
METHODOLOGICAL GUIDELINES

GENERAL REQUIREMENTS FOR GRAPHIC DOCUMENTS

MG V-06-2022

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1 Scope

This Guide establishes general requirements and rules for drawing up graphic materials, developed by students in the educational process: drawings, schemes, graphs, diagrams, etc.

This Guide is applicable to all graphic materials, developed by the students in the process of studying at the university, except for construction development, mining and geological development.

This Guide is applied by the students of all faculties of NLC "Abylkas Saginov Karaganda Technical University" (hereinafter - University) and is included in the internal normative documents of the quality management system (QMS).

2 Regulatory references

This Guide uses references to the following normative documents:

International standard ISO 9000: 2015 “Quality Management System. General provisions and glossary”.

State standard 2.104 – 2006 Unified system of design documentation. Basic inscriptions.

State standard 2.109 – 73 Unified system of design documentation. Basic requirements for drawings.

State standard 2. 111 – 2013 Unified system of design documentation. Regulatory compliance verification.

State standard 2.118– 2013 Unified system of design documentation. Technical proposal.

State standard 2.120– 2013 Unified system of design documentation. Technical project.

State standard 2.301 – 68 Unified system of design documentation. Formats.

State standard 2.302 – 68 Unified system of design documentation. Scale.

State standard 2.303 – 68 Unified system of design documentation. Lines.

State standard 2.304 – 81 Unified system of design documentation. Drafting fonts.

State standard 2.305 – 2008 Unified system of design documentation. Image, views, cuts, sections.

State standard 2.307– 2011 Unified system of design documentation. Dimensioning and limit deviations plotting.

State standard 2.308 – 2011 Unified system of design documentation. Specifying tolerances of the shape and surface position in the drawings.

State standard 2.309-73 Unified system of design documentation. Designation of the surface roughness.

State standard 2.312-72 Unified system of design documentation. Conventional images and conventional symbols of the welded joints’ seams.

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State standard 2.316 – 2008 Unified system of design documentation. Rules of plotting inscriptions, technical requirements and tables in the drawings.

State standard 2.503 – 2013 Unified system of design documentation. Rules of making modifications.

State standard 2.605-68 Unified system of design documentation. Educational and technical posters. General technical requirements.

State standard 2.701-2008 Unified system of design documentation. Schemes. Kinds and types. General requirements for execution.

State standard 2.702-2011 Unified system of design documentation. Rules of making electrical circuit diagrams.

State standard 2.703-2011 Unified system of design documentation. Rules of making kinematic diagrams.

State standard 2.704-2001 Unified system of design documentation. Rules of making hydraulic and pneumatic diagrams.

State standard 2.708-81 Unified system of design documentation. Rules of making electrical circuit diagrams of the digital computer technology.

State standard 2.747-68 Unified system of design documentation. Graphical symbols in the schemes. Size of the conventional graphic images.

State standard 2.770-68 Unified system of design documentation. Graphical symbols in the schemes. Elements of kinematics.

State standard 2.780-96 Unified system of design documentation. Graphical symbols. Working fluid conditioners, pneumatic and hydraulic containers.

State standard 2.782-96 Unified system of design documentation. Graphical symbols. Hydraulic and pneumatic machines.

State standard 2.784-96 Unified system of design documentation. Graphical symbols. Pipelines' elements.

State standard 3.1115-79 Unified system of design documentation. Rules of drawing up documents, used in the repair of products.

State standard 3.1119-83 Unified system of design documentation. General requirements for completeness and drawing up sets of documents for unit technological processes.

State standard 3.1128-93 Unified system of design documentation. General rules of drawing up graphic technological documents.

State standard 21.101 – 97 System of design documentation for construction. Basic requirements for project and working documentation.

DP V-01-2022 "Control of documented information".

3 Terms, definitions and abbreviations

Terms, definitions and abbreviations are used in this Guide, according to International Standard ISO 9000: 2015 “Quality Management System. General provisions

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and glossary”:

This Guide uses the following abbreviations:

University - NLC "Abylkas Saginov Karaganda Technical University";

QMR – quality management representative;

CQM&A – Center of Quality Management and Accreditation;

QMS – quality management system;

MG – Methodological Guidelines;

QMS – quality management system.

4 Responsibility and authority

4.1 The quality management representative is responsible for introduction of the requirements, specified in this Guide.

4.2 A developer is responsible for development of the requirements of this Guide, their compliance with the requirements of the DP X-01-2022.

5 Requirements for graphic materials

5.1 Format

State standard No.2.301 determines basic and additional sheet formats of the drawings and other documents.

5.1.1 The formats of sheet are determined by dimensions of the outer frame (made with a thin line) of originals, duplicates, copies.

5.1.2 The main formats are taken as a format with side dimensions of 841x1189 mm and other formats, obtained by means of consecutive division into two equal parts in parallel to a smaller side of the appropriate format. The designations and dimensions of the main formats' sides must correspond to the formats, specified in the table No.6.1.

5.1.3 Additional formats are created by means of increasing short sides of the main formats by a multiple of their dimensions. As a rule, the dimensions of derived formats should be chosen, according to Table No.6.2.

A4 sheets are arranged only vertically, A5 sheets are arranged only horizontally. Sheets of other formats can be arranged horizontally and vertically.

Table No.5.1 – Main formats, according to state standard No.2.301

Designation of the format, as per the state standard No.2.301		Size of the format's sides, mm	Limit deviations
A0	44	841*594	+3,0
A1	24	594* 841	+3,0
A2	22	420*594	+2,0
A3	12	297*420	+2,0

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A4	11	210*297	+2,0
A5*	–	148*210	+2,0
* A5 format is allowed to be used, if it is necessary			

Table No.5.2 – Additional formats, according to state standard No.2.301

Ratio	Format				
	A0	A1	A2	A3	A4
2	1189*1682	–	–	–	–
3	1189*2523	841*1783	594*1261	420*891	297*630
4	–	841*2378	594*1682	420*1189	297*841
5	–	–	594*2102	420*1486	297*1051
6	–	–	–	420*1783	297*1261
7	–	–	–	420*2080	297*1471
8	–	–	–	–	297*1682
9	–	–	–	–	297*1892

NOTE: The designation of the derived format is made from the designation of the main format and its ratio. For instance: A0*2, A4*8 etc.

5.2 Scale

State standard No.2.302 determines scale of the images and their designation in the drawings.

5.2.1 The scale of the images in the drawings must be selected in accordance with Table No.6.3.

Table No.5.3 – Scale

Reduction scale	1:2; 1:2,5; 1:4; 1:5; 1:10; 1:15; 1:20; 1:25; 1:40; 1:50; 1:75; 1:100; 1:200; 1:400; 1:500; 1:800; 1:1000
Natural size	1:1
Enlargement scale	2:1; 2,5:1; 4:1; 5:1; 10:1; 20:1; 40:1; 50:1; 100:1

When making general plans of the large objects, it is allowed to use the scale of 1:2000, 1:5000, 1:10000; 1:20000; 1:25000; 1:50000. When it is necessary, it is allowed to use enlargement scale of 100n:1, where n is an integer.

5.2.2 In the column of the main inscription, the scale of the main images is only specified, writing it in the form: 1:1, 1:2, 2:1, etc. and the scale of the images, which differs from the scale of the main image, is specified above these images in the form: M1:1, M1:2.

5.3 Lines

State standard No.2.303 determines tracing and the main usage of lines in the drawings. Special usage of the line (an image of thread, splines, boundary of zones

with different roughness, etc.) is defined in the relevant standards of the unified system of design documentation.

5.3.1 Nine types of lines are used in the drawings. Thickness of the lines must be the same for all images in this drawing, drawn on the same scale.

The thickness “S” of the main (solid thick) line of the drawing must be in the range from 0.5 to 1.4 mm. Thin lines, drawn with a pencil in the drawings of all formats, must have the thickness “S/2”, the thin lines, drawn with ink in the drawings of the A4-A2 formats, must have the thickness “S/3” and in the drawings of the formats A1 and more – the thickness “S/2”.

5.4 Drafting fonts

The state standard No.2.304 determines drafting fonts, plotted in the drawings and other technical documents.

5.4.1 The slope of letters and numbers to a base of the line must be about 75 degrees. A name, heading, designation are allowed to be written without the slope (except for the letters of Greek alphabet) in the main inscription and in the drawing’s field.

5.4.2 Font size is defined by the height of capital letters in millimeters. The following font size is determined: 2,5; 3,5; 5;7; 14; 20; 28; 40.

5.4.3 The height of letters and numbers, drawn with the ink in the drawings, must be not less than 2.5 mm and the height of letters and numbers, drawn with the pencil in the drawings, must be not less than 3.5 mm.

5.5 Specification

State standard No.2.108 defines a form and establishes the procedure of filling in product specifications of all branches of industry.

5.5.1 A specification is a document, which contains a list of all components, included in this specifiable product, as well as design documents.

The specification determines content of the assembly unit, complex and set for their manufacture.

5.5.2 The specification is drawn up in the form of a table on the separate A4 sheets for each assembly unit, complex and set, according to the forms No.1 (front page) and 1a (the following pages) (Appendix A).

5.5.3 The specification consists of sections that are arranged in the following sequence: “Documentation”, “Complexes”, “Assembly units”, “Parts”, “Standard products”, “Other products”, “Materials”, “Sets”.

The presence of these or other sections in the specification’s table is determined by a structure of the specified product. The name of each section is specified in the form of the heading in the column “Name” and underlined with the thin line. One free line must be left under each heading, it must be left not less than one free line above each heading.

5.5.4 The specification columns are filled from top to bottom as follows:

– the formats of documents are specified in the column “Format”, the designations of which are written in the column “Designation”. If the document is drawn up

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from several sheets of different formats, then an asterisk is put in the column and all formats are enumerated in the column "Note". The column is not filled for the documents, written down in the sections "Standard products", "Other products" and "Material". ND (no drawing) is specified in the column for the parts, which do not have the drawings;

- the designations of zone are specified in the column "Zone", where a written down component is situated (when the drawing's field is divided into zones, according to the state standard No.2.104);

- ordinal numbers of the components are specified in the column "Pos." (position), which are directly included in the specified product, with a sequence of their writing in the specification;

- it is specified in the column "Designation": the designation of written down documents in the section "Documentation" in accordance with the state standard No.2.201; the column is not filled in the sections "Standard products", "Other products" and "Materials";

a) it is specified in the column "Name":

- only names of the documents, for example: "Assembly drawing", "Dimensional drawing", "Technical specifications", etc. in the "Documentation" section for the documents, included in the main set of documents of the specified product and drawn up for this product;

- the names of products in accordance with the main inscription in the main design documents of these products (for parts, for example: "Crane body", "Bushing", "Cover", "Pin", etc.) in the sections "Complexes", "Assembly units", "Parts", "Sets. The name, consisting of several words, has an adjective, which is put in the first place, for example, "Gear wheel". As a rule, information about the usage and location of products is not added in the names of products. It is specified the name and material, as well as the dimensions, which are necessary for parts' manufacture for the parts, which do not have the drawings;

- in the section "Standard products" there is the name of products according to:

- 1) national standards (RK NS);
- 2) regional standards (State standard);
- 3) technical specifications (TS);
- 4) company standards.

A record is made for products' groups, combined, according to their functional usage (for example, bearings, fixing hardware, electrical products, etc.) within each category of standards. Within each group in alphabetical order of the products names. Within each name in ascending order of the standards designations and within each designation of standard in ascending order of the main parameters or the dimensions of products;

- the name and conventional symbols of the products in accordance with their delivery documents, specifying the designations of these documents - in the section "Other products";

- the designations of materials, determined in the standards and technical specifications for these materials in the “Materials” section.

To write down some products and materials that differ in size and other data and which are used, according to the same document (and written in the specification under the designation of the same document), a common part of the names of these products or materials together with the designation of the specified document can be written on each sheet of the specification one time in the form of a common name (title). Only parameters and dimensions of each specified product and material are written under the common name;

- it is specified in the column “Qty” (quantity): for the components of the product, written down in the specification - their quantity per one specified product; in the “Materials” section - total amount of materials per one specified product, specifying a unit of magnitude. It is permitted to write units of magnitude in the column “Note” in close proximity to the column “Qty”; the column is not filled in the “Documentation” section;

- additional information for planning and organizing production is specified in the column “Note”, as well as other information, related to the products, materials and documents, written down in the specification, for example, weight is written for the parts, which do not have the drawings.

It is necessary to leave a few free lines for additional records after each section of the specification. It is permitted to reserve position numbers that are put in the specification when filling spare lines.

If the assembly unit is made by means of deposit welding or casting parts with an alloy, rubber and other materials and drawn in the A4 format, the specification and image are allowed to be shown on one sheet.

The specification for repair drawings may be drawn up in the drawing’s field for each assembly unit, complex or set. The specification is filled in the same order and in the same form as the specification, drawn up on the separate sheets.

An example of drawing up a specification is given in the Appendix B.

5.6 Images: views, cuts, sections

State standard No.2.305 establishes the rules of depicting objects (products, structures and their components) in the drawings.

5.6.1 The images of objects must be made, as per a rectangular projection method.

5.6.2 Images, made in the drawing, are divided into views, cuts, sections, depending on their content.

5.6.3 The quantity of images (views, cuts, sections) must be minimum, necessary for complete and clear understanding of the object (the products and their components).

5.6.4 The parts and the assembly units must be depicted in the functional position or in the position, being convenient for their manufacture. However, if the assembly units have an inclined functional position, they are depicted vertically and horizontal-

ly.

5.6.5 Views

The following names of views, made on the basic planes of projections, are defined:

- front view (main view);
- top view;
- left-side view;
- right-side view;
- bottom view;
- back view.

If top, right-side, bottom, back views are not in the direct projection link with the main image (view or section, depicted on the frontal plane of projections), then they must be marked with an inscription in capital letter in the drawing, according to Figure No.5.1.

A direction of the projection must be indicated with an arrow near an appropriate image. The same capital letter should be put above the arrow and under the made image (view) (Figure 5.1).

If any part of the object cannot be depicted on the above-mentioned views without distorting a shape and size, then it is used additional views, made on the planes, being not parallel to the basic planes of projections, as shown in Figures No.5.2 and 5.3.

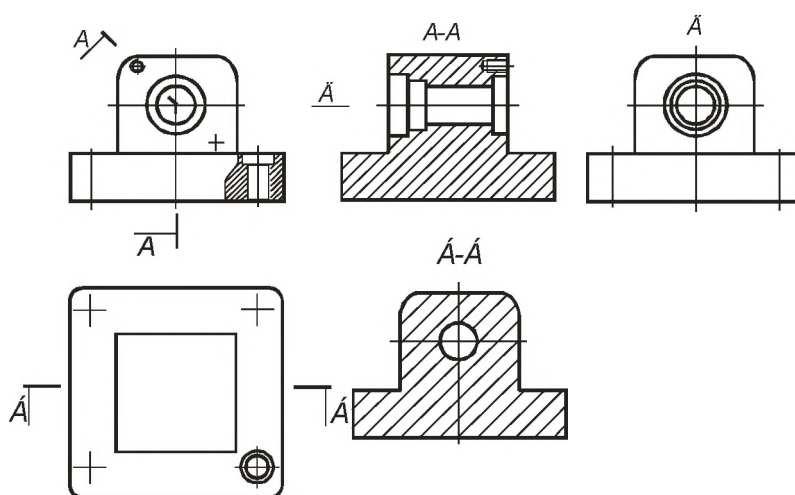


Figure 5.1 – Image of views or sections in the drawings, which are not projectively linked with the main image

An additional view must be marked with the inscription of “B” type in Figure 5.2 and the arrow, indicating the direction of view with an appropriate letter designation (arrow “B”, Figure 5.2), must be put on the object’s image, linked with the additional

view.

When the additional view is in the direct projection link with the appropriate image, the arrow is not depicted (Figure 5.3).

Additional views are arranged as shown in Figures No.5.2 and 5.3. Arrangement of the additional views is more preferable in Figures 5.2 and 5.3.

The additional view is allowed to be turned, but as a rule, including retention of the position, defined for this object in the main image; in addition, the graphical symbol \odot must be added to the inscription. If it is necessary, an angle of rotation is specified (Figure 5.2).

The image of a separate, limited place of the object's surface is called a partial view.

The partial view can be limited with a break line with the smallest size as much as possible or cannot. The partial view must be marked in the drawing like the additional view.

5.6.6 Cuts

Cuts are divided into horizontal, vertical, oblique cuts, depending on the position of a cutting plane relative to a horizontal plane of the projection.

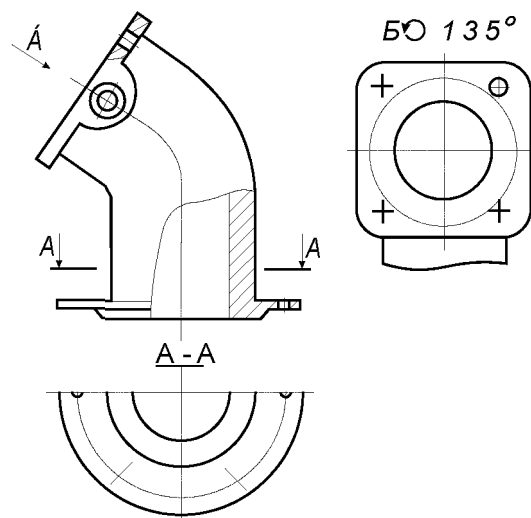


Figure 5.2 – Image of additional views in the drawings

Depending on quantity of the cutting planes, the cuts are divided into simple and complex cuts.

The position of the cutting plane is indicated in the drawing with a section line. An open line must be used for the section line. When there is a complex cut, strokes are also put at the places of intersection of the cutting planes between each other. Arrows should be put on the first and the last strokes, indicating the direction of the view, as shown in the figure No.6.4. The arrows must be depicted at a distance of 2-3 mm from the end of the stroke.

The first and the last strokes must not cross an outline of the appropriate image.

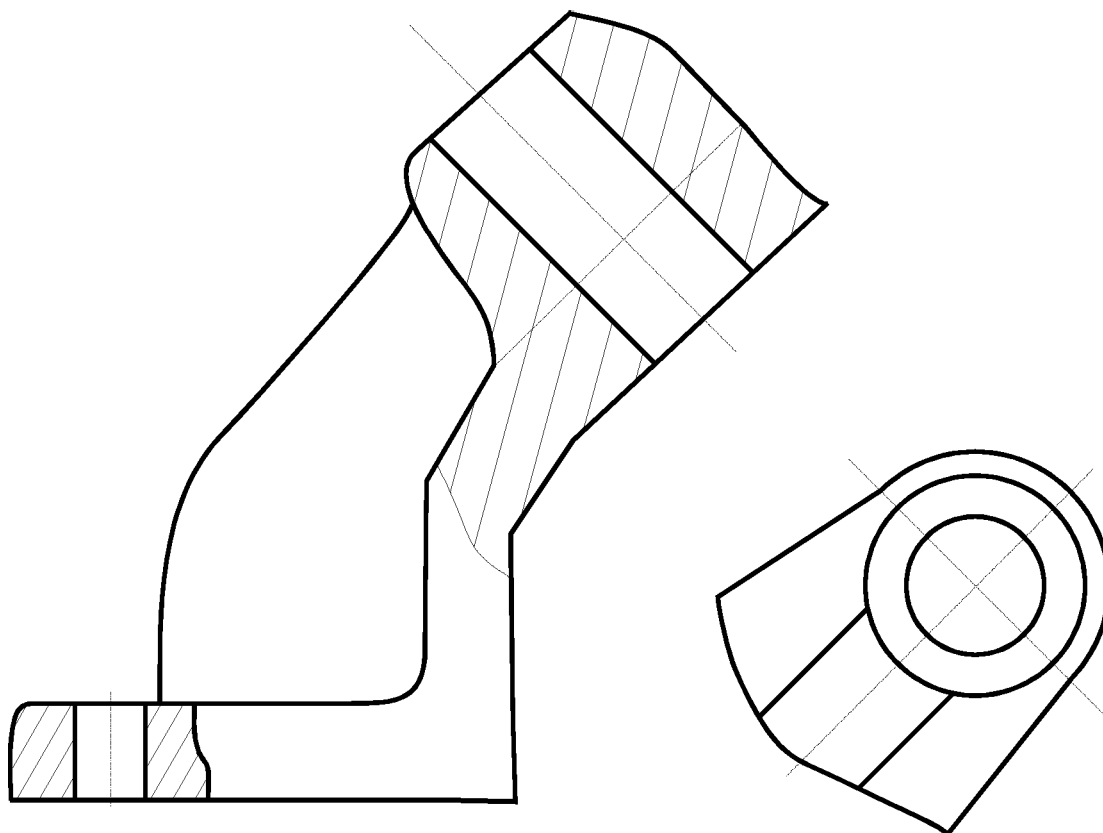


Figure 5.3 – Image of additional view in the direct projection link with the appropriate image

The same capital letter of the Russian alphabet is put at the beginning and end of the section line and, if it is necessary, at the places of intersection of the cutting planes. The letters are depicted near the arrows, indicating the direction of the view and in the places of bend from the side of the outer angle.

The cut must be marked with the inscription of “A-A” type (always two letters, separated by a dash).

When the cutting plane coincides with a plane of symmetry of the object in general and appropriate images are situated on the same sheet in the direct projection link, and are not separated by any other images, the position of the cutting plane is not marked for horizontal, front and longitudinal cuts, and the cut does not have the inscription.

When there are broken cuts, the cutting planes are approximately turned until they are combined in one plane, whereas a direction of the rotation cannot coincide with the direction of the view, as shown in the figure No.5.4.

The cut that is used to find out a structure of the object only in the separate, limited place, is called a partial cut.

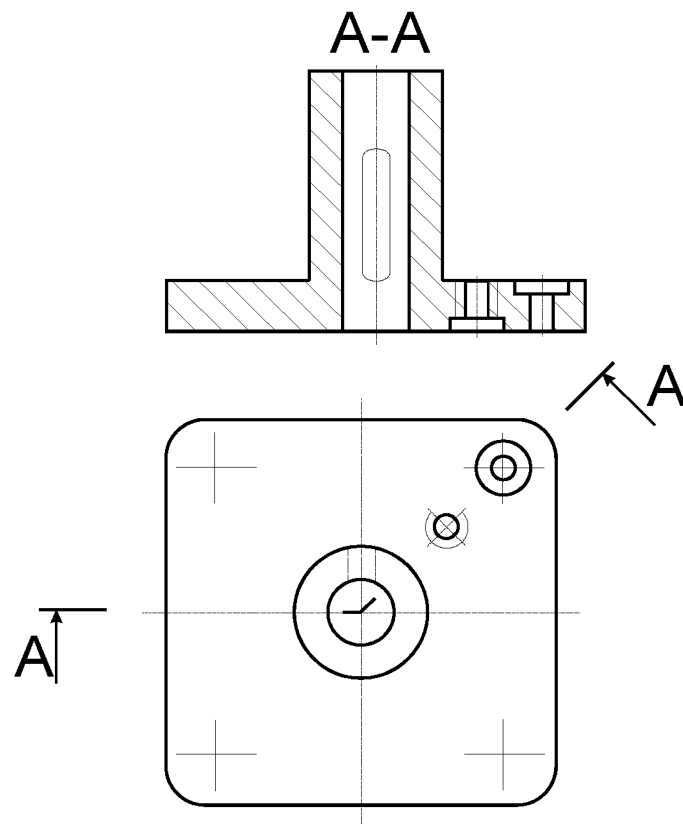


Figure 6.4 – Image of cuts and section line in the drawings

The partial cut is underlined with a solid wavy line on the view. These lines must not coincide with any other lines of the image (Figure 5.5).

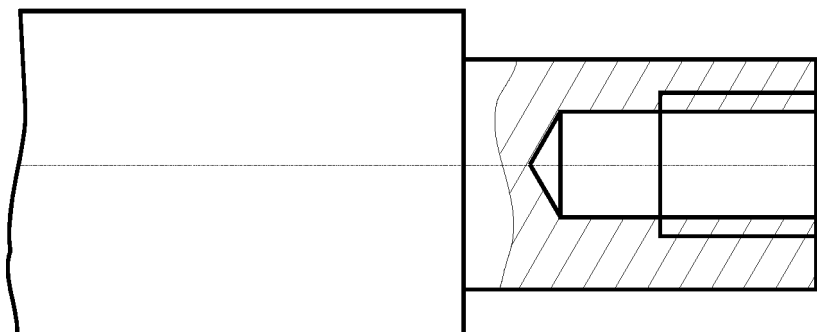


Figure 5.5 – Image of partial cut in the drawing

5.6.7 Sections

The sections, included in the cut, are divided into removed and revolved sections, as shown in the figures No.5.6 and 5.7.

The removed sections are preferable (Figure 5.6).

A contour of the removed section, as well as the section, that is included in the cut, is depicted as solid main lines and the contour of the revolved section is depicted as solid thin lines, moreover the contour of the image is not interrupted at the location of the revolved section (Figures 5.6 and 5.7).

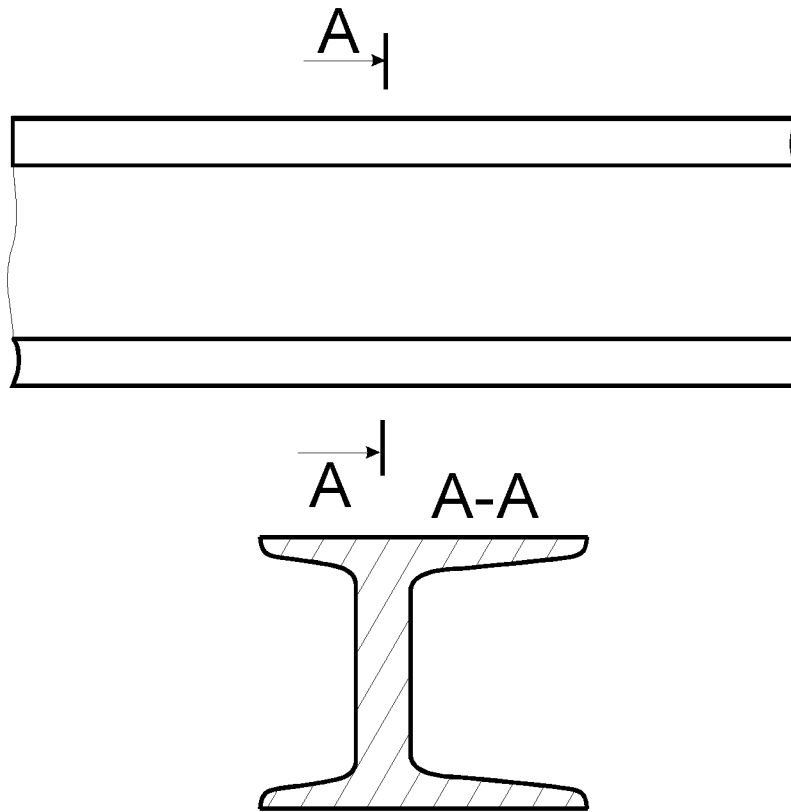


Figure 5.6 – Removed sections

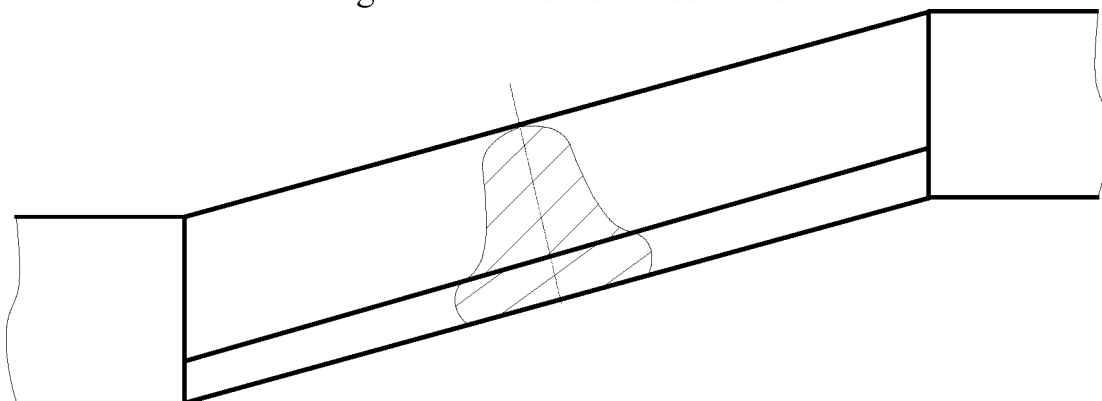


Figure 5.7 – Revolved sections

The section must correspond to the direction, indicated by the arrows, in terms of arrangement and location (Figure 5.6). It is permitted to arrange the section in any place of the drawing's field, also including a rotation and addition of the graphical



symbol .

5.6.8 Removed elements

A removed element is an additional separate image (it is usually enlarged) of any part of the object that requires graphical and other explanations, relating to a shape, size and other data.

The removed element can contain detailed information, not shown in the appropriate image and can differ from it, in terms of content (for example, the image can be a view and the removed element can be a section).

When using the removed element, an appropriate place is marked with a closed solid thin line: a circle, an oval, etc., on the view, cut or section, denoting the removed element with an uppercase letter or a combination of the uppercase letter and an Arabic numeral on the shoulder of a leader line. The designation and the scale (A (2:1)), in which it is made, are specified above the image of the removed element

The removed element is arranged as close as possible to the appropriate place on the image of the object.

If the view, cut or section is a symmetrical figure, it is allowed to draw a half of the image or a little more than the half of the image, in the latter case, drawing the break line.

If the object has several similar, equally spaced elements, then one or two such elements are completely shown in the image of this object and the rest of elements are shown more simply or schematically.

It is allowed to depict a part of the object with properly specifying the quantity of elements, their location.

The parts such as male screws, rivets, dowels, non-hollow shafts and spindles, connecting rods, handles, etc. are shown in uncut view, in case of a longitudinal section. Balls are always shown in uncut view.

Nuts and washers are, as a rule, shown in uncut view in the assembly drawings.

The elements such as arms of the flywheels, pulleys, gears, thin walls like reinforcing ribs, etc. are shown unhatched, if the cutting plane is directed along an axis or with a long side of such an element.

If such elements of the part have a local drilled hole, a hollow, etc., then the partial cut is made.

Objects or elements that have a constant or regularly changing cross section (shafts, chains, rods, shaped steel, connecting rods, etc.) are permitted to be depicted with breaks.

Partial images and the images, having the breaks, are limited, as per one of the following ways:

- a) a solid thin break line, which can go beyond the contour of the image at length of 3-4 mm. This line can be slanting relative to a contour line;
- b) the solid wavy line, joining appropriate contour lines.

5.7 Dimensioning and limit deviations plotting

State standard No.2.307 establishes the rules of dimensioning and plotting limit

deviations in the drawings of the product.

5.7.1 The basis of determining the size of the product and its elements are dimensional values, plotted in the drawing. The total number of dimensions must be minimum in the drawing, but sufficient for manufacture and control of the product.

5.7.2 The dimensions, that are not subjected to being made for this drawing and are specified for more convenient usage of the drawing, are called reference. Reference dimensions are marked with the “*” sign in the drawing and it is written in the technical requirements: “* Reference dimensions”. If all the dimensions are reference in the drawing, they are not marked with the “*” sign and it is written in the technical requirements: “Reference dimensions”.

The dimensions, which determine the size of the elements, whereby this product is installed in the installation place or attached to another product, are called installation dimensions and mounting dimensions.

The dimensions, that determine limiting external (or internal) outlines of the product, are called overall dimensions.

5.7.3 All the dimensions of the part must be plotted together with limit deviations in the drawing (except for dimensions of low-duty chamfers and curvature radiuses). It is allowed not to specify the limit deviations in the following cases:

- for the dimensions, that define zones of different roughness of the same surface, zones of the heat treatment, coating, finishing, knurling, notching, as well as for diameters of the knurled and notched surfaces. In these cases, the “≈” sign is plotted for such dimensions;

- for the dimensions of the parts of one-off products, determined with fitting allowance.

5.7.4 Tolerances of the free dimensions (not affecting a method of parts joining) are allowed to be specified with a general inscription in the drawing’s field.

5.7.5 It is not allowed to specify the dimensions of the same element again in the different images, the technical requirements, the main inscription and the specification, except for the reference dimensions.

5.7.6 Depending on a choice of the measuring bases and required accuracy of the manufacture of separate elements of the part, three systems of plotting the dimensions of the elements are used:

- a chain system involves plotting the dimensions of the separate elements sequentially, one after another, i.e. the dimensions are links of one dimension chain. In this case, the circuit must be open, except for cases, when one of the dimensions is entire;

- a coordinate system is characterized by the fact, that the dimensions are plotted in the drawing in the form of coordinates, that determine a position of the part’s elements relative to the same base surface;

- a combined system is a combination of the chain system and the coordinate system. This system is the most spread, because it provides convenience of the measurement in the manufacture and control of the part’s dimensions without their addi-

tional calculations (Figure 5.8).

5.7.7 The basis of determining the required accuracy of the product during the manufacture is the limit deviations of the dimensions, specified in the drawing, as well as the limit deviations of the shape and location of the surfaces.

The limit deviations of the dimensions (linear and angular dimensions) are specified immediately after put down dimensions.

The limit deviations of the linear dimensions are specified in the drawings with the conventional symbols of tolerance and fit zones, adopted in the unified system of tolerances and fits, as well as numerical values of the limit deviations.

5.7.8 Unspecified limit deviations of the dimensions of relatively low accuracy (from the 12th accuracy degree and lower) are allowed not to be specified specifically for nominal dimensions. They can be specified on condition that this record definitely determines a value and a direction of the limit deviations.

The limit deviations of the dimensions of various elements, specified in one general record, must have the same level of accuracy.

Examples of a general record in the technical requirements of the drawing, taking into account accuracy degrees and location of the tolerance zones as per the unified system of tolerances and fits:

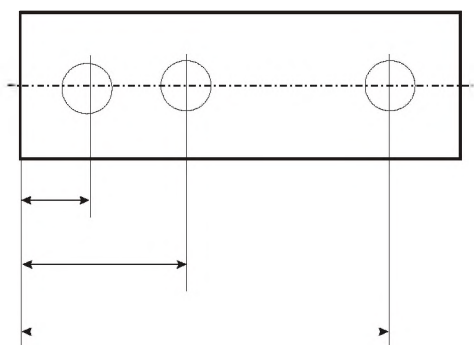
a) unspecified limit deviations of the dimensions: holes H14, shafts h14, the others $\pm \frac{IT14}{2}$

b) unspecified limit deviations of the dimensions: diameters H12, h12, the others $\pm \frac{IT12}{2}$

c) unspecified limit deviations of the dimensions $\pm \frac{IT14}{2}$

6.7.9 Tolerances of the shape and location of the surfaces are specified in the drawing only if they are necessary due to functional and technological reasons.

A type of the shape tolerance and the location of the surfaces must be indicated in the drawing with signs (graphical symbols).



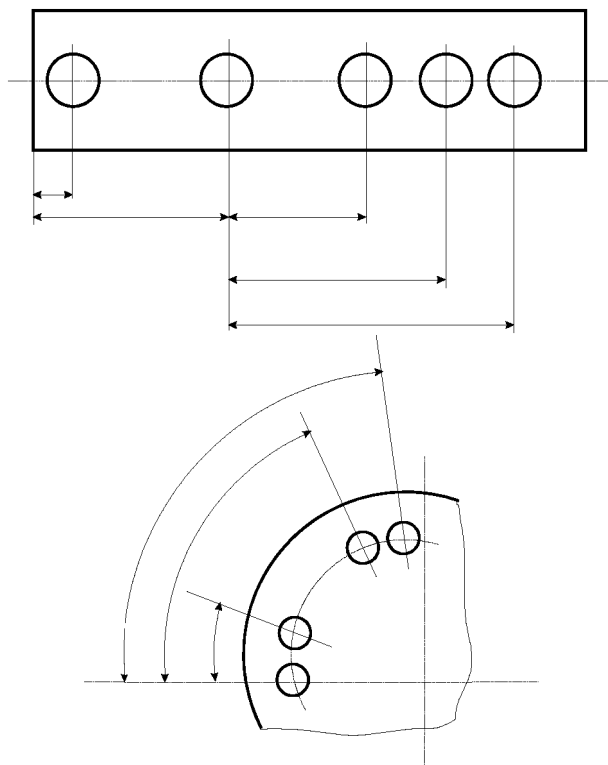


Figure 5.8 – Plotting dimensions in the drawings

The tolerance of the shape and the location of the surfaces are allowed to be specified as a text in the technical requirements, as a rule, in that cases, when there is not a sign of the tolerance's type. In these cases, the text must contain:

- a) a type of the tolerance;
- b) specifying a surface or other element, which the tolerance is determined for;
- c) a numerical value of the tolerance in millimeters;
- d) specifying bases relative to which the tolerance is determined;
- e) specifying dependent tolerances of the shape and location.

When there is a conventional symbol, data of the shape's tolerances and the location of the surfaces are specified in the rectangular frame, divided into two or more parts (Figure 5.9), where it is put:

- a sign of the tolerance in the first part;
- numerical values of the tolerance in millimeters in the second part;
- a letter designation of the base (bases) or a letter designation of the surface, which a location tolerance is associated with in the third and following parts.

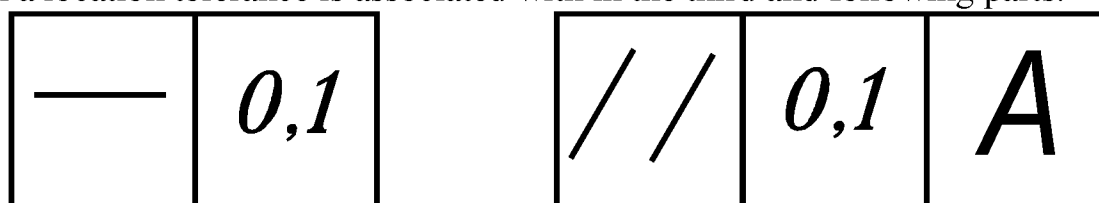


Figure 5.9 – Designation of the data of shape's tolerances and location of the surfaces

A frame is connected to an element, which the tolerance is related to, with the solid thin line, ending with the arrow. A connecting line can be straight or broken, but a direction of the segment, ending with the arrow, must correspond to a direction of the deviation measurement (Figure 5.10).

If the tolerance relates to the surface or its profile, then the frame is connected to the contour line of the surface or its prolongation, moreover the connecting line must not be prolongation of the dimension line (Figure 5.11, a).

If the tolerance relates to the axis or the plane of symmetry, then the connecting line must be the prolongation of the dimension line (Figure 5.11, b)

The bases are indicated with a blackened triangle, which is connected to the frame by means of connecting lines. If the base is the surface or its profile, then the base of the triangle is arranged on the contour line of the surface or on its prolongation (Figure 5.12, a). If the base is the axis or the plane of symmetry, then the connecting line must be the prolongation of the dimension line (Figure 5.12, b).

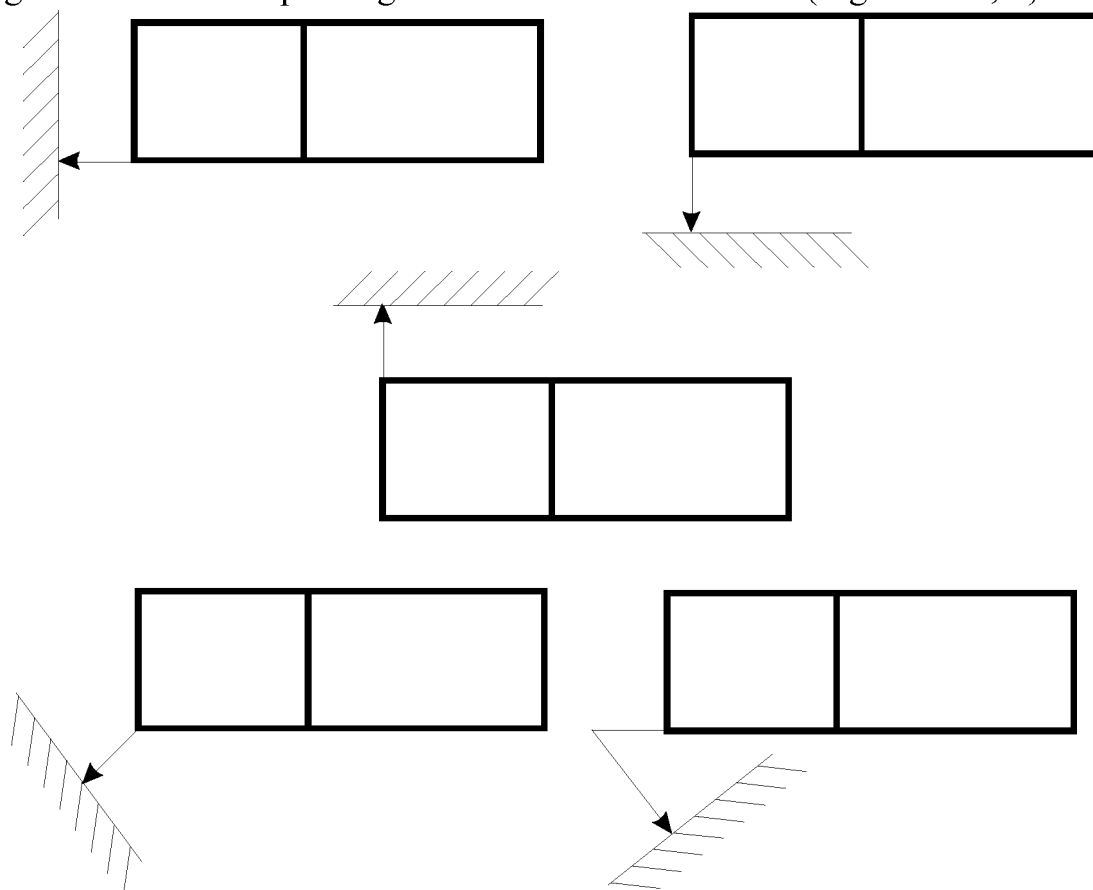


Figure 5.10 – Connecting the frame to the element in the drawings

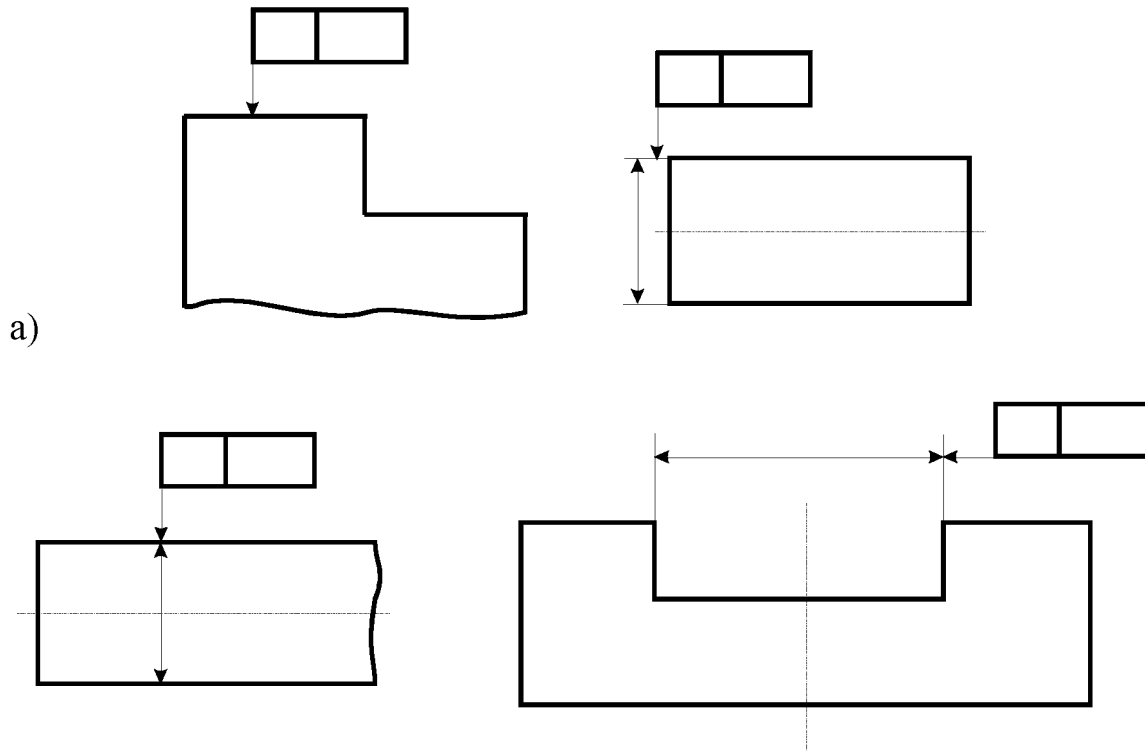


Figure 5.11 – Types of the frame connection to the surface

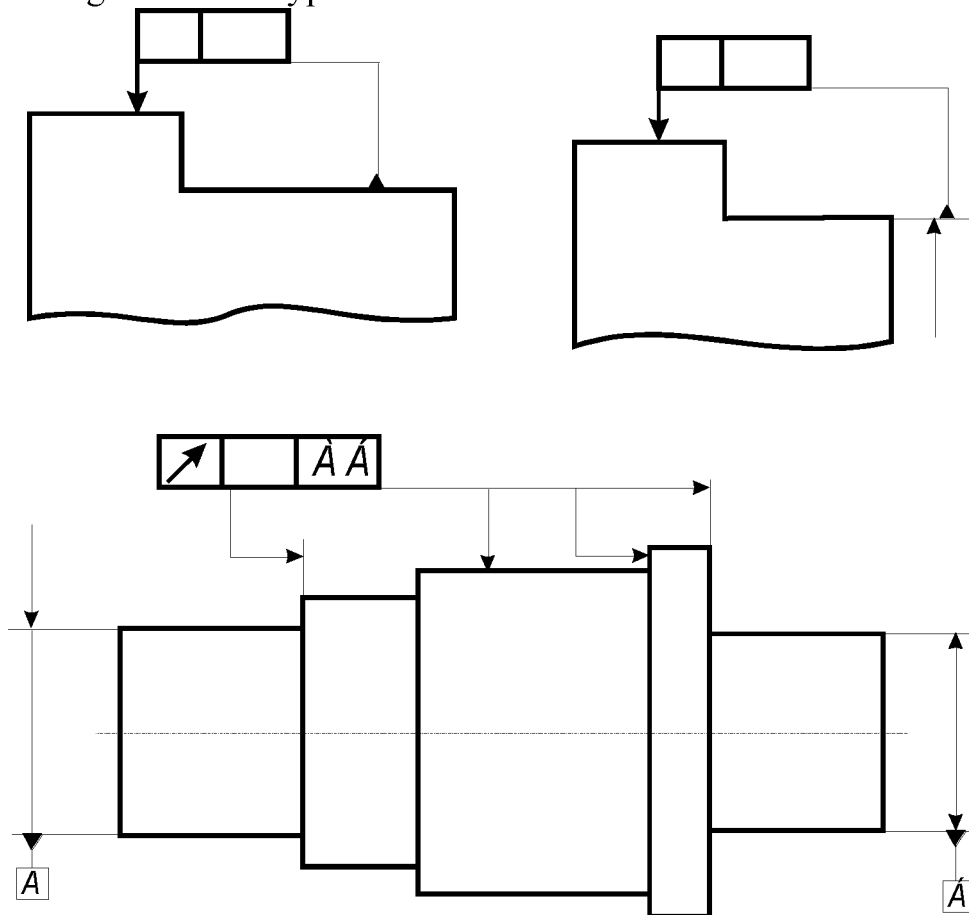


Figure 5.12 – Designation of the bases in the drawings

State standard No.2.308 establishes the rules of specifying the tolerances of the shape and the location of the surfaces on the products' drawings.

5.7.10 Surface roughness is indicated in the drawing for all made surfaces of the product, relating to this drawing, regardless of the methods of their formation, except for the surfaces, the roughness of which is not associated with structural requirements.

State standard No.2.309 determines the designations of the surface roughness and the rules of plotting them on the products' drawings (Figure 5.13).

One of the signs shown in Figure No.5.14, is used in the designation of the surface roughness.

Height "h" must be approximately equal to the height of the dimensional values, used in the drawing. Height $H = (1.5 \dots 5) h$.

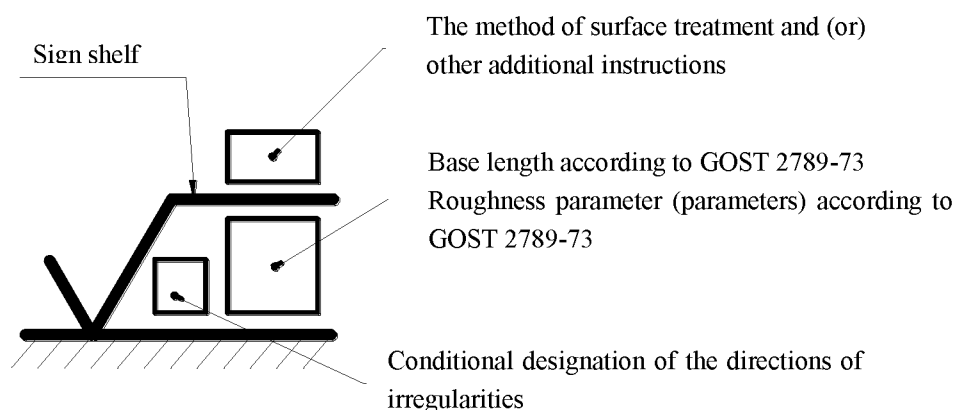


Figure 5.13 – Designation of the surface roughness in the drawings

The first sign is used, if a type of the surface treatment is not determined by a designer.

The second sign is used, if the surface must be treated by means of removing a layer of the material, for example, lathe turning, milling, drilling, etc.

The third sign is used, if the surface must be made without removing the layer of the material, for example, casting, forging, stamping, rolling, drawing, etc.

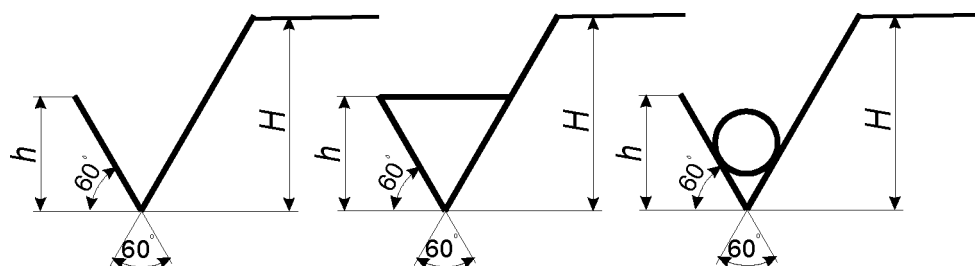


Figure 5.14 – Usage of various designation symbols of the surface roughness in the drawings, according to the type of treatment

On the image of the product, the designation of the surface roughness is arranged:

- on the contour lines, when the size is plotted from these lines;
- on the extension lines (as close as possible to the dimension line);
- on the shoulders of the leader lines;
- on the dimension lines or their prolongations (if there is not enough space on the sheet).

sheet).

If there is not enough space, it is allowed to arrange the designation of roughness on the dimension lines or their prolongations, on the frame of shape tolerance and to break the extension line as well (Figure 5.15).

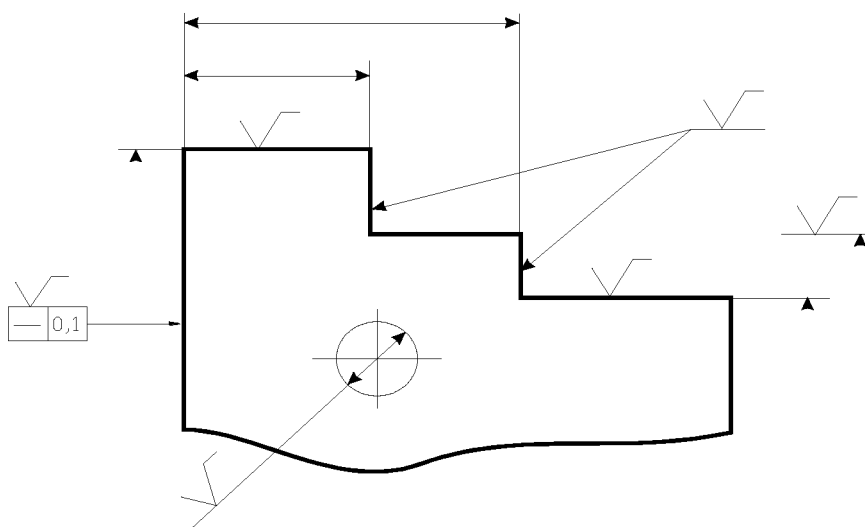


Figure 5.15 – Designation of the surface roughness in the product's image

When specifying the same roughness for all surfaces of the product, the designation of the roughness is put in the upper right corner of the drawing and is not plotted on the image (Figure 5.16, a).

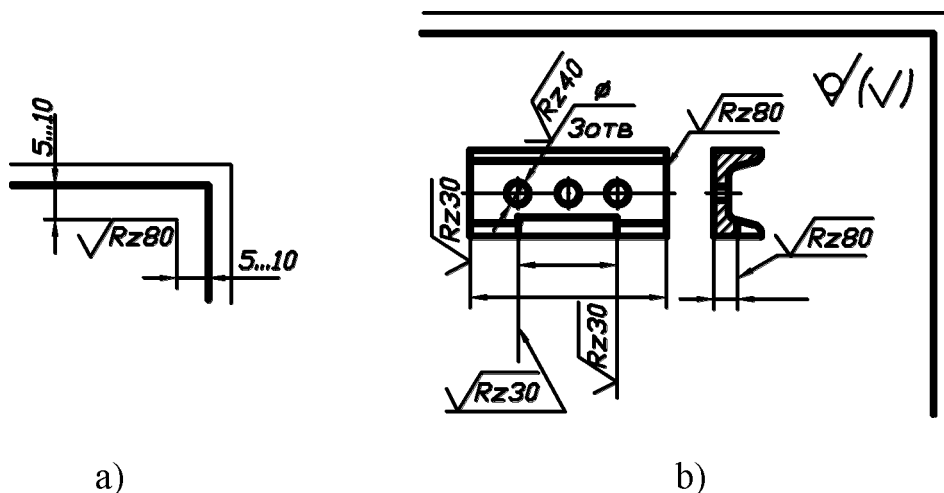


Figure 5.16 – Designation of the same roughness for some surfaces

When specifying the same roughness for some surfaces of the product, the designation of the same roughness and the conventional symbol ($\sqrt{\text{ }}$) are put (Figure 5.16) in the upper right corner of the drawing.

The designation of the same surface roughness of a complex configuration is allowed to be provided in the technical requirements of the drawing with reference to the letter designation of the surface, for example: "surface roughness A - $\sqrt{\text{ }}$ ".

5.8 Conventional images and conventional symbols of the welded joints' seams

State standard No.2.312 determines conventional images and the conventional symbols of the welded joints' seams.

5.8.1 A welded joint is conventionally depicted:

- with a visible solid main line (Figure 5.17, a);
- with an invisible dashed line (Figure 5.17, b).

A visible weld spot is conventionally depicted with the "+" sign, which is made with the main solid lines (Figure 5.17, c).

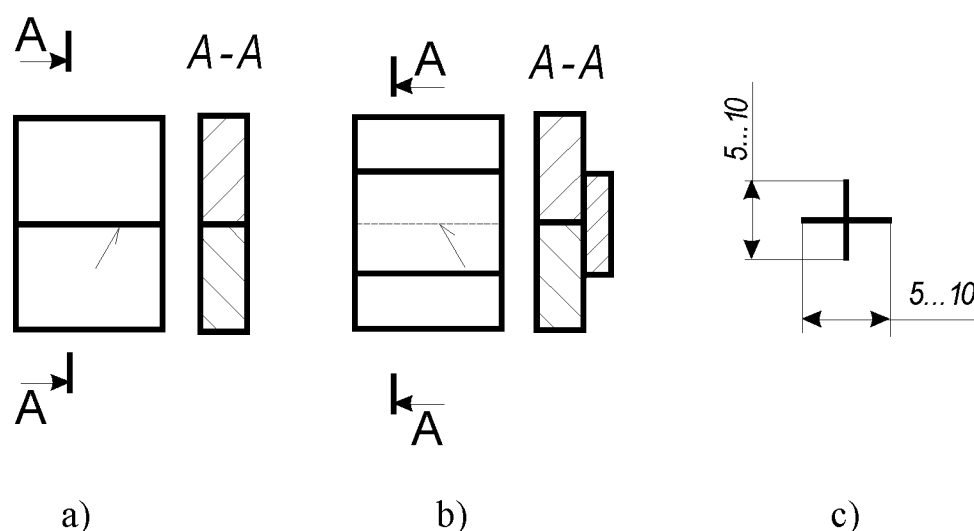


Figure 5.17 – Image of the welded seams

A leader line is drawn from the image of the seam or a single point, ending with a one-way arrow.

5.8.2 The conventional symbol of the seam is plotted:

- a) on the shoulder of the leader line, drawn from the image of the seam, from the front side (Figure 5.18);
- b) under the shoulder of the leader line, drawn from the image of the seam, from the back side (Figure 5.19).

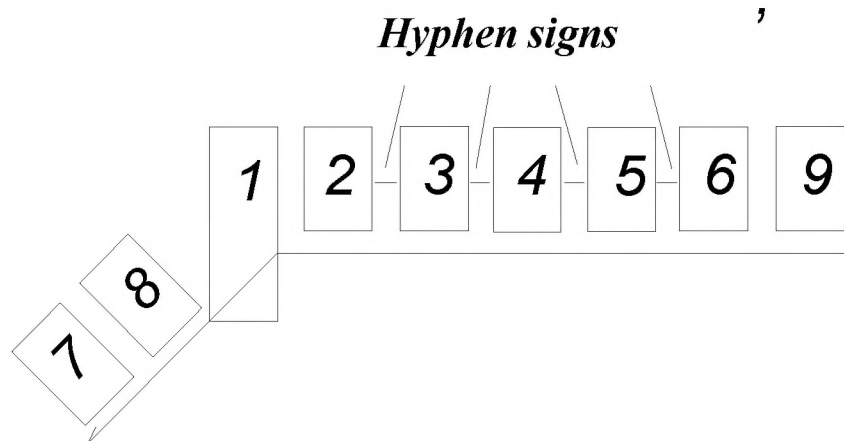


Figure 5.18 – Conventional symbol of the seam on the shoulder of the leader line

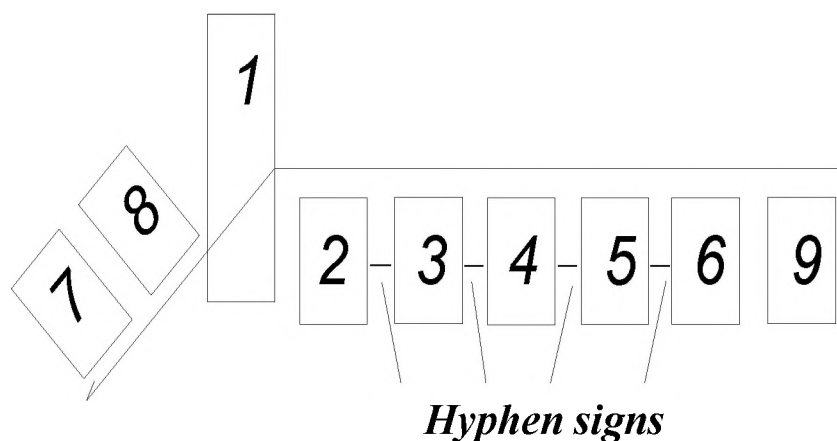


Figure 5.19 – Conventional symbol of the welded seam under the shoulder of the leader line

The conventional symbol of the welded seams must generally contain the following things in the sequence, shown by a rectangle 1-9 in accordance with Figures No. 5.18 and 5.19:

- 1 – an auxiliary sign of the seam: along a closed line or an erection welded seam;
- 2 – a designation of the standard for types and structural elements of the welded joints' seams;
- 3 – an alphanumeric designation of the seam for the types and the structural elements of the welded joints' seams, according to a standard;
- 4 – the sign and size of the seam's leg (only for corner seams); the sign is made with the solid thin lines, the height of the sign must be the same as the height of the numbers, included in the designation of the seam;

5 – auxiliary signs: for an intermittent welded seam - the length of the welded section, the sign “1” or “2” and a step; for a single weld spot – a rated diameter of the spot or a rivet weld, the sign “1” or “2” and the step; for a seam of the electric resistance roller welding – rated width of the seam; for the intermittent welded seam of the electric resistance roller welding – the rated width of the seam, a multiplication sign, the length of the welded section, the sign “1” and the step;

6 – auxiliary signs: “remove reinforcement of the welded seam” or “treat cold laps and unevenness of the seam with a smooth transition to the basic metal”;

7 – quantity of the identical seams in the drawing;

8 – an ordinal number of the identical seams;

9 – the designation of the roughness of a machined surface.

The designation of the roughness is allowed to be provided in the technical requirements of the drawing. Examples of the conventional symbols of the welded seams in the drawings are shown in Figure No.5.20.

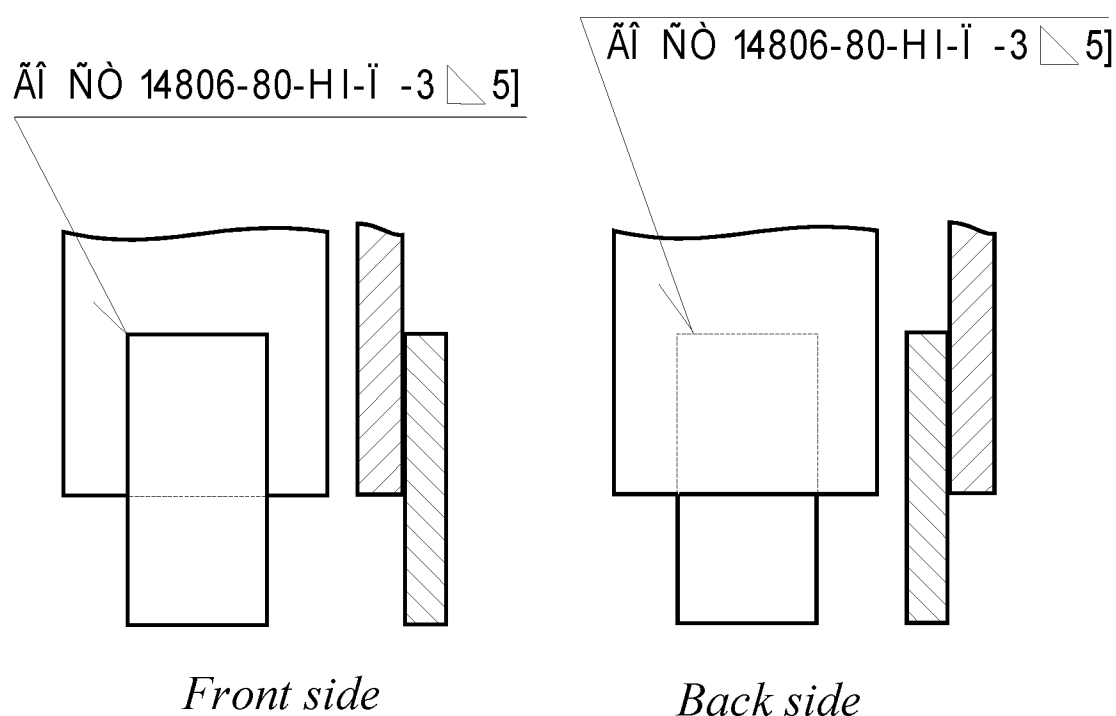


Figure 5.20 – Examples of the conventional symbols of the welded joints in the drawings

5.8.3 Drawings of the welded parts are drawn up as drawings of the assembly units.

5.9 Rules of plotting inscriptions, technical requirements and tables in the drawings

State standard No.2.316 establishes the rules of plotting inscriptions, technical requirements and tables in the drawings of products.

5.9.1 In addition to the image of the object with dimensions and maximum deviations, the drawing can contain:

- a) a text part consisting of technical or technical specifications;
- b) inscriptions with the designation of images, as well as those related to individual elements of the product;
- c) tables with dimensions and other parameters, technical requirements, symbols, etc.

5.9.2 The execution of the main inscription of the drawing must be carried out in accordance with the requirements of R V-08-2022.

5.9.3 The text part, inscriptions and tables are included in the drawing in cases where the data contained in them, instructions and explanations cannot or are not expedient to be expressed graphically or by symbols.

5.9.4 The content of the text and inscriptions should be short and precise. The inscriptions in the drawings should not contain abbreviations of words, with the exception of generally accepted ones, as well as those established in standards and regulated by GOST 2.316.

5.9.5 The text in the drawing field, tables, inscriptions with the designation of images, as well as inscriptions directly related to the image are, as a rule, placed parallel to the main inscription of the drawing.

5.9.6 Near the images on the shelves of leader lines, only brief inscriptions are applied, for example, indications of the number of structural elements (holes, grooves, etc.), if they are not included in the table, as well as indications of the front side, the direction of fiber rolling and etc.

5.9.7 A leader line that intersects the image contour and is drawn away from any line ends with a dot (Figure 5.21).

The leader line drawn from the lines of the visible and invisible contour, as well as from the lines denoting surfaces, ends with an arrow (Figure 6.21).

At the end of the leader line, drawn from all other lines, there should be neither an arrow nor a dot (Figure 5.21).

5.9.8 Leader lines should not intersect with each other, be non-parallel hatching lines (if the leader line passes through a hatched field) and, if possible, not cross dimension lines and image elements that do not include the inscription placed on the shelf.

It is permitted to make leader lines with one break (Figure 5.22), as well as to draw two or more leader lines from one shelf (Figure 5.23).

5.9.9 Inscriptions related directly to the image can contain no more than two lines located above and below the leader line shelf.

5.9.10 The text part placed in the drawing field is placed above the main inscription.

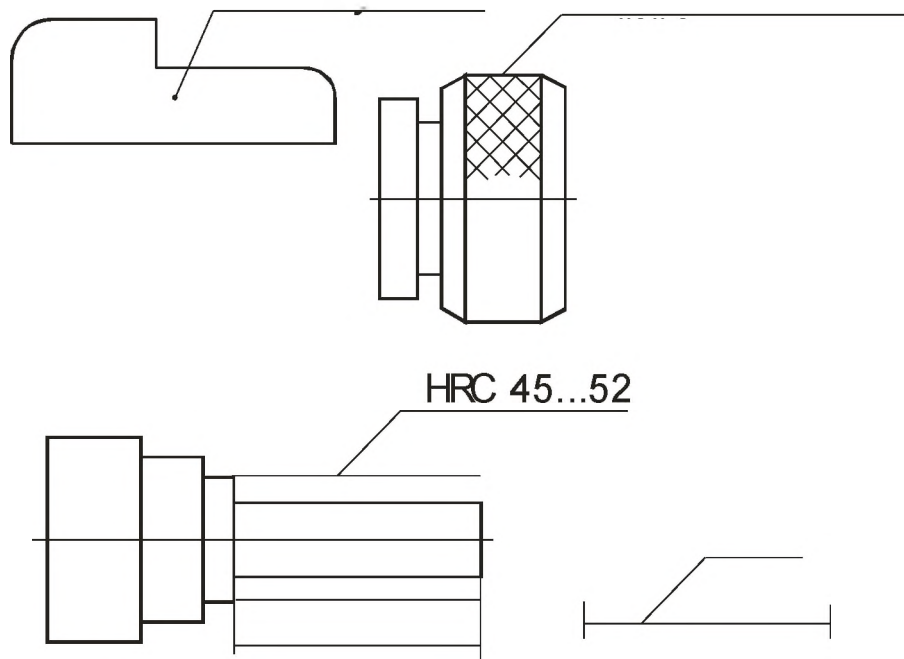


Figure 5.21 – Executing leader lines in the drawings

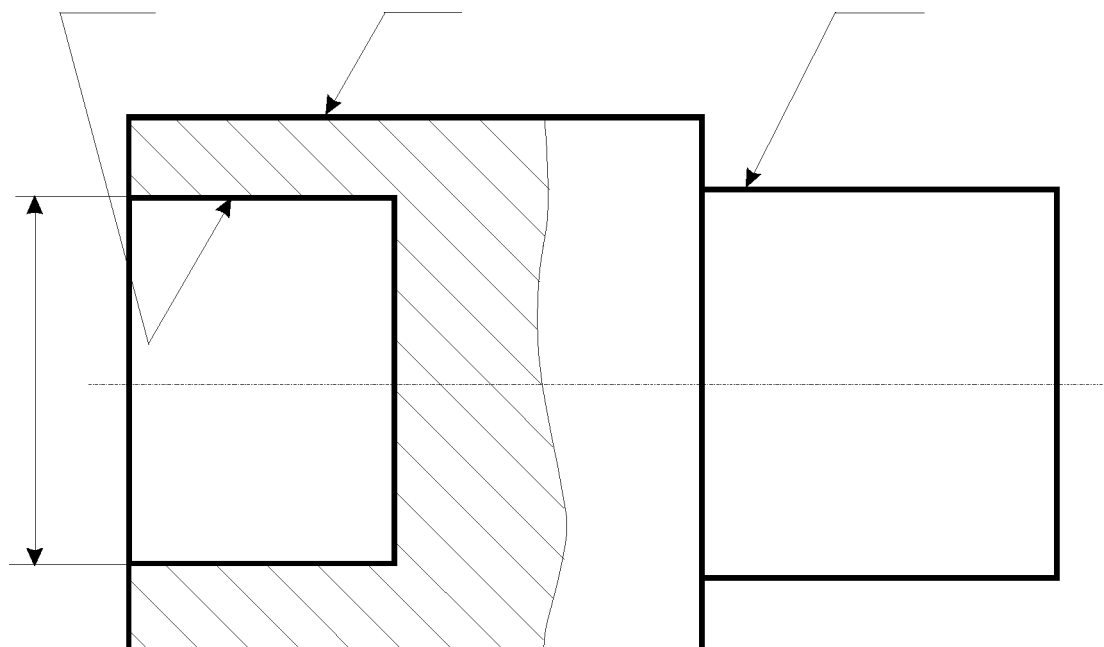


Figure 5.22 – Executing leader lines in the drawings

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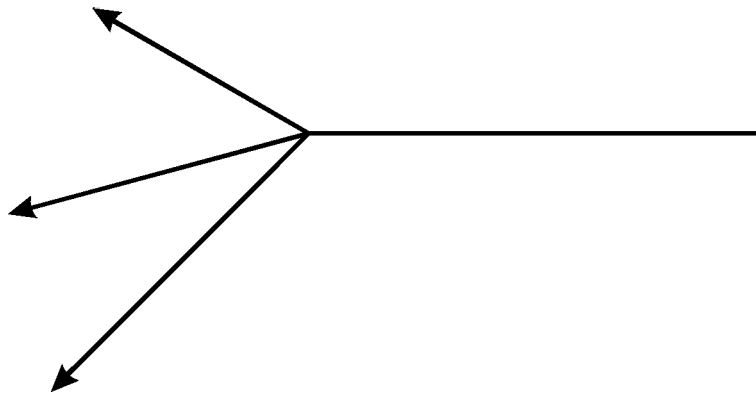


Figure 5.23 – Executing two and more leader lines from one shelf

It is not permitted to place images, tables, etc. between the text part and the main inscription.

On sheets larger than A4, it is permitted to place text in two or more columns. The width of the column should be no more than 185mm.

In the drawing, leave room for the continuation of the table of changes.

5.9.11. In the drawing of a product for which a table of parameters is established by the standard (for example, a gear, a worm, etc.), it is placed according to the rules established by the corresponding standard. All other tables are placed in the free space of the drawing field to the right of the image or below it and are performed in accordance with GOST 2. 105.

5.9.12 The technical requirements in the drawing are set out by grouping requirements that are homogeneous and similar in nature. If possible, in the following order:

a) requirements for the material, workpiece, heat treatment and material properties of the finished part (electrical, magnetic, dielectric, hardness, humidity, hygroscopicity, etc.). Indication of substitute materials;

b) dimensions, maximum deviations of dimensions, shape and relative position of surfaces, masses, etc.;

c) requirements for the quality of surfaces, instructions for their finishing, coatings;

d) gaps, location of individual structural elements;

e) requirements for setting up and regulating the product;

f) other requirements for the quality of products, for example, noiselessness, vibration resistance, self-braking, etc.;

g) conditions and test methods;

h) instructions on marking and branding;

i) rules for transportation and storage;

j) special operating conditions;

k) references to other documents containing technical requirements that apply to

this product but not shown in the drawing.

5.9.13 Paragraphs of technical requirements must have continuous numbering. Each item of technical requirements is written on a new line.

5.9.14 The heading "Technical requirements" is not written.

5.9.15 If it is necessary to indicate the technical characteristics of the product, it is placed separately from the technical requirements with independent numbering of paragraphs, in the free field of the drawing under the heading "Technical characteristics". At this, the heading "Technical requirements" is placed above the technical requirements. Both headings are underlined.

5.9.16 When drawing on two or more sheets, the text part is placed only on the first sheet, regardless of which sheets contain images that include the instructions given in the text part.

The inscriptions relating to the individual elements of the subject and applied on the shelves of the leader lines are placed on those sheets of the drawing on which they are most necessary for the convenience of reading the drawing.

5.9.17 To designate images (views, sections, sections), surfaces, dimensions and other elements of the product in the drawing, capital letters of the Russian alphabet are used, with the exception of the letters Ё, З, О, Х, Ъ, Ы, Ь.

Letter designations are assigned in alphabetical order without repetition and, as a rule, without gaps, regardless of the number of drawing sheets. It is preferable to designate images first.

In case of a lack of letters, digital indexing is used, for example: "A"; "A1"; "A2"; "B-B"; "B1-B1"; "B2-B2".

The letters are not underlined.

5.9.18 The font size of the letter designations should be approximately twice the size of the digits of the dimensional numbers used in the same drawing.

If in the drawing it is difficult to find additional images (sections, dimensions, additional views, detail elements) due to the high saturation of the drawing or its execution on two or more sheets, then additional images are marked with the sheet numbers or designations of the zones on which these images are placed (Figure 5.24).

In these cases, above additional images, their designations indicate the numbers of sheets or designations of zones on which additional images are marked (Figure 5.23).

5.9.19 The tables placed in the drawing are numbered within the drawing if there are references to them in the technical requirements. At the same time, the word "Table" with a serial number (without the N sign) is placed above the table on the left.

If there is only one table in the drawing, then it is not numbered.

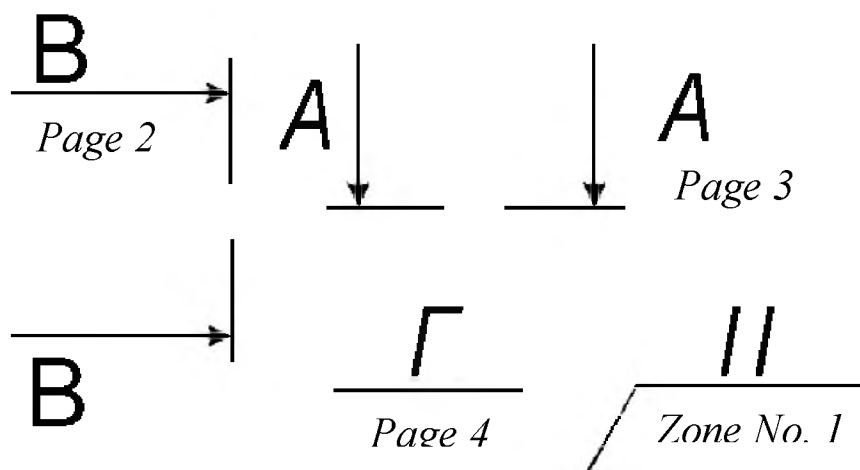


Figure 5.24 – Designation of additional images in the drawings

5.10 The rules of designating materials in product drawings and in the title block

In the drawings of parts, the necessary data is placed that fully characterizes the properties of the material of the finished part and the material from which it is made, i.e., the workpiece of the part. At the same time, information characterizing the material of the workpiece is entered into the main inscription, and data on the material of the finished part, if they differ from the properties of the material of the workpiece, are placed in the drawing field in the technical requirements.

The characteristic of the material indicated in the title block of the part drawing is recorded by the symbol established by the standard for this material in accordance with Table 5.4.

Table 5.4 - Material characteristic symbol

Grade	Examples of designations
1	2
Steel, sheet carbonaceous quality and ordinary quality of general purpose (according to GOST 16523-97)	Cold-rolled sheet of steel 25, size 2.0 ´ 1000 ´ 2000 mm, with a thickness tolerance of class B, category 4 according to normalized characteristics, surface finish group III: Sheet, c/r $\frac{B\ 2,0 \times 1000 \times 2000 \text{ГОСТ} 19\ 904 - 90}{4 - III - 25 \text{ГОСТ} 1652\ 3 - 97}$
Round and square hot-rolled steel	Hot-rolled round steel grade St3 with a diameter of 30 mm high precision (A): Round $\frac{A30 \text{ГОСТ} 259\ 0 - 2006}{\text{СТ} 3 \text{ГОСТ} 535 - 2006}$ Hot-rolled square steel grade St3 with the square side of 50 mm, high precision (B): Square $\frac{B50 \text{ГОСТ} 259\ 1 - 88}{\text{СТ} 3 \text{ГОСТ} 535 - 2006}$

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Rolled angle equal-shelf steel (according to GOST 8509-93)	Angular equal-shelf steel 56'56'5 mm in size, grade St2sp with normal rolling strength (B): $\text{Angle } \frac{Б56 \times 56 \times 5 \Gamma \text{OCT} 8509 - 93}{\text{Cт}2\text{cп} \Gamma \text{OCT} 5 35 - 2006}$
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There are used conventional designations that contain only the names of the material, the grade of the material and the number of the standard, which contains the full characteristics of the specified grade of material, for example:

Gray cast iron GCh10 GOST 1412-85;
Ductile cast iron KCh30 GOST 1215-79;
Steel 15 GOST 1050-2013
Steel St3 GOST 380-2005.

5.11 Rules of executing diagrams

GOST 2.701 establishes the types, types and general requirements for the implementation of schemes.

5.11.1 Diagrams are design documents, in which the component parts of the product, their relative position and connections between them are shown conditionally.

Depending on the elements that make up the product and the connections between them, the circuits are divided into the following types: kinematic (K), hydraulic (G), pneumatic (P) and electrical (E).

5.11.2 Diagrams are performed without observing the scale on sheets of a standard format with the main inscription according to R V-08-2022. In this case, the actual spatial arrangement of the component parts of the product can be ignored.

The elements of the product are depicted in the form of conventional graphic symbols established by the relevant USDD standards. The connection between them is shown by communication lines, conditionally representing shafts, couplings, pipelines, cables, etc.

5.11.3 Diagrams should be compact, the number of breaks and intersections of communication lines should be minimal. The elements that make up a separate device are highlighted in the diagram with dash-dotted lines indicating the name of this device. In a diagram of one type, it is permitted to depict elements of diagrams of other types that directly affect the operation of the product. These elements and their connections are represented by dashed lines.

Diagrams are assigned the designation of the product corresponding to them. After the designation, the scheme code should be written. The name of the scheme is indicated in the main inscription after the name of the product.

5.11.4 Kinematic diagrams must be drawn in accordance with GOST 2.703.

All the elements of the diagram must be depicted with conventional graphic symbols in accordance with GOST 2.770 or simplified external outlines.

5.11.5 Hydraulic and pneumatic diagrams must be drawn in accordance with

GOST 2.701 and GOST 2.704.

All the elements of the diagrams must be depicted with conventional graphic symbols in accordance with GOST 2.780, GOST 2.782 and GOST 2.784.

5.11.6 Electrical circuits must be drawn in accordance with GOST 2.704, GOST 2.702 and GOST 2.708. All elements of the circuit must be depicted with conventional graphic symbols in accordance with GOST 2.747.

5.11.7 The development of programs and program documentation for computers, complexes and systems must be carried out in accordance with the requirements of a set of state standards that establish interrelated rules for the development, execution and circulation of program documentation (USPD).

5.12 Rules of executing training posters

GOST 2.605 establishes the rules for the implementation of training posters.

5.12.1 Training technical posters are designed to study a specific topic, for example:

a) designs, principles of operation, methods of use and maintenance of the product;

b) technological processes;

c) areas of technical knowledge.

Each poster must contain:

a) a title

b) a pictorial part;

c) an explanatory text (if needed).

5.12.2 The title of the poster should be short and consistent with the content of the poster. The name of the poster should be given as a title in the upper middle part of the poster.

5.12.3 The graphic part of the poster must have data explaining the content of the topic:

a) for products: external views and sections showing the structural device and the interaction of components, diagrams, tables, formulas, graphs, diagrams for various purposes, explaining the device and the rules for operating the product, and, if necessary, instructions for maintenance;

b) for technological processes: a conditional or schematic representation of the equipment in the technological sequence, as well as methods of working on it.

5.12.4 Coloring the product components, links, chains, etc. should, if possible, match their color in the product. The number of colors on the poster should be no more than six including black.

5.12.5 The explanatory text of the poster should be placed in the free field of the poster and contain the name of the components of the product depicted on the poster, explanations of the designations placed on the diagrams. The names, designations of elements, the text part of the posters must correspond to the names, symbols and the text part of the documentation, which the posters are intended to illustrate.

5.12.6 The component parts of the product depicted on the poster must have con-

tinuous numbering. Position numbers should be placed on leader lines in ascending clockwise order. Leader lines must be made in accordance with GOST 2.316.

5.13 Rules of selecting and executing technological documents used in manufacturing and repairing products

5.13.1 The completeness of technological documents is established depending on the type and nature of production according to Table 1 and Table 2 of GOST 3.1119.

5.13.2 When drawing up technological documents used in manufacturing products, USTD standards should be used.

5.13.3 The rules of processing documents used in repairing products are defined by GOST 3.1115.

6 Requirements for drawings

6.1 General view drawings

GOST 2.109 establishes general requirements for drawings.

General view drawings (GOST 2.118 and GOST 2.120) is a document that defines the design of the product and the interaction of its components, and explains the principle of operation of the product.

A general view drawing must include the following elements:

a) types, dimensions and sections of the product, inscriptions and text part, necessary for understanding its structural design, interaction of its components and principles of operation;

b) the name (if possible, the designation) of the component parts of the product, for which the principle of operation is explained; technical characteristics, material, number of components are given, with the help of which the principle of its operation is described, general images and composition of the product are explained;

c) the necessary overall, connecting, mounting and structural dimensions and, if required, the product diagram and technical characteristics.

A general view drawing is performed with simplification provided for by the standard for the design of working drawings. The components of the product (including borrowed and purchased ones) are depicted in a simplified way (individual even with outline outlines), if the structural device, the interaction of the components and the principle of operation of the product are understood. The component parts of the product can be shown on one sheet with a general view or on separate subsequent sheets of a general view drawing.

External elements of the image are indicated by Roman numerals, and views, sections, surfaces, dimensions and other elements of the drawing - in capital letters of the Russian alphabet

The names and designations of the components of the product are indicated in two ways:

1) on the shelves of leader lines drawn from the parts in the general view drawing;

2) in a table made on separate sheets of A4 format, as subsequent sheets of a gen-

eral view drawing.

If there is a table, the position numbers of the component parts of the product are indicated on the shelves of leader lines in accordance with this table.

.2 Assembly drawings

An assembly drawing must contain the following elements.

a) an image of an assembly unit, giving an idea of the interconnection of the components connected according to this drawing and providing the possibility of assembling and controlling the assembly unit. It is allowed to place connection diagrams or arrangements of components on assembly drawings, if they are not drawn up as independent documents. If necessary, assembly drawings provide data on the operation of the product and the interaction of its parts;

b) dimensions, tolerances and other parameters and requirements that must be met or controlled according to this assembly drawing. It is allowed to indicate as a reference the dimensions of the parts that determine the nature of the pairing;

c) instructions on the nature of the pairing and methods for its implementation, if the accuracy of the pairing is ensured not by the specified maximum deviations of dimensions, but by selection, fitting, etc., as well as instructions on the implementation of permanent connections;

d) position numbers of the components included in the product;

e) overall dimensions of the product;

f) Mounting, connecting and other necessary reference dimensions.

g) coordinates of the center of mass (if needed);

h) technical characteristics of the product (if needed).

6.3 Dimensional drawings

Dimensional drawings are not intended for manufacturing products and should not contain the data for manufacturing and assembly.

A dimensional drawing is made with maximum simplification, but in such a way that the extreme positions of the moving, retractable or folding parts are visible.

The number of views should be minimal, but sufficient to give an idea of the external outlines of the product. The image of the product is made with solid main lines, and the outlines of the parts moving to the extreme positions are thin dash-dotted lines with two dots.

In a dimensional drawing, the overall, installation and connecting dimensions are applied, which determine the position of the protruding parts, without indicating that all these dimensions are for reference. The installation and connecting dimensions required for linking with other products must be with maximum deviations. On the dimensional drawing, you can indicate the conditions of use, storage, transportation and operation of the product.

6.4 Mounting drawings

A mounting drawing must contain:

a) image of the mounted product;

b) an image of the products used when mounting, as well as a full or partial image of the device (structure, foundation) to which the product is attached;

c) mounting and connecting dimensions with limit deviations;

- d) list of components required for mounting;
- e) technical requirements for the mounting of the product.

A mounting drawing is executed according to the rules established for assembly drawings, taking into account additional rules developed for mounting parts.

The product to be mounted is depicted in a simplified, external outline, with the exception of those structural elements that are necessary for proper mounting and are performed with the necessary details. The device to which the product is attached (object, foundation) is depicted in a simplified way with solid thin lines. The name and designation of the device to which the mounted product is attached is indicated on the leader line shelf or directly on the image.

6.5 Part drawings

A part drawing must contain:

- a) designation of dimensions;
- b) designation of maximum deviations of dimensions;
- c) designation of maximum deviations of the geometric shape and location of surfaces;
- d) designation of the surface, part roughness;
- e) designation of coatings and indicators, properties of the material of the finished part;
- f) technical requirements for the material, dimensions and shape of the part and other data that it must comply with before assembly.

If the part will be machined during the assembly process and manufactured with an allowance, then the image is marked with dimensions, maximum deviations, roughness, etc., which it must correspond to after assembly. Such dimensions are enclosed in parentheses, which is recorded in the technical requirements by type: "Dimensions in brackets after assembly".

In the drawings of the parts to be coated, the dimensions and surface roughness before coating are indicated. It is permitted to indicate simultaneously the dimensions and surface roughness before and after coating.

7 Approval, negotiation and implementation

The approval of this MG is carried out with the QMR, The Board Member - Vice-Rector for Academic Affairs and is made out in the "Approval Sheet" (Appendix B).

The date of introduction of the document is the date of negotiation/approval of the document. The document comes into effect at the time of its approval.

8 Ensuring the availability

The provision of units with copies of this MG is carried out by posting on the website.

9 Storage

The storage of this MG is carried out in accordance with DP X-01-2022.

10 Analysis and updating

Verification, analysis and updating of this MG is carried out in accordance with DP X-01-2022.

11 Making changes

Making changes to this MG are made in accordance with DP X-01-2022.

Appendix B
(informative)

Example of drawing up a specification

Формат	Зона	Поз.	Обозначение	Наименование	Кол.	Примечание
				<u>Документация</u>		
				Сборочный чертеж		
				<u>Сборочные единицы</u>		
A4		1		Головка	1	
A4		2		Корпус	1	
A4		3		Рукоятка	1	
A4		4		Цилиндр	1	
				<u>Детали</u>		
A2		5		Вал	1	
A4		6		Втулка	1	
A3		7		Гайка	1	
A3		8		Кольцо	1	
A4		9		Кольцо	1	
A3		10		Крышка	1	
A4		11		Лист	3	
A4		12		Правка	1	
A4		13		Сухарь	3	
			Участок механической обработки съёмника винтового			
Изм.	Лист	№ докум.	Подп.	Дата	Съёмник винтовой	
Студент	Кислов				Стадия	Лист
Рук.	Жетесова					Листов
					1	2
Н.Контр.	Жуңусова				КарГТУ каф ТМ	
Зав.каф.	Шараф				гр ТМ-99	

