Screw Gauge

OBJECT: To determine the radius of a wire using screw gauge.
Apparatus used: wire, screw gauge.
Formula: Radius =diameter/2 or r=D/2
Theory - **Screw Gauge**- It is an instrument designed to have a least count .01 mm or even smaller. It is used to measure the thickness of very thin objects such a thin sheet, a wire or a hair etc. It is based upon the principle of a screw. It consists of a U- shaped frame, which has a fixed end at A. A fine and an accurate cut screw of uniform pitch passes through the other end of the frame. A cap fits on to the screw and carries on its inner edge 100 or 50 equal division marks. This is called the circular/head scale (CS/HS). There is another linear scale graduated on the parallel to the axis of the screw. This is called main/pitch scale (S). When the screw is rotated, the number of complete rotations can be read on the pitch scale, while the fraction of rotation can be read from the circular scale. In some screw gauges, the screw head is provided with a ratchet arrangement R (See Fig.1). When the studs A and B are in contact with each other or with some other object placed in between, the ratchet slips over the screw without moving the screw forward. This helps in avoiding undue pressure between the studs or on the object for accurate measurements.

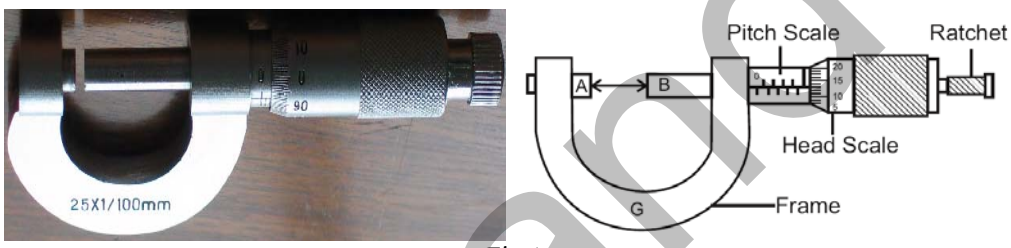

Fig.1

Procedure:
A. Least count of screw gauge: Least Count of a screw gauge is defined as the distance through which the screw moves on the pitch scale when the cap of the screw is rotated through one division on the circular/head scale.

$$\text{Least count of screw gauge} = \frac{\text{Pitch}}{\text{number of divisions on circular scale}}$$

Pitch: The distance between two consecutive threads taken parallel to its axis is called the pitch of the screw. It is a distance through which the screw moves forward or backward when one full rotation is given to the screw cap.
1. Find out distance moved on main scale for known number of rotation of circular scale. Find out distance traveled on main/pitch scale for one rotation of circular/head scale. This will provide you the pitch.
2. Find out the total number of divisions on circular scale.
3. Determine the ratio of pitch and total number of divisions on circular scale. This ratio is called as least count of the screw gauge.

Example: if distance traveled on main scale is 1mm for one rotation of circular scale and there are 100 divisions on circular scale then,
Pitch=1mm=0.1cm
Total number of divisions on circular scale=100
Least count of screw gauge=0.1/100=0.001cm

B. Checking of Zero error: The Screw gauge is checked to find whether there is any initial (zero) error in the instrument or not. If there is any initial error, suitable correction is to be made. Bring the studs A and B to touch each other with help of ratchet.
1. If the zero of the head scale lies on the pitch/main scale index line (I.L), the instrument has no error.
2. If the zero of the head scale is above the index line, it has negative error. So the zero correction is positive.
3. If the zero of the head scale is below the index line, it has positive error. So the zero correction is negative.
The type of error (ZE) and the suitable zero correction (ZC) for the given micrometer is determined with the help of fig.2.

C. Measurement:

1. Place the given wire gently in between the two studs A and B and rotate the ratchet till the wire is firmly but gently gripped.
2. Note the number of completed divisions in mm or cm on the main/pitch scale. This will give you main scale reading.
3. Note the reading on the circular/head scale against the index/reference line on the main/pitch scale. This will give you circular scale reading.
4. Multiply circular scale reading with the least count and add it to main scale reading. This will provide you un-corrected diameter of wire.
5. Repeat steps 1-4 minimum three times by griping the wire at different places.
6. Now turn the wire through 90^0 and again follow the steps 1-5.
7. Find the mean value of different readings.
8. Obtain the correct value of the diameter by applying correction.

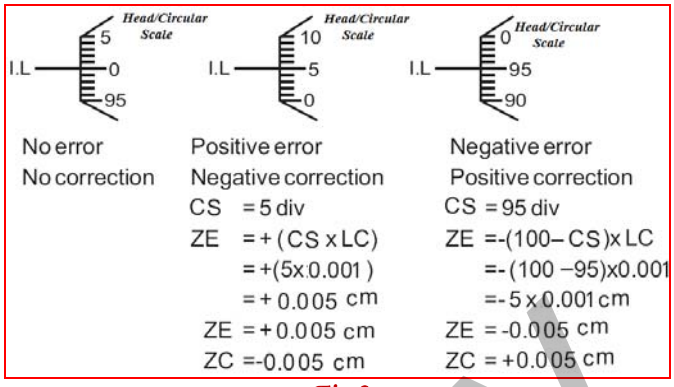

Fig.2

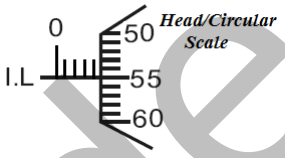

Fig.3

Example: *Suppose, pitch of screw gauge is 0.1cm and least count is 0.001cm. Assume 55th division of circular/head scale coincides with the index/reference line of pitch scale while the number of completed division on main/pitch scale is 4 (Fig.3). This means that the diameter of the wire is more than 0.4 cm and less than 0.5 cm. Now main scale reading will be 0.4cm and circular scale reading will be 55. Now un-corrected diameter will be,* d= M.S. + C.S. x L.C. = 0.4 + 55 x 0.001=0.455 cm

If there is 0.004cm of positive error in screw gauge then correct diameter will be: D=d+ZC=d-ZE=0.455-0.004=0.451cm

Observations-

1. Pitch =…..cm
2. Total number of divisions on circular scale=……..
3. Least count of screw gauge (LC)= ……..cm
4. Zero error (ZE)=……..cm
5. ***Table for diameter* (D) *of wire***

Sr. no.	M.S. (cm)	C.S. (div)	un-corrected diameter (d= MS + CS x LC) (cm)	Mean un-corrected diameter (d: cm)	corrected diameter (D=d± zero error) (cm)
1.					
2.					
3.					
4.					
5.					
6.					

Calculation: D = ……cm, r=D/2=…..cm

Result: The radius of wire = ……cm

Precautions:

1. The circular scale should be rotated in the same direction to avoid backlash error.
2. There should be no undue pressure on the wire. Rotate the circular scale and stop when one click is heard on the ratchet arrangement.
3. Measure diameter in two perpendicular directions by turning the wire by 90^0.