Experiment Title: Comparison of Microscope and Screw Gauge Readings

Objective

To compare the accuracy and precision of measurements using a moving microscope and a screw gauge by measuring the thickness of a wire.

Apparatus Required

- Moving microscope with inbuilt main scale and Vernier scale.
- Screw Gauge.
- Wire (thin metallic or non-metallic wire).

Theory

1. **Screw Gauge:**
    - Least Count = Pitch / Number of divisions on the circular scale.
    - Measures small dimensions (e.g., thickness) with high precision, typically to 0.01 mm.
2. **Moving Microscope:**
    - Equipped with an inbuilt linear scale (main scale) and Vernier scale for precise measurements.
    - Least Count = Value of one main scale division - Value of one Vernier scale division.
    - Works by focusing on the object and measuring the displacement of the microscope stage while focusing different edges of the object.

Procedure

Using Screw Gauge

1. Measure the pitch and determine the least count of the screw gauge.
2. Place the wire between the anvil and spindle of the screw gauge.
3. Rotate the thimble until the wire is gently but firmly clamped.
4. Record the main scale and circular scale readings.
5. Repeat the measurements at least three times and calculate the average thickness.

Using Moving Microscope

1. Determine the least count of the microscope:

$$\text{Least Count} = \frac{\text{Value of one main scale division}}{\text{Number of Vernier scale divisions}}$$

2. Place the wire under the microscope and adjust the focus to view the top edge of the wire against the inbuilt scale.
3. Note the initial reading (position of the microscope) using the main scale and Vernier scale.
4. Move the microscope to focus on the bottom edge of the wire and note the final reading.
5. Calculate the thickness as the difference between the two readings.
6. Repeat the measurements at least three times and calculate the average thickness.

Observations

Using Screw Gauge

- Least Count = ... mm

zero coincidence = ...
zero error = ...
zero correction = ...

Trial	**Main Scale Reading (mm)**	**Corrected HSR**	**MSR + HSR × LC**
1			
2			
3			

Average Thickness (mm): ...

Using Moving Microscope

- Least Count = ... mm

Trial	**Initial Reading**			**Final Reading**			**Thickness**
	MSR (mm)	**VSR**	**Total (mm)**	**MSR (mm)**	**VSR**	**Total (mm)**	
1							
2							
3							
⋮							

Average Thickness (mm): ...

1 Error Analysis

For a set of measurements we estimate the error of the measured value using standard deviation σ which is nothing but

$$\sigma_x = \sqrt{\overline{(x_i - \overline{x})^2}} \tag{1}$$

1.1 Error associated with measurment using Microscope

... .

1.2 Error associated with measurement using Scre Gauge

Calculations

- Least count of the screw gauge and moving microscope.
- Error analysis and comparison of precision.

Result

1. The screw gauge provides a highly precise measurement for the thickness of the wire.
2. The moving microscope is also precise, with a slightly different method of measurement, depending on the least count of its scales.

Conclusion

- The screw gauge is a direct and reliable tool for measuring small dimensions.
- The moving microscope, while slightly more complex, offers high precision for measurements involving focus and displacement.

Precautions

- Ensure zero error correction is applied for the screw gauge.
- Avoid parallax error while taking readings from the microscope scales.
- Handle the microscope and screw gauge carefully to prevent damage.