Experiment # 01

Object:

To determine the cross-sectional area of a given piece of wire using micrometer screw gauge.

Apparatus:

i. A micrometer screw gauge
ii. A small cylinder
iii. Small piece of wire

Theory:

A screw pitch gauge also known as a micrometer is a precision instrument. It is used for measuring diameter of circular objects mostly wires, with an accuracy of 0.001cm. It consists of a hollow cylinder mounted on a U frame. The hollow cylinder leads to a ratchet which is meant for fine adjustment. The U frame consists of a flat end known as stud and a screw on the other side. This screw can be moved inside the nut by fitted in the U frame by rotating the hollow cylinder called the thimble. This is called the main scale. The hollow cylinder or the thimble is graduated into 50 or 100 equal parts. This is called the circular scale.

Micrometer screw-gauge is another instrument used for measuring accurately the diameter of a thin wire or the thickness of a sheet of metal. It consists of a U-shaped frame fitted with a screwed spindle which is attached to a thimble.

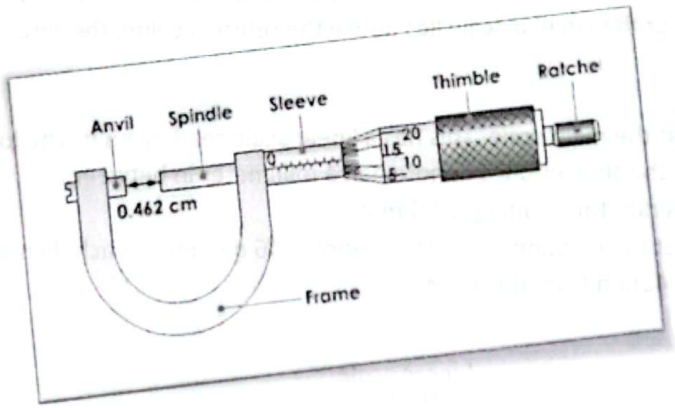


Fig: Screw gauge

The screw has a known pitch such as 0.5 mm. Pitch of the screw is the distance moved by the spindle per revolution. Hence in this case, for one revolution of the screw the spindle moves forward or backward 0.5 mm. This movement of the spindle is shown on an engraved linear millimeter scale on the sleeve. On the thimble there is a circular scale which is divided into 50 or 100 equal parts.

Pitch = distance covered on main scale/number of rotations

$$P = d/N$$

When the anvil and spindle end are brought in contact, the edge of the circular scale should be at the zero of the sleeve (linear scale) and the zero of the circular scale should be opposite to the datum line of the sleeve. If the zero is not coinciding with the datum line, there will be a positive or negative zero error as shown in figure below.

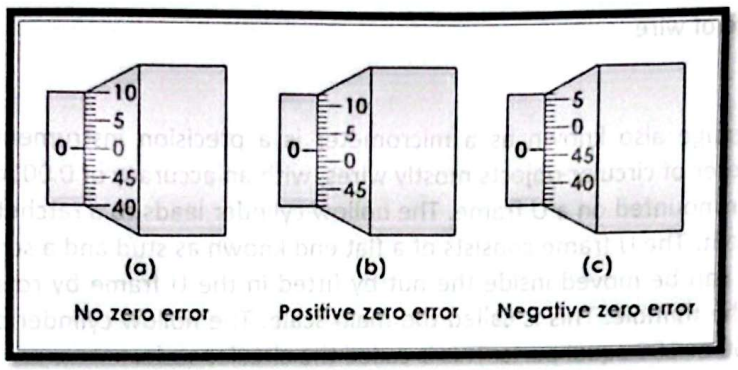
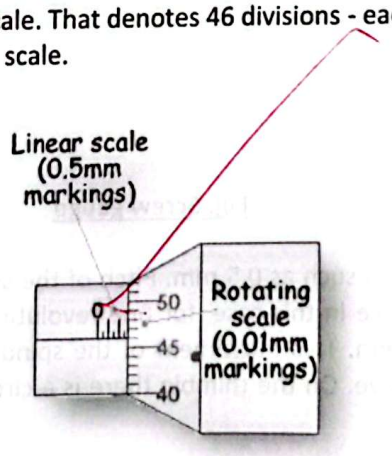


Fig: Zero error in case of screw gauge

- If the zero of the circular scale lies below the reference line, the zero error is positive.
- If the zero of the circular scale lies above the reference line, the zero error is negative.

To take a reading:

- First look at the main scale. This has a linear scale reading on it. The long lines are every millimeter the shorter ones denote half a millimeter in between.
- On the diagram this reading is 2.5 mm
- Now look at the rotating scale. That denotes 46 divisions - each division is 0.01mm so we have 0.46mm from this scale.



Pitch:

(a) The smallest division on main scale = 0.5 mm = 0.05 cm

(b) Total number of divisions or circular scale = 50 div

S.No.	Number of Rotations (N)	Distance on M.S (d) mm	Pitch P = d/N	Mean Pitch
1	1	0.5	0.5	0.5
2	2	1	0.5	0.5
3	3	1.5	0.5	0.5

Least Count:

Least Count (LC) = pitch of the screw/no. of divisions on circular scale

= 1/100 mm

= 0.01 mm

= 0.001 cm

i. Determining the cross-sectional area of a given piece of wire

Working formula:

- The cross-sectional area of wire is given by $A = \pi r^2$

Procedure:

1. Determine the pitch of the screw and then find the least count of the instrument with the help of formula given above.
2. Find the zero error, if any, by closing the studs of the screw gauge using the ratchet to avoid under pressure between the studs.
3. Place the small wire whose diameter D is to be determined between the studs and screw up the gauge using ratchet, till the studs just hold the object. Too much pressing may alter the diameter of the object.
4. Note the last visible division of the main scale. This gives the main scale reading in millimeters. Convert it into centimeters and record it. Then take the circular scale reading against the reference line. Multiply it with the least count to get the scale reading against the reference line. Multiply it with the least count to get the fractional part. Add fractional part and main scale reading to get total reading.
5. Apply zero error, observed in step 2, to the total reading to get the correct reading.
6. Repeat the observations at least three times at different places and arrange them in a tabular form and take their mean.

Calculations:

Quantity to be measured	S. No	Main Scale Reading (MR) mm	Circular Scale Reading (CR) div	Fractional Part FP=CRxLC mm	Total Reading T=MR+FP mm	Corrected Reading R=T-Z mm	Mean Reading mm
Diameter of Wire (D)	1	1.5	49	0.49	1.99	1.99	1.99
	2	1.5	49	0.49	1.99	1.99	1.99
	3	1.5	49	0.49	1.99	1.99	1.99

calculations?

- Radius of wire (r) = D/2 = 0.995 mm
- Cross sectional area of piece of wire A = πr2 = 3.110 mm^2

Result:

Cross sectional area of the given piece of wire = 0.0311 cm^2

20/Feb/26