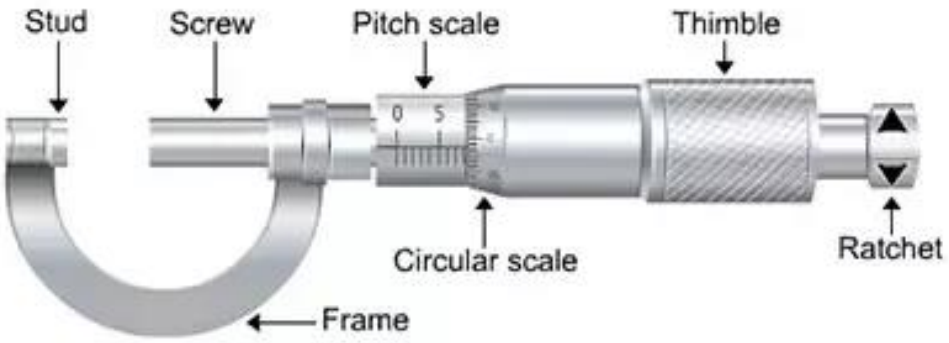
EXPERIMENT: Determine the diameter of a given wire using a screw gauge.

MATERIAL REQUIRED

Given wire, screw gauge

THEORY

Screw Gauge is a mechanical tool that facilitates measuring the diameter or radius or thickness of a thin wire or thickness of a thin metal sheet with utmost accuracy. Figure1 shows the schematic of the Screw Gauge. This tool consists mainly of a U shaped frame and a spindle (or screw) attached to the thimble. There are two scales known as Pitch Scale which is the main scale and is engraved on the barrel with vertical lines. Another one is the Circular Scale which is engraved horizontally on the thimble. Pitch scale measures the distance in millimetre (mm) travelled by the spindle per revolution. One revolution by the circular scale is equal to half of the millimetre of displacement of the screw is called a micrometre screw gauge. Micrometre gauges are more accurate and precise as compared to the Vernier Caliper scale.



(i) **Pitch:** The pitch of the screw is the distance through which the screw moves along the main scale in one complete rotation of the cap on which is engraved the circular scale.

(ii) **Least Count:** The least count of the screw gauge is the distance through which the screw moves when the cap is rotated through one division on the circular scale.

(iii) **Zero error and correction:** When the opposite studs on the frame are brought into contact, if the zero of the head scale coincides with the circular scale axis, there is no zero error (See Fig.1 (a)).

When the zero mark of the circular scale and the main scale do not coincide on bringing the studs in contact the instrument has zero error. The zero of the circular scale may be in advance or behind the zero of the main scale by a certain number of divisions on circular scale.

If the zero of the circular scale is behind the zero of the pitch scale, the zero error is positive (See Fig. 1 (b)).

On the other hand, If the zero of the circular scale is ahead of the zero of main scale the zero error is negative (See Fig. 1 (c)).

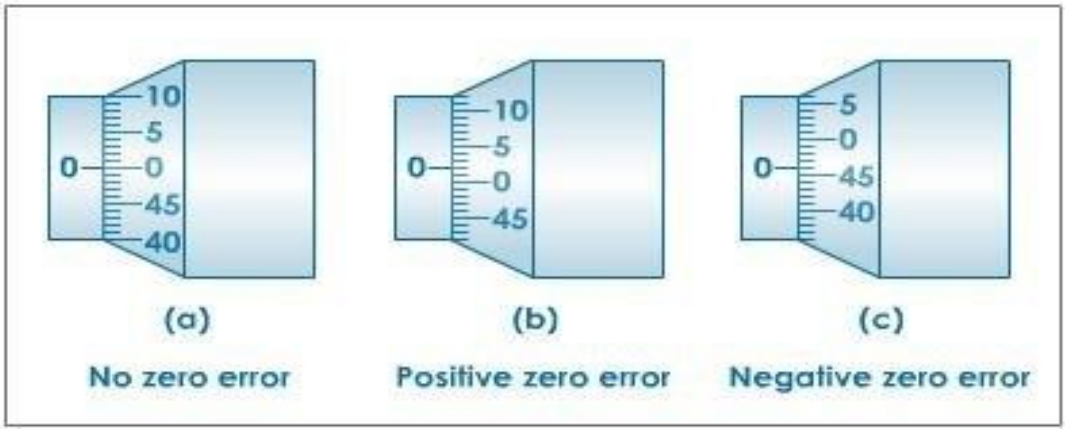


Fig.1

(iv) **Back-lash error:** Owing to ill-fitting or wear between the screws and the nut, there is generally some space for the play of the screw, the screw may not move along the its axis for appreciable rotation of the head (or cap, on which circular scale is marked). The error so introduced is called back-lash errors. To eliminate it you must advance the screw, holding it by the ratched cap, when making final adjustment for finding zero error or the diameter of the wire.

PROCEDURE

(i) **Measuring pitch:** To measure the pitch give several rotation to its cap and observe the distance through which screw moves. Calculate the pitch using the following formula.

$$Pitch = \frac{distance\ moved}{No.of\ complete\ rotation}$$

(ii) **Measuring least count:** To measure the least count note the number of divisions on the circular scale and calculate

$$Least\ Count\ (L.C) = \frac{Pitch\ of\ the\ screw\ guage}{No.of\ divisions\ on\ circular\ scale}$$

(iii) **Measuring zero error:** With the studs in contact observe the numbers of divisions by which zero of the circular scale deviates from the zero of the main scale. This number multiplied by the least count gives the required zero error (As discussed previously).

(iv) **Calculate the zero correction:** It is negative of zero error.
Zero correction = – zero error (Where zero error is put with its proper sign).
Zero correction is added algebraically in the observed diameter of wire to get the corrected reading.

(v) **Measuring diameter:** To measure the diameter of the wire move the screw back to make a gap between the studs. Insert the wire between the studs. Turn the screw forward by holding it from the ratchet cap and wire should be held gently between the two studs.

(vi) Read the nearest division on the circular scale in line with the main scale and also find the complete rotations of the cap with the help of the main scale. Calculate the observed diameter:

Observed diameter = Pitch × number of complete rotation + L.C. × circular scale reading

(vii) Repeat the experiment for 5 observations at different points of the wire along its length. Find the mean observed diameter and apply the zero correction to obtain correct diameter.

OBSERVATIONS

Linear distance covered in 4 complete rotations = ... mm

Linear distance covered in 1 complete rotations = ... mm

∴ Pitch of the screw = ... mm = ... cm

Number of divisions on circular scale = ...

Least count = $\frac{Pitch}{No.of\ divisions\ on\ circular\ scale}$ =..... cm

zero error = ...

zero correction (ZC) = – (zero error)

= ..... to be added algebraically.

Table: Screw gauge readings for diameter

S.No.	Readings		Observed Reading (OR) = m x pitch + n x L.C.	Corrected diameter (CR) = OR +ZC
	Linear Scale m (div.)	Circular Scale n (div.)		
1. 2. 3. 4. 5.				

Mean corrected diameter (D) = ... cm

SOURCES OF ERRORS

(i) If the instrument be screwed up tightly when finding zero error or taking reading of diameter of wire (perhaps on account of defective on hard ratchet cap) it may compress the wire out of shape.

(ii) If the screw is not turned by holding the ratchet cap then the screw may compress the wire out of shape.

(iii) As mentioned earlier, to eliminate the back-lash error, the screw should always be turned in the same direction (i.e. in forward direction) when making the final adjustment. Negligence of this procedure can come a major error.