Metrology, standardization and certification

Lecture plan:

1. Types of interchangeability
2. The precision and error in the technique
3. Limit sizes, deviations and tolerance

Types of interchangeability

Interchangeability is called the principle of normalization of requirements to the size of the elements of parts, junctions, mechanisms used in the designing, through which it is possible to produce them independently and put together or replaced without further processing in accordance with technical requirements of the product

There are following types of interoperability:

1. Full
2. Partial

Partial interchangeability can be:

2.1. Dimension and parametric

2.2. External and internal

Types of interchangeability (examples)

Example (complete interchangeability): In Russia, for the first time in the world, in the XVIII century, under Peter I, during the inspection, the gun Tula and Izhevsk plants were subjected to such a test: take 25 rifles of the two plants, disassembled them, mixing all the components and then re-assembled and prepared 50 fully working guns.

Dragoon rifle of 18th century

Types of interchangeability (examples)

Example (parametric interchangeability): Two electric motors have the same power, output shaft speed and operating life, but one engine is made on the legs in a horizontal configuration (Fig. a) and the other with flange in the vertical modification (Fig. b). Engine mounting to the frame or other parts of the transmission is carried out using a variety of mounting surfaces and the mounting dimensions. The engine (Fig. B) can not be replaced (for example, in case of breakage) at the motor (Figure A), because it has no openings are provided in the flange, which allow to fix the motor in a vertical position

A)

B)

Electric motors *(N = 1 kW; n = 1000 rpm)*

A) on the legs *; B)* with flange

Advantages of the interchangeable production:

1. Simplifies the design process
2. Provides extensive specialization and cooperation
3. Reduces the cost of production
4. Can be organized the mass production
5. Simplifies an assembly process
6. Simplifies the repair

The precision and error in the technique

The precision in the technique - a degree of approximation of the value of the parameter product, process, etc. to its predetermined value

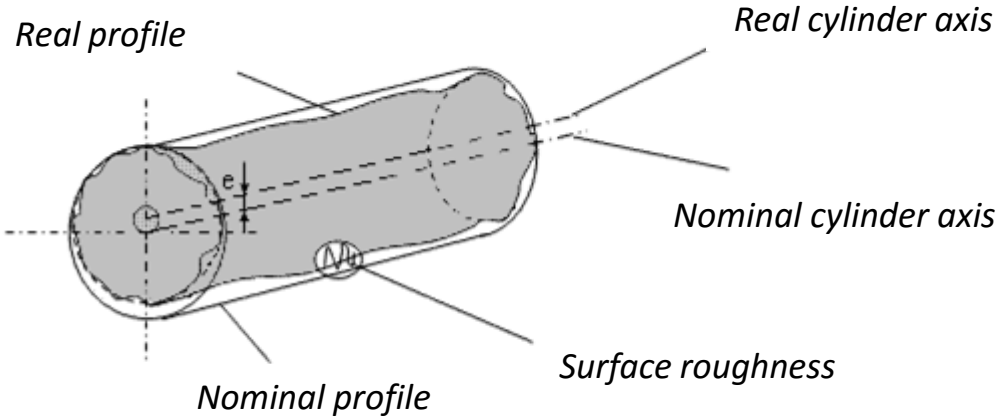
The error - the difference between the approximate value of the certain quantity and its exact value

The geometrical precision of the details of the elements necessary to normalize the following parameters:

1. Size
2. Form of surface
3. The arrangement of surfaces the elements details
4. Surface roughness
5. Waviness of surface

The main causes of errors in the geometric parameters of the elements of parts

1. The state of the equipment and its accuracy.
2. The quality and condition of industrial equipment and tools.
3. Processing modes.
4. Heterogeneity of the work piece material.
5. The elastic deformation of the machine, fixtures, tools and parts.
6. The temperature deformation of the machine, appliances, tools and parts
7. Qualifications and subjective working errors.



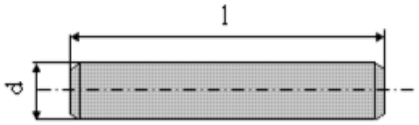
Nominal and real profile of the cylinder

Limit sizes, deviations and tolerance

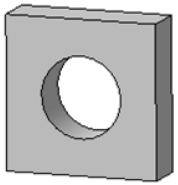
Size is the numerical value of the linear value (diameter, length, etc.) in the selected units (mm)

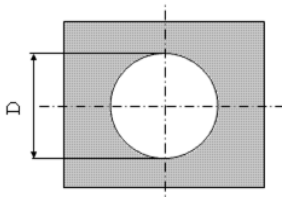
There are three main types of sizes:

1. The outer size (shaft)

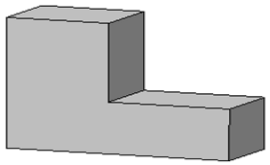


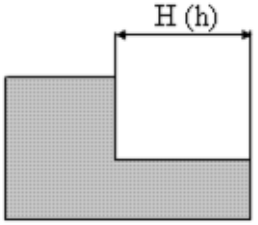
2. The inner size (hole)





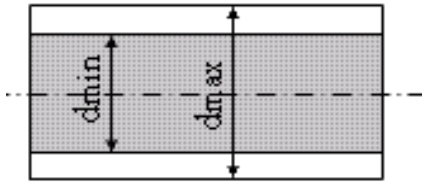
3. Half-open size



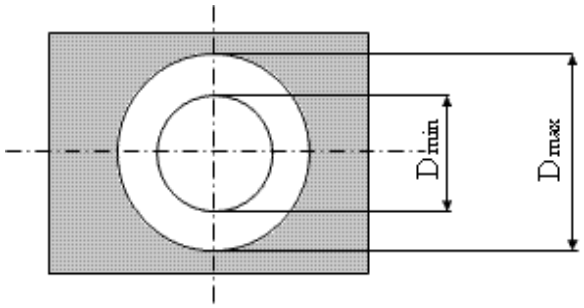


Limit sizes, deviations and tolerance

Basic size: size, relative to which deviations are determined

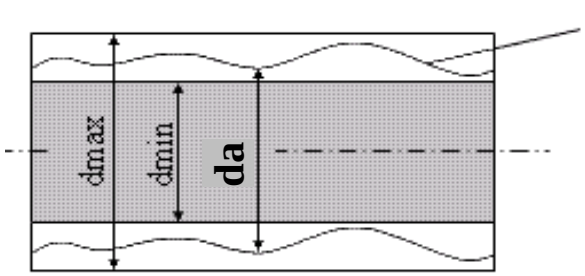


Limit size of the shaft



Limit size of the hole

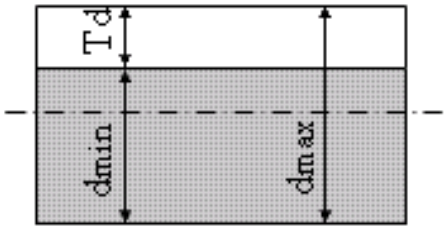
Limits of size: two peaks of allowable sizes of an element, between which must be (or which may be equal) the actual size



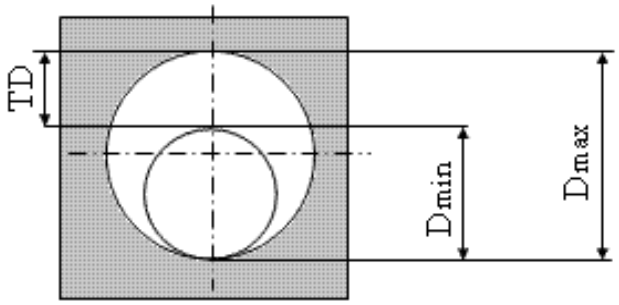
*Actual size of the shaft (**da**)*

Actual size: size of the element, which have set by measurement with permissible error

Limit sizes, deviations and tolerance

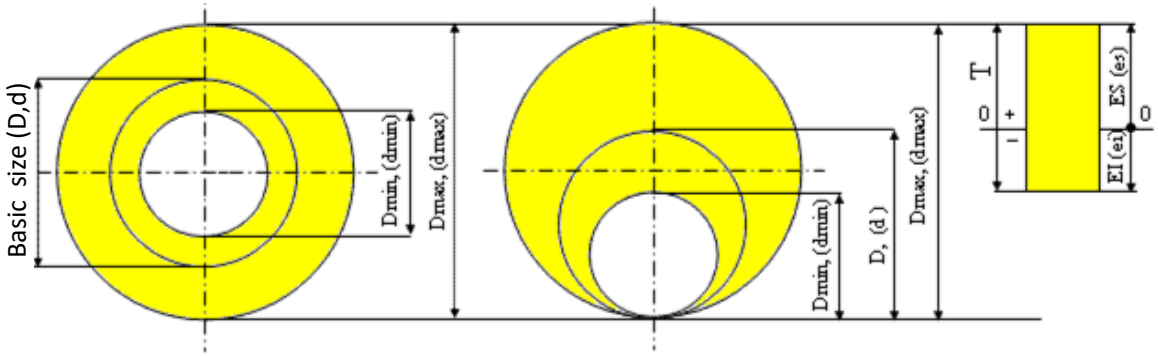


The preferred shaft image,
Td –diameter tolerance of the shaft



The preferred hole image,
TD – diameter tolerance of the hole

Tolerance (TD, Td): the difference between the maximum and minimum limit of sizes hole or shaft, or the absolute value of the algebraic difference between the upper and lower deviations

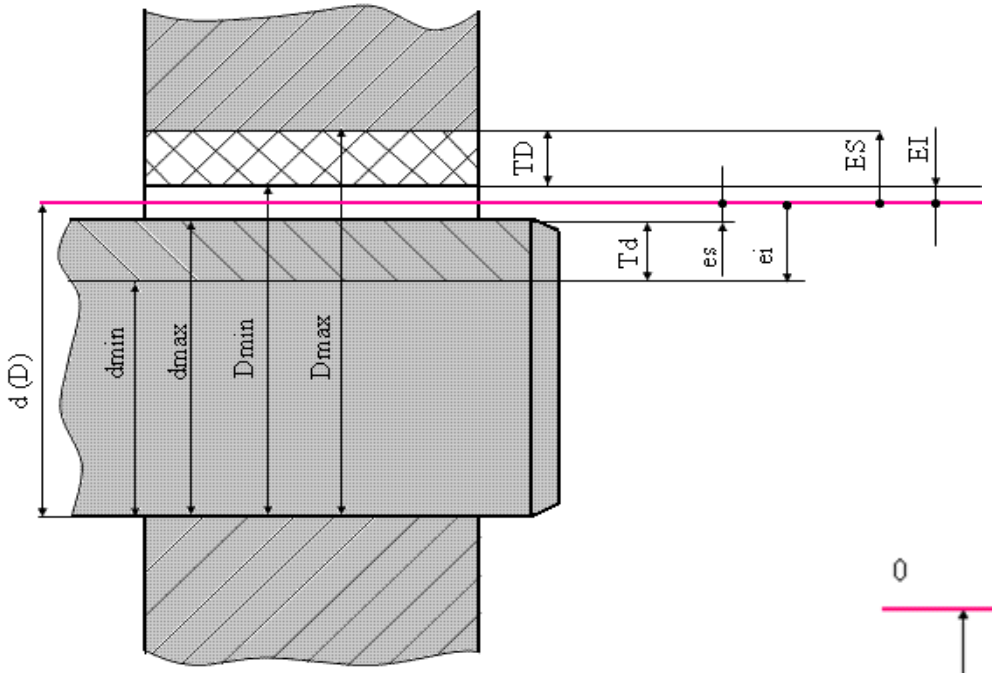


Tolerance (T) for the general case

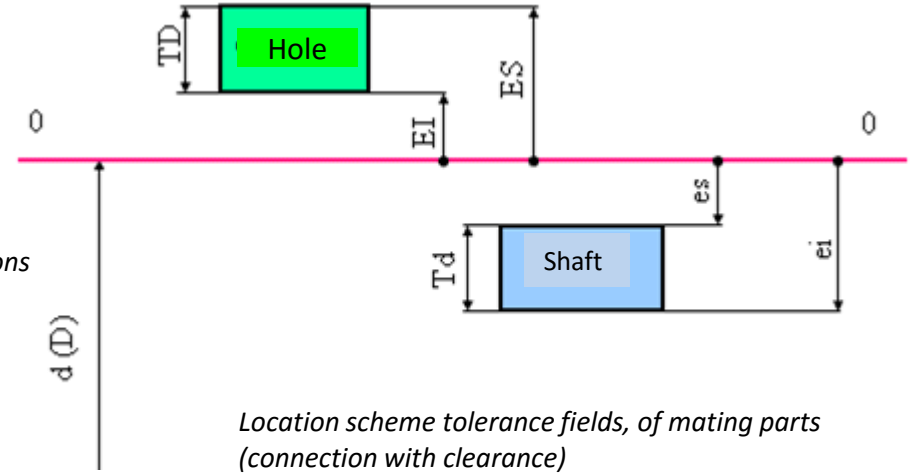
Upper deviation (ES, es): algebraic difference between the maximum limit and the respective nominal size

Lower deviation (EI, ei): algebraic difference between the minimum limit and the corresponding nominal sizes

Schematic representation of fields tolerances



Conditional image of the shaft and sleeve with a clearance connections



Location scheme tolerance fields, of mating parts (connection with clearance)

Thank you for attention