Metrology, standardization and certification

Theme 12: Measuring tools

Lecture plan:

1. The total measurement error.
2. Selecting measurement tool.
3. Beam tool.
4. Micrometric tool.
5. Dial indicating tools.
6. Profilographs and profilometers.
7. Instrumental microscopes.
8. Coordinate measuring machine.

The total measurement error

$$\Delta_{\Sigma} = \Delta_{mod} + \Delta_{m} + \Delta_{mt} + \Delta_{con} + \Delta_{o} \leq \Delta_{per},$$

where the components of this error: Δ_{mod} – measurement model; Δ_{m} – measurement method; Δ_{mt} – measuring tools; Δ_{con} – conditions in which measurements are carried out; Δ_{o} – operator.
Δ_{per} – permissible error.

According to GOST 8.051-81 (ST SEV 303-76) permitted limits of measurement error for a range of 1 - 500 mm are set from 20% to 35% value of tolerance.

Δ_{mt} – measuring tools error is about 50% of the total error. Therefore it is necessary to choose the means of measuring with an accuracy of 0.1 ... 0.17 (large values for precision grade) from tolerance a controlled size. Thus, the accuracy of measuring tool must be approximately one order higher than the accuracy of the controlled parameter (in 8 ... 10).

Selecting measurement tool

Task: Select measurement tool for size control Ø80 js7 (± 0,015).

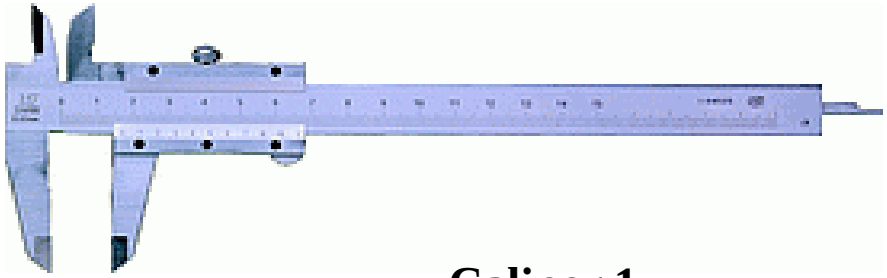
Decision:

1. Define the tolerance for controlled size:
   Td = es-ei = 0,015 - (-0,015) = 0,030 mm;
2. Define the maximum permissible error of measurement tool:
   $\Delta mt = 0{,}1 \cdot 0{,}030 = 0{,}003$ mm = 3 μm.
3. Select measurement tool depending on the estimated Δmt:
   meets the required specification the lever-gear head Δmt = 2.5 μm
   and indicator with Δmt = 2 ... 4 μm.

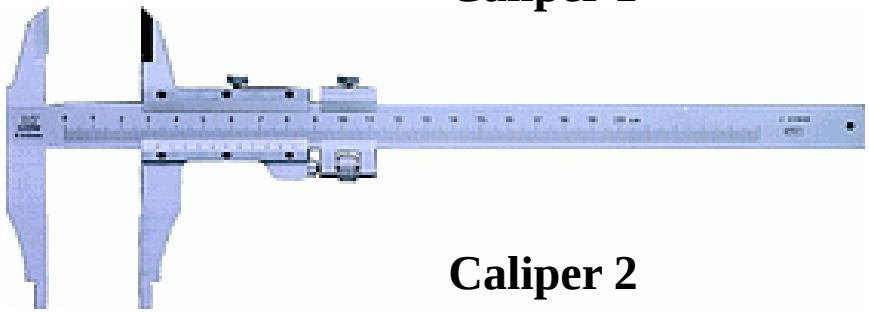
Since the main deviation is written in lowercase letters, then you must select the measurement tool for monitoring the size of the shaft.

Conclusion: The problem is solved, measurement tools above are suitable for the control shaft size Ø80 js7 (± 0,015).

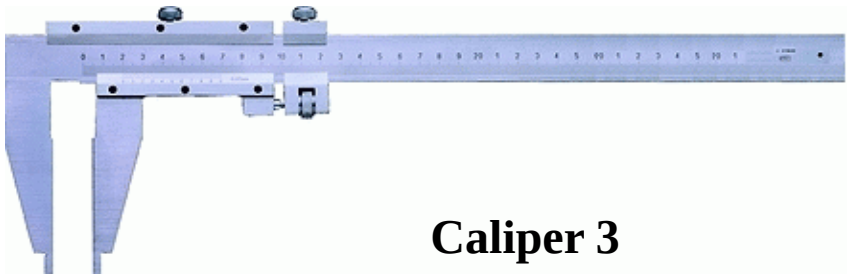
Beam tool



Caliper 1



Caliper 2

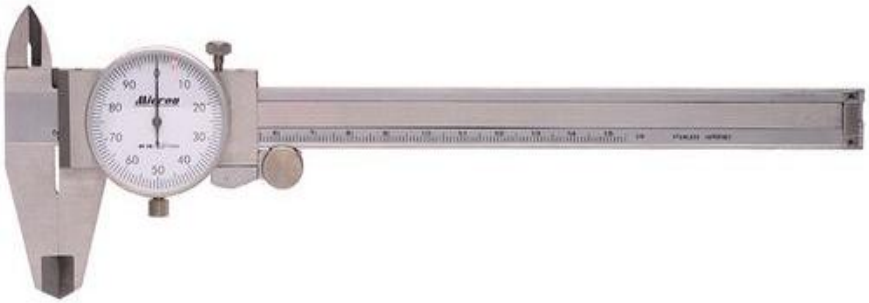


Caliper 3

Caliper 1 has a measuring range from 0 to 125 mm and the vernier scale with interval of 0.1 mm. **Caliper 2** is made with different measuring ranges: 0 ... 160 mm; 0 ... 200 mm; 0 ... 250 mm and vernier with scale division value of 0.05 and 0.1 mm.

Caliper 3 is available with measuring ranges from 0 ... 160 mm to 0 ... 2000 mm with interval of the vernier scale of 0.05 mm and 0.1 mm.

Beam tool

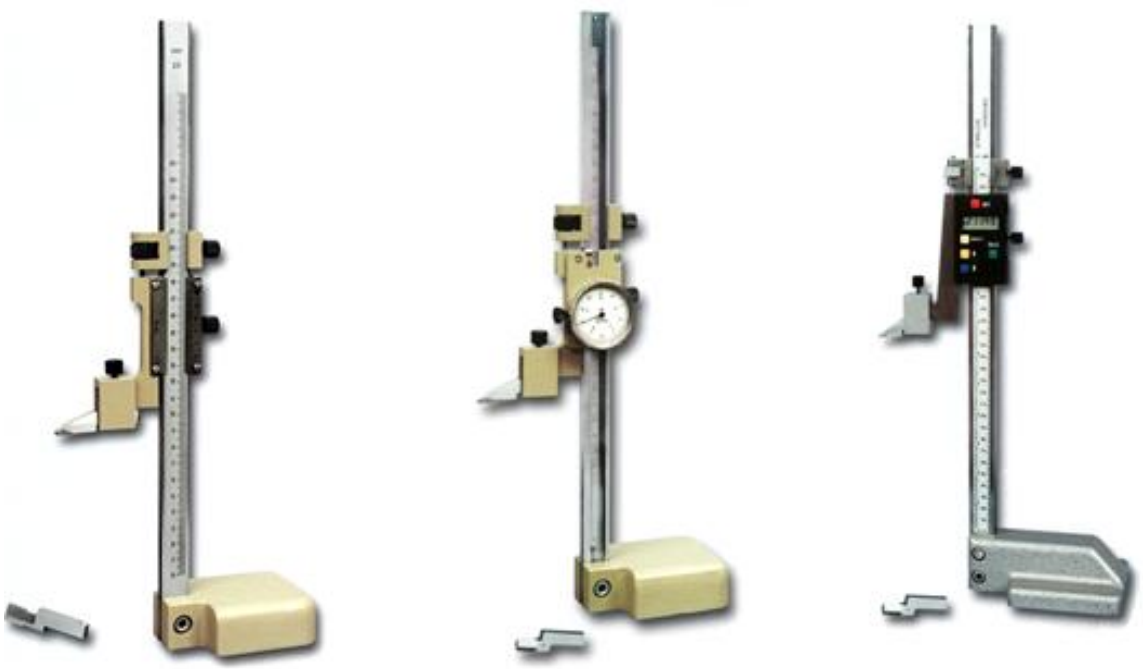


International firms and domestic tool plants are manufacturing the calipers with a dial and digital reading device.

Slide depth gage with a thin rod

Slide depth gage

Beam tool

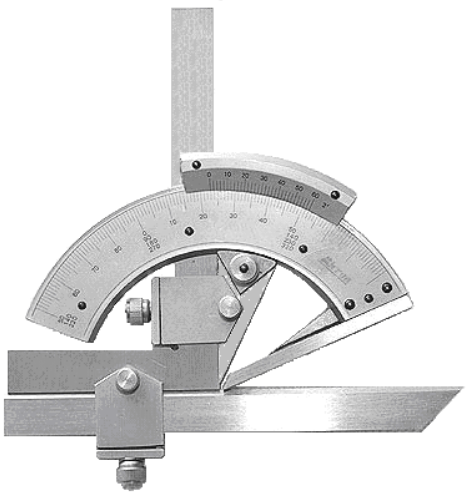


Vernier height gauges

Protractors

5УМ

4УМ



УМ–127

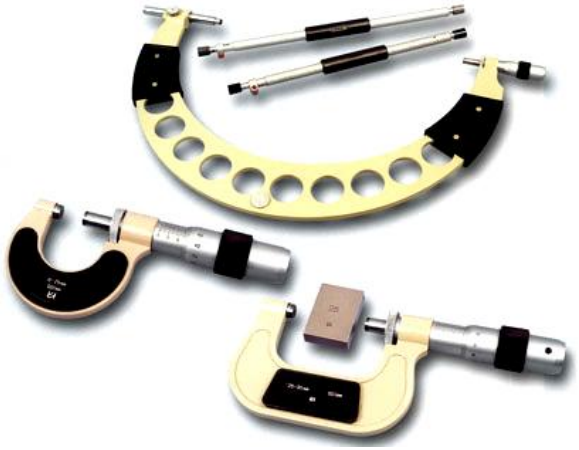
2УРИ

Micrometric tool

Smooth micrometer

Thread micrometer

Tube micrometer

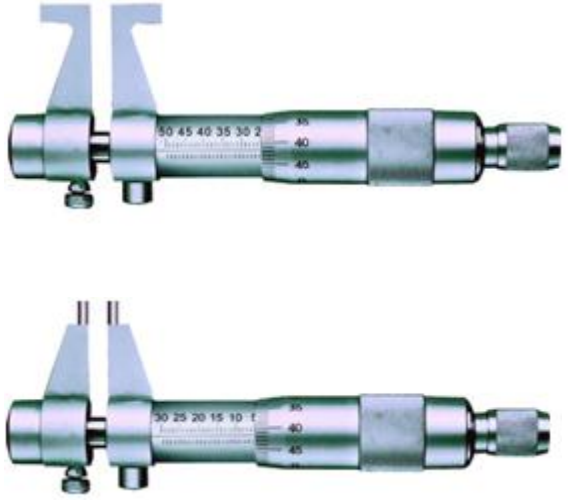


Smooth micrometers

Sheet micrometer

Micrometric tool

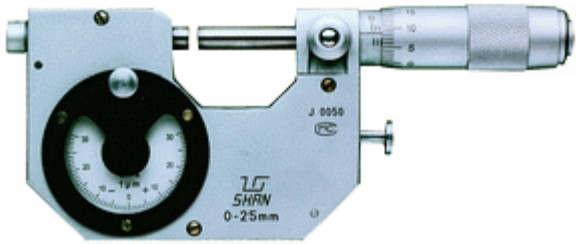
Micrometric depth gage with extension points



Tubular inside micrometers

Micrometric tool

Limit micrometer



Dial indicating micrometer

Desktop micrometer

Micrometer with digital reading device

Stands and tripods for dial indicating tools

Stands

Tripods

Dial indicating tools

Dial indicating snap gage

Dial indicating hole gage

Dial indicating depth gage

Dial indicating tools

Dial indicating wall gage

Dial indicating tools

Thickness gage

Microcator

Instrumental microscopes

Nicon M800

БМИ–1Ц

Profilographs and profilometers

Profilograph-profilometer BV–7669

Portable profilometer TR- 110

Profilograph-profilometer MarSurf M300

Coordinate measuring machine

The measurements on coordinate measuring machines can make contact by using special probes with ruby-tipped and non-contact method using a laser scanner.

Coordinate measuring machine Coord 3 is designed for measuring parts with dimensions on the axes XYZ: 500 × 400 × 400 with an accuracy of (2,5 + 3L) μm, where L - length of detail measured in meters.

Thank you for attention