Metrology, standardization and certification

Theme 11: Rationing of form and location the elements of details

Lecture plan:

1. Reasons for rationing the form and location the elements of details.
2. Rationing of the form deviations.
3. Rationing of the location deviations.
4. Rationing of the composite deviations.

Reasons for rationing the form and location the elements of details

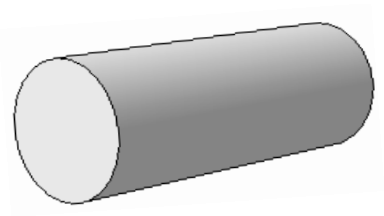
The vast majority of parts used in mechanical engineering, have a simple geometric shape. This is mainly cylindrical and flat surface, much less - gears and housing parts. Get the ideal shape of parts in the manufacturing process is impossible because of the errors of the machine tools, tooling, etc.

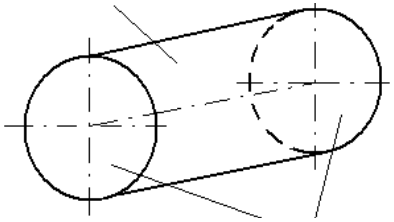
Distortion of form of elements reduces operational properties of these parts. Thus mobile connections in deviation from the ideal cylindrical shape leads to a jerky movement, rapid wear due to contact over a limited surface.

In fixed connections the distortion of form leads to uneven interference in the joints, because of which bonding strength is reduced, and the centering accuracy is reduced also.

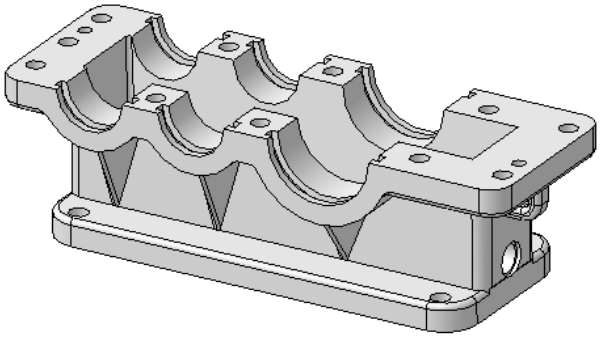
In addition, the distortion of the form influences on a labor input and assembly accuracy, increases the amount of fitting works, affects the accuracy of the bases in the manufacture and control.

Reasons for rationing the form and location the elements of details





Simplest part consisting of three surfaces



Housing part

The performance of machines is affected not only by the dimension and form deviations, but the mutual position of component geometrical features are also of great importance. Geometrical requirements that specify positional accuracy are called location deviations.

Rationing of the form and location deviations

Russian Standard GOST 24643-81 implements 16 accuracy grades for geometrical tolerances. The tolerance values between any two adjacent grades differs by the factor of 1,6.

The following relative geometrical accuracy specifications are implemented:

A – normal relative geometrical accuracy (tolerances of form or location accounts for 60% of the dimension tolerance).

B – increased relative geometrical accuracy (tolerances of form or location accounts for 40% of the dimension tolerance).

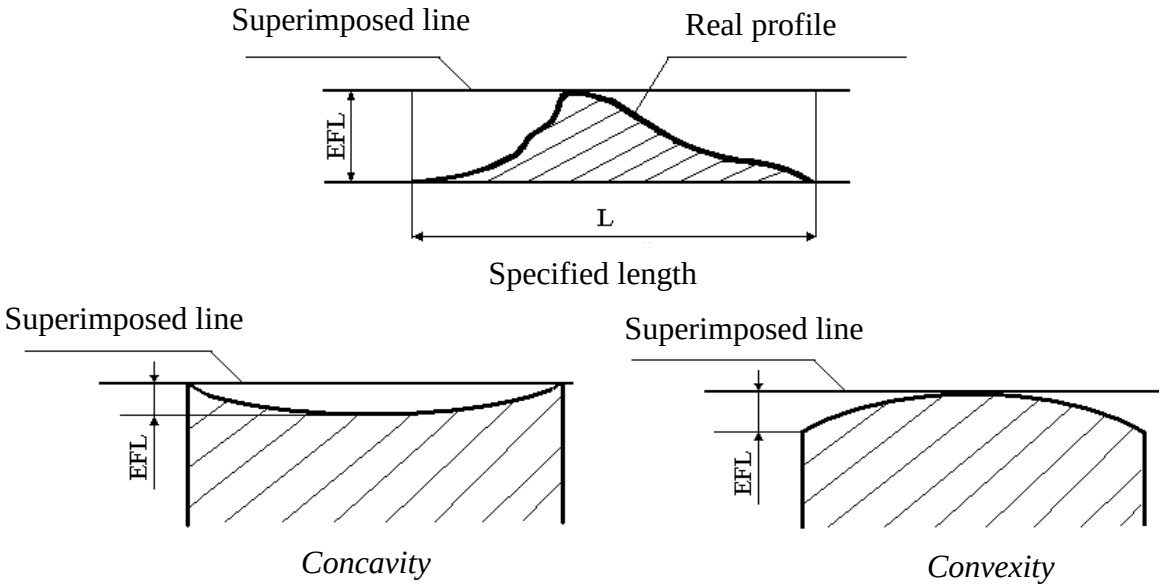
C – high relative geometrical accuracy (tolerances of form or location accounts for 25% of the dimension tolerance).

Rationing of the form deviations

- **Form deviations** define the deviation of the actual feature shape relatively to the geometrically ideal nominal shape.

Kind of form deviations	**Tolerance sign**
Straightness	
Flatness	
Roundness	
Cylindricity	
Longitudinal section profile	

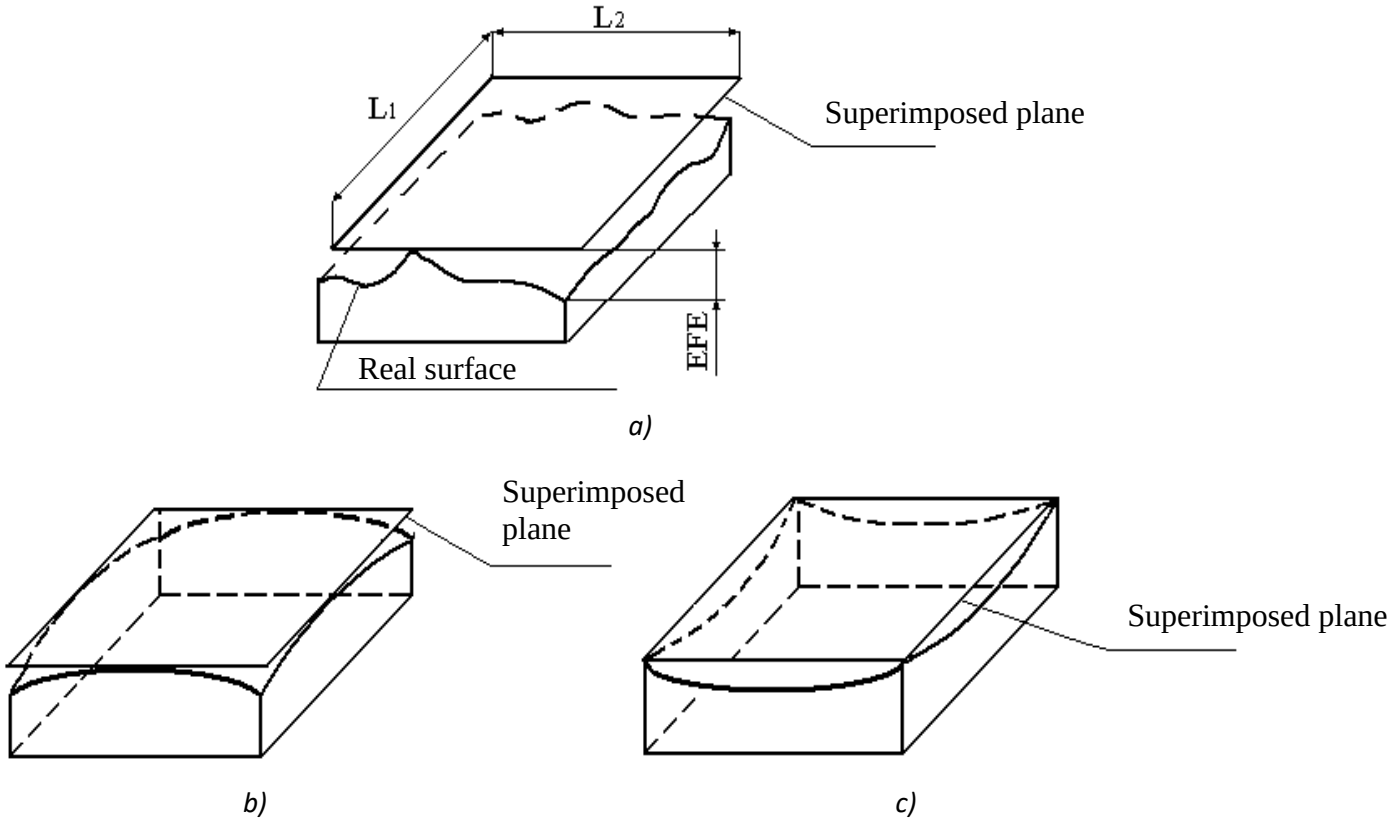
Rationing of the form deviations



Deviations from straightness

Deviation from straightness in a plane is called greatest distance EFL from the points of the real profile to a superimposed line within the specified length.

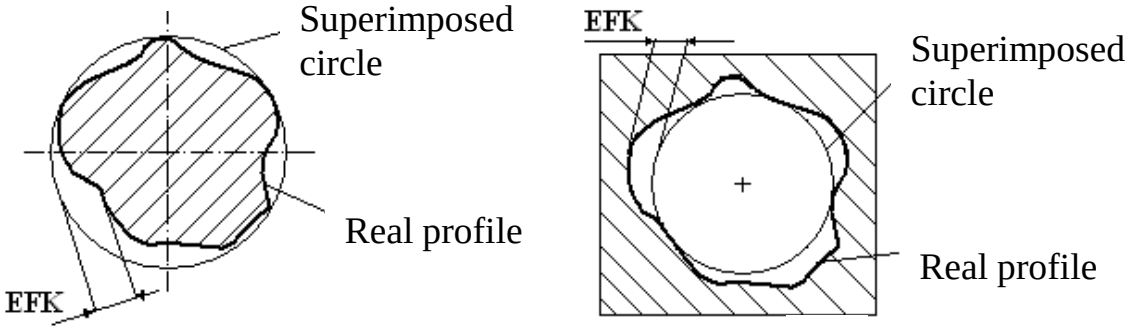
Rationing of the form deviations



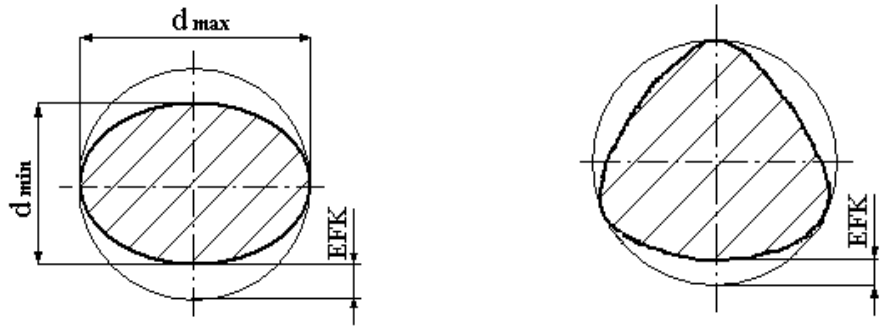
Deviation from flatness : a) complex; b), c) particular

Deviation from flatness is the greatest distance EFE from the real surface points to a superimposed plane within a normalized site.

Rationing of the form deviations



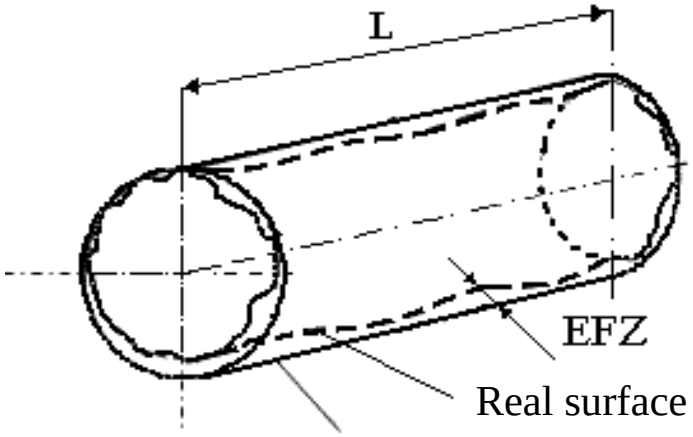
Deviations from roundness



Ellipticity *Faceting*

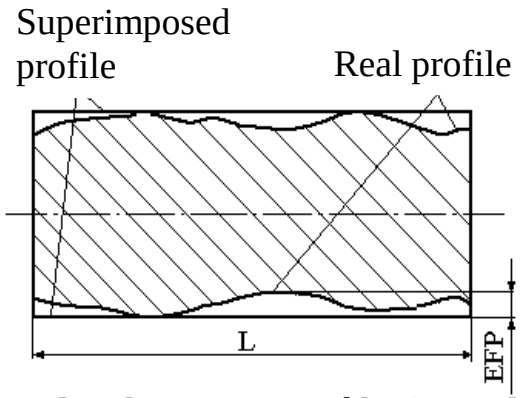
Deviations from roundness is the greatest distance EFK from the real profile points to the superimposed circle.

Rationing of the form deviations

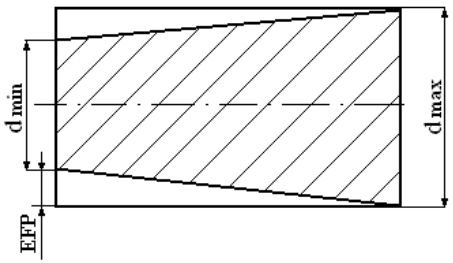


Deviation from cylindricity is called largest distance EFZ from the real surface points to the superimposed cylinder within normalized site.

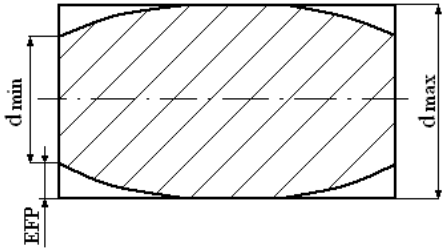
Rationing of the form deviations



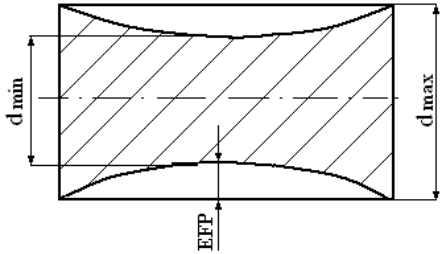
Longitudinal section profile (complex)



Taper



Barreling

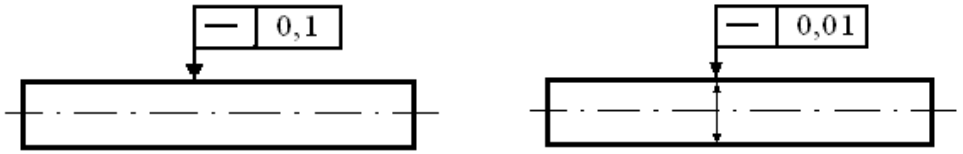


Saddle-shaped

Longitudinal section profile (particular)

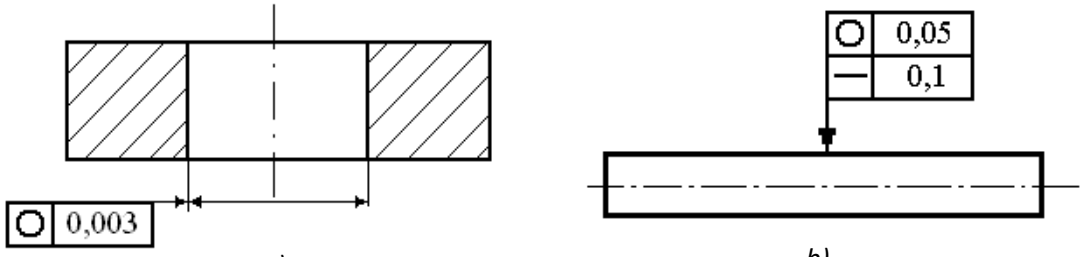
Deviation of a profile longitudinal section is called the greatest distance EFP from the points of the generatrix real surface lying in a plane passing through its axis to the corresponding side of the superimposed profile within normalized site.

Designation of form deviations in the drawing



a) b)

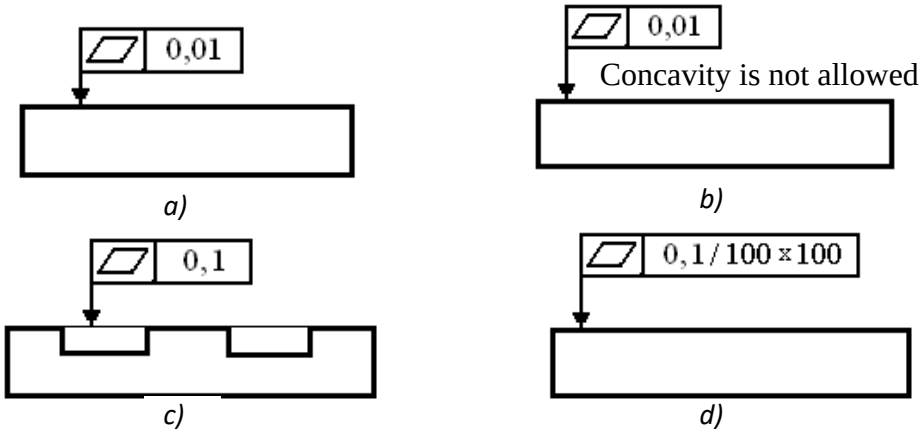
Examples of designations the symbols of straightness tolerances in the drawing: a) generatrix in a plane, b) axis in a space



a) b)

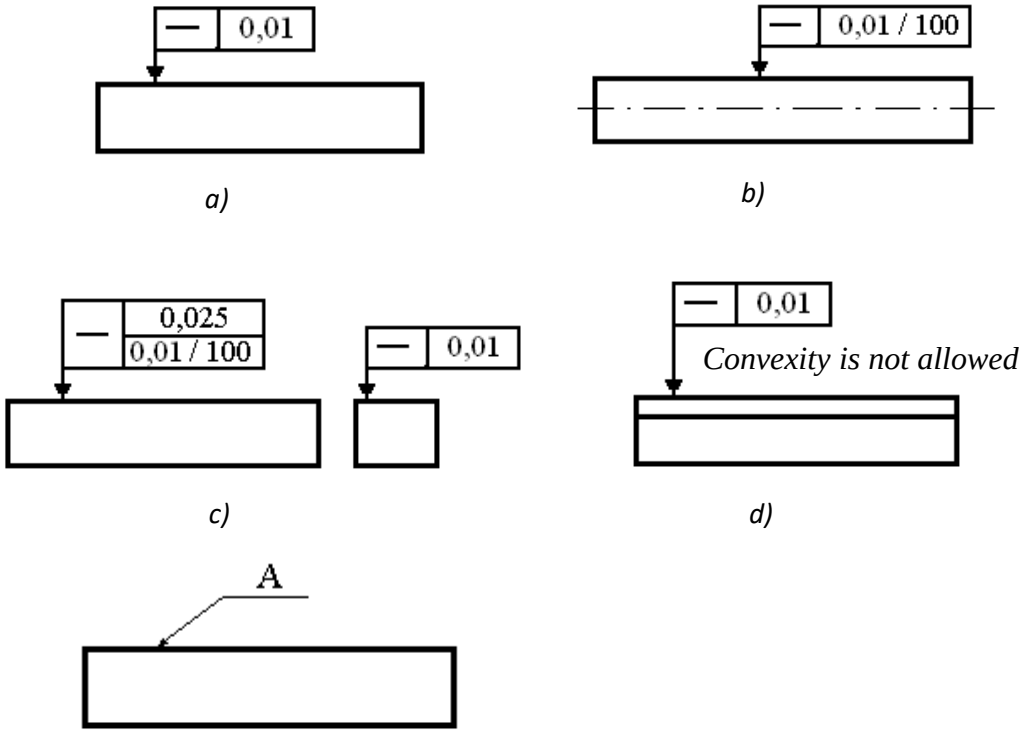
Examples of designations the symbols of roundness tolerances (a), deviation from roundness and straightness at the same time (b) in the drawing.

Designation of form deviations in the drawing



Examples of designations the symbols of flatness tolerances in the drawing:

Designation of form deviations in the drawing



Technical requirements:

1. Surface straightness tolerance - 0.01 mm on the whole length.

Examples of designations the symbols of straightness tolerances in the drawing

Rationing of the location deviations

- **Location deviations** define the deviation of the actual feature relatively to the geometrically ideal position.

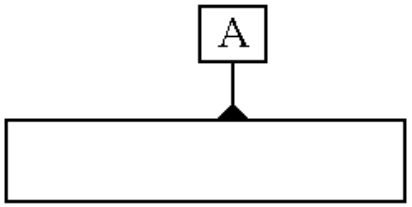
Kind of location deviations	Tolerance sign
Parallelism	//
Perpendicularity	⊥
Angularity	∠
Coaxiality	◎
Symmetry	⌯
Position	⌖
Crossed axes	×

Rationing of the location deviations

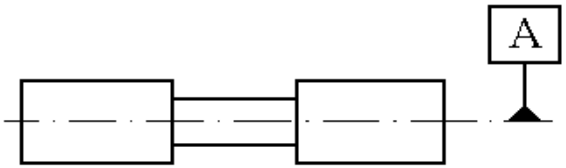
The ***datum*** is the element of part in relation to which tolerance of the location of the element is set, and identifies the relevant deviations.

Datum can be different surfaces, including the plane and axis.

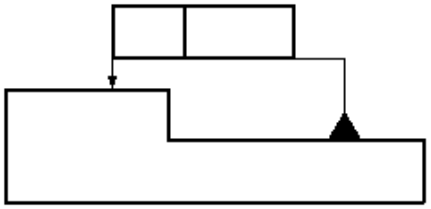
In the drawing, the ***datum*** surface is indicated with a special sign.



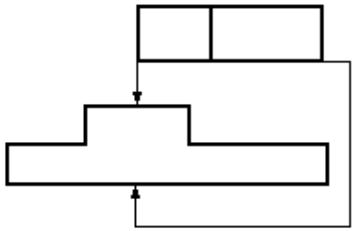
Datum is a plane



Datum is an axis



a)



b)

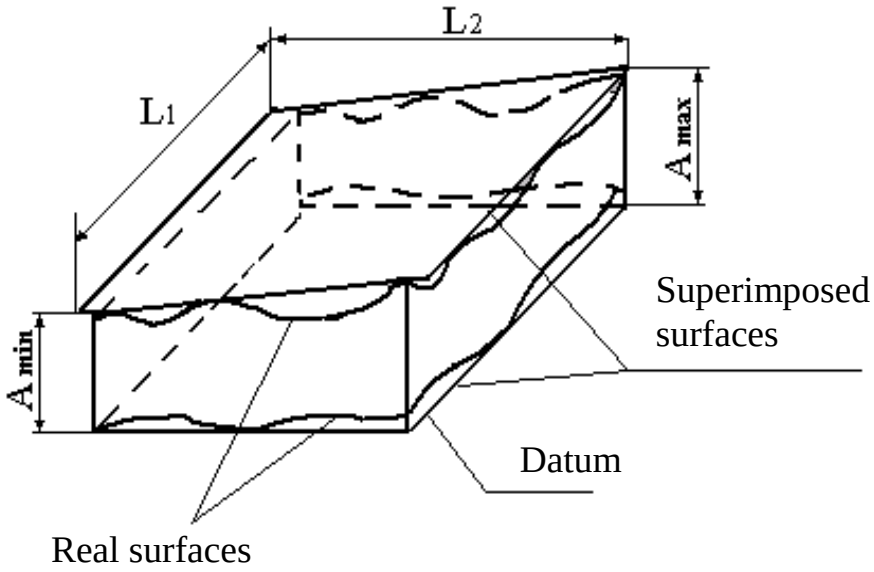
Variants of designation of datum in the drawing (a)

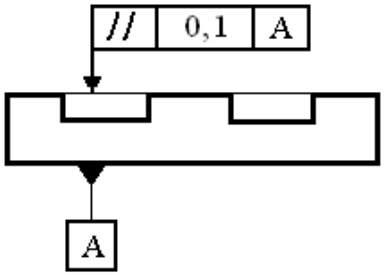
Datum can be each of planes (b)

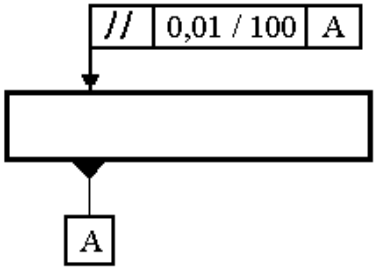
Rationing of the location deviations

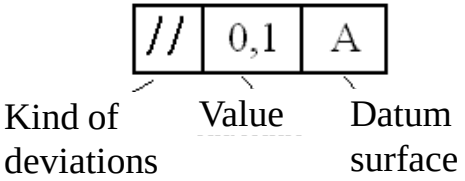
The deviation from the parallelism of the planes - the difference between the largest and smallest distance EPA between the planes within a normalized site:

EPA = Amax - Amin





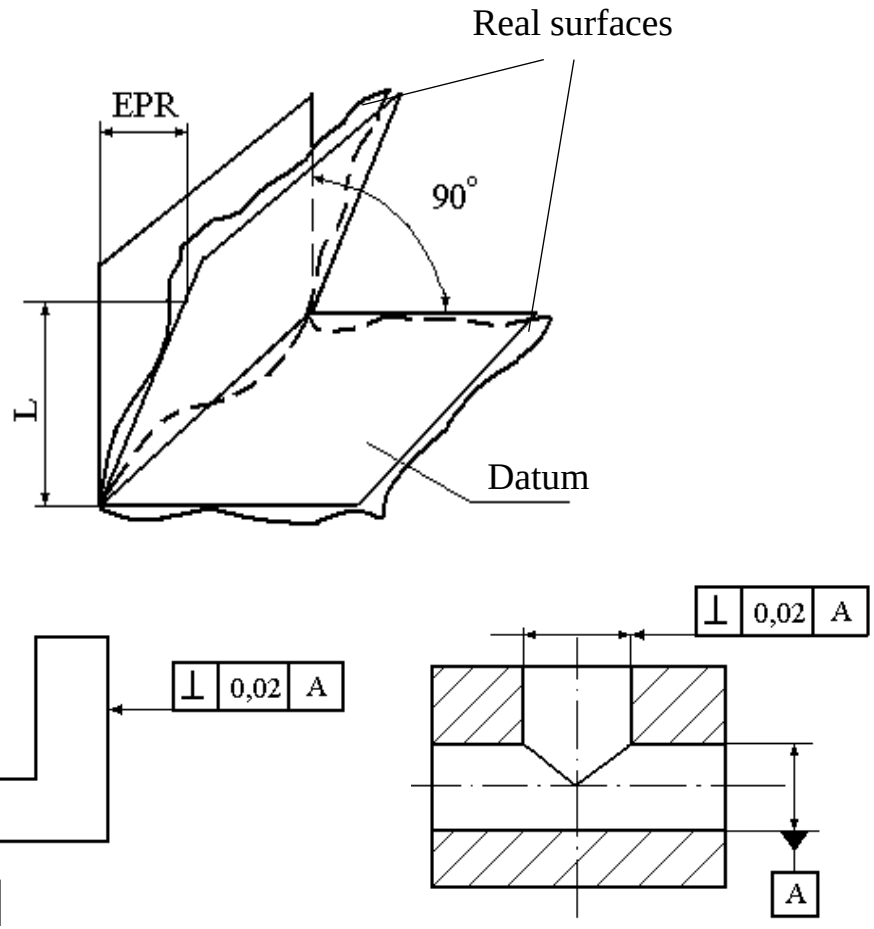




*Samples of designation of the **deviation from the parallelism** in the drawing*

Rationing of the location deviations

Deviation from the perpendicularity of planes - the deviation of the angle between the planes of the right angle (90 °) expressed in linear units EPR on the length of normalized site.



*Samples of designation of the **deviation from the perpendicularity** in the drawing*

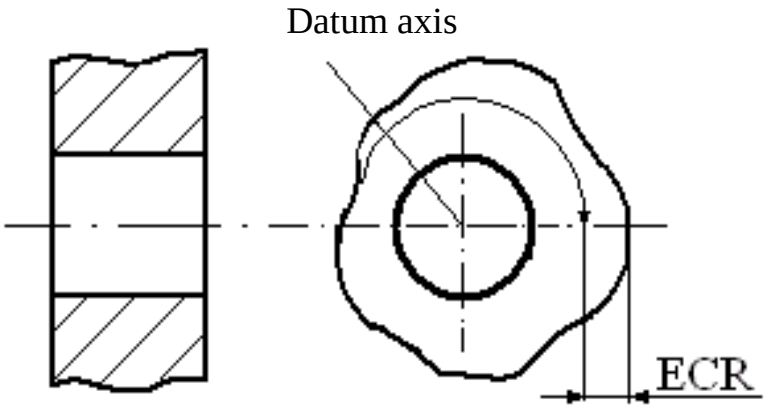
Rationing of the composite deviations

- **Composite deviations** are the result of combination of form and location deviations.

Kind of location deviations	Tolerance sign
Circular run-out	
Total run-out	
Form of a line	
Form of a surface	

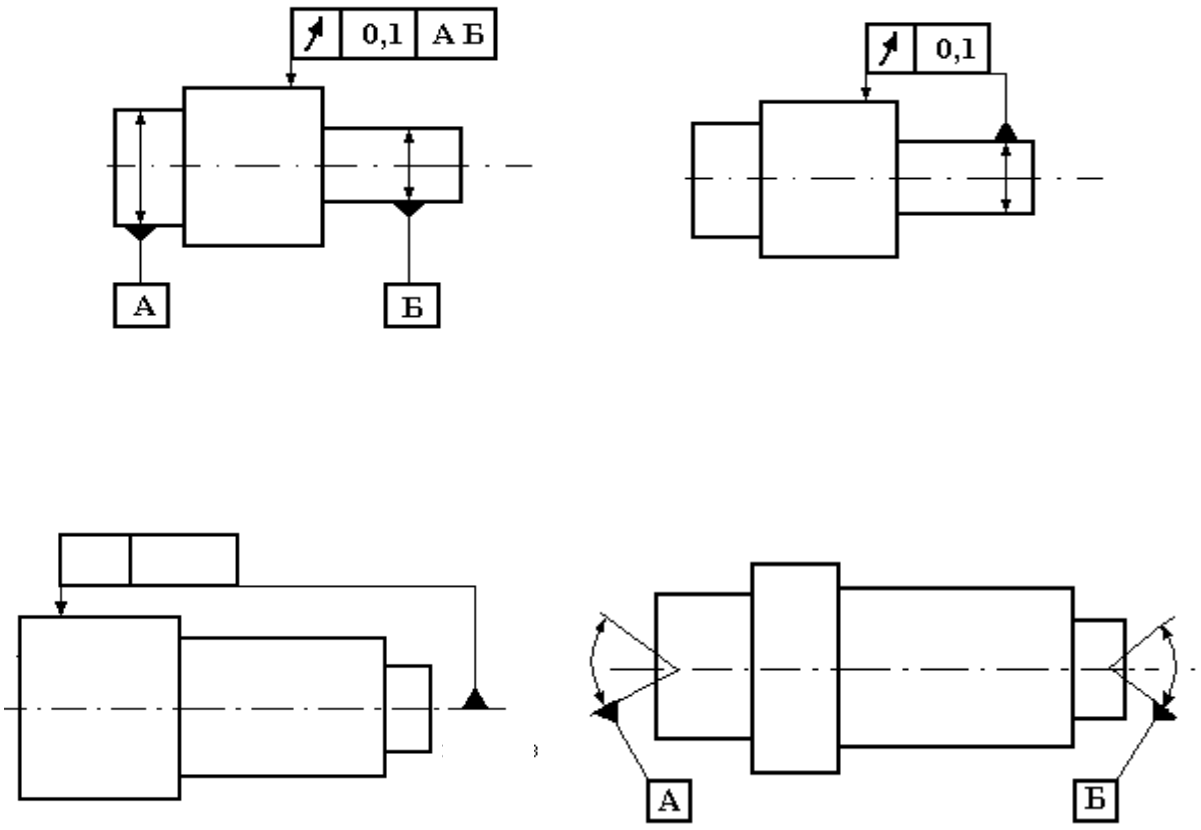
Rationing of the composite deviations

Radial run-out is difference between the largest and smallest distance ECR from the real surface profile of the rotation axis to the datum axis in the sectional plane perpendicular to the datum axis.



Radial run-out refers to the **composite** parameters because it is the result of joint manifestations of *deviation from roundness* (form deviation) of section profile and *coaxiality* (local deviation)

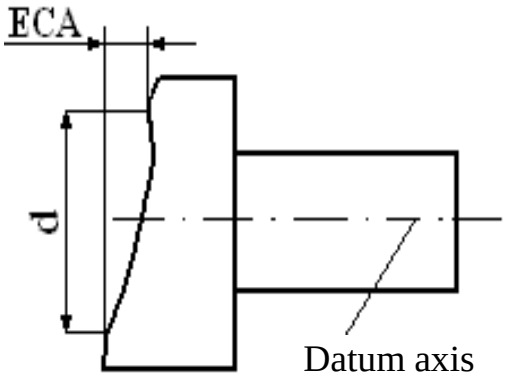
Rationing of the composite deviations



*Designation of the **radial run-out** in the drawing*

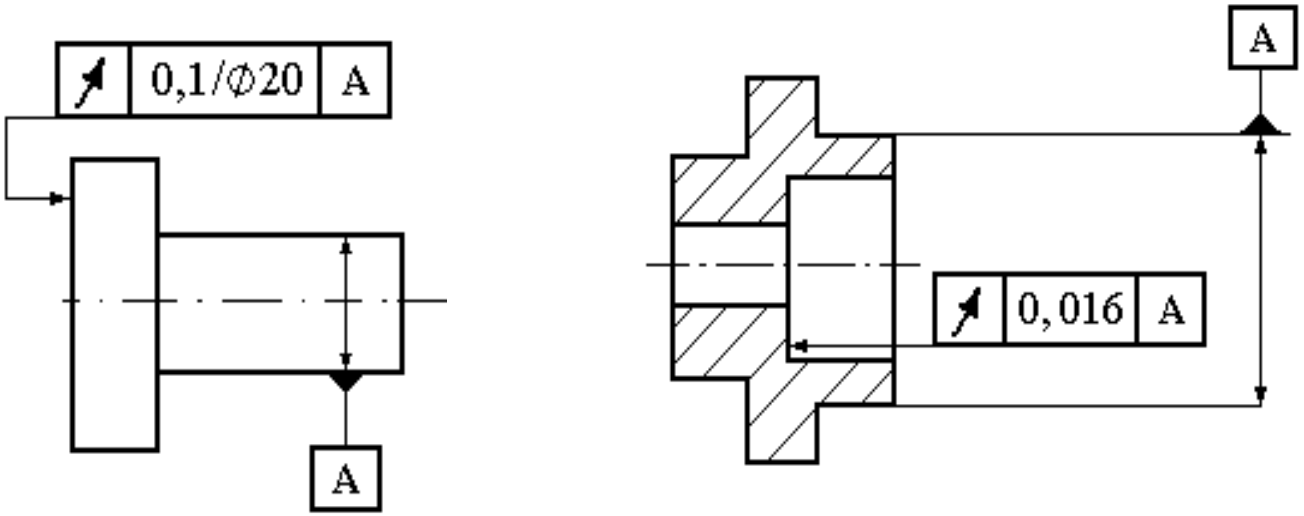
Rationing of the composite deviations

Face run-out is the difference between the largest and smallest distances ENA from the real profile of the face points of the surface to a plane perpendicular to the datum axis.



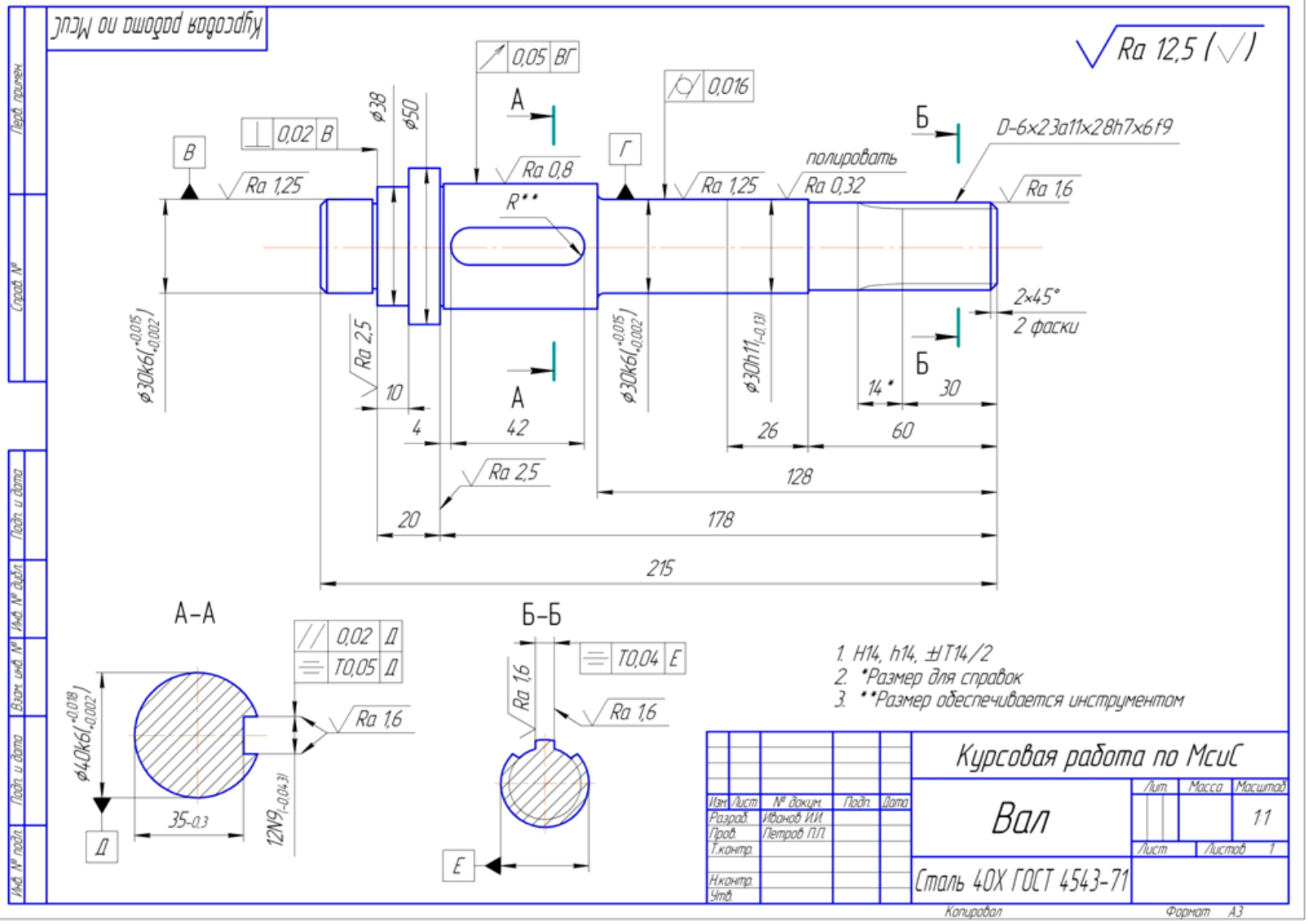
Face run-out refers to the **composite deviation** because it is the result of joint manifestations of flatness deviation and perpendicularity deviation of the face relative to the axle of the datum surface.

Rationing of the composite deviations



*Designation of the **face run-out** in the drawing*

The radius in which you want to measure the face run-out is indicated, if necessary. Such designations in the drawing are rare. This means that, in principle, face run-out can be measured at any radius from the axis, but the preferably determine run-out at the greatest distance from the axis (2 ... 3 mm from the outer surface).


Курсовая работа по МсиС
Ra 12,5
0,05 ВГ
0,016
0,02 В
ø38
ø50
А
Б
В
Г
Ra 1,25
Ra 0,8
Ra 0,32
полировать
Ra 1,6
D-6×23a11×28h7×6f9
R**
2×45°
2 фаски
ø30К6(+0,015 +0,002)
Ra 2,5
ø30h11(-0,13)
10
4
42
14 *
30
26
60
128
20
178
215
А-А
Б-Б
0,02 Д
Т0,05 Д
Т0,04 Е
ø40К6(+0,018 +0,002)
35-0,3
12N9(-0,043)
Д
Е
1. H14, h14, ±IT14/2
2. *Размер для справок
3. **Размер обеспечивается инструментом
Вал
Сталь 40Х ГОСТ 4543-71
Масса
Масштаб
1:1
Лист
Листов 1
Копировал
Формат А3

Thank you for attention