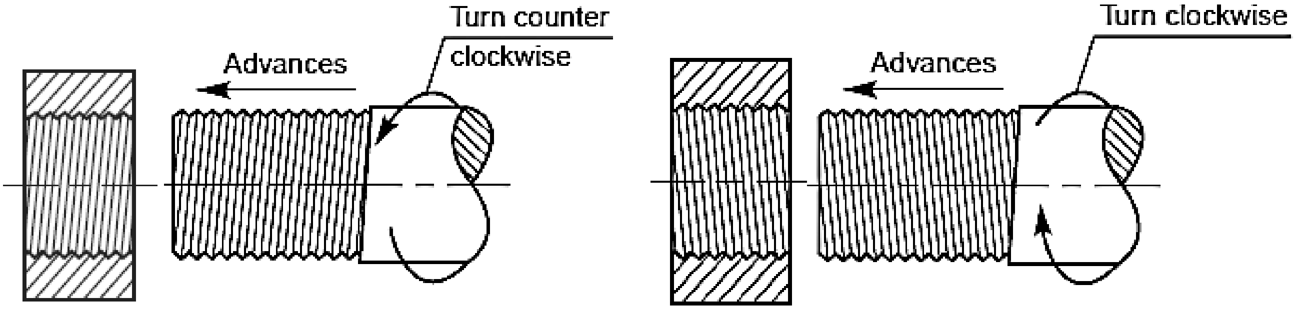
Fig. 6. Classification of screw threads

Surface type: *Straight* or *taper(ed)* threads.

A thread, cut on the cylindrical surface of a screw or a nut, is called a straight thread, while that cut on the conical surface, is called a taper or tapered thread.

Thread line direction: *Right-hand* and *Left-hand* threads.

Screw threads may be right-hand or left-hand, depending on the direction of the helix (Fig. 7).



Left hand Right hand

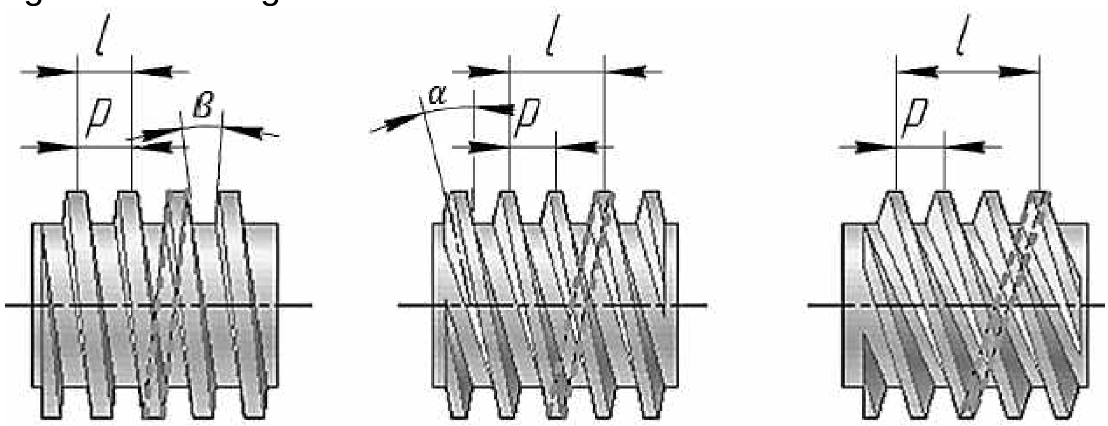
Fig. 7. Right-hand and left-hand threads

A right-hand thread is one which advances into the nut, when turned in a clockwise direction and a left-hand thread is one which advances into the nut when turned in a counter clockwise direction. An abbreviation LH is used to indicate a left-hand thread. Unless otherwise stated, a thread should be considered as a right-hand one. Fig. 7 illustrates both right and left hand thread forms.

No of starts: *Single* or *multiple start* threads.

A single-start thread consists of a single, continuous helical groove for which the lead is equal to the pitch. As the depth of the thread depends on the pitch, greater the lead desired, greater will be the pitch and hence smaller will be the core diameter, reducing the strength of the fastener. To overcome this drawback, multi-start threads are recommended.

Fig. 8 shows single and multi-start threads.



a *b* *c*

Fig. 8. Single-start: pitch and lead equal, Double-start: lead twice the pitch,

Triple-start: lead three times pitch

In multi-start threads, lead may be increased by increasing the number of starts, without increasing the pitch. For a double-start thread, lead is equal to twice the pitch and for a triple-start thread lead is equal to thrice the pitch.

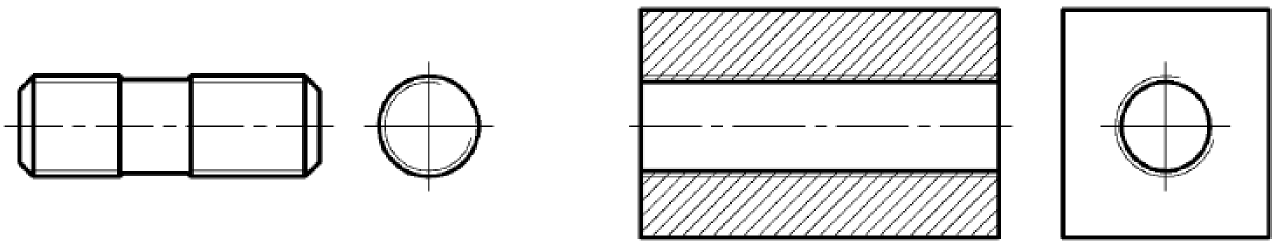
In double-start threads, two threads are cut separately, starting at points, diametrically opposite to each other. In triple-start threads, the starting points are 120° apart on the circumference of the screws.

Multi-start threads are also used wherever quick action is desired, as in fountain pens, automobile starters, arbor press spindles, hydraulic valve spindles, etc.

Representation of threads

The true projection of a threaded portion of a part consists of a series of helices and it takes considerable time to draw them. Hence it is the usual practice to follow some conventional methods to represent screw threads.

Fig. 9 shows orthographic projection of a screw thread, where conventional representation of external and internal threads is shown according to ISO and USDD recommendations.



External thread Internal thread

Fig. 9. Conventional representation of threads

It may be noted from Fig. 10, that the crests of screw threads are indicated by a continuous thick line and the roots, by a continuous thin line.

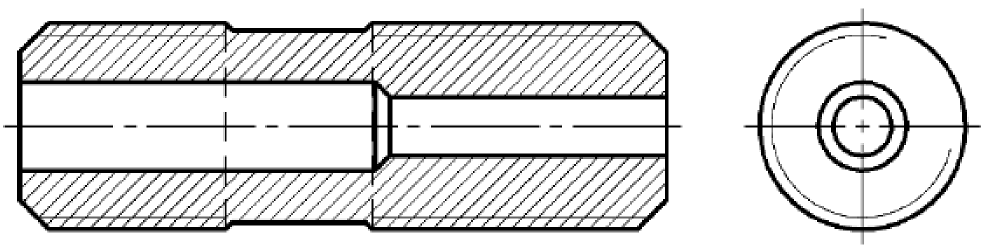


Fig. 10. Conventional representation of threads in section

For threaded parts in section, hatching should be extended to the line defining the crest of the thread. In the view from side, the threaded roots are represented by a portion of a circle, drawn with a continuous thin line, of length approximately three-quarters of the circumference.

The limit of useful length of screw threads is represented by a continuous thick line. The length up to which the incomplete threads are formed beyond the useful limit, is known as a run-out. It is represented by two inclined lines.

Representation of Threaded Parts in Assembly

Fig. 11 shows the conventional representation of threads in engagement.

In the Fig. 11 the external threaded parts are shown covering the internal threaded parts and should not be shown as hidden by them.

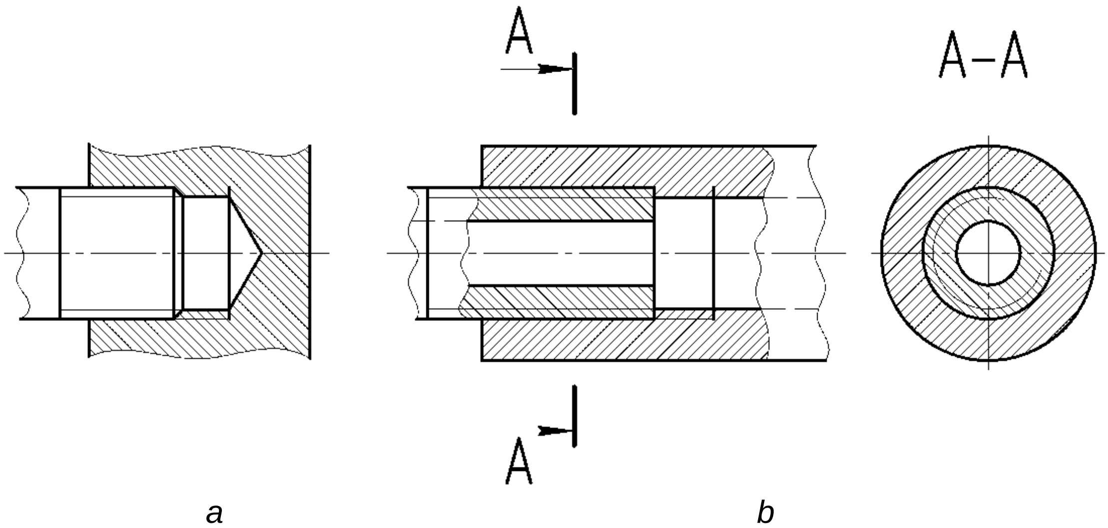


Fig. 11. External and internal threads in engagement

Thread designation

The diameter-pitch combination of metric thread is designated by the letter «**M**» followed by the value of the nominal diameter, **d** – the nominal diameter and P – pitch, the two values being separated by the symbol «×».

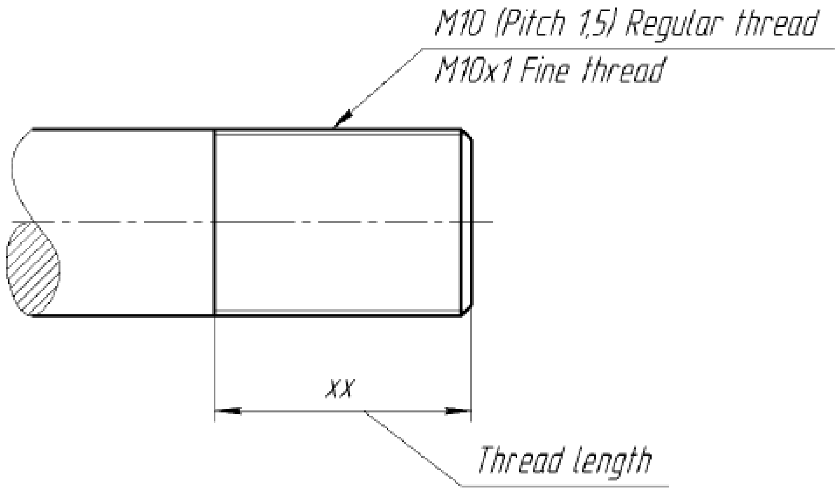


Fig. 12. Thread

For example (Fig. 12), a combination of nominal diameter 10 mm and pitch 1.25 mm is designated as **M10 × 1.25**.

If there is no indication of pitch in the designation, it means the thread of a regular (coarse) pitch. For example, **M10** means that the nominal diameter of the thread is 10 mm and pitch is 1,5 mm (see table A1).

BOLTED JOINT

Bolted joint is an assembly unit which consists of a bolt, nut, washer, cotter pin and fastening parts. A nut and a bolt comprise what is known as a screw pair (Fig. 13). Such a pair is used for fastening together parts, used in engineering construction.

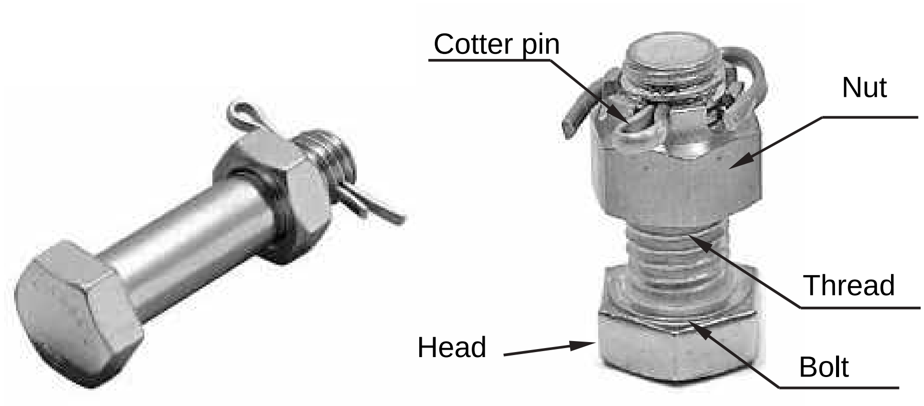


Fig. 13. Bolted joint

A bolt comprise of two parts — a shank and a head (Fig. 14). The shank is cylindrical and is threaded at the tail end for a sufficient length so as to effectively engage with a nut. The shape of the head depends upon the purpose for which the bolt is required. While considering the length of the bolt, the thickness of the head is not taken into account.

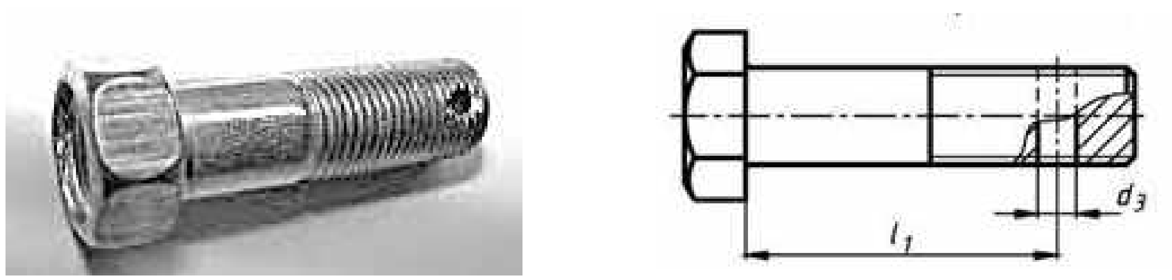


Fig. 14. Hexagonal head bolt

Nuts in general are square or hexagonal in shape (Fig. 15). For nuts, hexagonal shape is preferred to the square one, as it is easy to tighten even in a limited space. This is because, with only one-sixth of a turn, the spanner can be re-introduced in the same position. However, square nuts are used when frequency loosening and tightening is required, for example on job holding devices like vices, tool posts in machines, etc. The sharp corners on the head of bolts and nuts are removed by chamfering.

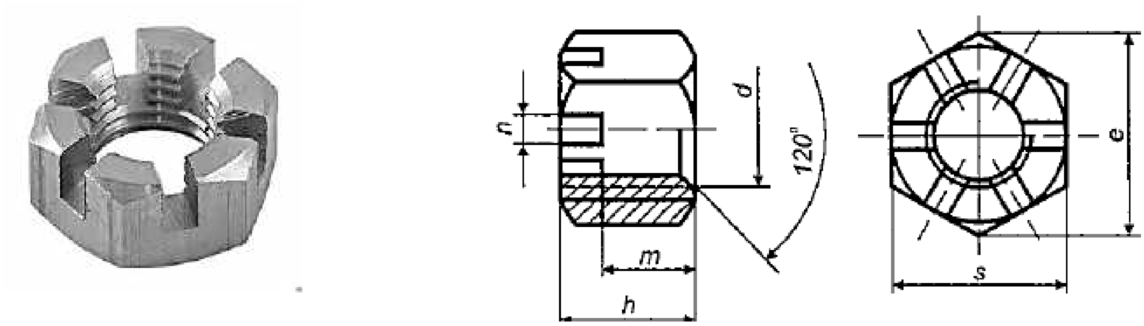


Fig. 15 Slotted nut

A washer is a cylindrical piece of metal with a hole to receive the bolt. It is used to give a perfect seating for the nut and to distribute the tightening force uniformly to the parts under the joint. It also prevents the nut from damaging the metal surface under the joint. Fig. 16 shows a washer.

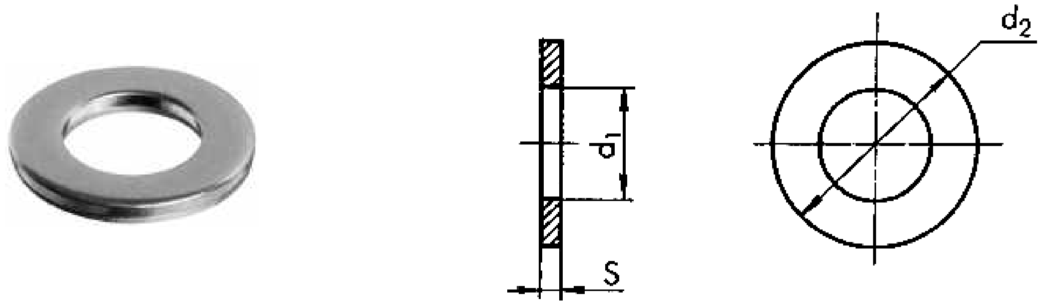


Fig. 16. Flat Washer

To prevent nut self-unfastening in bolted joints in this case use cotter pins (Fig. 17). To set cotter pins threaded ends of bolts are provided with special holes and screwed in special slotted nuts.

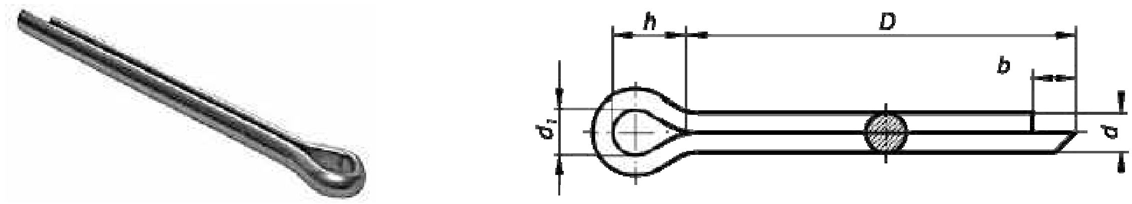


Fig. 17. Cotter pin

Diameters of holes in joining parts as a role are a little more then bolt diameter:

$$d_{hole} = (1{,}05 \ldots 1{,}1)\ d,$$

where d – nominal thread bolt diameter.

Length ***L*** of a bolt is defined by the formula:

$$L = B_1 + B_2 + S + H + a + c, \tag{1}$$

where B_1 and B_2 – thickness of joining parts;

S – height of a plain washer, GOST 11371-68 (see Table A.13);

H – height of a slotted nut GOST 5918-70 (see Table A.10);

a – extra coils of a bolt from a nut (2–3 pitches);

c – height of a chamfer (see Table A.18).

Found bolt length *L* is verified with standard values from the Table A.8 and accepted equal to a nearest standard size.

Conventional designations of bolts according to the standard are putting as follows:

– the name of a product;
– designation of bolt series;
– designation of a thread with matching tolerance zone;
– length of the bolt, ***L***;
– designation of a strength class (see Table A.2);
– designation of coating and its thickness (see Table A.4);
– number of GOST.

Designation of a bolt series 2 with nominal thread diameter ***d*** = 16 mm, fine thread with pitch 1.25 mm, tolerance zone 8g, length ***L*** = 60 mm, strength class 5.8, coating 01 thickness 6 mcm with hexagonal head GOST 7798–70:

Bolt 2M16×1.25–8g×60.58.016 GOST 7798–70.

Succession of bolted joint drawing

1. Wright down the source data of given variant from the Table 1:
   – bolt GOST;
   – thread designation;
   – thickness of joining parts.
2. Drawing of the bolted joint is located in the Fig. 18.
3. Draw three views of a bolted joint (front view, top view and left side view). Scale of a drawing is chosen depending on the real sizes of a bolted joint:
   – calculate bolt length by formula 1 and verify it with Table A.8;
   – select bolt from Tables A.6, A.7 and find parameter d_3 of the selected bolt;
   – by the found parameter d_3 select cotter pin from the Table A.12;
   – determine through hole diameter of joining part by GOST 11284–75 (see Table A.5) or calculate by the formula: $d_{hole} = (1,05…1,1)\,d$;
   – draw full sectioned front view of the bolted joint.
4. Place dimensions:
   – bolt length ***L***,
   – thickness of joining parts B_1 and B_2,
   – thread designation in bolted joint,
   – designations of standard parts (Bolt, Nut, Washer and Cotter Pin) should be placed on leaders. Sample of drawing execution is given in the Fig.19.

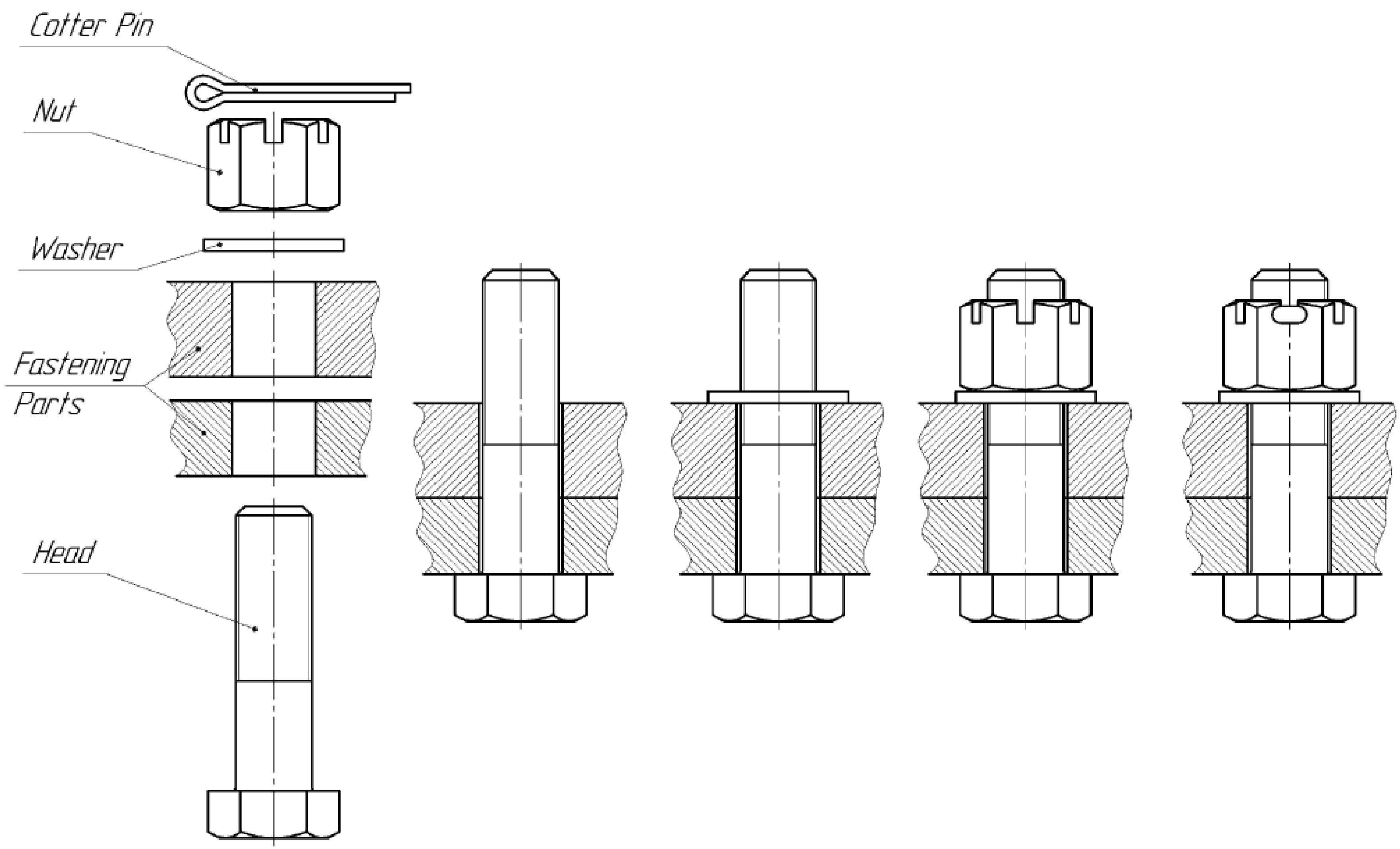


Fig. 18. Sequence of implementation of a Bolted joint

Table 1

Variants of tasks

Variant number	Bolted joint					
	Bolt made from steel 45, thread tolerance 8g. **Nut** GOST 5918–73 steel 45, thread tolerance 7H. **Cotter Pin** GOST 397–79, material subgroup 00. **Washer** GOST 11371–78, material group 06. All the parts in bolted joint are without coating					
	Bolt				**B_1**	**B_2**
	Thread	**GOST**	**Coating**			
			Type	**Thickness, mcm**		
1	M16	7798–70	Oxide	6	20	20
2	M20 × 1,5	7798–70	Zinc	4	12	25
3	M24 × 2	7798–70	Cadmium	8	25	30
4	M 20 × 1,5	7798–70	Oxide	9	12	20
5	M24	7798–70	Copper	7	20	35
6	M16	7798–70	Zinc	5	15	25
7	M24	7798–70	Cadmium	10	25	40
8	M24 × 2	7798–70	Oxide	4	30	45
9	M20	7798–70	Copper	9	20	40
10	M12	7798–70	Cadmium	7	10	30
11	M16 × 1,5	7798–70	Copper	8	15	25
12	M12	7798–70	Copper	4	15	30
13	M16	7798–70	Oxide	9	10	25
14	M20	7798–70	Zinc	6	30	25
15	M12 × 1	7805–81	Cadmium	5	20	25
16	M12	7805–81	Oxide	11	10	35
17	M20	7805–81	Copper	5	20	25
18	M20 × 1,5	7805–81	Zinc	12	25	35
19	M10	7805–81	Copper	7	25	20
20	M20	7805–81	Oxide	4	15	25
21	M16	7805–81	Cadmium	6	18	35
22	M12	7805–81	Zinc	9	15	15
23	M24 × 1,5	7805–81	Brass-nickel	8	30	30
24	M20	7805–81	Oxide	4	30	22
25	M10	7805–81	Zinc	5	12	16
26	M6 × 1	7805–81	Cadmium	11	10	12
27	M16	7805–81	Brass-nickel	6	20	30
28	M20 × 1,5	7805–81	Oxide	10	15	25
29	M16	7798–70	Copper	9	15	25
30	M12	7798–70	Oxide	4	15	30
31	M20 × 1,5	7805–81	Copper	8	25	35
32	M 24×2	7798-70	Copper	4	30	45

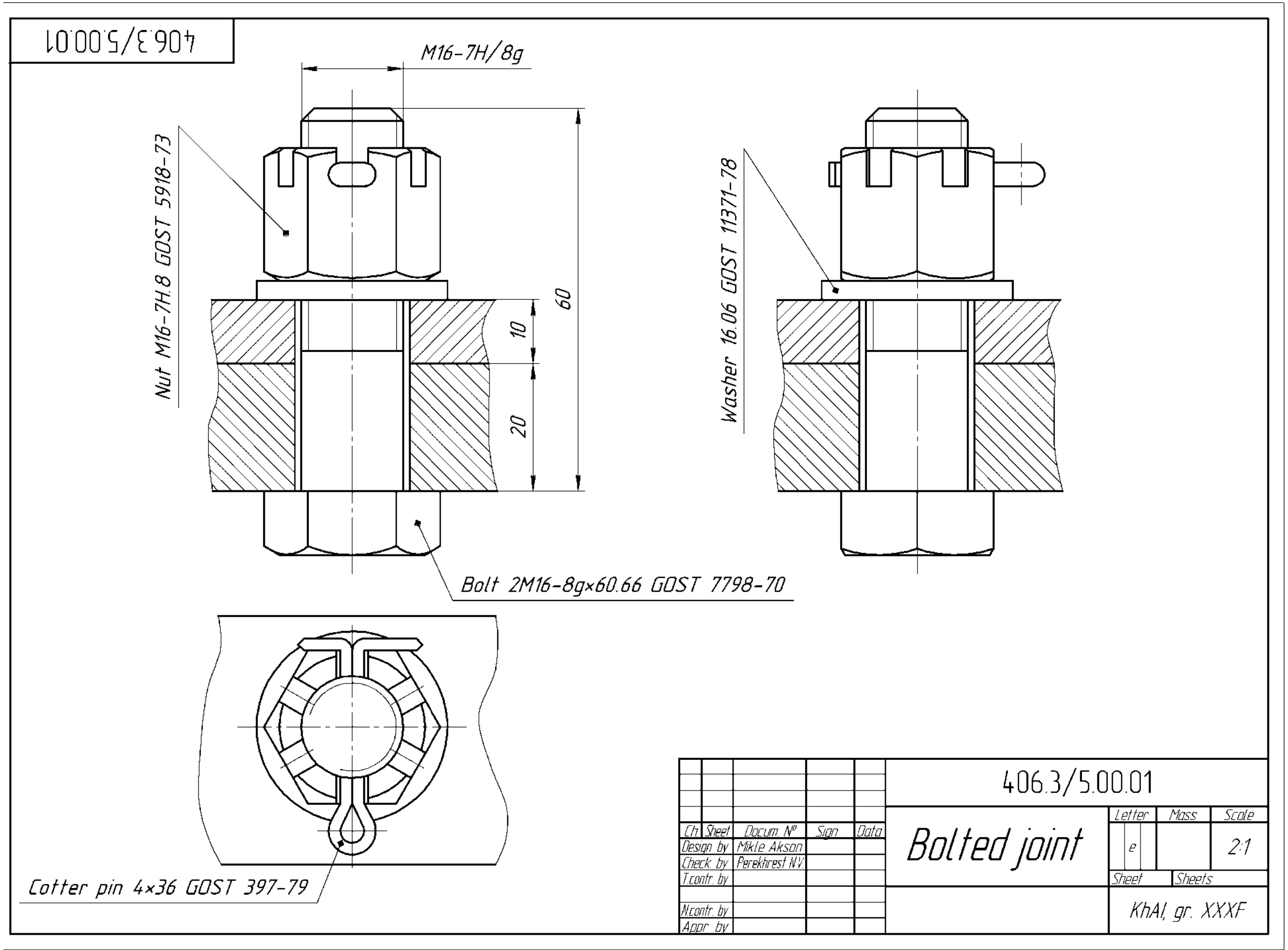


Fig. 19. Example of a Bolted joint drawing

BOLT CONNECTION WITH A BOLT STUD

Stud joint is an assembly unit which consists of a stud, nut, washer and fastening parts (Fig. 20).

The stud is used in place of a bolt, when there is insufficient space to accommodate the bolt-head or to avoid use of an unnecessarily long bolt. Studs are commonly used to connect cylinder-covers to engine cylinders (GOST 22032–76 – GOST 22040–76).

Stud consists of cylindrical shank with threads cut on both the ends (Fig. 21, *a*). It is used where there is no place for accommodating the bolt head or when one of the parts to be joined is too thick to use an ordinary bolt.

The nut-end ℓ0 (Fig. 21, *b*) is threaded for a length slightly more than the thickness of a nut or nuts to be used.

The other end **ℓ_1,** called the *metal-end* is threaded for a length at least equal to the diameter of the stud. The length of the plain part between the two ends depends upon the thickness of the piece adjoining the nut.

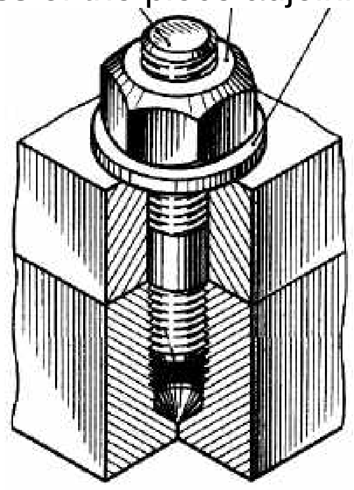
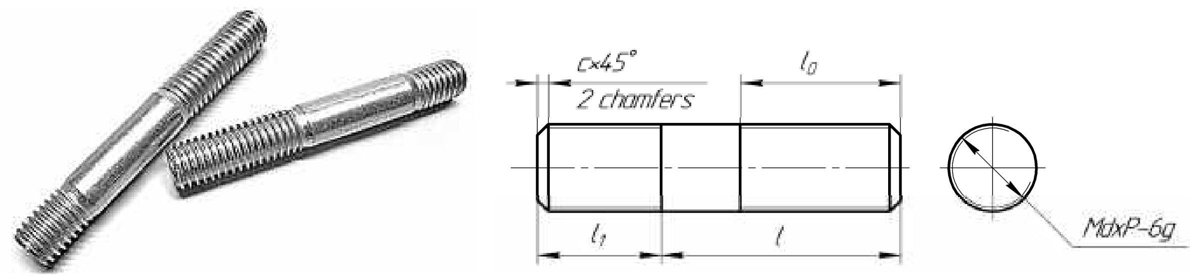


Fig. 20. Stud joint



a *b*

Fig. 21. A Stud (*a*) and drawing of a stud (*b*): **ℓ_1** – length of the *metal-end* of a stud, **ℓ_0** – length of the *nut-end* of a stud, **ℓ** – length of a stud

The sizes of studs are determined by GOST 22032–76 – GOST 22040–76 (see Table A.14), where length of the metal end ℓ_1, depends on material of a part with a threaded hole.

Areas of stud's application are listed in the Table 2 in dependence of value ℓ_1.

The sizes of studs are determined by GOST 22032–76 – GOST 22040–76 (see Table A.14) depending on length of the metal end ℓ_1, which depends on material of a part with a threaded hole.

Table 2

Standards of studs depending on the length ℓ_1

Length of the metal end	GOST	Area of application
$\ell_1 = d$	22032–76	For threaded holes in steel, bronze and brass parts where $\delta s > 8$ % and in parts made from titanium alloys
$\ell_1 = 1,25\ d$	22034–76	For threaded holes in parts made from malleable cast or grey iron where $\delta s > 8$ %
$\ell_1 = 1,6\ d$	22036–76	For threaded holes in parts made from malleable cast or grey iron. Allowed to apply in steel and bronze parts if $\delta s < 8$ %
$\ell_1 = 2\ d$	22038–76	For threaded holes in parts made from light alloys. Allowed to apply in steel parts
$\ell_1 = 2,5\ d$	22040–76	

Stud joint is carried out as follows: in one of joining parts make a blind or through threaded hole, and in the other – a hole without thread by a diameter $d_{hole} = 1.1d$ (see Table A.5).

Stud is screwed up by the screwed end of a length ℓ_1 in the first hole and freely passes through second, then on the prominent end of stud put on a washer and screw a nut. The formation of joint is shown in a Fig. 24.

Length ℓ of a stud is defined by the formula

$$\ell = B + H + S + a, \tag{2}$$

where B – thickness of a joining part;

H – height of a nut (~0,8 *d*) GOST 5915–70 (see Table A.9);

S – height of a washer, GOST 6402–70 (see Table A.11);

a – prominence of a stud from a nut (2–3 pitches);

c – height of a chamfer (see Table A.18).

Found stud length ℓ is verified with standard values from the table A.15 and accepted equal to a nearest greater standard size.

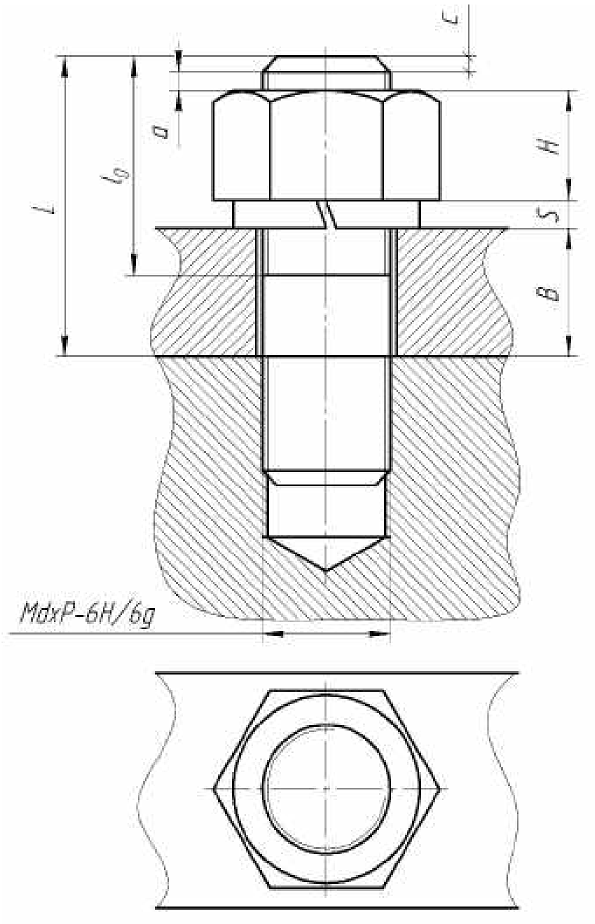


Fig. 22. Parameters of a Stud joint

Conventional designation of a stud, according to the standard, writes down in the following order:

– the name of a product;
– designation of a thread with matching tolerance zone;
– a mark «×»;
– length of a stud and a dot;
– designation of a strength class and a dot (see Table A.2);
– conventional designation of coating thickness (see Table A.4);
– number of GOST.

Designation of a stud with nominal thread diameter d=16 mm, fine thread with pitch 1,25 mm, tolerance zone 6g, length ℓ = 75 mm, strength class 6.6, coating 02 with thickness 6 mcm by GOST 22032–76.

Stud M16–6g×75.66.026 GOST 22032–76.

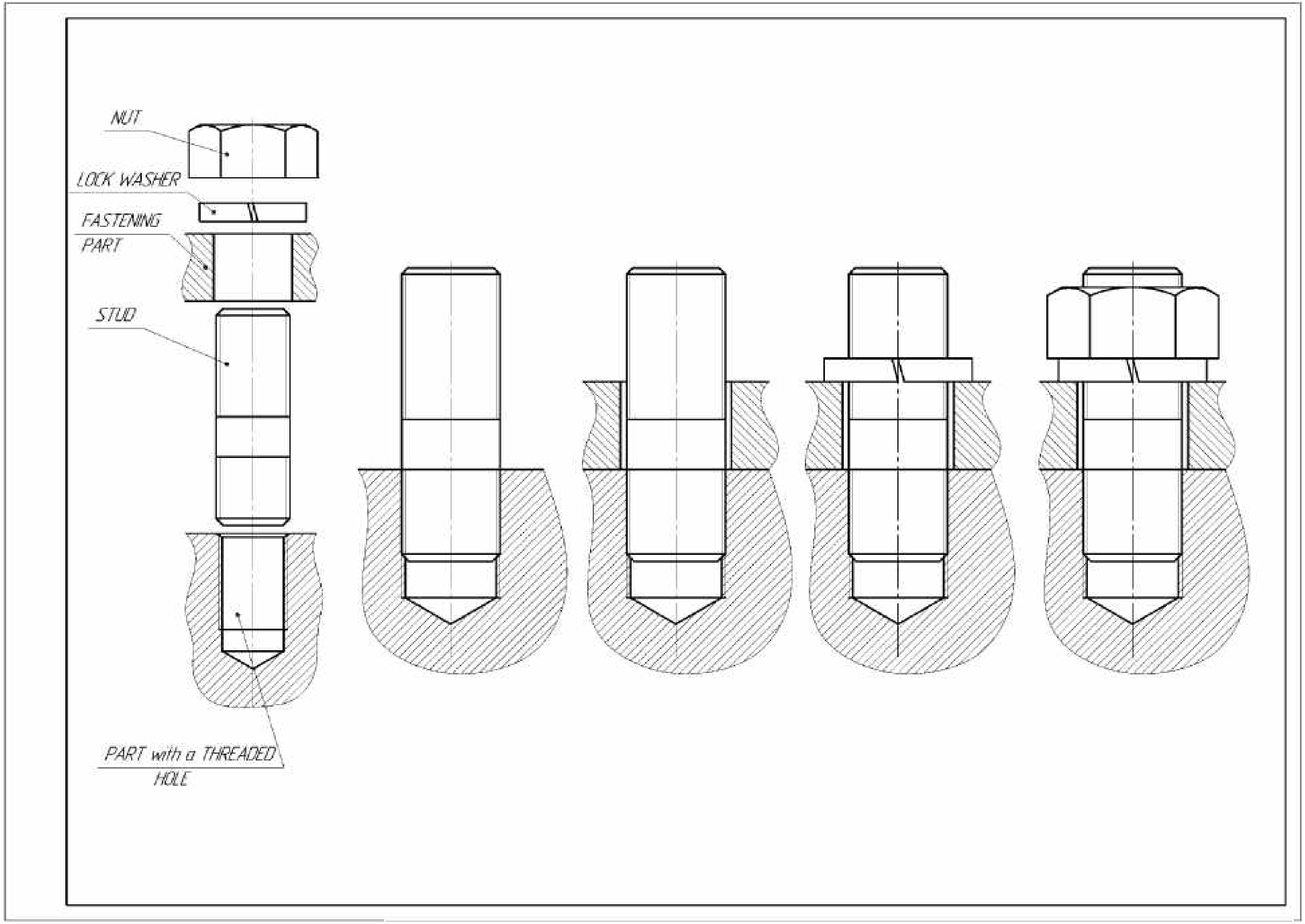


Fig. 23. Sequence of implementation of a stud joint

Succession of stud joint drawing

1. Wright down the source data of given variant (see Table 3).

2. Drawing of a Stud joint has to be carried out on a blank white drawing paper of A3 size. Scale of a drawing (common for entire drawing) has to be chosen depending on real sizes of a stud joint. Drawing should be divided to a few parts, each part for a proper image (see Fig. 28).

3. Draw front sectioned view and top view of a joining part with through hole (Fig. 24):

– define through hole diameter of a joining part (GOST 11284–75) (see Table A.5) or calculate by by the formula: $d_{hole} = 1,1\ d$;

– place following dimensions: through hole diameter d_{hole} and joining part thickness ***B***.

4. Draw front and top view of a blind thread hole. Make a full section on a front view (Fig. 25):

– define depth of a blind hole (ℓ_{hole}), which depends on the length of a metal end ℓ_1 of a stud, by formula

$$\ell_{hole} = \ell_1 + 2P + 4P = \ell_1 + 6P,$$

where 2P – reserve of thread, 4P – thread runout;

– calculate length of a thread in a hole:

$$\ell_{thread} = \ell_1 + 2P,$$

– determine sizes of chamfer by GOST 10549–80 (Table A.18) depending on major thread diameter ***d:***

$$d_c = 1,05\ d,$$

– place following dimensions: designation of Internal Thread, Thread Length, Thread Depth, Chamfer sizes (angle 120º and Chamfer diameter d_c).

5. Draw front and top view of a Stud (see Fig. 21, b).

To do this:

– define length of a screwed end ℓ_1 = ***1d*** *or* ***1,25d****, or* ***1,6d*** *, or* ***2d****.*

– compare calculated value ℓ_1 to the standard one (see Table A.3) and assign to ℓ_1 nearest standard value;

– calculate stud length ℓ by formula (2);

– compare calculated length ℓ to the standard one (see Table A.15) and assign to ℓ nearest greater standard value from the Table A.15;

– define thread length of the nut end of a stud ℓ_0 (see Table A.15);

– place following dimensions and text: thread designation, distances ***ℓ, ℓ***$_{1}$***, ℓ***$_{0}$*,* chamfer distances.

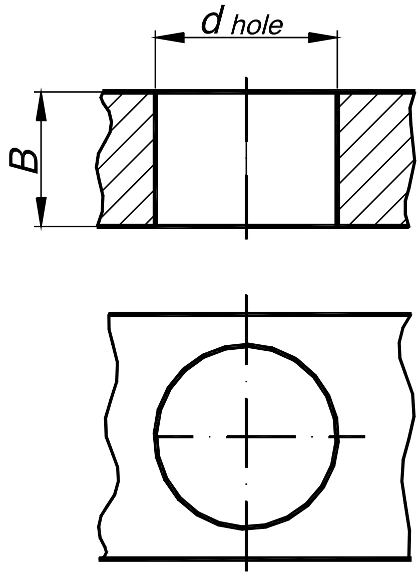


Fig. 24. Joining part

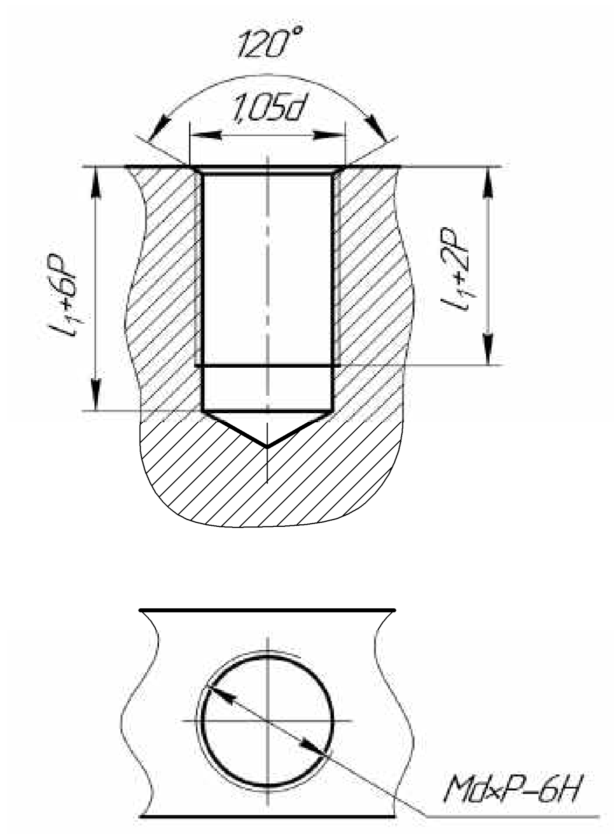


Fig. 25. Blind Thread Hole

6. Draw three views (front view, top view and side view) of a Stud joint:

– to prevent nut self-unfastening use Lock Washer. Sizes of a lock washer define depending on the core diameter the lock washer to be put on GOST 6402–70 (Table A.11). Examples how to draw a nut and lock washer on a front view of a stud joint are given in Fig. 26 and 27

– draw full sectioned front view of a stud joint;

– performing threaded joint on assembly drawing (in this case stud joint can be considered as a fragment of assembly drawing) thread in a hole should be drawn throughout all the hole depth – simplification (unlike design or working drawing);

– place dimensions: stud length ***ℓ,*** joining part thickness ***B***, thread designation in stud joint;

– designations of standard parts (Stud, Nut and Washer) should be placed on leaders.

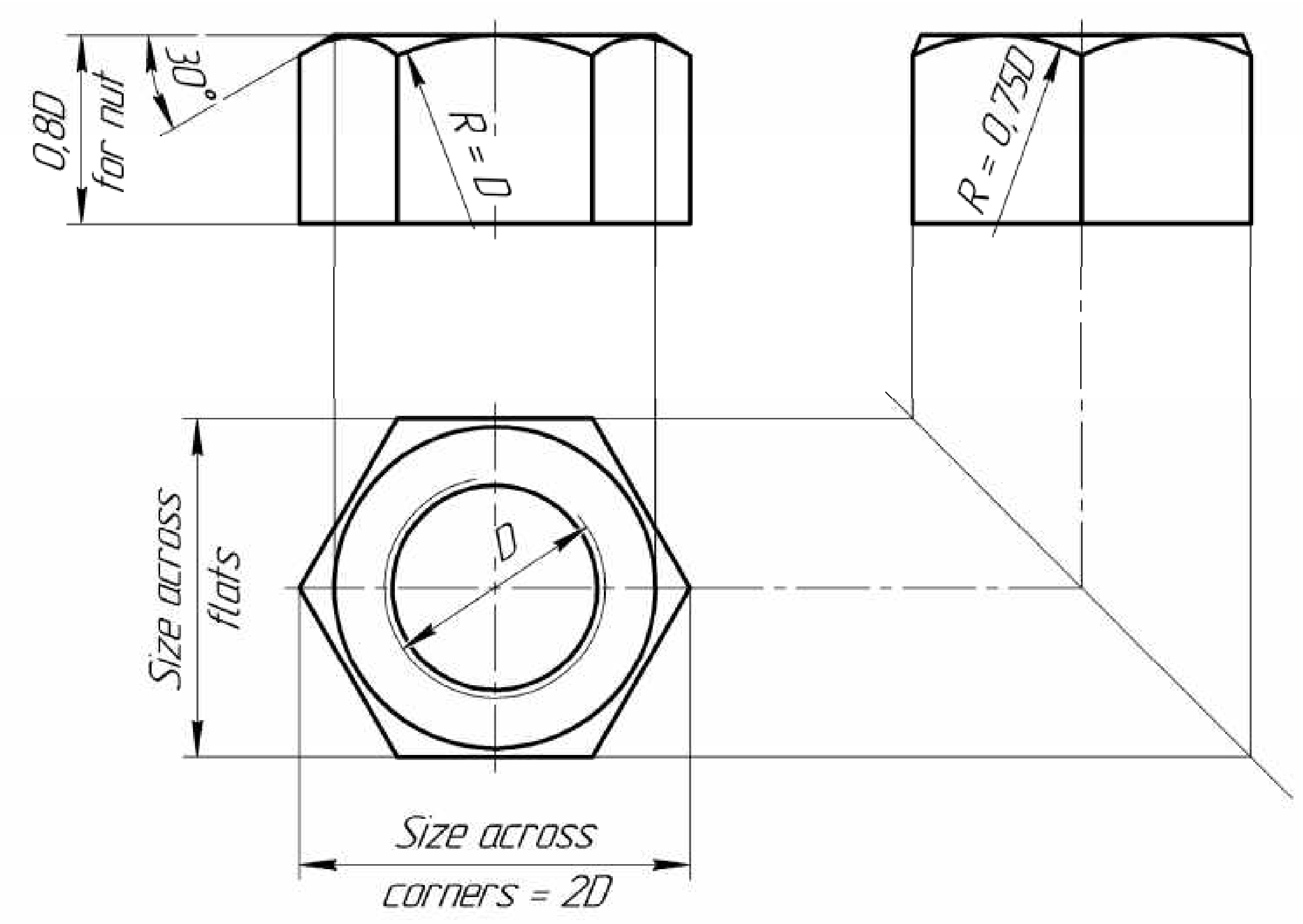


Fig. 26. Three view drawing of a typical nut

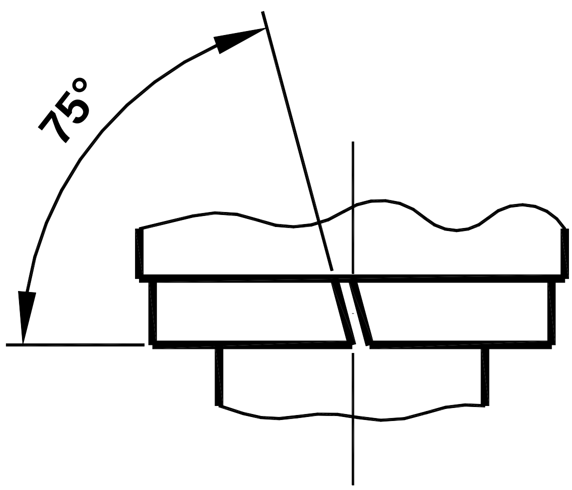


Fig. 27. Drawing of a Lock Washer

Table 3

Variants of tasks

Variant number	Stud fastening		Part Thickness *B*
	Studs GOST 22032–76 – GOST 22040–76 made from steel 45, thread tolerance 6g. **Nut** GOST 5915–70 made from steel 45, thread tolerance 6H. **Washer** GOST 6402–70 Regular Series, made from steel 65G. All the parts are without coating		
	Thread	ℓ_1	
1	M20 × 1,5	1,6*d*	22
2	M24 × 2	*d*	25
3	M8	1,25*d*	10
4	M24 × 2	1,25d	25
5	M10	*d*	12
6	M6	*d*	8
7	M30 × 2	1,25*d*	28
8	M8 × 1	1,6*d*	10
9	M8 × 1	*d*	10
10	M24 × 2	1,25*d*	25
11	M10	1,6*d*	15
12	M24 × 2	1,25*d*	25
13	M6	*d*	6
14	M8	1,6*d*	12
15	M24	1,25*d*	25
16	M30 × 2	1,25*d*	30
17	M12 × 1,25	*d*	12
18	M30	*d*	35
19	M10	1,25*d*	12
20	M30 × 2	1,6*d*	22
21	M6	1,25*d*	6
22	M30 × 2	*d*	28
23	M24 × 2	1,6*d*	25
24	M12 × 1,25	1,25*d*	12
25	M 8	2*d*	12
26	M 10×1	1,6*d*	12
27	M 12	1,6*d*	12
28	M24 × 1,5	*d*	25
29	M22 × 2	1,6*d*	22
30	M16	*d*	15
31	M30 × 1,5	1,25*d*	25
32	M24 × 2	1,6*d*	20

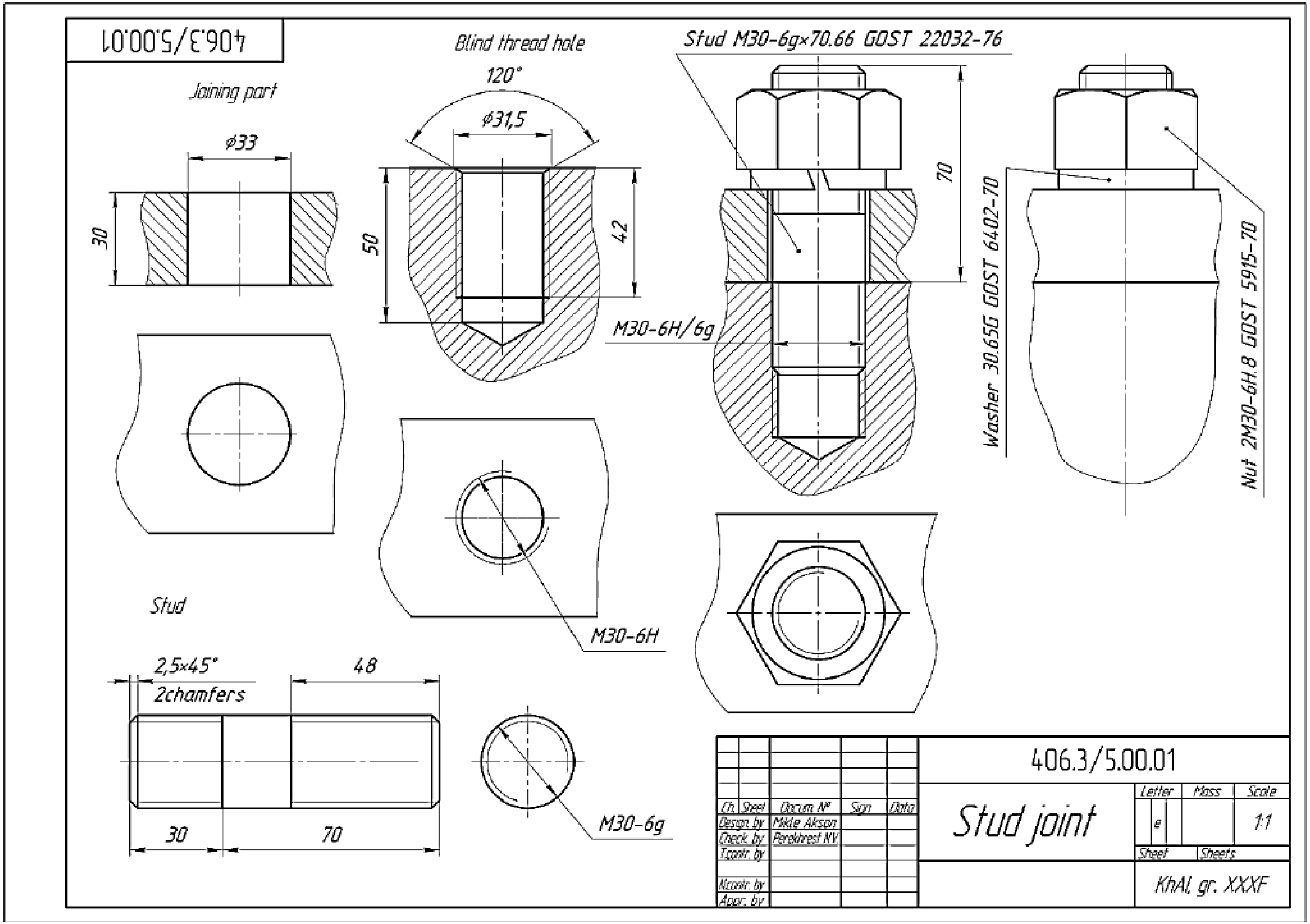
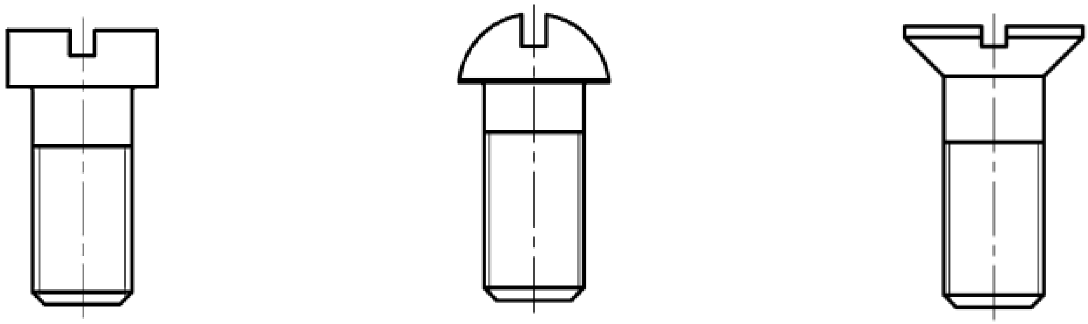


Fig. 28. Example of a Stud joint drawing

SCREWED JOINT

Screwed joint is an assembly unit consisting of the screw and fastened parts. By destination metal screws are classified on machine screws and set screws (Fig. 29).

GOST1491–80 GOST17473–80 GOST17475–80



a *b* *c*

Fig. 29. Screws with cylindrical or cheese (*a*), round or cap (*b*) and countersunk (*c*) heads

Machine screws are used in detachable joints to join parts. They represent a cylindrical rod with one threaded end which is screwed in one joining part and a head of a various form on the other end.

Set-screws are similar to machine screws, but are threaded practically throughout all the length. They are used to prevent relative movement between two parts. They are screwed into a tapped hole in the part adjoining the screw-head, while its end presses on the other part, thus preventing relative rotation or sliding. Heads of set-screws except those which can be operated by spanners or wrenches are provided with screw-driver slots.

Screw joint is similar to a stud joint. To join two parts with a screw the one should be provided with a tapped hole and the other with a smooth through hole. The screw is inserted into a smooth hole and screwed into a tapped hole (Fig. 30).

The screw, unlike the stud, is screwed up with a stock of several thread coils before a margin between fastened parts while the stud is screwed for all the length of a metal end.

Conventional designation of a screw according to the standard is putting as follows:

– name of a product;
– designation of accuracy rating (**B** – normal, **A** – fine);
– designation of a thread with matching tolerance zone;
– length of a screw;
– designation of a strength class (see Table A.2);
– designation of a coating and its thickness (see Table A.4);
– GOST number.

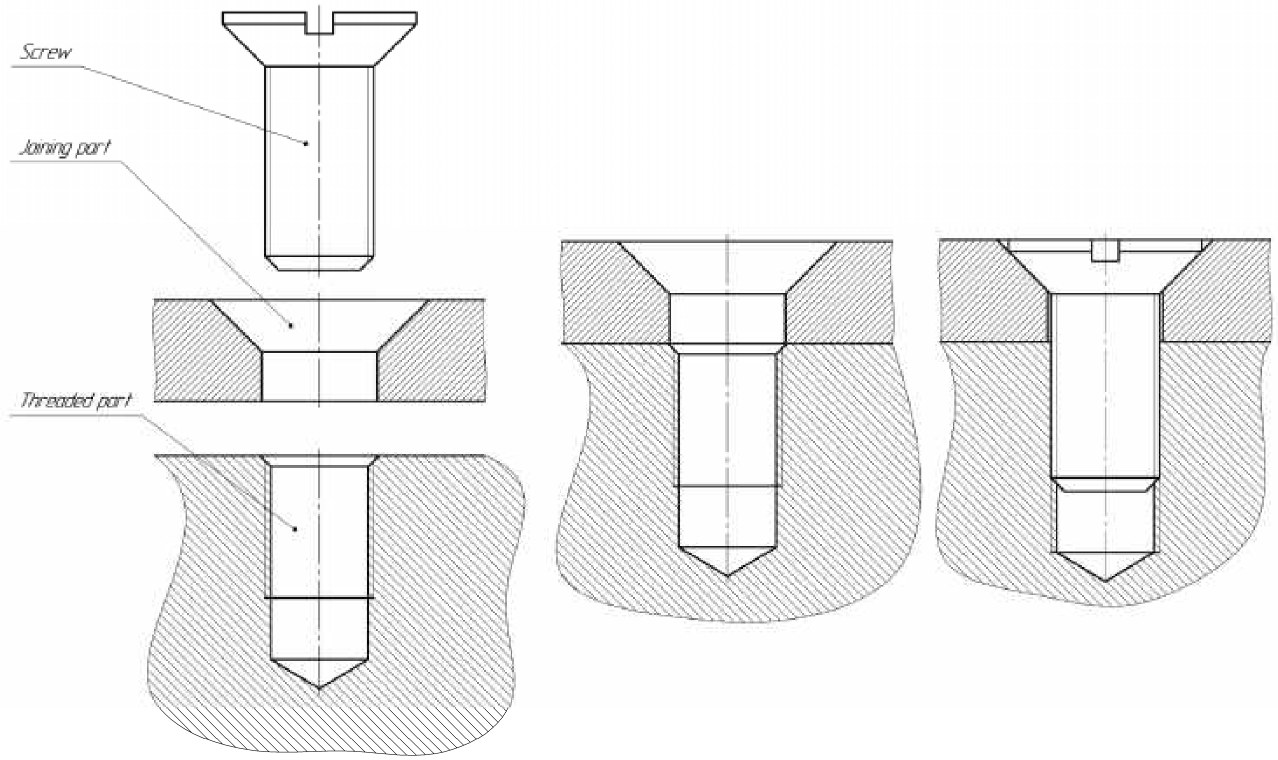


Fig. 30. Stages of screwed joint drawing

Designation of a screw of an extended precision with nominal thread diameter d = 8 mm, fine thread with pitch 1 mm, tolerance zone 6g, length *l* = 50 mm, strength class 4.8, coating 01 of a thickness 6 mcm with cylindrical head by GOST 1491–80:

Screw A.M8×1–6g×50.48.016 GOST 1491–80.

Succession of screwed joint drawing

1. Wright down the source data of given variant from the Table 4:
– screw GOST;
– thread designation;
– screw length;
– designation of screw material;
– designation of coating;
– thickness of a joining part.

2. Working field of a sheet A3-size divide into two equal areas by vertical thin continuous line. Drawing of a screwed joint is shown in Fig. 31. Scale of a drawing is chosen depending on the real sizes of a screwed joint.

3. Draw front sectioned view of a joining part with through hole (Fig. 31):

– for round-headed and cylindrical-headed screws the hole is made smooth and cylindrical according to GOST 11284–75 (see Table A.5), otherwise diameter can be calculated by formula $d_{hole} \cong 1,1\ d$, where d – nominal thread diameter;

– for countersunk-headed screws hole design and dimensions can be found according to GOST 12876–67 (see Table A.19);

– place following dimensions: through hole diameter d_{hole} and joining part thickness ***B.***

4. Draw front and top view of a blind thread hole. Make a full section on a front view (Fig. 31):

– the depth of a tapped hole is calculated in the same way as for stud joint by formula

$$\ell_{hole} = \ell 1 + 6P,$$

where ℓ_1 – length of the part of a screw, screwed into a tapped hole.

The length of a part of the screw, screwed in a tapped hole ℓ_1 is determined differently depending on a design of the screw:

– for countersunk-headed screws $\ell_1 \cong \ell - B$, where ℓ – length of the screw; B – thickness of a joining part (Fig. 30, Table A.16);

– for round-headed and cylindrical-headed screws $\ell_1 = \ell - B - S,$ where ℓ – length of a screw, B – thickness of a joining part; S – height of a washer (see Table A.17);

– calculate length of a thread in a hole:

$$\ell_{thread} = \ell_1 + 2P,$$

– determine sizes of chamfer by GOST 10549–80 (Table A.18) depending on major thread diameter ***d:***

$$d_c = 1,05\ d,$$

– place following dimensions: designation of Internal Thread, Thread Length, Thread Depth, Chamfer sizes (angle 120º and Chamfer diameter d_c).

Draw two views of a screwed joint (front full sectioned view and top view).

If round-headed and cylindrical-headed screws are used in a screwed joint set lock washer between head of a screw and joining part. Dimensions of the lock washer can be taken from GOST 6402–70 (see Table A.11). Image of a lock washer is placed on the Fig.27.

Screw-driver slot on a screw head should be drawn inclined at an angle 45º to a centerline of a screw on the view, perpendicular to the screw axis (top view in our case:

– place dimensions: screw length ℓ, joining part thickness ***B***, thread designation in screwed joint;

– designations of standard parts (Srew and Washer) should be placed on leaders.

Sample of drawing is given on the fig. 31.

Table 4

Variants of tasks

Screwed joint									
Variant number				**Washer** GOST 6402–70, Regular Series, made from steel 65G, without coating					Joining part, thickness *B*
	Screw GOST 17475–80			**Screw** GOST 1491–80					
	Thread nominal diameter, tolerance zone 6g	Screw Length, l	Material	Thread nominal diameter, tolerance zone 6g	Screw Lengt, l	Material	Coating: Type	Coating: Thickness, mcm	
1	M8 × 1	25	Steel 45	M10	30	Steel 20	Oxide	6	10
2	M10	30	Steel 10	M8 × 1	30	Steel 45	Zinc	4	12
3	M10 × 1	30	Steel 20	M12	30	Steel 10	Cadmium	8	15
4	M12	45	Steel 45	M14 × 1,25	45	Steel 20	Oxide	9	15
5	M14 × 1	35	Steel 10	M16	35	Steel 45	Copper	7	15
6	M16	30	Steel 10	M20 × 1,5	30	Steel 20	Zinc	5	10
7	M20 × 1	25	Steel 20	M24	25	Steel 10	Cadmium	10	15
8	M24	16	Steel 45	M27 × 2	16	Steel 20	Oxide	4	6
9	M27 × 1,5	30	Steel 20	M30	30	Steel 45	Copper	9	10
10	M30 × 2	20	Steel 20	M24	20	Steel 10	Cadmium	7	6
11	M10	14	Steel 35	M8 × 1	14	Steel 20	Copper	8	4
12	M8 × 1	40	Steel 45	M10	40	Steel 35	Copper	4	12
13	M12	50	Steel 35	M10 × 1	50	Steel 45	Oxide	9	15
14	M14 × 1,25	25	Steel 10	M12	25	Steel 45	Zinc	6	8
15	M16	45	Steel 20	M14 × 1	45	Steel 10	Cadmium	5	12
16	M20 × 1,5	55	Steel 45	M16	55	Steel 20	Oxide	11	20
17	M24	25	Steel 35	M20 × 1	25	Steel 45	Copper	5	12
18	M27 × 2	30	Steel 10	M24	30	Steel 45	Zinc	12	12
19	M30	35	Steel 35	M27 × 1,5	35	Steel 10	Copper	7	10
20	M24 × 2	30	Steel 45	M30	30	Steel 35	Oxide	4	12
21	M8	55	Steel 20	M10 × 1	55	Steel 45	Cadmium	6	18
22	M10 × 1	40	Steel 10	M8	40	Steel 20	Zinc	9	15
23	M10 × 1,25	25	Steel 45	M12	25	Steel 10	Brass-nickel	8	8
24	M12 × 1,25	20	Steel 45	M14	20	Steel 35	Oxide	4	5
25	M14	40	Steel 10	M16 × 1	40	Steel 45	Zinc	5	12
26	M16 × 1,5	55	Steel 20	M20	55	Steel 10	Cadmium	11	18
27	M20	35	Steel 35	M24 × 2	35	Steel 20	Brass-nickel	6	15
28	M24 × 1,5	30	Steel 20	M27	30	Steel 35	Oxide	10	14
29	M27	25	Steel 45	M30 × 1,5	30	Steel 20	Copper	9	10
30	M30 × 2	30	Steel 45	M24	30	Steel 35	Oxide	4	12
31	M10	14	Steel 35	M8 × 1	14	Steel 20	Copper	8	4
32	M8 × 1	40	Steel 45	M10	40	Steel 35	Copper	4	12

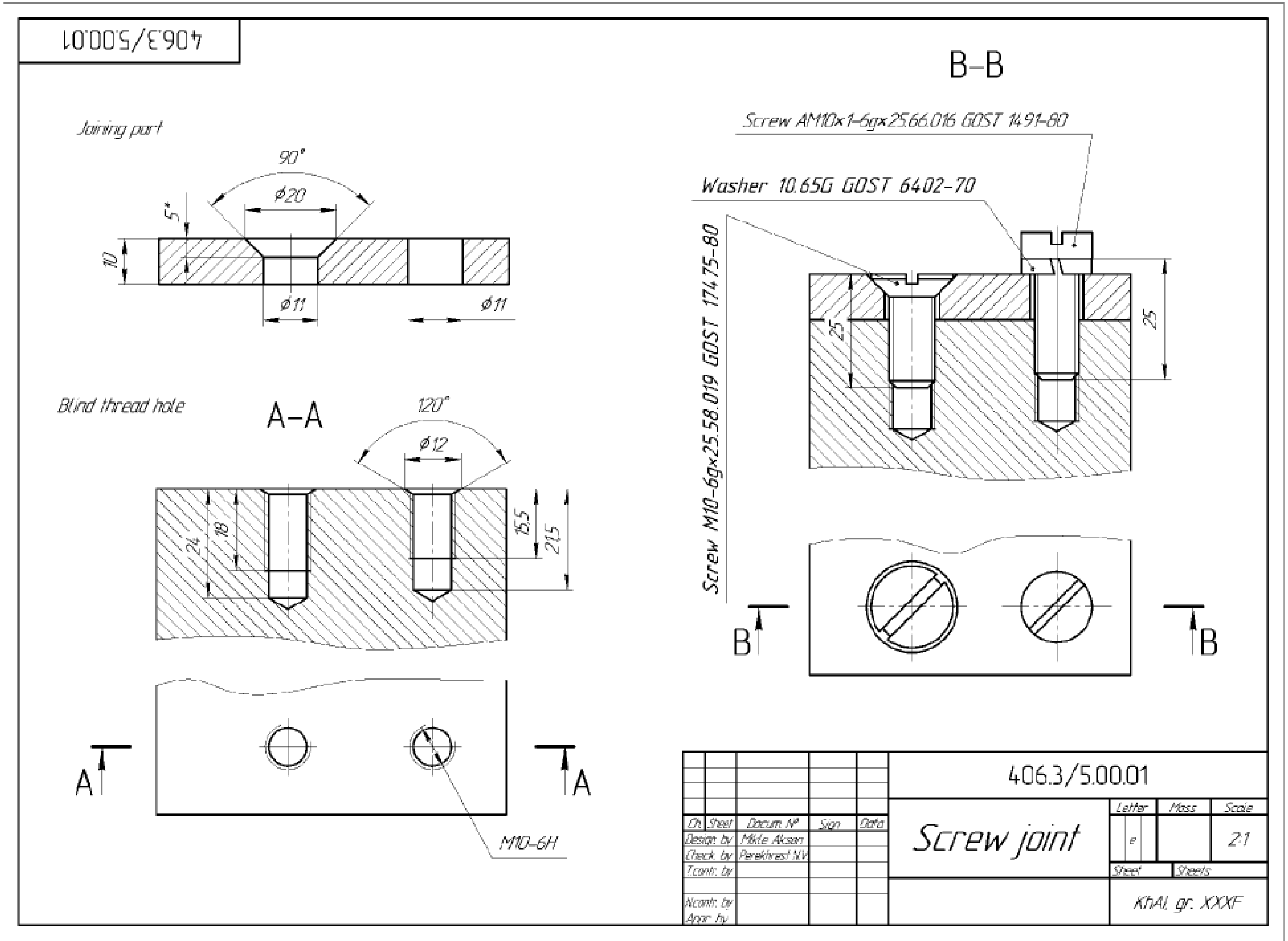


Fig. 31. Example of a Screwed joint drawing

Appendix

Table A.1

Metric Thread. Diameters and Pitches

(extract from GOST 8724–2002)

Nominal Thread Diameter d, mm			Pitch P, mm	
1-st row	2-nd row	3-rd row	regular	fine
1	—	—	0,25	0,2
—	1,1	—	0,25	0,2
1,2	—	—	0,25	0,2
—	1,4	—	0,30	0,2
1,6	—	—	0,35	0,2
—	1,8	—	0,35	0,2
2	—	—	0,40	0,25
—	2,2	—	0,45	0,25
2,5	—	—	0,45	0,35
3	—	—	0,50	0,35
—	3,5	—	0,60	0,35
4	—	—	0,70	0,5
—	4,5	—	0,75	0,5
5	—	—	0,80	0,5
—	—	5,5	—	0,5
6	—	—	1	0,75; 0,5
—	—	7	1	0,75; 0,5
8	—	—	1,25	1; 0,75; 0,5
—	—	9	1,25	1; 0,75; 0,5
10	—	—	1,5	1,25; 1; 0,75; 0,5
—	—	11	1,5	1; 0,75; 0,5
12	—	—	1,75	1,5; 1,25; 1; 0,75; 0,5
—	14	—	2	1,5; 1,25; 1; 0,75; 0,5
—	—	15	—	1,5; 1
16	—	—	2	1,5; 1; 0,75; 0,5
—	—	17	—	1,5; 1
—	18	—	2,5	2; 1,5; 1; 0,75; 0,5
20	—	—	2,5	2; 1,5; 1; 0,75; 0,5
—	22	—	2,5	2; 1,5; 1; 0,75; 0,5
24	—	—	3	2; 1,5; 1; 0,75
—	—	25	—	2; 1,5; 1
—	—	26	—	1,5
—	27	—	3	2; 1,5; 1; 0,75
—	—	28	—	2; 1,5; 1
30	—	—	3,5	3; 2; 1,5; 1; 0,75
—	—	32	—	2; 1,5
—	33	—	3,5	3; 2; 1,5; 1; 0,75
—	—	35	—	1,5
36	—	—	4	3; 2; 1,5; 1

Nominal Thread Diameter d, mm			Pitch P, mm	
1-st row	2-nd row	3-rd row	regular	fine
—	—	38	—	1,5
—	39	—	4	3; 2; 1,5; 1
—	—	40	—	3; 2; 1,5
42	—	—	4,5	4; 3; 2; 1,5; 1
—	45	—	4,5	4; 3; 2; 1,5; 1
48	—	—	5	4; 3; 2; 1,5; 1
—	—	50	—	3; 2; 1,5
—	52	—	5	4; 3; 2; 1,5; 1
—	—	55	—	4; 3; 2; 1,5
56	—	—	5,5	4; 3; 2; 1,5; 1
—	—	58	—	4; 3; 2; 1,5
—	60	—	5,5	4; 3; 2; 1,5; 1
—	—	62	—	4; 3; 2; 1,5
64	—	—	6	4; 3; 2; 1,5; 1
—	—	65	—	4; 3; 2; 1,5
—	68	—	6	4; 3; 2; 1,5; 1
—	—	70	—	6; 4; 3; 2; 1,5
72	—	—	—	6; 4; 3; 2; 1,5; 1
—	—	75	—	4; 3; 2; 1,5
—	76	—	—	6; 4; 3; 2; 1,5; 1
—	—	78	—	2
80	—	—	—	6; 4; 3; 2; 1,5; 1
—	—	82	—	2
—	85	—	—	6; 4; 3; 2; 1,5
90	—	—	—	6; 4; 3; 2; 1,5
—	95	—	—	6; 4; 3; 2; 1,5
100	—	—	—	6; 4; 3; 2; 1,5
—	105	—	—	6; 4; 3; 2; 1,5
110	—	—	—	6; 4; 3; 2; 1,5
—	115	—	—	6; 4; 3; 2; 1,5
—	120	—	—	6; 4; 3; 2; 1,5
125	—	—	—	6; 4; 3; 2; 1,5

Comments:

Choosing thread diameter, give preference to the 1-st row, then to the second and only then to the third one

Table A.2

Strength classes for studs, bolts and screws made from carbon and alloyed steel (GOST 1759–70)

Steel mark	St3kp 10	10kp	20	10* 10kp*	35 45 40G	35**, 35H, 38HA, 45G	40H, 30HGSA	35HGSA
Strength class	3.6	4.6	5.6	5.8	6.6	8.8	10.9	12.9

* For studs, bolts and screws thread diameter up to 12 mm.
** For studs, bolts and screws thread diameter up to 16 mm.

Table A.3

Strength classes for nuts made from carbon and alloyed steels (GOST 1759-70)

Steel mark	St3kp	10 kp, 10, 20	St5, 15, 15kp, 35	20, 20kp,35, 45	35H, 38HA	40H, 30HGSA	35HGSA, 40HNMA
Strength class	4	5	6	8	10	12	14

Table A.4

Types and designation of coatings for bolts, screws, studs and nuts (GOST 1759–70)

Designation	Types of coatings	Designation	Types of coatings
00	Without coating	05	Oxide
01	Zinc with chromating	06	Phosphate with oiling
02	Cadmium with chromating	07	Stannic
03	Multilayer brass-nickel	08	Copper
04	Multilayer brass-nickel-chrome	09	Zinc

Table A.5

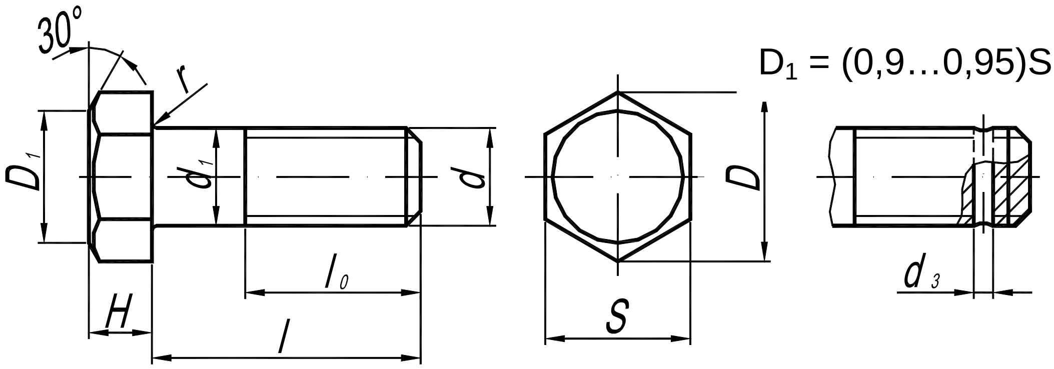
Through holes for fastening parts (GOST 11284–75)

Diameters of cores of fastenings		6	8	10	12	16	20	24	30
Through Hole Diameters	1-st row	6,4	8,4	10,5	13	17	21	25	31
	2-nd row	6,6	9,0	11	14	18	22	26	33

Table A.6

Hexagonal-headed Bolts of a single precision
GOST 7798–70

Series 1 Series 2



Nominal Thread Diameter d		6	8	10	12	16	20	24
Pitch of the thread	Regular	1	1,25	1,5	1,75	2	2,5	3
	Fine		1	1,25	1,25	1,5	1,5	2
d_1		6	8	10	12	16	20	24
S		10	13	17	19	24	30	36
H		4	5,5	7	8	10	13	15
D		10,9	14,2	18,7	20,9	26,5	33,3	39,6
r	Min	0,25	0,4	0,4	0,6	0,6	0,8	0,8
	Max	0,6	1,1	1,1	1,6	1,6	2,2	2,2
d_3		1,6	2	2,5	3,2	4	5	5

Table A.7

Hexagonal-headed Bolts of an extended precision
GOST 7805–70

Nominal Thread Diameter d		6	8	10	12	16	20	24
Pitch of the thread	Regular	1	1,25	1,5	1,75	2	2,5	3
	Fine		1	1,25	1,25	1,5	1,5	2
d_1		6	8	10	12	16	20	24
S		10	13	17	19	24	30	36
H		4	5,5	7	8	10	13	15
D		11	14,4	18,9	21,1	26,8	33,6	40,3
r	Min	0,25	0,4	0,4	0,6	0,6	0,8	0,8
	Max	0,6	0,6	0,6	1,1	1,1	1,2	1,2
d_3		1,6	2	2,5	3,2	4	5	5

Table A.8

Bolt length l and Length of the treaded end l_0

Bolt length l	Nominal Thread Diameter d												
	6	8	10	12	(14)	16	20	(22)	24	(27)	30	36	42
	Length of the treaded end l_0												
16	×	×	×	×	×								
(18)	×	×	×	×	×	×							
20	×	×	×	×	×	×							
(22)	18	×	×	×	×	×							
25	18	×	×	×	×	×	×						
(28)	18	22	×	×	×	×	×	×					
30	18	22	×	×	×	×	×	×					
(32)	18	22	26	×	×	×	×	×	×				
35	18	22	26	30	×	×	×	×	×	×			
(38)	18	22	26	30	×	×	×	×	×	×			
40	18	22	26	30	34	×	×	×	×	×	×		
45	18	22	26	30	34	38	×	×	×	×	×		
50	18	22	26	30	34	38	×	×	×	×	×	×	
55	18	22	26	30	34	38	46	×	×	×	×	×	×
60	18	22	26	30	34	38	46	50	×	×	×	×	×
65	18	22	26	30	34	38	46	50	54	×	×	×	×
70	18	22	26	30	34	38	46	50	54	60	×	×	×
75	18	22	26	30	34	38	46	50	54	60	66	×	×
80	18	22	26	30	34	38	46	50	54	60	66	×	×
(85)	18	22	26	30	34	38	46	50	54	60	66	×	×
90	18	22	26	30	34	38	46	50	54	60	66	78	×
(95)		22	26	30	34	38	46	50	54	60	66	78	×
100		22	26	30	34	38	46	50	54	60	66	78	×
(105)			26	30	34	38	46	50	54	60	66	78	90
110			26	30	34	38	46	50	54	60	66	78	90
(115)			26	30	34	38	46	50	54	60	66	78	90
120			26	30	34	38	46	50	54	60	66	78	90

Notes: 1. Dimensions in brackets are not recommended for usage.
2. Mark «×» labels bolts threaded throughout all the length (l = l_0).

Example of designation:

– bolt series 1 with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6g, length l = 50 mm, strength class 5.8, without coating: **Bolt M12–6g×50.58 GOST 7798–70**;

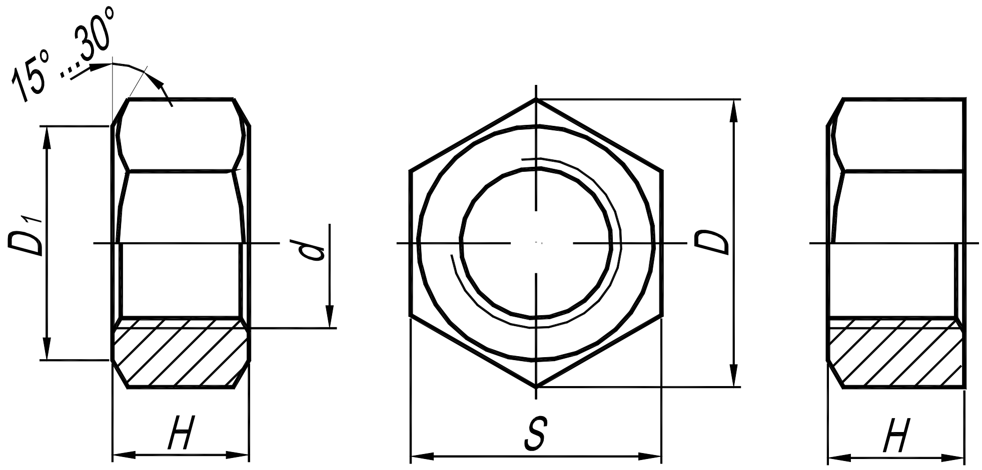
– bolt series 2 with nominal thread diameter d = 12 mm, fine thread with pitch 1.25 mm, tolerance zone 8g, length 50 mm, strength class 5.8, coating 01 thickness 9 mcm: **Bolt 2 M12×1,25–6g × 50.58.019 GOST 7798–70**;

– bolt series 1 with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6g, length l = 50 mm, strength class 5.8, without coating: **Bolt M12–6g×50.58 GOST 7805–70.**

Table A.9

Hex Nuts of a single precision by GOST 5915–70

Series 1 Series 2



$D_1 = (0{,}9 \ldots 0{,}95)S$

Nominal Thread Diameter d		6	8	10	12	16	20	24	30
Pitch	Regular	1	1,25	1,5	1,75	2	2,5	3	3,5
	Fine	–	1	1,25	1,25	1,5	1,5	2	2
S		10	13	17	19	24	30	36	46
H		5	6,5	8	10	13	16	19	24
D		10,9	14,2	18,7	20,9	26,2	33,0	39,6	50,9

Example of designation:

– hex Nut series 1 with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6H, strength class 5, without coating:

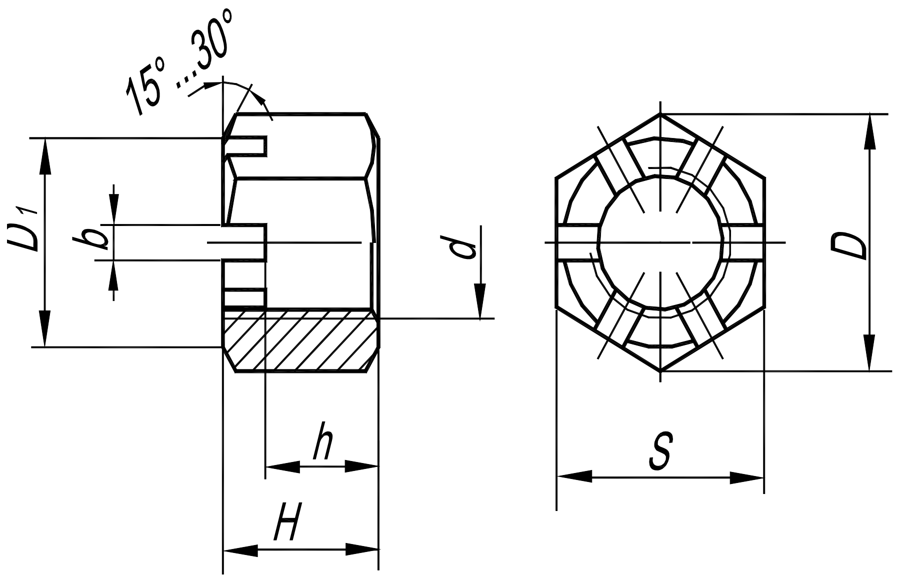
Nut M12–6H.5 GOST 5915–70;

– hex Nut series 2 with nominal thread diameter d = 12 mm, fine thread with pitch 1.25 mm, tolerance zone 6H, strength class 5, coating 01, thickness 9 mcm:

Nut 2 M12×1.25–6H.5.019 GOST 5915–70.

Table A.10

Slotted Hex Nuts of a single precision by GOST 5918–70



$D_1 = (0,9…0,95)\ S$

Nominal Thread Diameter d		6	8	10	12	16	20	24	30
Pitch	Regular	1	1,25	1,5	1,75	2	2,5	3	3,5
	Fine	–	1	1,25	1,25	1,5	1,5	2	2
S		10	13	17	19	24	30	36	46
H		7,7	9,8	12,4	15,8	20,8	24	29,5	34,6
D		10,9	14,2	17,6	19,9	26,2	33,0	39,6	50,9
b		2	2,5	2,8	3,5	4,5	4,5	5,5	7
h		5	6,5	8	10	13	16	19	24
Cotter Pin		1,6 × 16	2 × 20	2,5 × 25	3,2 × 32	4 × 36	4 × 40	5 × 45	6,3 × 60

Example of designation:

– slotted Hex Nut with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6H, strength class 5, without coating:

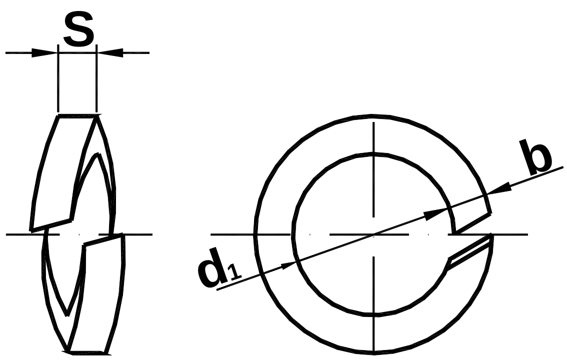
Nut M12–6H.5 GOST 5918–70;

– slotted Hex Nut with nominal thread diameter d = 12 mm, fine thread with pitch 1.25 mm, tolerance zone 6H, strength class 5, coating 01 thickness 9 mcm:

Nut M12×1.25–6H.5.019 GOST 5918–70.

Table A.11

Lock Washers (GOST 6402–70)



Nominal Thread Diameter of fastening part *d*	Nominal Lock Washer Diameter d_1	Dimensions *S* and *b*			
		Light Series		Regular Series	Heavy Series
		S	*b*	*S = b*	*S = b*
5	5,1	1,0	1,2	1,2	1,6
6	6,1	1,2	1,6	1,4	2,0
8	8,2	1,6	2,0	2,0	2,5
10	10,2	2,0	2,5	2,5	3,0
12	12,2	2,5	3,5	3,0	3,5
14	14,2	3,0	4,0	3,2	4,0
16	16,3	3,2	4,5	3,5	4,5
18	18,3	3,5	5,0	4,0	5,0
20	20,5	4,0	5,5	4,5	5,5
22	22,5	4,5	6,0	5,0	6,0
24	24,5	4,8	6,5	5,5	7,0
27	27,5	5,5	7,0	6,0	8,0
30	30,5	6,0	8,0	6,5	9,0
36	36,5	6,0	10,0	8,0	10,0
42	42,5	7,0	12,0	9,0	12,0
48	48,5	7,0	12,0	10,0	–

Examples of designations:

– lock Washer for bolt, screw or stud with nominal thread diameter 12 mm, Light Series, made from bronze mark BrKMz3-1, without coating:

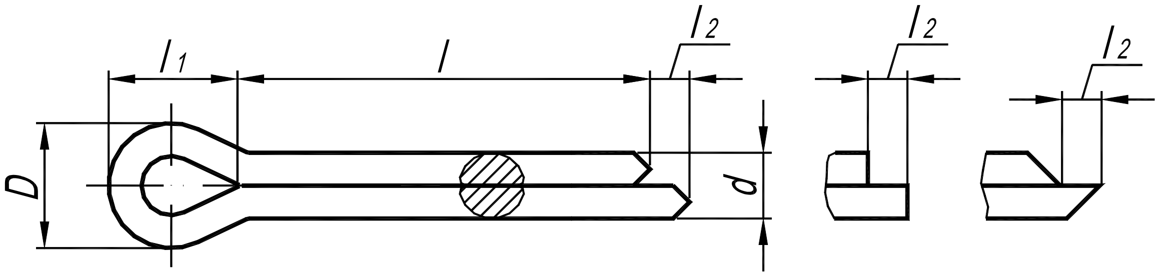
Washer 12L.BrKMz3–1 GOST 6402–70;

– lock Washer for bolt, screw or stud with nominal thread diameter 12 mm, Light Series, made from steel 65G, cadmium coating thickness 9 mcm:

Washer 12.65G.02.9 GOST 6402–70.

Table A.12

Cotter Pins (GOST 397–79)



Conventional Cotter Pin Diameter, equal to Hole Diameter	1	1,2	1,6	2	2,5	3,2	4	5
d	0,9	1	1,4	1,8	2,3	2,9	3,7	4,6
D	1,8	2,25	2,8	3,6	4,6	5,8	7,4	9,2
l_1 ≈	2,3	3,0	3,2	4	5	6,4	8	10
l_2	1,6	2,5	2,5	2,5	2,5	3,2	4	4
Recommended Bolt Diameters	3,6 … … 4,5	4,5 … … 5,5	5,5 … … 7	7 … 9	9 … … 11	11 … … 14	14 … … 20	20 … … 28
l	6…20	8…25	8…32	10...40	12…50	14…63	18…80	20…100

Dimension *l* within given limits accept from row: 6, 8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 60, 70, 80, 90.

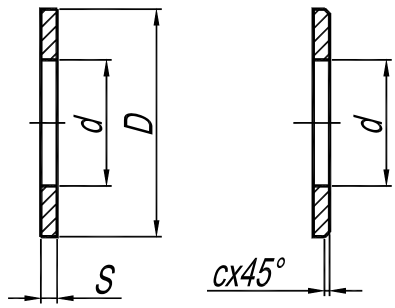
Example of designation: cotter Pin of conventional diameter 5 mm, length 28 mm, from low-carbon steel, without coating:

Cotter Pin 5×28 GOST 397–79.

Table A.13

Plain Washers (GOST 11371–78)

Series 1 Series 2



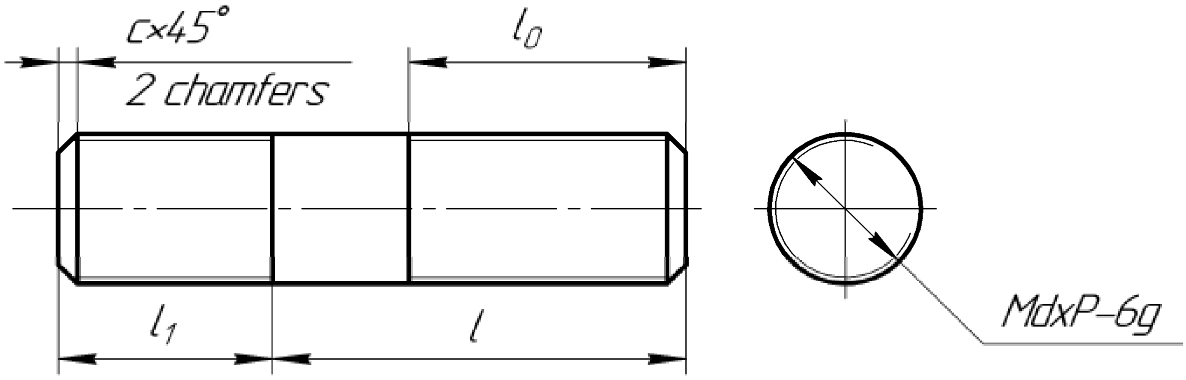
Core Diameter of fastening part	*d*	*D*	*S*	c
2	2,2	5	0,3	–
3	3,2	7	0,5	–
4	4,3	9	0,8	-
5	5,3	10	1,0	0,3
6	6,4	12,5	1,6	0,4
8	8,4	17	1,6	0,4
10	10,5	21	2,0	0,5
12	13	24	2,5	0,6
14	15	28	2,5	0,8
16	17	30	2,5	0,8
18	19	34	3,0	0,8
20	21	37	3,0	1,0
22	23	39	3,0	1,0
24	25	44	4,0	1,0
27	28	50	4,0	1,2
30	31	56	4,0	1,2
36	37	66	5,0	1,6
42	43	78	7,0	1,6

Example of designation: plain Washer series 1 Core Diameter 12 mm, given thickness, material group 01, with coating type 05:

Washer 12.01.05 GOST 11371–78.

Table A.14

Studs (GOST 22032–76 – GOST 22040–76)



Nominal Thread Diameter d		5	6	8	10	12	16	20	24	30	36	42	48
Pitch	regular	0,8	1	1,25	1,5	1,75	2	2,5	3	3,5	4	4,5	5
	fine	–	–	1	1,25		1,5		2		3		
l_1 = 1d		5	6	8	10	12	16	20	24	30	36	42	48
l_1 = 1,25d		6,5	7,5	10	12	15	20	25	30	38	45	52	60
l_1 = 1,6d		8	10	14	16	20	25	32	38	48	56	68	76
l_1 = 2d		10	12	16	20	24	32	40	48	60	72	84	95
l_1 = 2,5d		12	16	20	25	30	40	50	60	75	88	105	120

Example of designation: designation of a stud of extended precision with nominal thread diameter d = 16 mm, fine thread with pitch 1 mm, tolerance zone 6g, length l = 100 mm, strength class 6.6, coating 02 of a thickness 6 mcm with cylindrical head by GOST 22032–76:

Stud M16x1–6g×100.66.026 GOST 22032–76.

Table A.15

Length of a Stud *l* and length of a nut end l_0 of a stud

Length of a Stud *l*	Nominal Thread Diameter *d*											
	5	6	8	10	12	16	20	24	30	36	42	48
	Length of a nut end l_0											
12	x	x	x	–	–	–	–	–	–	–	–	–
14	x	x	x	–	–	–	–	–	–	–	–	–
16	x	x	x	x	–	–	–	–	–	–	–	–
20	16	x	x	x	–	–	–	–	–	–	–	–
25	16	18	x	x	x	x	–	–	–	–	–	–
30	16	18	20	x	x	x	–	–	–	–	–	–
35	16	18	20	26	x	x	–	–	–	–	–	–
40	16	18	20	26	30	x	x	–	–	–	–	–
45	16	18	20	26	30	x	x	x	–	–	–	–
50	16	18	20	26	30	38	x	–	–	–	–	–
55	16	18	20	26	30	38	x	–	–	–	–	–
60	16	18	20	26	30	38	46	x	x	–	–	–
65	16	18	20	26	30	38	46	x	x	–	–	–
70	16	18	20	26	30	38	46	–	x	x	–	–
75	16	18	20	26	30	38	46	–	x	x	–	–
80	16	18	20	26	30	38	46	54	x	x	x	x
85	16	18	20	26	30	38	46	54	66	x	x	x
90	16	18	20	26	30	38	46	54	66	x	x	x
100	16	18	20	26	30	38	46	54	66	78	x	x
110	16	18	20	26	30	38	46	54	66	78	90	x
130	22	24	28	32	36	44	52	60	72	84	96	x
140	22	24	28	32	36	44	52	60	72	84	96	106
150	22	24	28	32	36	44	52	60	72	84	96	106
160	22	24	28	32	36	44	52	60	72	84	96	106
170	22	24	28	32	36	44	52	60	72	84	96	106
180	22	24	28	32	36	44	52	60	72	84	96	106
190	22	24	28	32	36	44	52	60	72	84	96	106
200	22	24	28	32	36	44	52	60	72	84	96	106
220	–	–	–	–	49	57	65	60	72	84	96	121
240	–	–	–	–	–	–	65	73	85	97	109	121

Notice: 1. Sizes placed in brackets are not recommended for usage.

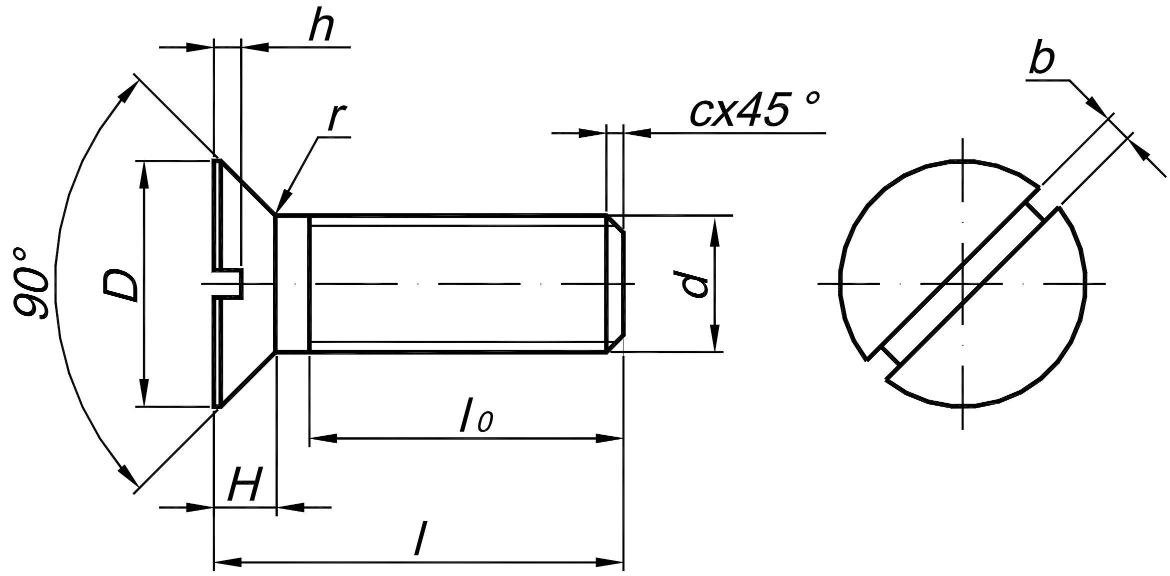
2. Mark «×» labels studs with screwed end length

$$l_0 = l - 0,5d - 2P,$$

where P – pitch of the thread.

Table A.16

Countersunk-headed Screws GOST 17475–80



Nominal Thread Diameter d		4	6	8	10	12	16	20
Pitch of the thread	Regular	0,7	1	1,25	1,5	1,75	2	2,5
	Fine	–	–	1	1,25	1,25	1,5	1,5
D		7,5	11	15	18	22	29	36
H		2	3	4	4,8	5,6	7	9
b		1	1,5	2	2,5	3	4	4
h		1	1,5	2	2,3	2,5	3,5	4
r		0,2	0,2	0,25	0,3	0,4	0,5	0,5
l_0		12	16	20	26	30	38	46
c		0,7	1	1,4	1,6	1,6	2	2,5

Examples of Designations:

– screw with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6g, length 50 mm, strength class 5.8, without coating:

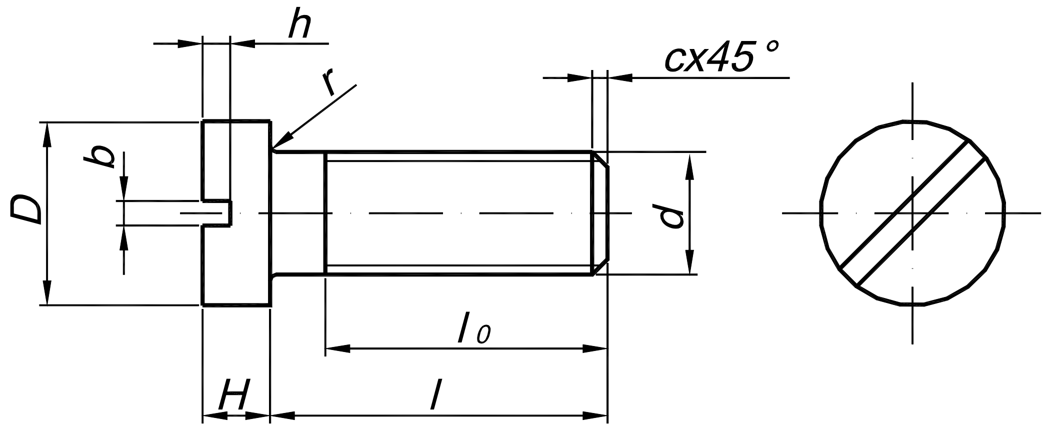
Screw M12–6g×50.58 GOST 17475–80;

– screw with nominal thread diameter d = 12 mm, fine thread with pitch 1.25 mm, tolerance zone 6g, length 50 mm, strength class 5.8, coating 01 thickness 9 mcm:

Screw M12×1,25–6g×50.58.019 GOST 17475–80.

Table A.17

Cylindrical-headed Screws GOST 1491–80



Nominal Thread Diameter d		4	6	8	10	12	16	20
Pitch of the thread	Regular	0,7	1	1,25	1,5	1,75	2	2,5
	Fine	–	–	1	1,25	1,25	1,5	1,5
D		7	10	12,5	15	18	24	30
H		2,5	3,5	5	6	7	9	11
b		1	1,5	2	2,5	3	4	4
h		1,4	2	2,5	3	3,5	4	4,5
r		0,2	0,2	0,5	0,6	0,8	1	1
l_0		12	16	20	26	30	38	46
c		0,7	1	1,4	1,6	1,6	2	2,5

Examples of Designations:

– screw with nominal thread diameter d = 12 mm, regular thread, tolerance zone 6g, length 50 mm, strength class 5.8, without coating:

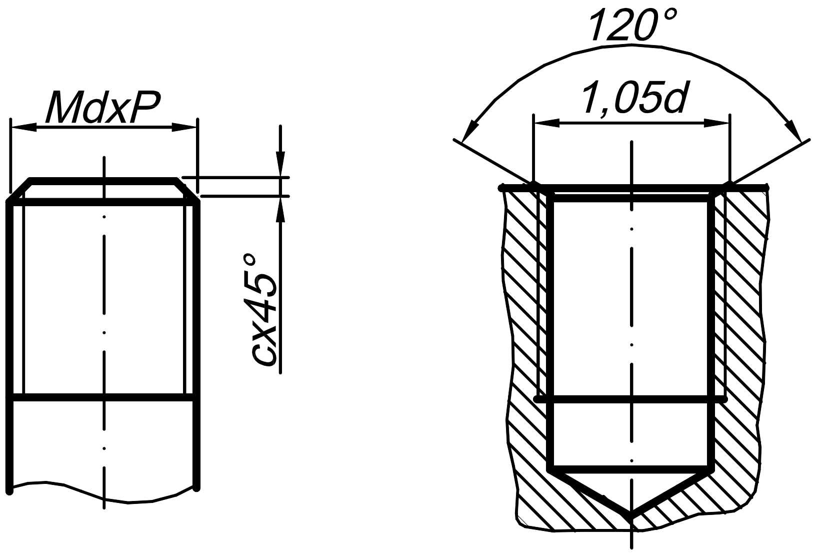
Screw M12–6g×50.58 GOST 1491–80;

– screw with nominal thread diameter d = 12 mm, fine thread with pitch 1.25 mm, tolerance zone 6g, length 50 mm, strength class 5.8, coating 01 thickness 9 mcm:

Screw M12×1,25–6g×50.58.019 GOST 1491–80.

Table A.18

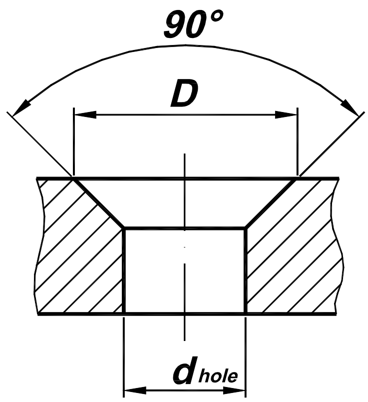
Chamfers for External and Internal Metric Thread fastenings
GOST 10549–80



Pitch P, mm	0,5	0,75	1,0	1,25	1,5	1,75	2	2,5	3	3,5	4
Chamfer Distance **c**, min	0,5	1,0	1,0	1,6	1,6	1,6	2,0	2,5	2,5	2,5	3,0

Table A.19

Holes for countersunk-headed screws
(Extract from GOST 12876–67)



Nominal Thread Diameter *d*	4	6	8	10	12	14	16	18	20
D	8,3	12,3	16,5	20	24	28	31	35	39

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CONTENT

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