

Ch-02

Units & Measurement

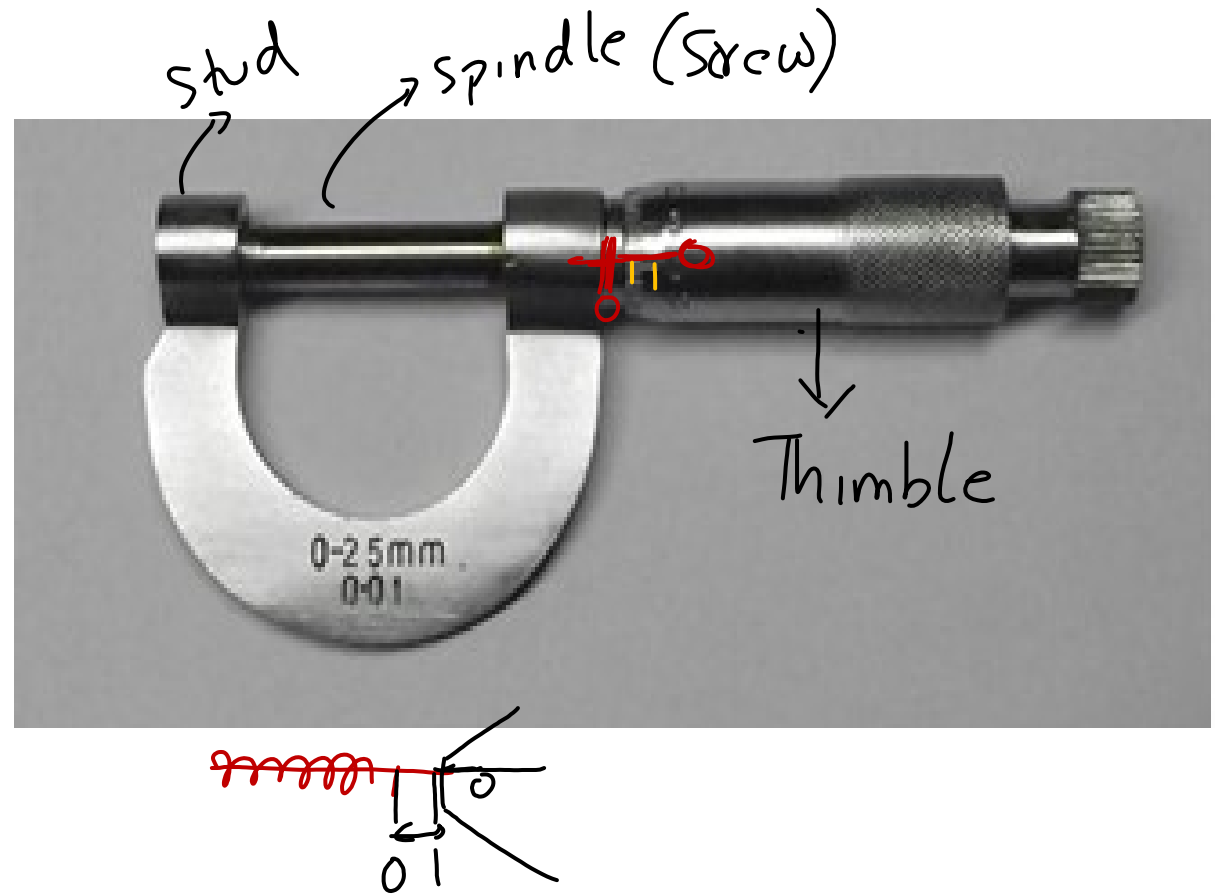
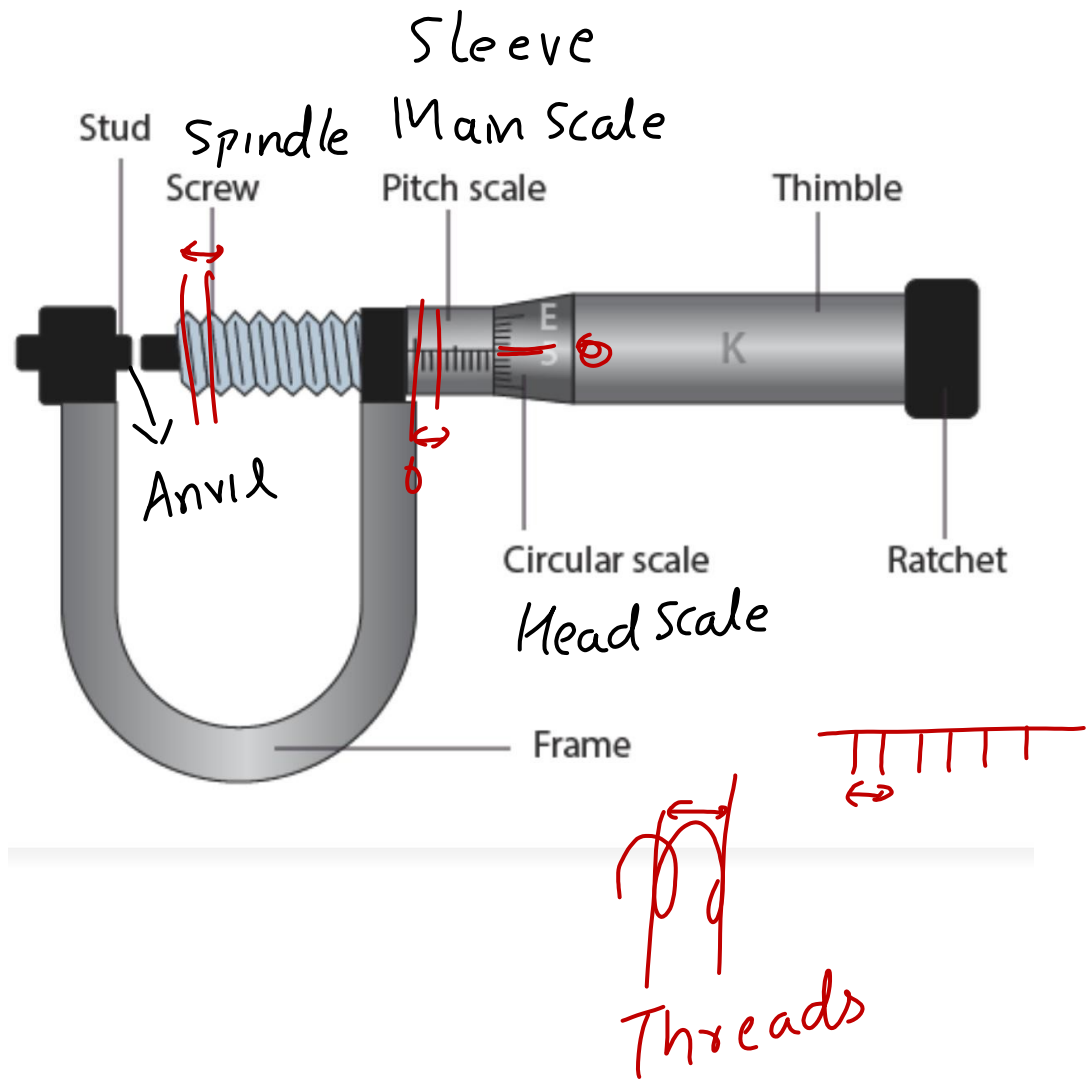
Lect-09

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Today's Goal



Screw Gauge

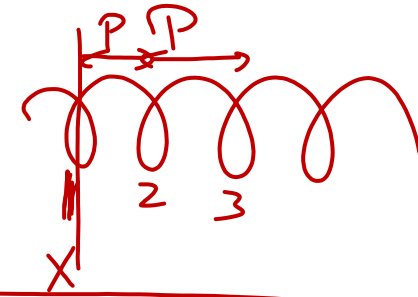


Pitch:



100
divisions

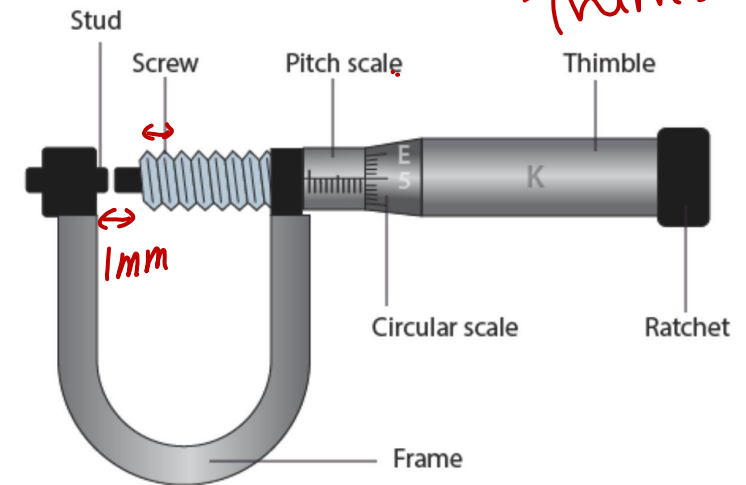
Micrometer
Screw



- Distance between two consecutive threads
- Distance moved by screw due to one complete rotation.
- Markings on the main scale.

Circular Scale
Thimble

$$\text{Least Count: } \frac{\text{Pitch}}{\text{No. of Circular Scale Divisions}}$$



Q1) Two full turns of the circular scale of a gauge cover a distance of 1mm on scale. The total number of divisions on circular scale is 50. Find the least count.

- a) 0.10 mm
- b) 0.01 mm
- c) 0.50 mm
- d) 0.05 mm

$$2 \text{ full rotations} \rightarrow 1 \text{ mm} \quad \text{CSD} = 50$$

$$\text{Pitch} \rightarrow 1 \text{ full rotation} \rightarrow \frac{1}{2} \text{ mm} = 0.5 \text{ mm}$$

$$\text{L.C} = \frac{\text{Pitch}}{\text{no of CSD}} = \frac{0.5 \text{ mm}}{50} = \frac{1}{100} = 0.01 \text{ mm}$$

Q2) The least count of the main scale of a Screw Gauge is 1mm. The minimum number of divisions on its circular scale required to measure 5 μ m diameter of a wire is [JEE MAINS 2019]

- a) 50
- b) 200
- c) 500
- d) 100

$$\text{Pitch} = 1\text{mm}$$

$$\text{no of CSD} = ?$$

$$L.C = 5\mu\text{m}$$

$$L.C = \frac{\text{pitch}}{\text{no of CSD}}$$

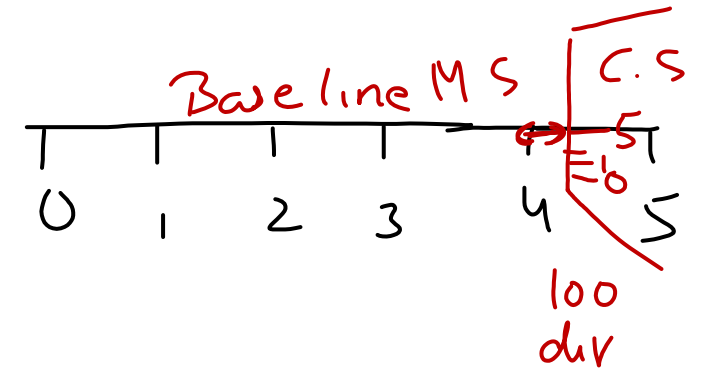
$$5 \times 10^{-6} \text{m} = \frac{10^{-3} \text{m}}{\text{no of CSD}}$$

$$\text{no of CSD} = \frac{10^{-3}}{5 \times 10^{-6}}$$

$$= \frac{10^{-3+6}}{5} = \frac{10^3}{5}$$

$$= \frac{1000}{5} = 200$$

Finding Reading

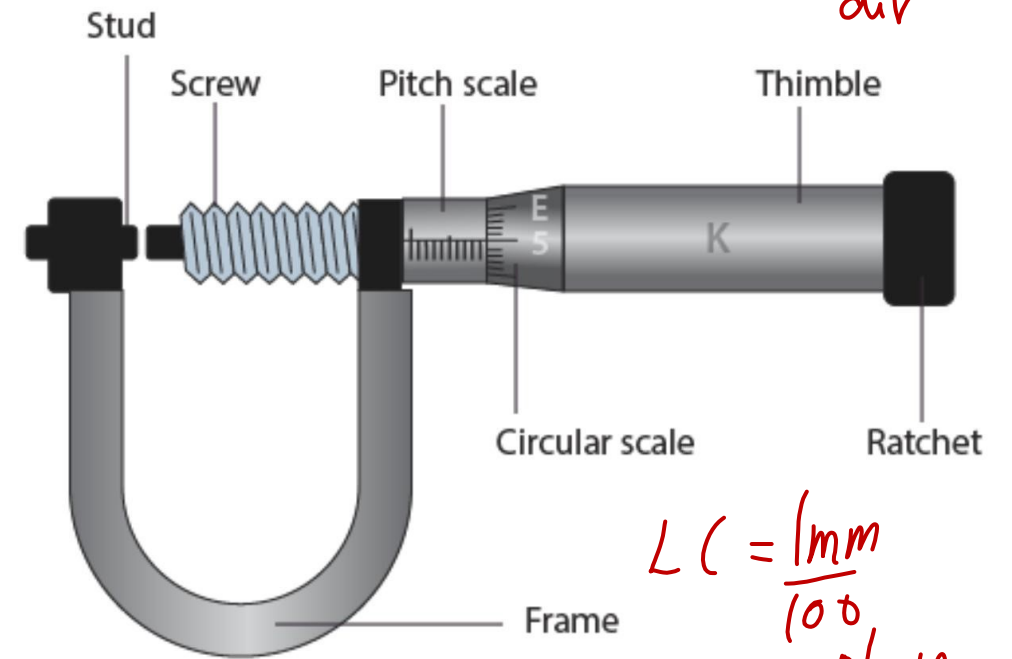


$$\text{Reading} = \text{MSR} + \text{CSR}$$

= Reading on MS just before zero of CS + L.C. × Co-inciding div of CS with base line

$$4 \text{ mm} + 0.01 \times 5$$

$$4 + 0.05 = 4.05 \text{ mm}$$



$$L.C. = \frac{1 \text{ mm}}{100}$$

$$= 0.01 \text{ mm}$$

Q3) Circular Scale has 100 divisions. Calculate diameter of wire.

- a) 0.534 cm
- b) 0.345 cm
- c) 0.435 cm
- d) 0.450 cm

$$\text{Reading} = \text{MSR} + \text{CSR}$$

$$= 5\text{mm} + \text{LC} \times \text{Coinciding div of CS with Baseline}$$

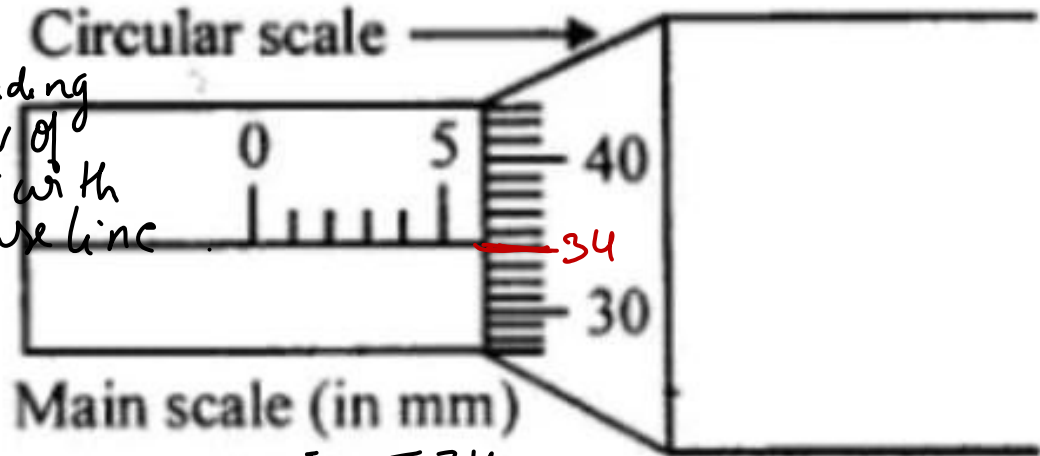
$$= 5\text{mm} + 0.01 \times 34$$

$$= 5\text{mm} + 0.34\text{mm}$$

$$= 5.34\text{mm}$$

$$\text{Pitch} = 1\text{mm}$$

$$\text{LC} = \frac{\text{Pitch}}{\text{No of CS D}} = \frac{1\text{mm}}{100} = 0.01\text{mm}$$



$$\rightarrow \frac{5.34\text{mm}}{10} = 0.534\text{cm}$$

Q4) The thimble of a screw has 50 divisions and spindle advances 1 mm when the screw is turned through two rotations.

When the screw is used to measure the diameter of wire, the reading on sleeve is found to be 0.5 mm and reading on thimble is found 27 divisions. What is the diameter of wire in cm.

Pitch Scale
Main Scale

a) 0.027 cm

2 rotations \rightarrow 1 mm

b) 0.005 cm

1 rotation \rightarrow $\frac{1}{2}$ mm

c) 0.077 cm

(Pitch)

d) 0.035 cm

$$L.C = \frac{\text{Pitch}}{\text{no. of CSD}} = \frac{\frac{1}{2} \text{ mm}}{50} = \frac{1}{100} \text{ mm} = 0.01 \text{ mm}$$

$$\text{Reading} = \text{MSR} + \text{CSR}$$

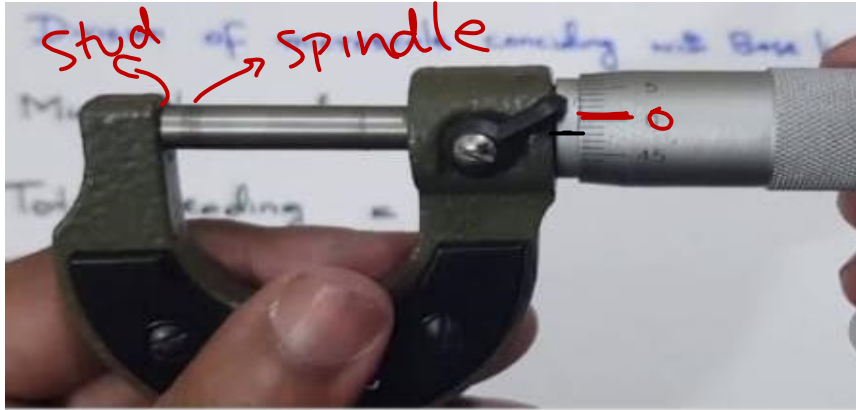
$$= 0.5 \text{ mm} + \text{L.C} \times \text{Coinciding div of CS with Base line}$$

$$= 0.5 \text{ mm} + 0.01 \times 27$$

$$= 0.5 + 0.27$$

$$= 0.77 \text{ mm} = \frac{0.77}{10} \text{ cm} = 0.077 \text{ cm}$$

Zero Error & Correct Reading



If Zero of Circular Scale does not Coincide with base line (at initial condition before starting measurement, when spindle and stud touch each other), then it is said that there is a zero error in screw gauge.

Two types of Zero Error:-

a) Positive Zero Error

b) Negative Zero Error

$$\text{Correct Reading} = \text{Reading} - \text{Zero error}$$

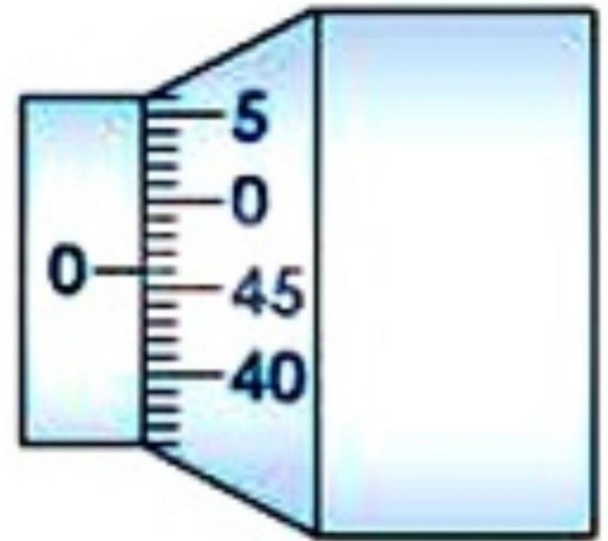
b) Negative Zero Error

When zero of C.S is above the
Base line

-ve zero error = $-L.C \times$ (counting
div of
C.S with Base line

Correct Reading = Reading - Zero Error

$$10 = 6 - (-4)$$



Negative zero error

Q5) The Pitch and the number of divisions, on the circular scale for a given screw gauge are 0.5 mm and 100, respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line.

The readings of the main scale and the circular scale for a thin sheet are 5.5 mm and 48 respectively, the thickness of this sheet is

- a) 5.950 mm
- b) 5.725 mm
- c) 5.755 mm
- d) 5.740 mm

$$\text{Pitch} = 0.5 \text{ mm}$$

$$\text{no of CSD} = 100$$

$$L.C. = \frac{\text{pitch}}{\text{no of CSD}} = \frac{0.5}{100} = 0.005 \text{ mm}$$

$$+ve \text{ zero error} = L.C. \times (\text{Coinciding div}) = 0.005 \times 3 = +0.015 \text{ mm}$$

$$\text{Reading} = \text{MSR} + \text{CSR}$$

$$= 5.5 \text{ mm} + \text{L.C.} \times \text{Coinciding div}$$

$$= 5.5 \text{ mm} + 0.005 \times 48$$

$$= 5.5 \text{ mm} + 0.240 \text{ mm}$$

$$= 5.740 \text{ mm}$$

$$\begin{array}{r} 5.5 \\ 0.240 \\ \hline 5.740 \end{array}$$

$$\begin{array}{r} 5.740 \\ - 0.015 \\ \hline 5.725 \end{array}$$

$$\begin{aligned} \text{Correct Reading} &= \text{Reading} - \text{Zero error} \\ &= 5.740 \text{ mm} - 0.015 \text{ mm} = 5.725 \text{ mm} \end{aligned}$$

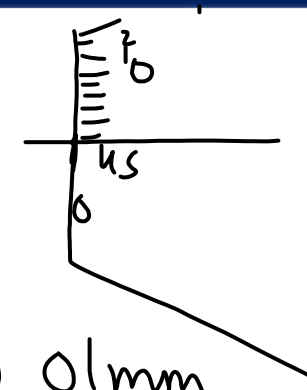
Q6) A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of aluminium. Before starting the measurement, it is found that when two jaws of the screw gauge are brought in contact, the 45th division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet, if the main scale reading is 0.5 mm and the 25th division coincides with the main scale line?

- a) 0.75 mm
- ~~b) 0.80 mm~~
- c) 0.70 mm
- d) 0.50 mm

Pitch = 0.5 mm
 no of CSD = 50

$$L.C = \frac{\text{pitch}}{\text{no of CSD}} = \frac{0.5}{50} = \frac{5}{500} = \frac{1}{100} = 0.01 \text{ mm}$$

-ve zero error = -L.C x coinciding div = -0.01 x 5 = -0.05 mm



$$\begin{aligned}
 \text{Reading} &= \text{MSR} + \text{CSR} \\
 &= 0.5 \text{ mm} + LC \times \text{Coinciding div} \\
 &= 0.5 \text{ mm} + 0.01 \times 25 \\
 &= 0.5 + 0.25 \\
 &= 0.75 \text{ mm}
 \end{aligned}$$

$$\begin{array}{r}
 0.75 \\
 + 0.05 \\
 \hline
 0.80
 \end{array}$$

$$\begin{aligned}
 \text{Correct Reading} &= \text{Reading} - \text{Zero error} \\
 &= 0.75 - (-0.05) = 0.80 \text{ mm}
 \end{aligned}$$

Thank You

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<http://physicswallahalakhpandey.com/alpha-xi-physics/02-units-and-measurement/>