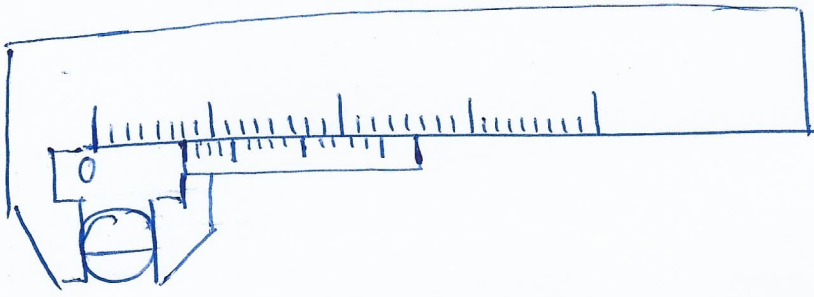


# VERNIER CALLIPER ✓



Least Count or Vernier Constant (LC)  
= Smallest value which can be measured accurately.

Value = MSD + L.C × VSD

7 + L.C × (5)

← No. of divisions on main scale before zero of Vernier Scale.

↓ Vernier scale division which coincides perfectly with a main scale division.

$$L.C = 1 \text{ MSD} - 1 \text{ VSD}$$

$$N \text{ VSD} = (N-1) \text{ MSD}$$

$$1 \text{ VSD} = \left( \frac{N-1}{N} \right) \text{ MSD}$$

$$L.C = 1 \text{ MSD} - \left( \frac{N-1}{N} \right) \text{ MSD}$$

$$= \frac{1}{N} \text{ MSD}$$

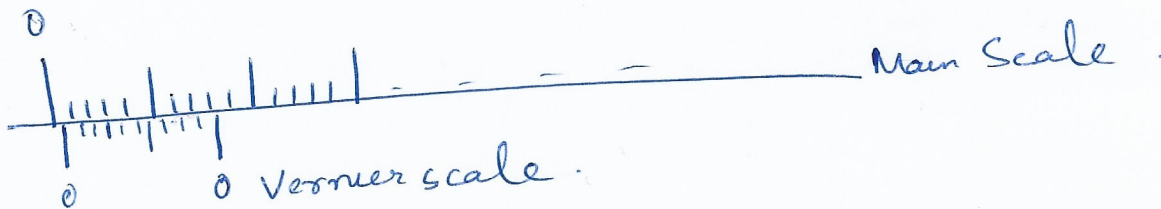
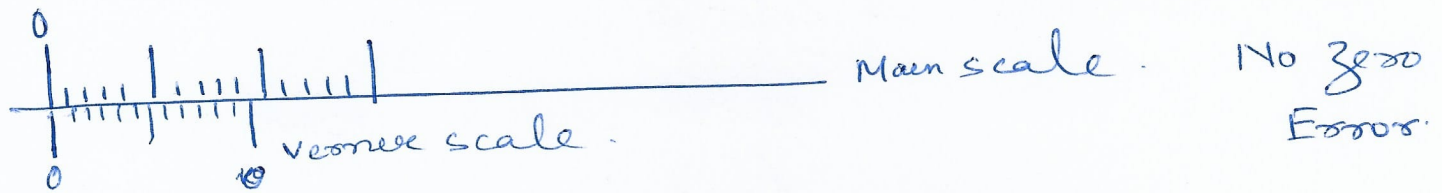
eg. 50 VSD coincides with 49 MSD  
find L.C if 20 <sup>divisions</sup> ~~marks~~ on Main scale is equal to 4 cm.

$$1 \text{ MSD} = \frac{4}{20} \text{ cm} = \frac{1}{5} \text{ cm} = 0.2 \text{ cm}.$$

$$L.C = 1 \text{ MSD} - 1 \text{ VSD}.$$

$$L.C = \frac{1}{N} \text{ MSD} = \frac{1}{50} \times 0.2 \text{ cm} = 0.004 \text{ cm}$$

### ZERO ERROR



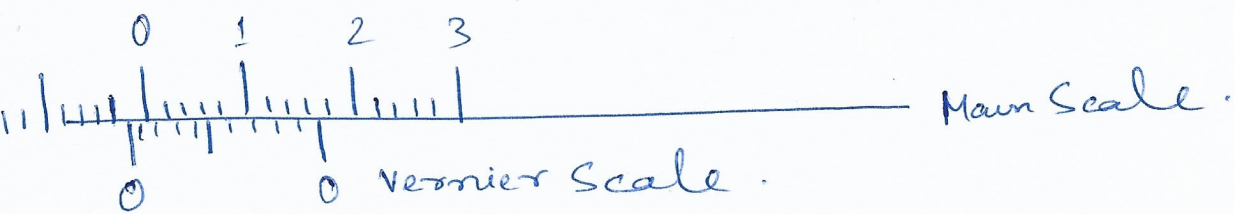
$$\text{Value} = \left| \frac{0 + L.C \times 3}{\text{Zero Error}} \right|$$

$$\text{Measurement} = X \text{ cm}.$$

$$\begin{aligned} \text{Actual} &= X - \text{Value} \\ &= \text{Measured} - \text{Zero Error} \end{aligned}$$

When zero of Vernier scale is right of zero of Main scale then ~~the~~ positive Zero Error in Apparatus.

$$\text{Zero Correction} = -(\text{Zero Error})$$



$$\text{Zero Error} = \left| -1 + \text{L.C}(5) \right|$$

$$\text{Measurement} = X \text{ cm}$$

$$\text{Actual} = X + \text{Zero Error}$$

$$\begin{aligned} \text{Zero Correction} &= - \text{Zero Error} & \left| \begin{array}{l} \text{Positive} \\ \text{Zero Error} \end{array} \right. \\ &= + \text{Zero Error} & \left| \begin{array}{l} \text{Negative} \\ \text{Zero Error} \end{array} \right. \end{aligned}$$

Measured < Actual.

Measured > Actual.

$$1 \text{ mm} = 1 \text{ MSD.}$$

$$\text{L.C} = \frac{1}{N} \text{ MSD.} = \frac{1}{10} (1 \text{ mm}) = 0.1 \text{ mm} = 0.01 \text{ cm.}$$

$$\text{Zero Error} = 0 + 7 \times 0.01 \text{ cm} = 0.07 \text{ cm.}$$

$$\begin{aligned} \text{Measurement} &= 3.04 \text{ cm} \\ &= 3 \text{ cm} + 0.04 \text{ cm} \\ &= 3.04 \text{ cm.} \end{aligned}$$



(49)  $1 \text{ MSD} = \frac{1 \phi \times 4 \text{ cm}}{25 \phi \times 4} = 0.04 \text{ cm}.$

$15 \text{ mm} \Rightarrow \text{--- MSD}$

$105 \text{ mm} \Rightarrow \frac{105}{0.04} \text{ MSD}.$

$\Rightarrow \frac{150}{4} = 37.5 \text{ MSD}.$

$L.C = 1 \text{ MSD} - 1 \text{ VSD}$

$= 1 \text{ MSD} - \frac{37.5}{50} \text{ MSD}$

$= \frac{12.5}{50} \text{ MSD} = \frac{1}{4} \text{ MSD}.$

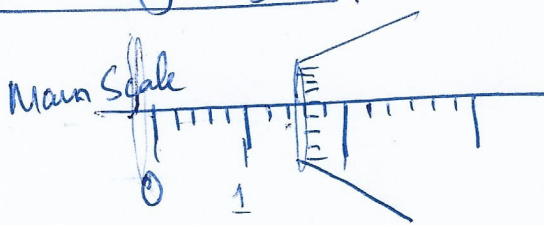
~~1 MSD =~~

$= \frac{0.04}{4} = \underline{\underline{0.01 \text{ cm}}}$

$50 \text{ VSD} \Rightarrow 37.5 \text{ MSD}$

$1 \text{ VSD} = \frac{37.5}{50} \text{ MSD}.$

Screw Gauge



Measurement =  $\boxed{\begin{matrix} \text{MSD} \\ + (\text{L.C} \times \text{CSD}) \end{matrix}}$

$L.C = \frac{1 \text{ MSD}}{\text{No. of Circular Scale divisions}}$

$\frac{\text{Pitch}}{\text{No. of Circular Scale Division}}$

Pitch of Screw Gauge =

distance travelled one Main Scale on one complete rotation of Circular Scale

If zero of Circular Scale is below the Main Scale then positive Zero Error

$$\text{Zero Correction} = - |L \cdot C \times CSD|$$

If zero of Circular Scale is Above the Main Scale then Negative Zero Error.

$$\text{Zero Correction} = + |-1MSD + L \cdot C \times CSD|$$

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