Table of Contents

1. Scope 2
2. Objective 2
3. Definitions 2
4. Responsibility 3
5. Procedure 4
6. Precautions 12
7. References 12
8. Appendices 13
9. Revision History 13
1. Scope

This Standard Operating Procedure (SOP) applies to the staff and students using the Draper® External Micrometer in the laboratories of the Pharmacy Department, University of Malta.

2. Objective

To describe the procedure for the operation, calibration and maintenance of the Draper® External Micrometer.

3. Definitions

3.1. Adjusting Wrench: Contains two small protrusions used to appropriately adjust the barrel and the ratchet through their two small orifices.

3.2. Anvil: The fixed portion on which the object to be measured rests against when the spindle moves towards it.

3.3. Barrel: The stationary round part of the micrometer that contains the linear scale. This scale is divided into 25mm divisions that are separated from further subdivisions of ½ mm each by the reference line.

3.4. External Micrometer: An instrument that accurately measures the outside diameter, length and thickness of small objects. The measured size of the object to be measured is the distance between the spindle and the anvil when they are just in contact with the sides of the object.

3.5. Frame: Holds the anvil and the spindle in constant relation to each other.

3.6. Heat Isolation Plate: Prevents heat transfer from the hands of the operator to the micrometer.

3.7. Lead Error: The difference between the actual value of the gauge block and the observed reading during the calibration process.
3.8. **Lock Nut:** A device to lock the spindle in its exact position allowing correct readings to be taken without altering the distance between the two measuring faces, thus retaining perfect alignment.

3.9. **Primary Pointer:** The zero mark on the thimble scale. When this lines up with the central reference line of the barrel scale, the distance between the anvil and the spindle is exactly an integral or a half-integral number of millimetres.

3.10. **Ratchet:** Allows the instrument to have “just enough” torque to rotate the thimble in a gentle manner thus preventing damage to the spindle/anvil mechanism and to the object being measured. This also prevents inaccurate readings from being obtained since the micrometer will not continue to advance once sufficient resistance is encountered.

3.11. **Spindle:** Moves towards the object to be measured to hold it in place as the ratchet is rotated.

3.12. **Thimble:** The rotating part of the micrometer that contains the fine scale. This scale is divided into 50 divisions where each division represents 0.01mm (i.e. one revolution equals 0.5mm).

3.13. **Zero Point Alignment:** When the primary pointer on the thimble scale is in line with the reference line of the barrel scale whenever the spindle is rotated until it makes contact with the anvil.

4. **Responsibility**

4.1. The members of the Department of Pharmacy (staff and students) are responsible for following this SOP.

4.2. The designated Laboratory Officer or Laboratory Assistant is responsible for ensuring that this SOP is followed.
5. Procedure

5.1. Diagram of an External Micrometer

5.2. Operation

5.2.1. Keep the micrometer in stable room temperature before starting the measuring process.
5.2.2. Hold the micrometer from its heat isolation plate.
5.2.3. Rotate the ratchet anticlockwise allowing sufficient space between the anvil and the spindle to accommodate the object to be measured.
5.2.4. Place the object to be measured between the anvil and the spindle.
5.2.5. Spin the ratchet clockwise until the spindle just meets the object.
5.2.6. Keep spinning the ratchet gently until 3 clicks are heard.
5.2.7. Check that both the anvil and the spindle are touching the object evenly.
5.2.8. Set the lock nut while the micrometer is still on the object.
5.2.9. Remove the object from the micrometer.
5.2.10. Read off the value from the barrel scale to obtain reading to the nearest half millimetre.
5.2.11. Read off the value from the thimble scale that is parallel with the reference line of the barrel scale.
5.2.12. Add both values obtained from 5.2.10. and 5.2.11. to obtain the total measurement reading.
5.2.13. Micrometer reading example

**EXAMPLE 1**

Barrel scale reads = 12.50mm  
Thimble scale reads = 0.16mm  
**Total Measurement** = 12.66mm

**EXAMPLE 2**

Barrel scale reads = 16.00mm  
Thimble scale reads = 0.355mm  
**Total Measurement** = 16.355mm

5.2.14. Reset the lock nut to the unlock position.
5.2.15. Turn the ratchet clockwise to slightly close the micrometer prior to its storage.

5.3. **Calibration**

5.3.1. Obtain standard gauge blocks.
5.3.2. Keep the micrometer in stable room temperature before starting the calibration process.
5.3.3. Hold the micrometer from its heat isolation plate.
5.3.4. Move the spindle towards the anvil until they make contact to check that the primary pointer on the thimble scale is in line with the reference line of the barrel scale. If not so, use the adjusting wrench to achieve this zero point alignment.
5.3.5. Spin the ratchet anticlockwise until enough space is present between the anvil and the spindle to accomodate the gauge block.
5.3.6. Place the gauge block between the anvil and the spindle.
5.3.7. Spin the ratchet clockwise until the spindle just meets the gauge block.
5.3.8. Keep spinning the ratchet gently until 3 clicks are heard.
5.3.9. Check that both anvil and spindle are touching the gauge block evenly.
5.3.10. Set the lock nut while the micrometer is still on the gauge block.

5.3.11. Read off the value from the barrel scale to obtain a reading to the nearest half millimetre.

5.3.12. Read off the value from the thimble scale that is parallel with the reference line of the barrel scale.

5.3.13. Add both values obtained from 5.3.11. and 5.3.12. to obtain the total measurement reading.

5.3.14. Compare the reading obtained with the actual value of the gauge block to determine whether a lead error exists.

5.3.15. Repeat the calibration procedure with different successive gauge blocks to calibrate the micrometer at several points throughout its range.

If reading varies by more than +/- 0.0003mm to 0.0005mm:

5.3.16. Record this lead error.

5.3.17. Compensate any readings obtained with the micrometer by this relevant lead error if micrometer cannot be immediately replaced or repaired.

5.4. Maintenance

5.4.1. Inspect the micrometer for any signs of damage, such as indications that it might have been dropped.

5.4.2. Check that both spindle and anvil tips are flat, free from scratches, dents and chipped edges.

5.4.3. Move the thimble through its entire range (i.e. 25mm) to check that it moves smoothly.

5.4.4. Perform the zero point alignment test (see 5.3.4).

To clean the tips of the anvil and the spindle:

5.4.5. Rub off any visible dirt, dust and grit with a lint free cloth.

5.4.6. Close the micrometer all the way with a piece of paper clamped in between.

5.4.7. Pull the paper out whilst rubbing the tips of the spindle and the anvil clean.
5.5. Average time taken to carry out Procedure

<table>
<thead>
<tr>
<th>Procedure Section</th>
<th>Average Time (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>1.5 (for one measurement)</td>
</tr>
<tr>
<td>Calibration</td>
<td>2 (for one-point calibration)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>N/A</td>
</tr>
</tbody>
</table>

5.6. Flow Charts

5.6.1. Operation

Start

Keep micrometer in stable room temperature before starting measuring process

Hold micrometer from its heat isolation plate

Rotate ratchet anticlockwise allowing sufficient space between anvil and spindle to accommodate object to be measured

Place object to be measured between anvil and spindle

Spin ratchet clockwise until spindle just meets object

Keep spinning ratchet gently until 3 clicks are heard

Check that both anvil and spindle are touching object evenly

Set lock nut
1. Remove object from micrometer
2. Read off value from barrel scale to obtain a reading to the nearest half millimetre
3. Read off value from thimble scale that is parallel with reference line of barrel scale
4. Add up values obtained from the barrel and thimble scales respectively to obtain total measurement reading
5. Reset lock nut to the unlock position
6. Turn ratchet clockwise to slightly close micrometer prior to its storage

End
5.6.2. Calibration

Start

Obtain standard gauge blocks

Keep micrometer in stable room temperature before starting calibration

Hold micrometer from its heat isolation plate

Move spindle towards anvil until they make contact with each other

Primary pointer on thimble scale in line with reference line of barrel scale

Yes

Spin ratchet anticlockwise until enough space is present between anvil and spindle to accommodate gauge block

Place desired gauge block between anvil and spindle

Spin ratchet clockwise until spindle just meets gauge block

Continue to gently spin ratchet until 3 clicks are heard

Check that both anvil and spindle are touching gauge block evenly

Set lock nut

No

Use adjusting wrench to adjust barrel until this is achieved
1. Read off value from barrel scale to obtain reading to the nearest half millimetre.

2. Read off value from thimble scale that is parallel with reference line of barrel scale.

3. Add up values obtained from the barrel and thimble scales respectively to obtain total measurement reading.

4. Compare reading obtained with actual value of gauge block.

   - If reading varies by > +/- 0.0003mm to 0.0005mm, go to step 2.
   - If reading does not vary, go to step 5.

5. Record this lead error.

6. Can micrometer be immediately changed or repaired?
   - If yes, stop.
   - If no, go to step 7.

7. Compensate any readings obtained with micrometer with this relevant lead error.

8. Repeat calibration with different gauge block/s.
   - If yes, stop.
   - If no, start again from step 1.

End.
5.6.3. Maintenance

Start

Inspect micrometer for any signs of damage

Check that both spindle and anvil tips are flat, free from scratches, dents and chipped edges

Move thimble through its entire range to check that it moves smoothly

Move spindle towards anvil until they make contact with each other

Primary pointer on thimble scale in line with reference line of barrel scale

Yes

Tips of anvil and/or spindle need/s cleaning

Yes

Rub off any visible dirt, dust and grit with a lint free cloth

Close micrometer all the way with a piece of paper clamped in between

Pull paper out whilst rubbing tips of spindle and anvil clean

End

No

No

Use adjusting wrench to adjust barrel until this is achieved

End
6. Precautions

6.1. The micrometer is a highly heat sensitive instrument and should be stored at room temperature.

6.2. Hold the micrometer from its heat isolation plate whilst handling to prevent heat transfer from hand of user to the micrometer.

6.3. The object to be measured should also be kept at room temperature since this may also affect the reading.

6.4. Do not overtighten the micrometer as this can lead to deformation of both the anvil and spindle and the object being measured.

6.5. Store the micrometer in its appropriate storage compartment to prevent any wearing of the anvil and/or spindle.

6.6. Store the micrometer with the anvil and spindle not in contact with each other so that any temperature fluctuations will not stress the instrument.

6.7. Measure the desired object a number of times to ensure that the reading obtained is accurate.

6.8. Do not operate abruptly, drop or strike the micrometer.

7. References


8. Appendices

N/A

9. Revision History

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Amendments/ Reasons for change</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Initial Release</td>
</tr>
</tbody>
</table>