Tomsk Polytechnic University

DESCRIPTIVE GEOMETRY
ENGINEERING GRAPHICS

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Lecture 9

DIMENSIONING

Plan

1. Dimension and Extension Lines.
2. Dimension Figures
3. Ways of dimensioning
4. Types of the sizes
5. Dimensioning According to The Base
6. Simplifications in Dimensioning

When a drawing is made, dimensioning is of vital importance since one can determine the size of an object represented only by its dimensioning, whatever the scale is and however accurately the drawing is completed.

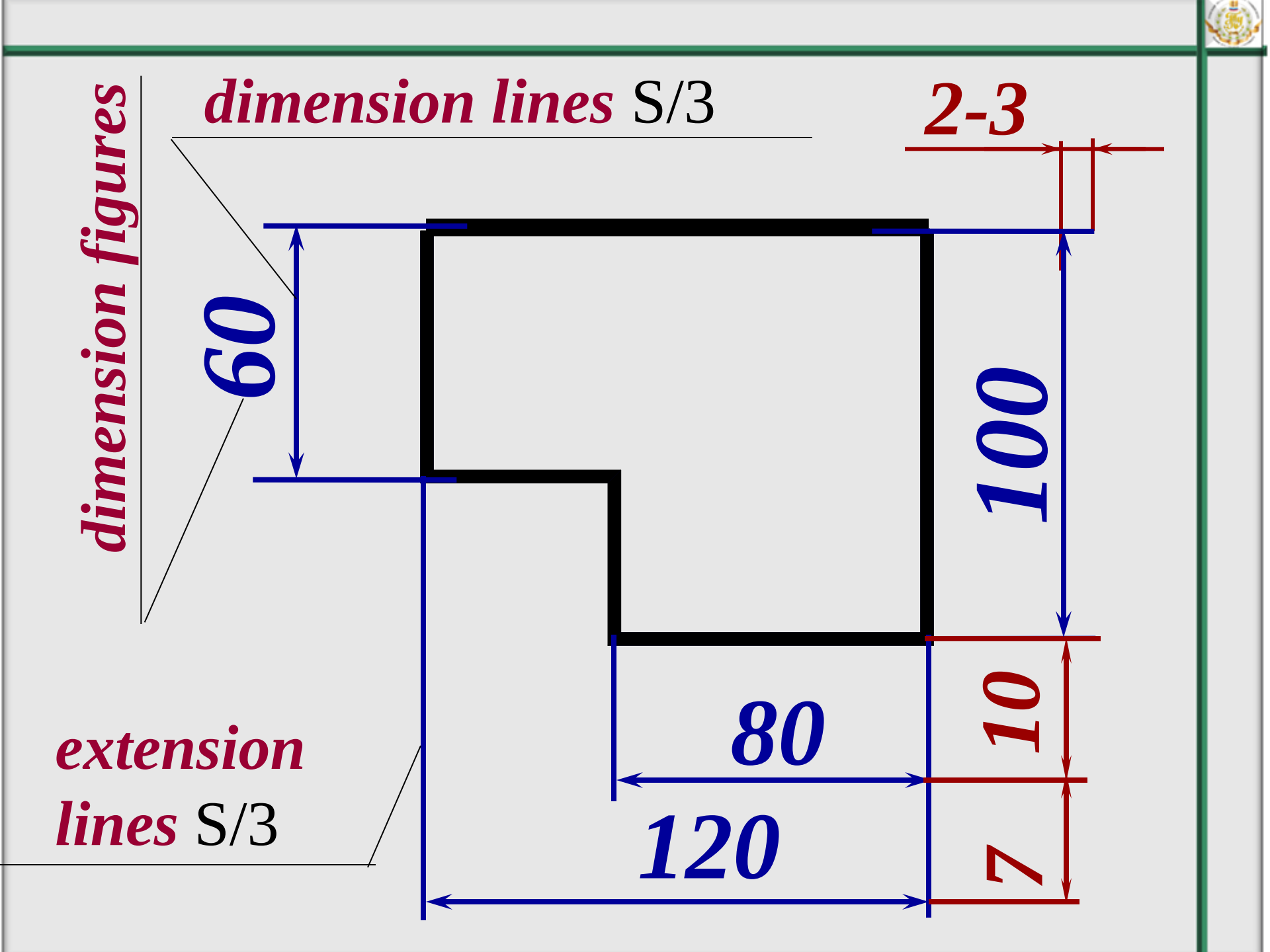
When dimensioning a drawing, it is very important to specify the dimensions correctly in accordance with an object's application and the conditions of its manufacture.

Dimension and Extension Lines. Dimension Figures

Dimensioning of a drawing is completed with:

- ***dimension figures ;***
- ***dimension lines;***
- ***extension lines***

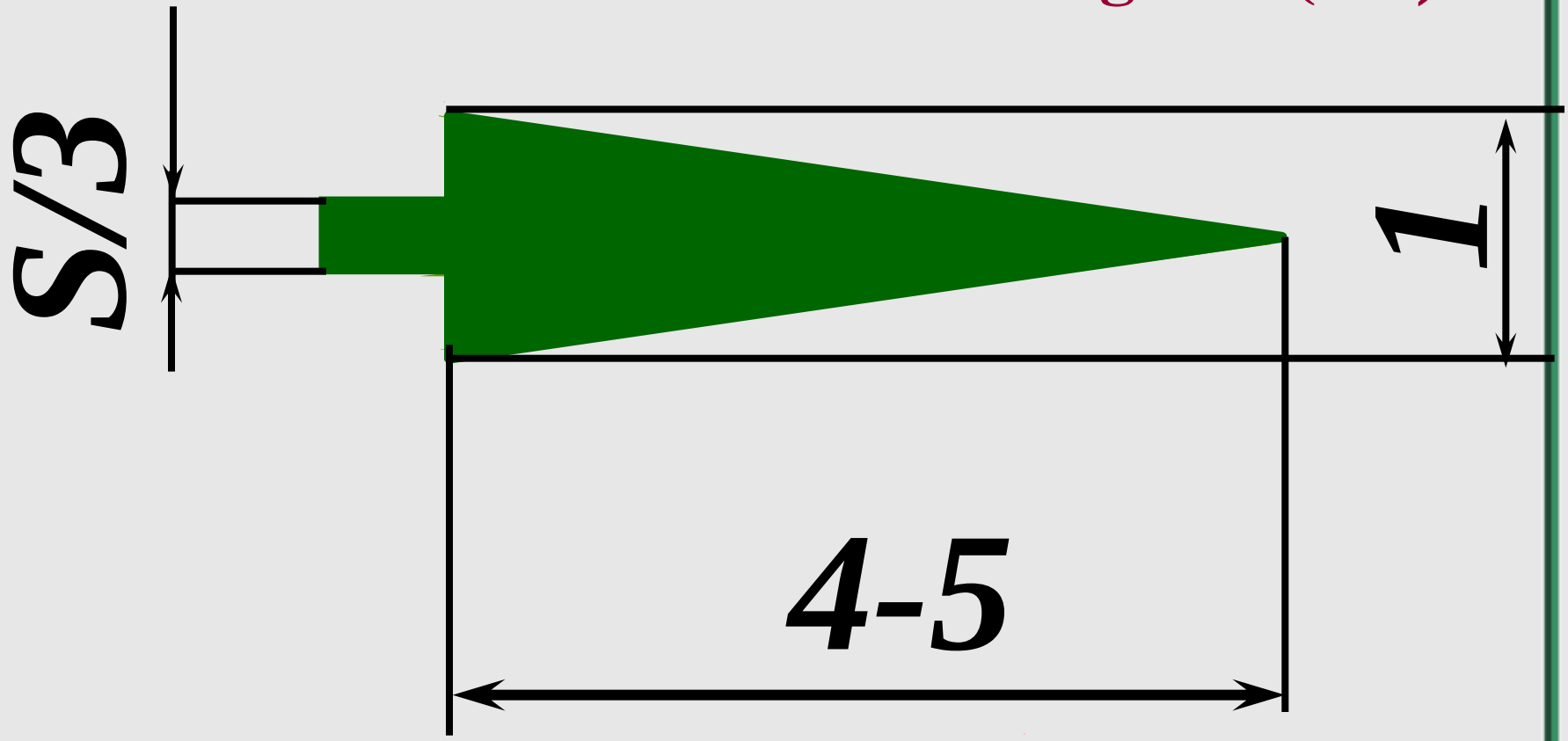
Engineering drawings are usually dimensioned **in millimetres**, and it is not necessary to put on the abbreviation for the units used **(mm)**


dimension lines S/3
dimension figures
2-3
60
100
80
10
120
7
extension
lines S/3

Extension lines, as well as axis or centre lines, should extend to 2…3 mm past the arrowheads of dimension lines

The length of arrowheads depends on the thickness *s* of the base-line of a given drawing.

The recommended arrowhead's length is (4-5) *S*



The length of arrowheads should be approximately equal for all dimensions of a given drawing.

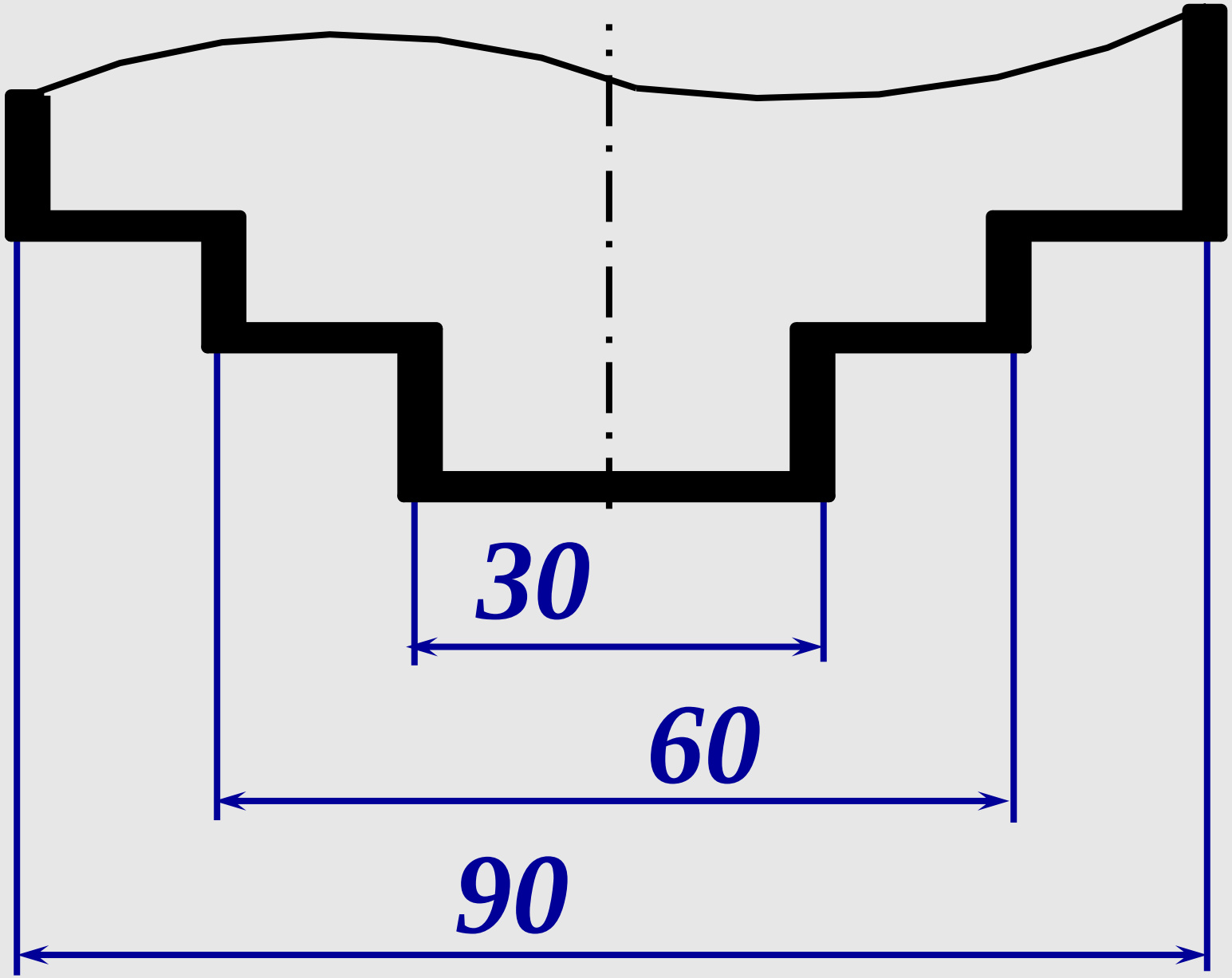
The distance between the parallel dimension lines **should be not less than 7 mm**.

The distance between a dimension line and parallel to it contour (axis or centre) line – **not less than 10 mm**.

A dimension figure is placed **on top of the dimension line**, parallel to it and, as a rule, **closer to its centre**.

If parallel dimensions are to be shown, it avoids confusion if the smallest dimension is **put closest to the outline, and the others arranged in ascending order**.

If several parallel dimension lines, symmetric to the common axis, are to be drawn, it is easier to read the drawing if they **are arranged chequer-wise**.


30
60
90

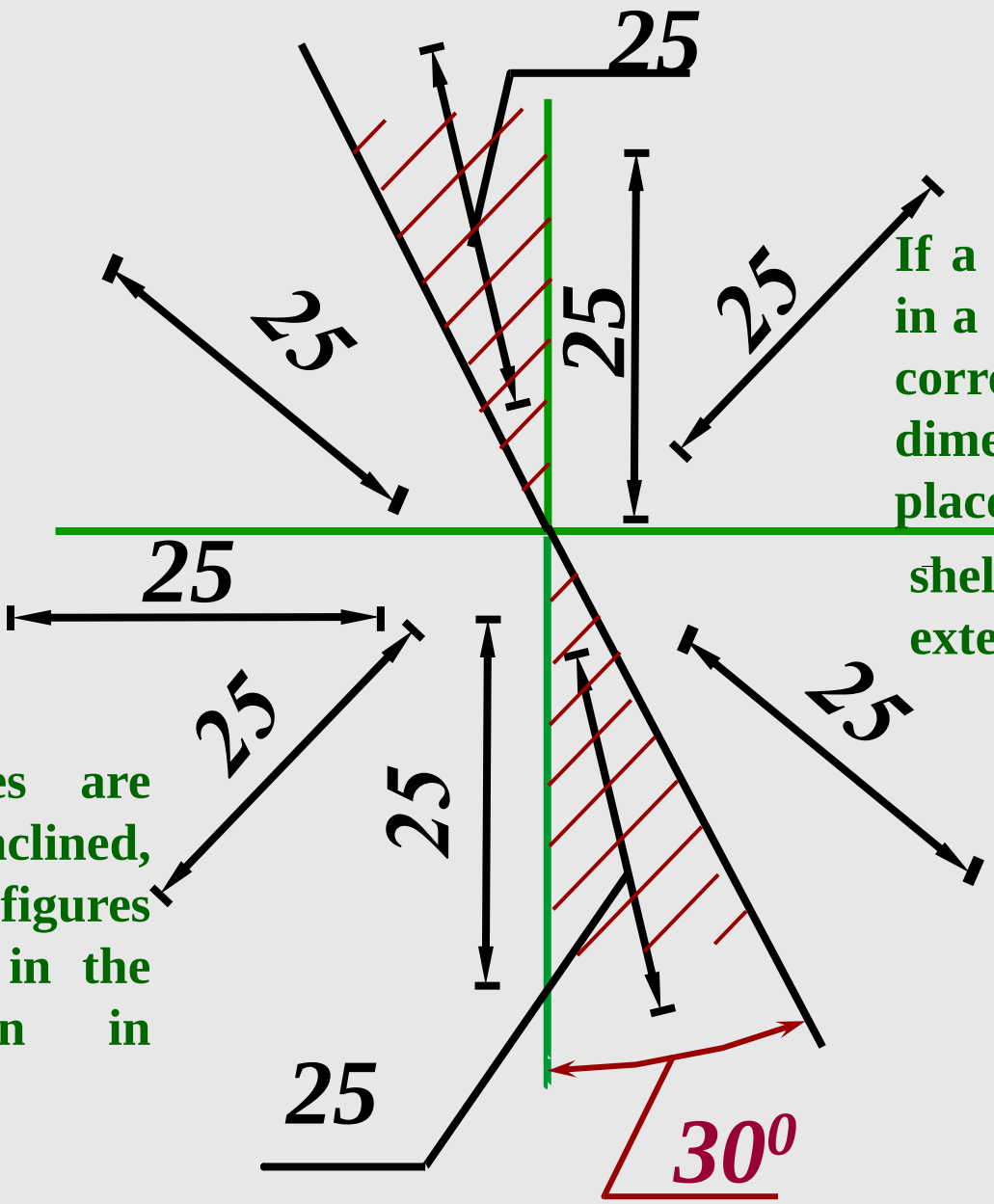
Ways of dimensioning

Contour (axis, centre, extension) lines must **never be used as dimension lines.**

Dimension lines **must never be used** as a continuation of contour (axis, centre, extension) lines.

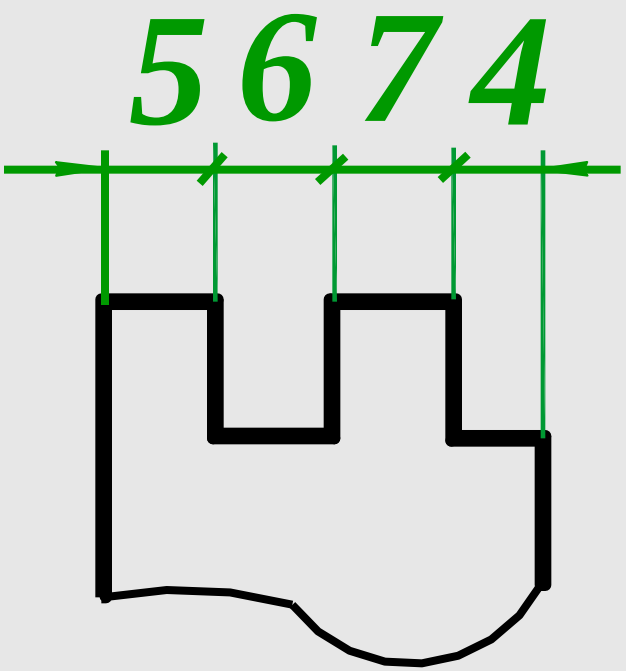
Dimension lines should be drawn outside the outline, whenever possible, and should be kept well clear of the intersection points of lines, the conjugate points of arcs, and arcs and lines on a drawing.

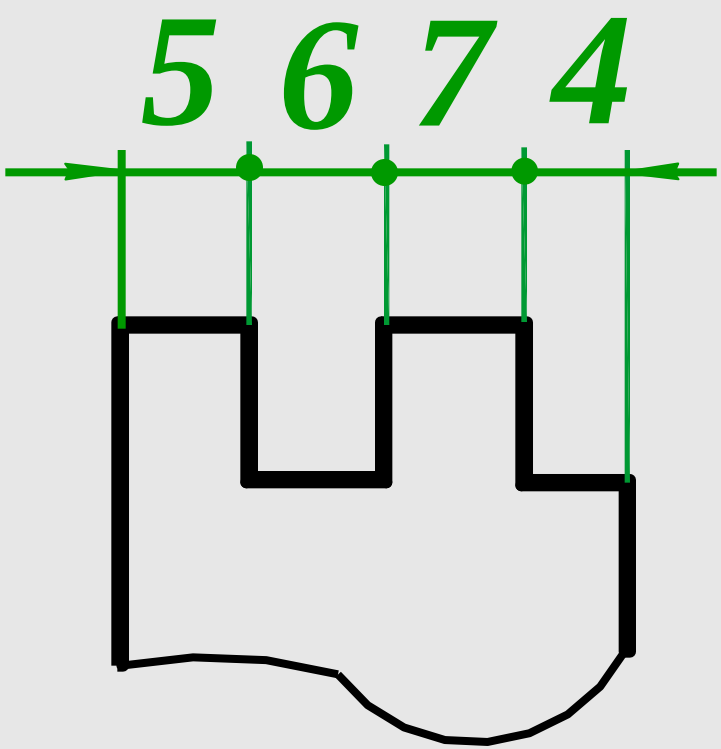
The distance between a dimension line and a dimension figure is about 1-1.5 mm.



If a dimension line is in a hatched area, the corresponding dimension figure is placed on the shelf of an extension line

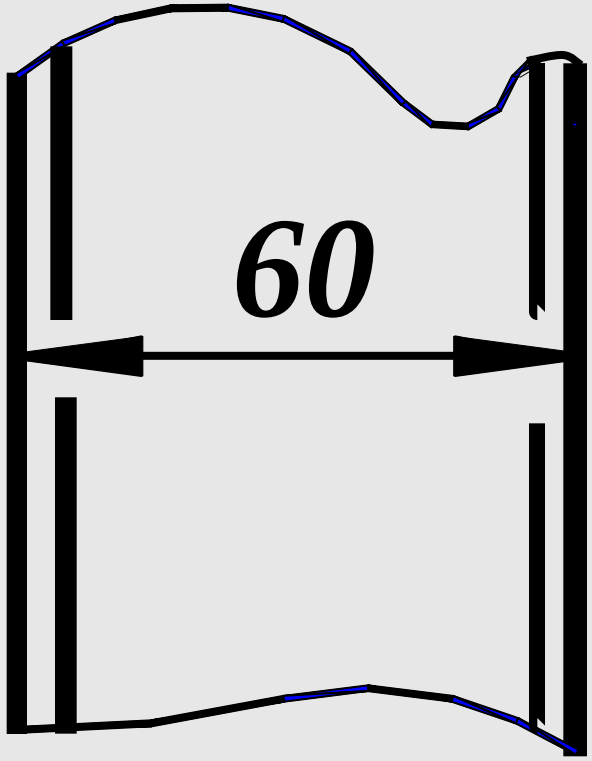
If the lines are vertical or inclined, dimension figures are printed in the way shown in figure.

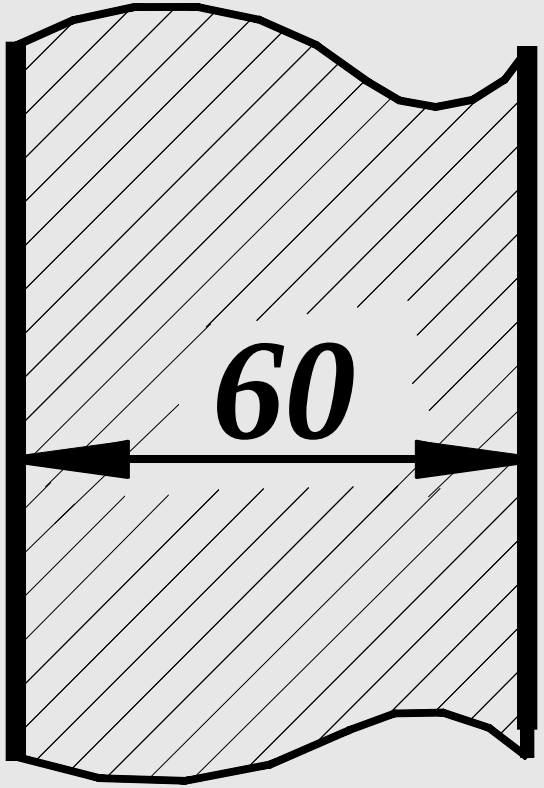




When printing a group of adjacent small dimensions, replace the arrowheads by clearly **printed dots or hatching lines on the extension lines**

Dimension figures must never be crossed or separated by any lines of a drawing. Dimension figures must never touch any line.





If it is necessary to print a dimension figure on an axis line or in a hatched section, the axis/hatching line may be broken.

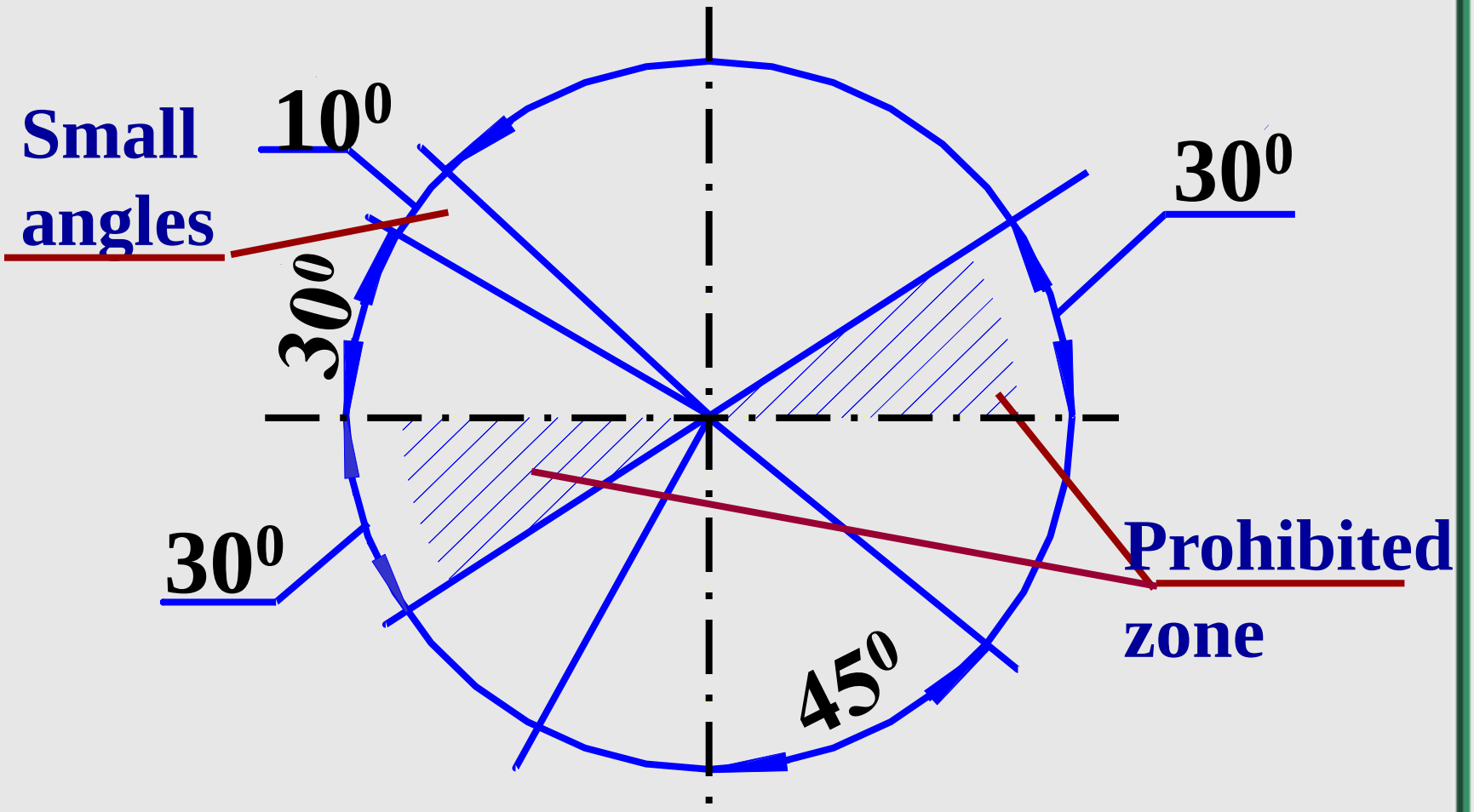
Dimensioning angles

The angles are dimensioned in degrees, minutes and seconds, the units should be designated.

When dimensioning angles, draw the dimension lines with a compass; the point of the compass should be on the point of the angle.

In the area above the horizontal axis line dimension figures are placed on top of dimension **lines from the side of convexity**, in the area below the horizontal axis line dimension figures are placed **from the side of concavity**.

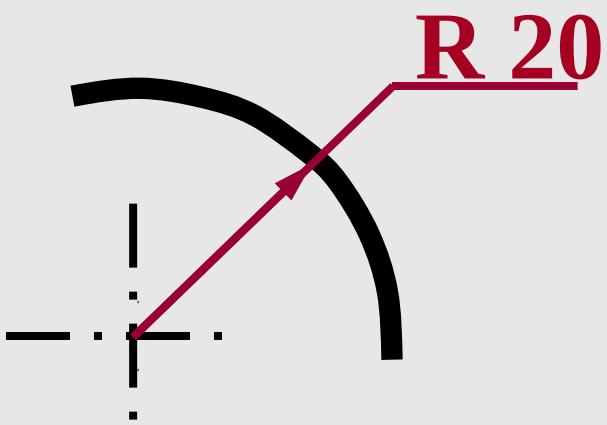
If a dimension is to be placed in a hatched area, it is printed on the shelf of an extension line.



Likewise dimension the small angles, if there is not enough space, in whatever area they are situated (angle 5°).

Dimensioning of radiuses

Radius is denoted by the letter R placed in front of the dimension, e.g. R20. There are no other symbols or signs between the letter R and a dimension.

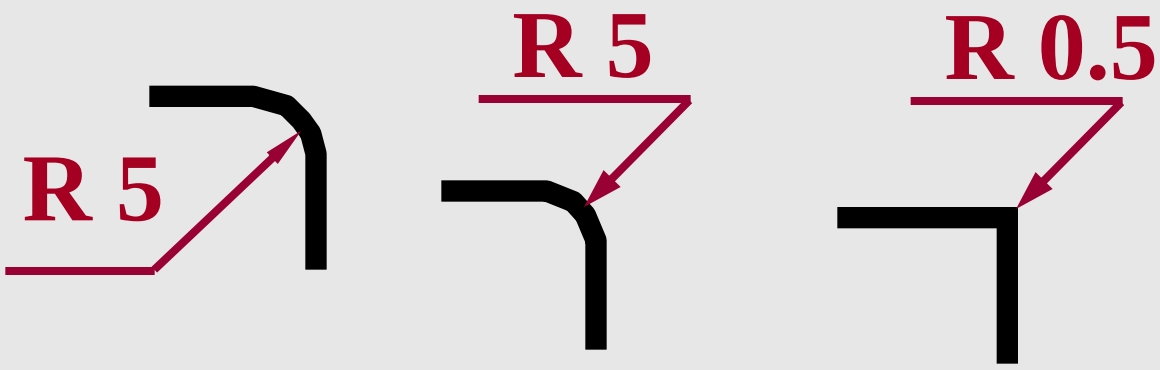


The radius dimension line is placed on that representation where the arc is projected in true shape.

The dimension line should follow the direction of the true radius and terminate with one arrowhead touching the outline, or the corresponding extension line.

If a radius is less than 6 mm (*on a drawing)*, the arrowhead should be placed from the external side of the arc.

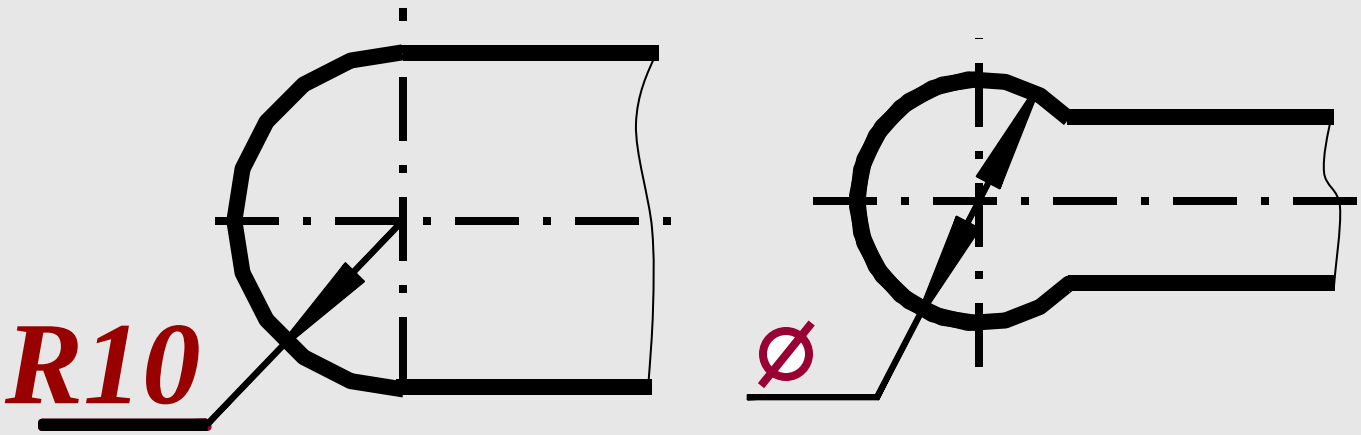
The arcs of radius 1 mm and less are not drawn but the dimensions are shown.



If the centre of an arc of a large radius must be marked, it may be drawn nearer to the outline and the dimension line is broken.

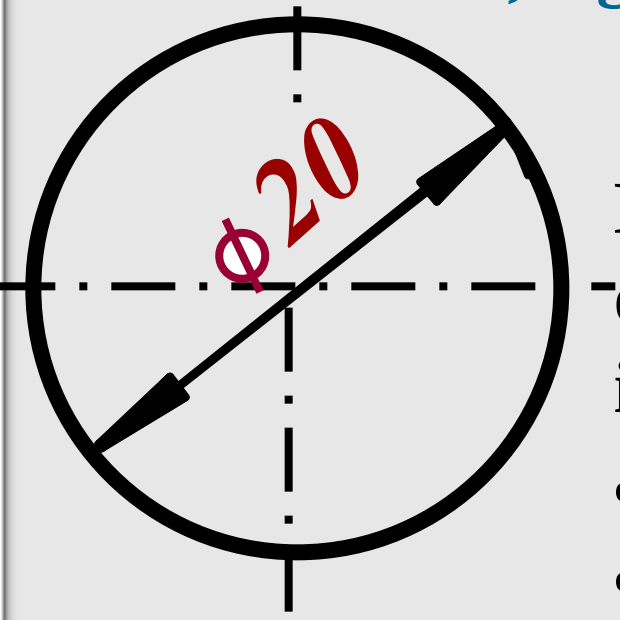
Note: **Radii specify the arcs which round-off the outline, and also most of the arcs are of 180° and less.**

Full circles and arcs of more than 180° are specified only by diameters, even though they may have breaks.

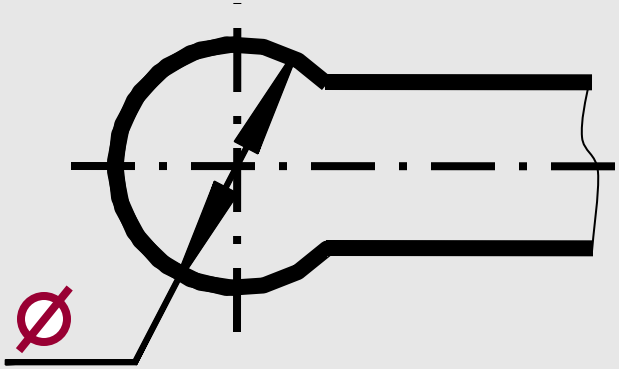


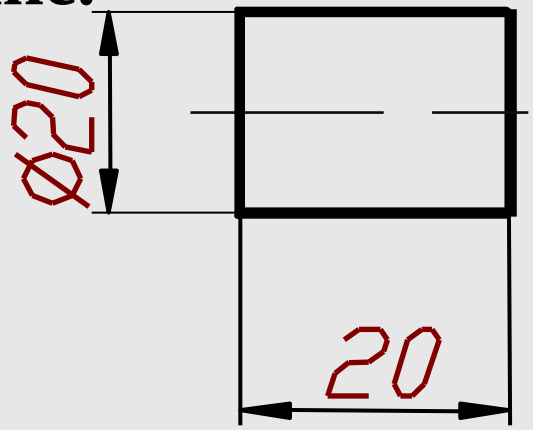
Dimensioning of diameters

Diameter is denoted by the symbol ∅ placed in front of the dimension, e.g. ∅ 50.



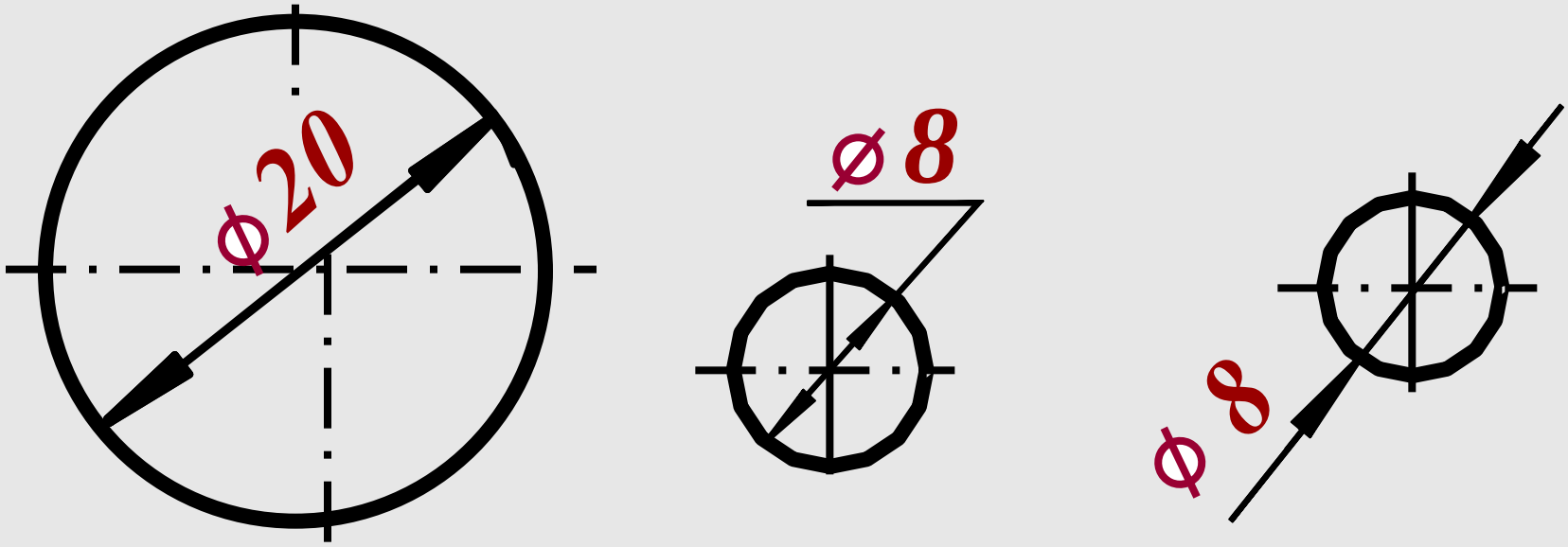
Diameter may be dimensioned either on a representation where a circle or its part is projected in true size, or on a representation where it is projected as a straight line.





In figure presents several examples of diameter dimensioning. Some of the dimensions are placed on the shelves of the extension lines. The shelves are passed horizontally and are produced by means of a break of the dimension line proper.

Note: The break should be located at a distance from an arrowhead.



The quantity of the sizes should be minimal, but sufficient for manufacturing and the control of a product;

Irrespective of quantity of images the size is rendered once.

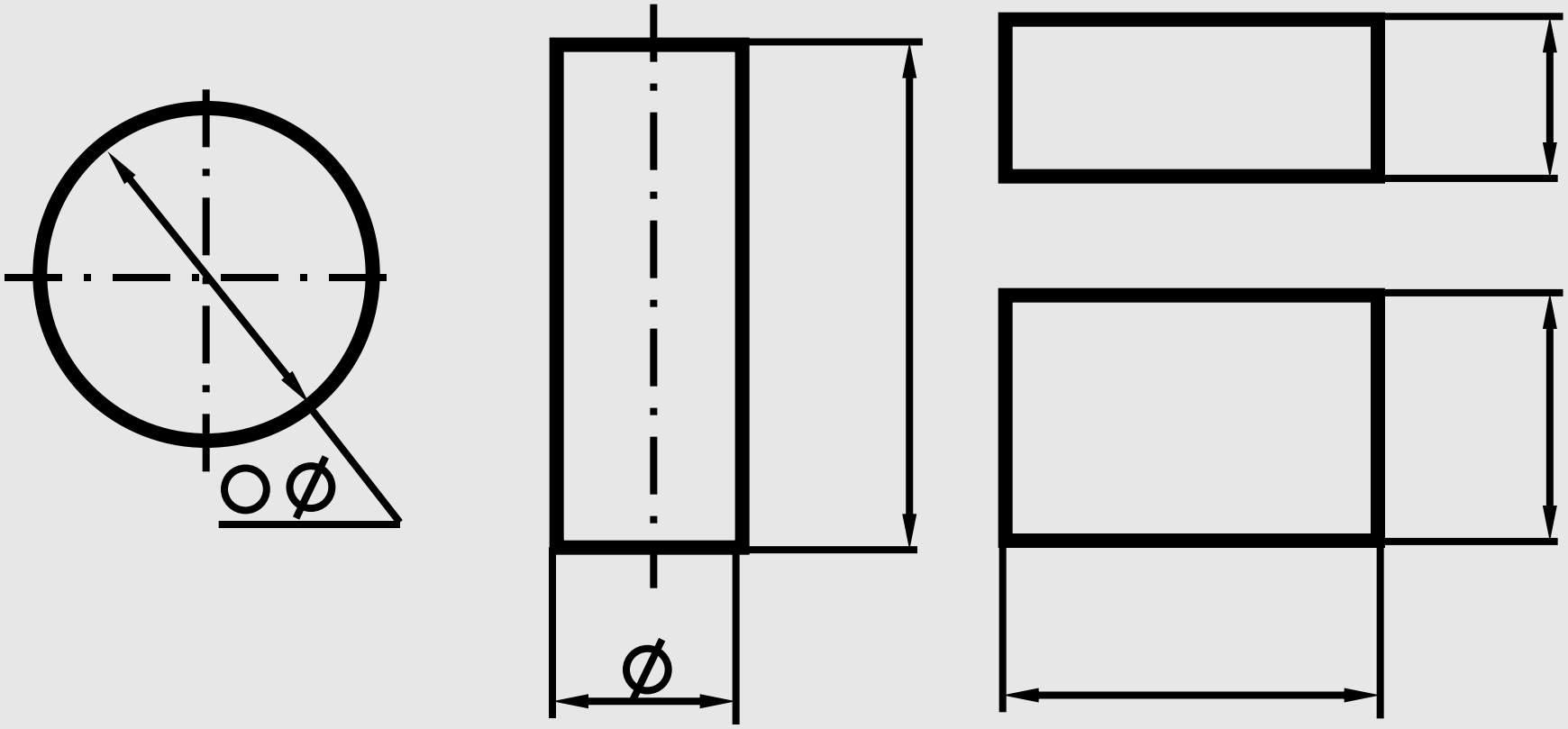
Types of the sizes

All dimensions may be divided in two groups:

Forming

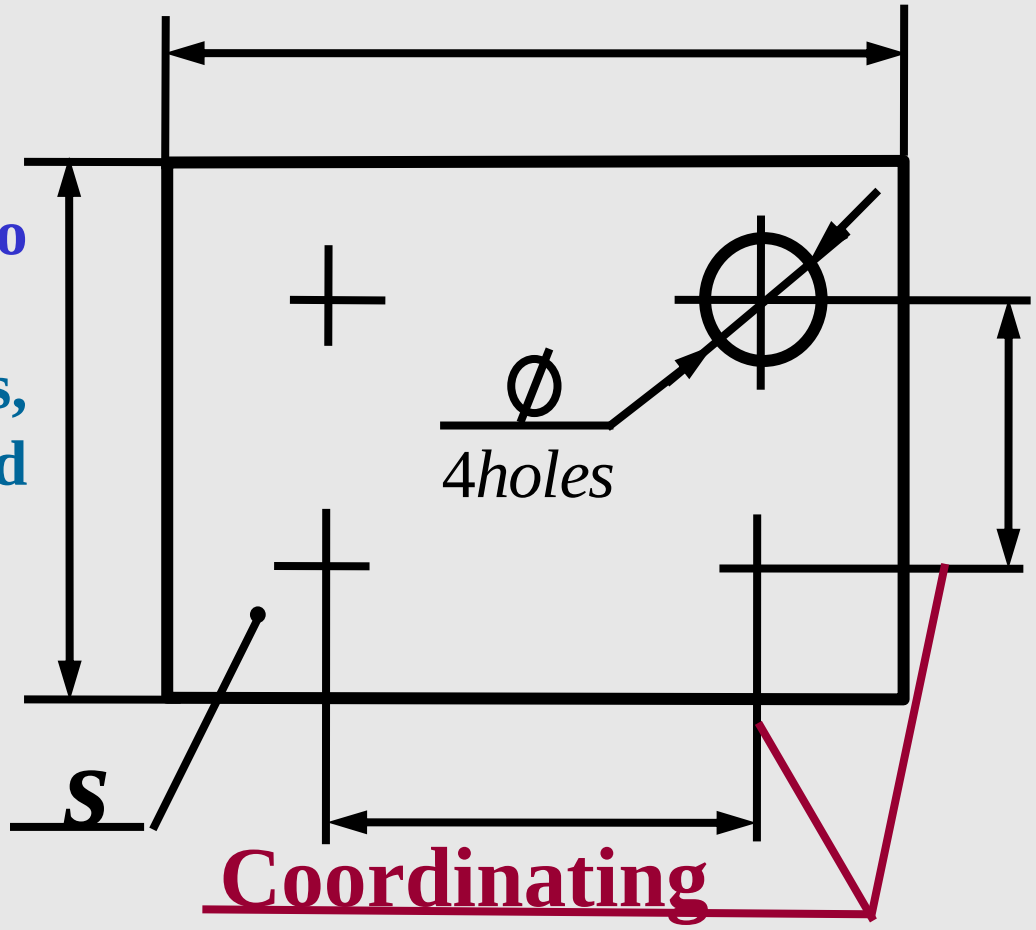
Coordinating

Forming. **Dimensions determining the form of any element of a detail.**



Coordinating. **Dimensions of the arrangement of a detail's elements:** **distance between holes centres;**

from edges and frames to holes centres;
distances to walls of slots, grooves, flanges and other elements



It is recommended to group the dimensions of one constructive element in one drawing space of the element view on which this element is represented most completely;

When dimensioning a step-type hole, its diameter is shown together with its depth. The number of the holes is printed once at the smallest diameter.

Dimensioning According to The Base

Surfaces, lines or points co-ordinating the position of a part in an assembly unit or in the process of its manufacturing are referred to as *the Base*.

There are four types of dimension base: constructional, technological, measuring and assembling, each having its own assignment.

A Constructional base is a surface, line or point determining the position of a part in an assembly unit. Other elements of the part or other parts of the assembly unit are oriented relative to this base. All adjacent dimensions are specified in accordance with it.

Dimensioning according to the constructional base is not connected with the process of manufacturing a part.

A Technological base is a surface, line or point relative to which each of the surfaces processed during a part manufacturing are oriented. They are selected subject to the sequence of the mechanical processing of the parts.

All free dimensions are usually specified according to this base.

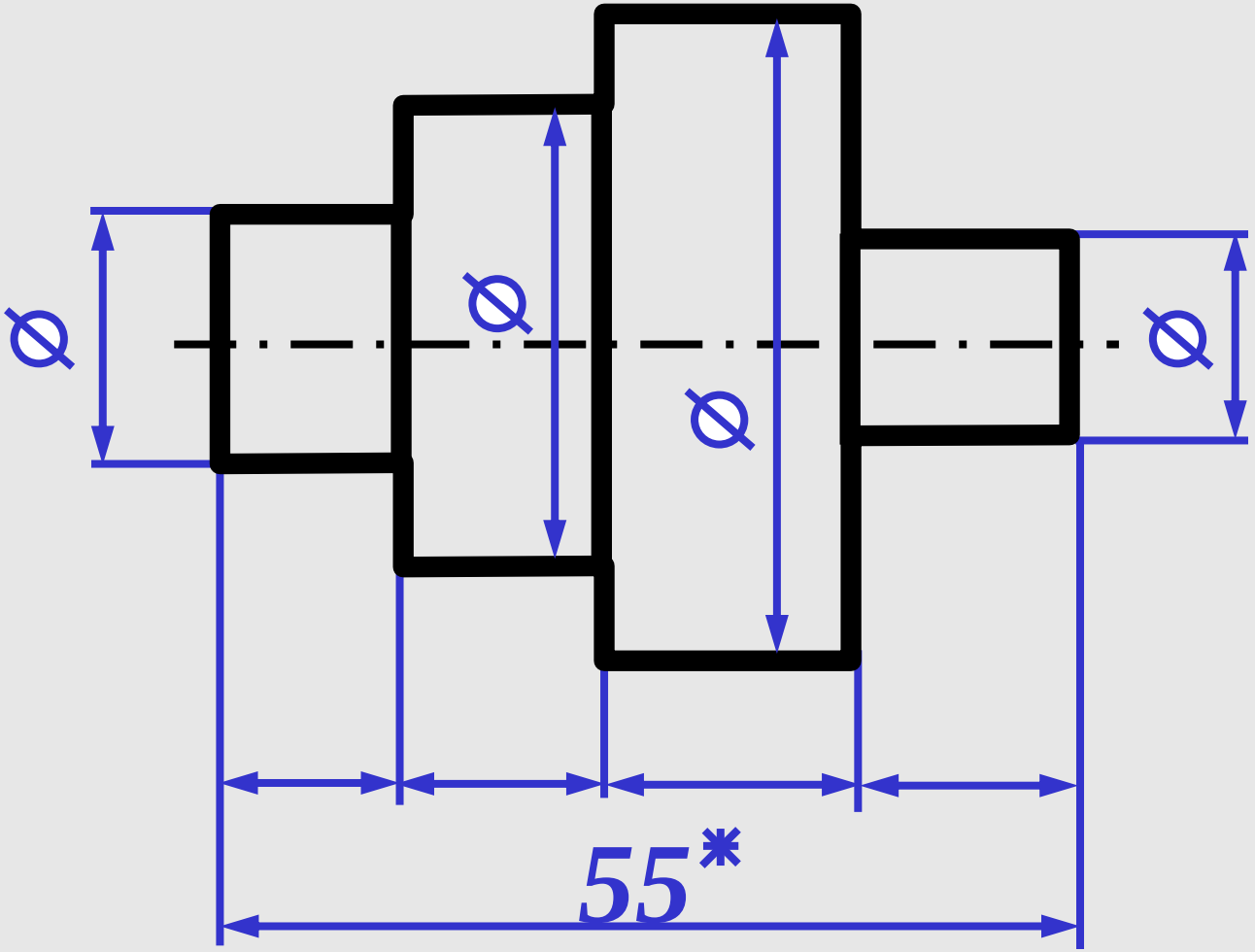
A Measuring base is a surface, line or point from which the dimensions are indicated during the measurement of ready-to-use parts.

An Assembling base is a set of surfaces, lines or points relative to which the parts are oriented during their assembly.

There are three methods of dimensioning most frequently applied in practice:

- **chaining;**
- **from a base;**
- **combinatorial**

Chaining method

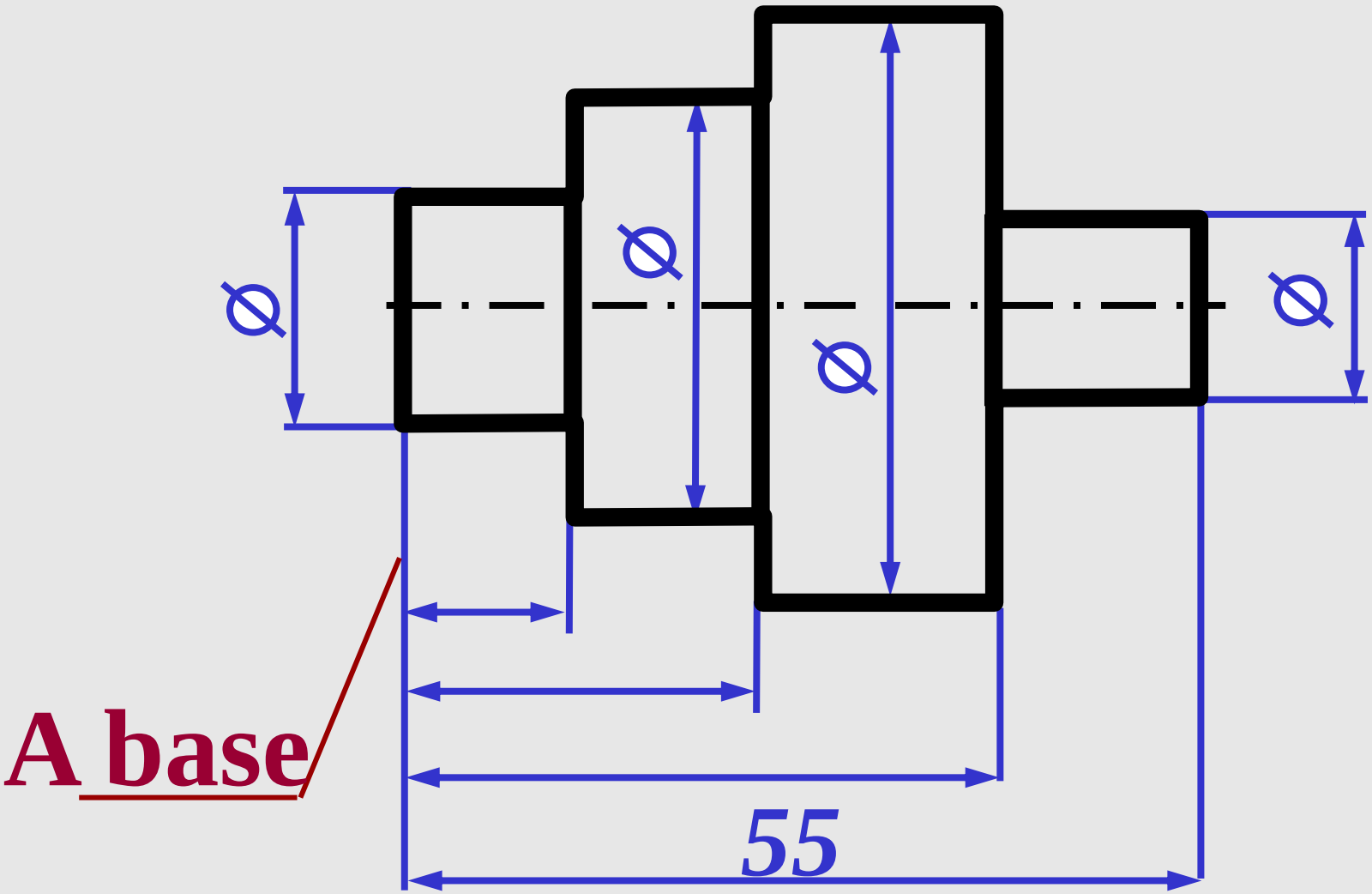


**Referential Dimensions*

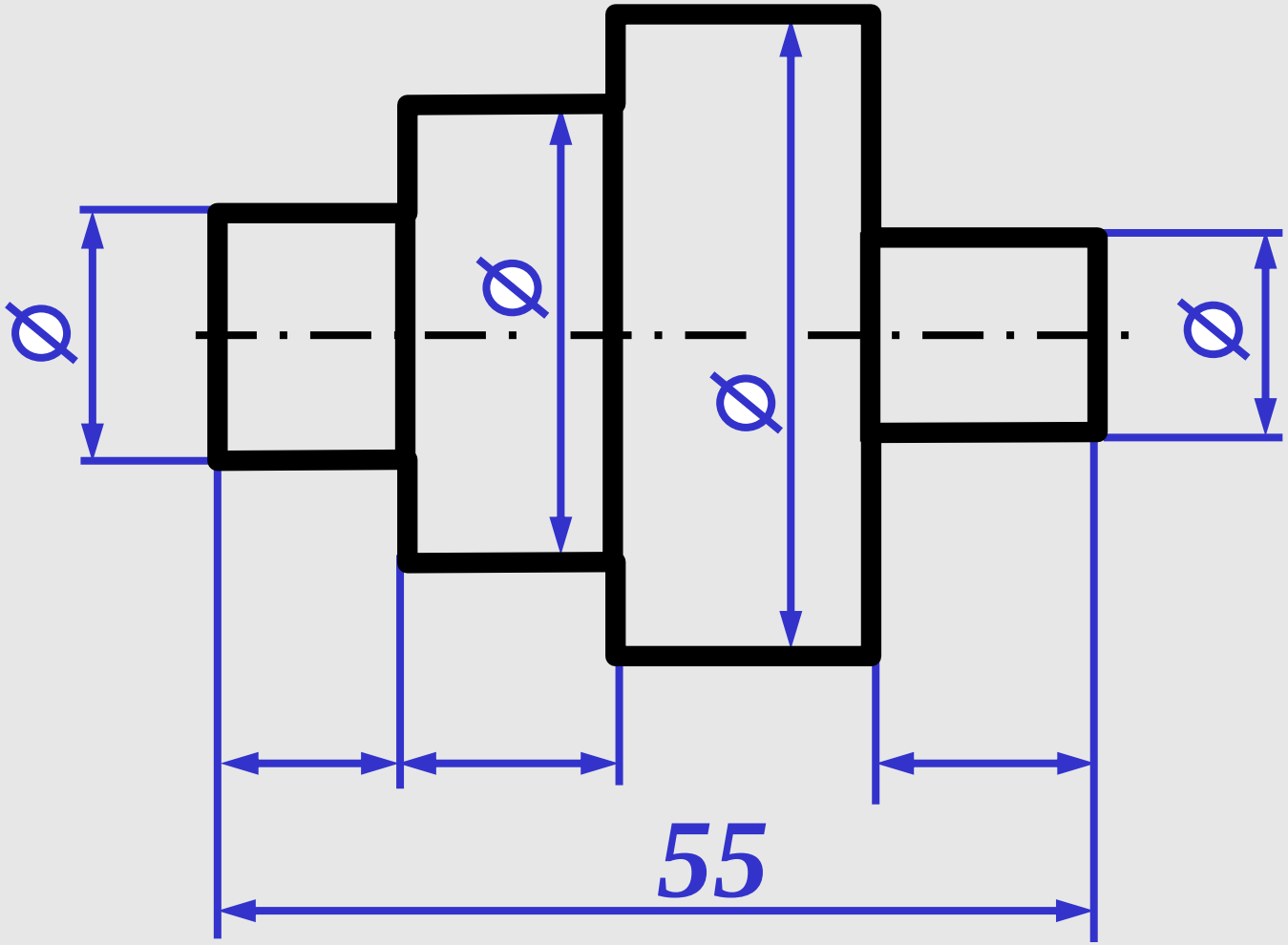
Referential dimensions are the dimensions which cannot be completed on a given drawing. But they should be shown to make the drawing easier to use.

They are usually denoted by the symbol * and the following note printed in the technical requirements: “*Referential Dimensions”.

From a base



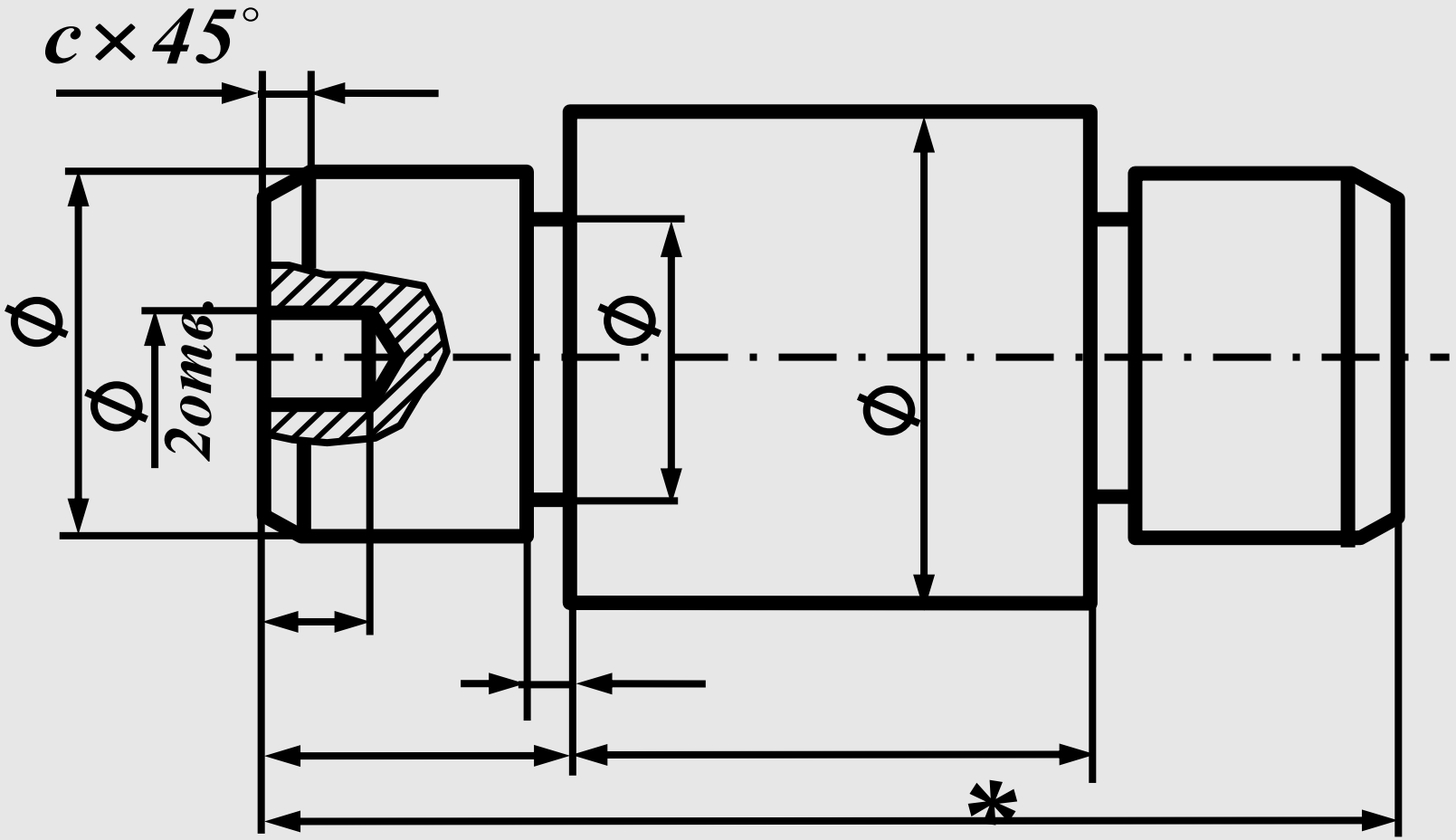
Combinatorial method



Simplifications in Dimensioning

There are some simplifications allowing us to reduce the number of dimensions on a drawing.

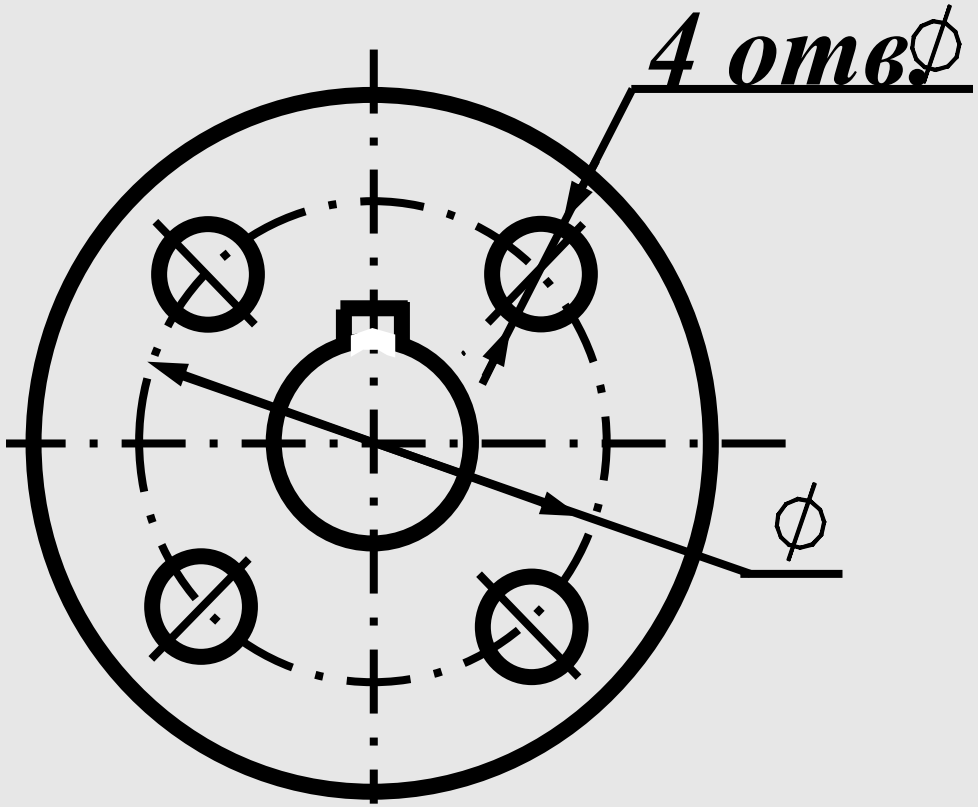
For example, dimensions of two symmetrically positioned elements (except holes) are put on only once (no numbering shown), grouped in one place.



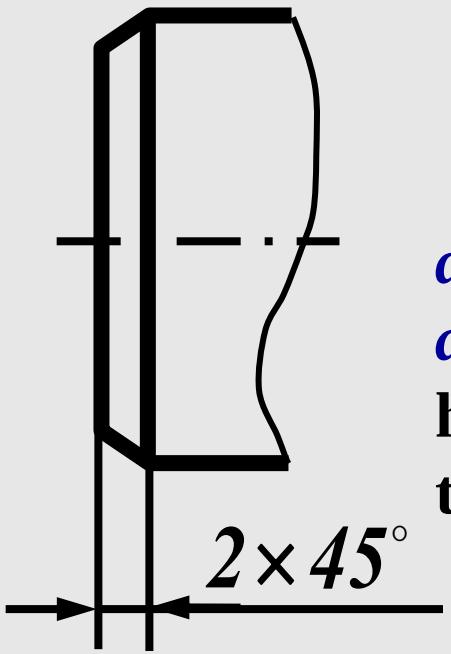
Dimensions of chamfers and grooves are not included in a dimension chain

When several elements, similar in the form and size, are dimensioned, the dimensions of only one of them is shown and the number of the elements.

The number of the elements is placed on the shelf of an extension line in front of the dimensional figure. It may also be placed under the shelf.

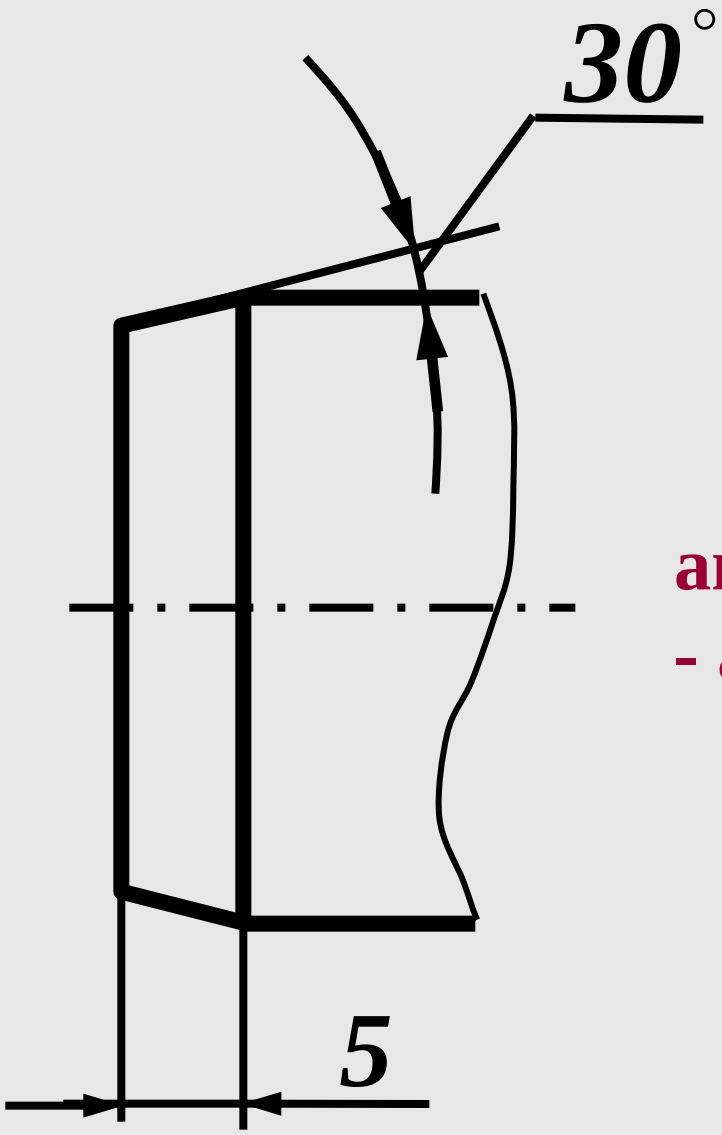


Chamfers dimensioning



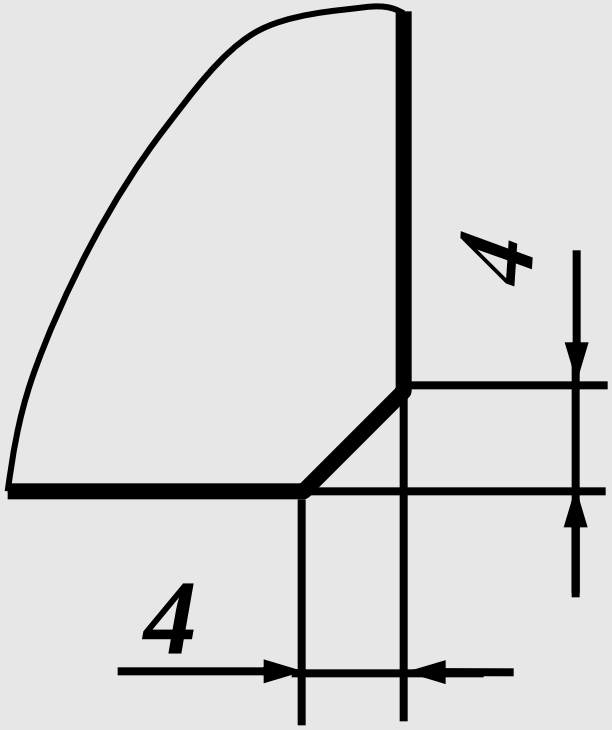
When dimensioning cone chamfers, the *dimension line is passed parallel to the cone axis*. The first figure shows the truncated cone height, the second - the inclination angle of the cone generatrix.

This simplification is permitted only if the inclination angle of the cone generatrix is 45°.



At any other value of the angle two dimensions are printed - a linear one and an angle ones.

Dimensioning on a flat facet



If the chamfer height (height of a truncated cone) on a drawing is 1 mm or less, the chamfer is not drawn but is dimensioned