Abstract:

In this experiment three linear measurement devices; namely, Vernier Caliper, Micrometer screw gauge and Depth-gauge micrometer were used for measuring different dimentionsof objects according to the use and application suited for each device.

Vernier caliper was used to measure the inner and outer diameter of the specimen with an uncertainity of $\pm$ 0.01 mm

Micrometer screw gauge was also used to measure the outer diameter of the specimen with an uncertainity of $\pm$ 0.005 mm ie higher accuracy the the vernier caliper

Micrometer screw gauge can not be used to measure large diameter specimens due to small range of readings available corresponding to its size

Depth-gauge micrometer was used for measuring the depth of the specimen

Dial-caliper was not used or tested because of the device damage

Objectives:

1- Learn to use different linear measuring devices: micrometer screw gauge, vernier caliper, and depth gauge micrometer for linear measurment
2- Investigate the measurment application each device is suited for use with and accuracy limit given by each device

Compare accuracy

Nomenclature

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Apparatus :

1. The work piece :

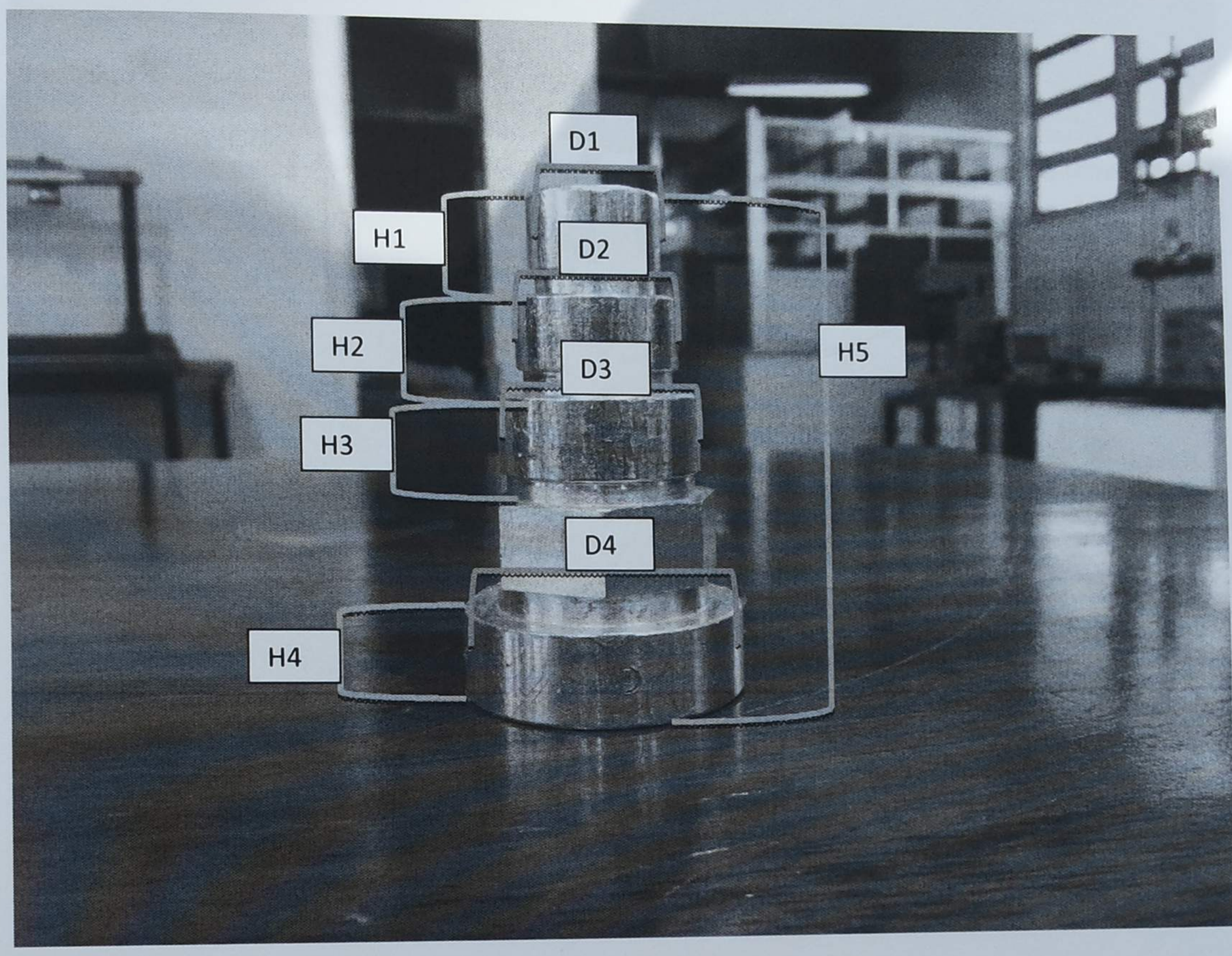

Figure 1: The work piece.

General Procedure:

1- Micrometer was used to measure the outer diameters of the specimen.
2- Depth gauge micrometer was used to measure different depth of the specimen.
3- Vernier caliper was used to measure the outer, inner diameters and different depth of the specimen.

what is this workpiece explain

2. Micrometer :

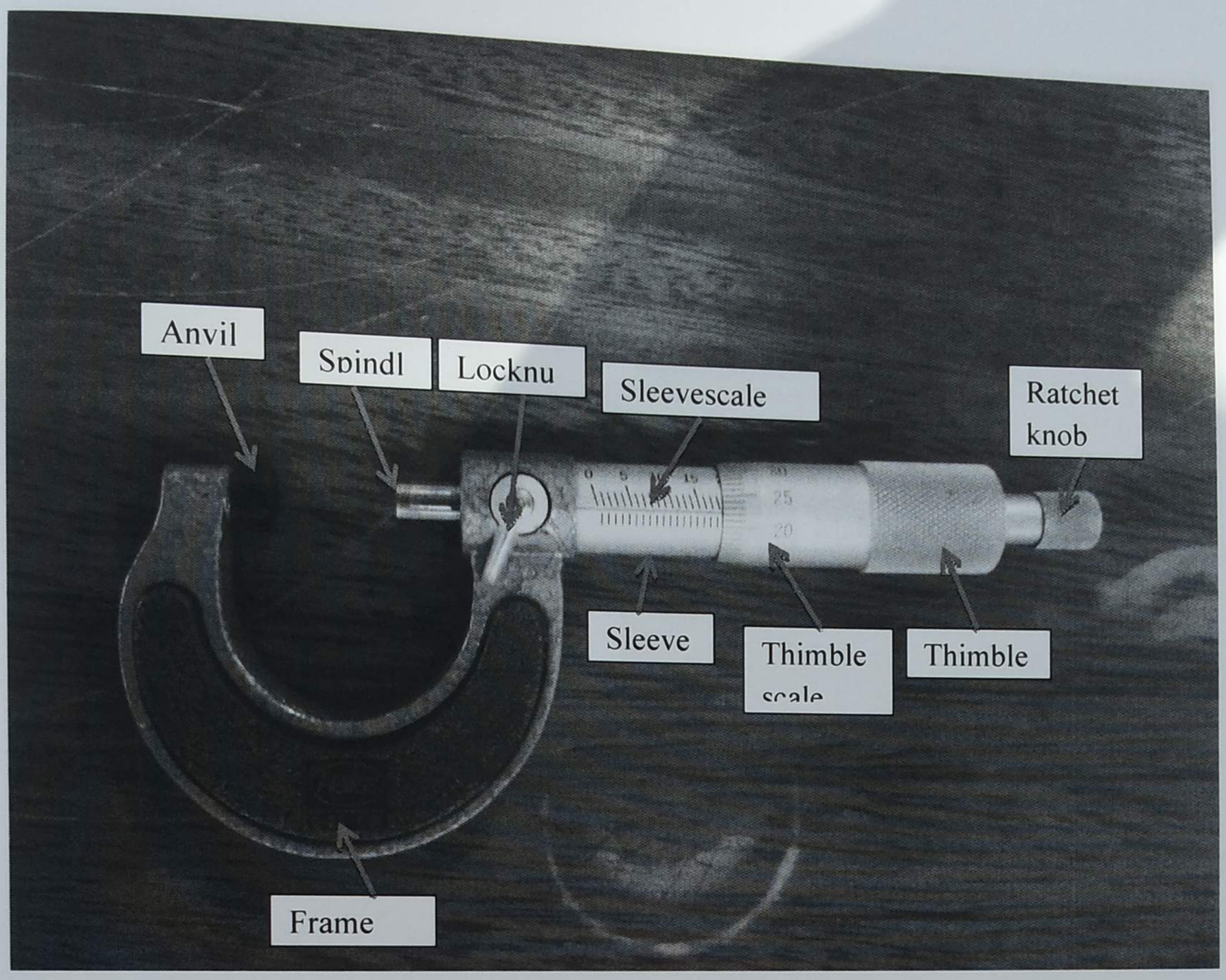

Figure 2: the micrometer.

How to use it :

- Close the spindle on the work piece using the thimble and the ratchet knob is used to make sure that the spindle touch the surface of the piece .
- Take the reading on the sleeve scale and write it down .
- Take the reading on the thimble scale (the reading that is on the parallel line of the sleeve scale) and multiply it with the proper scale .
- sum the two readings to get the quantity measured .

3. The vernier caliper :

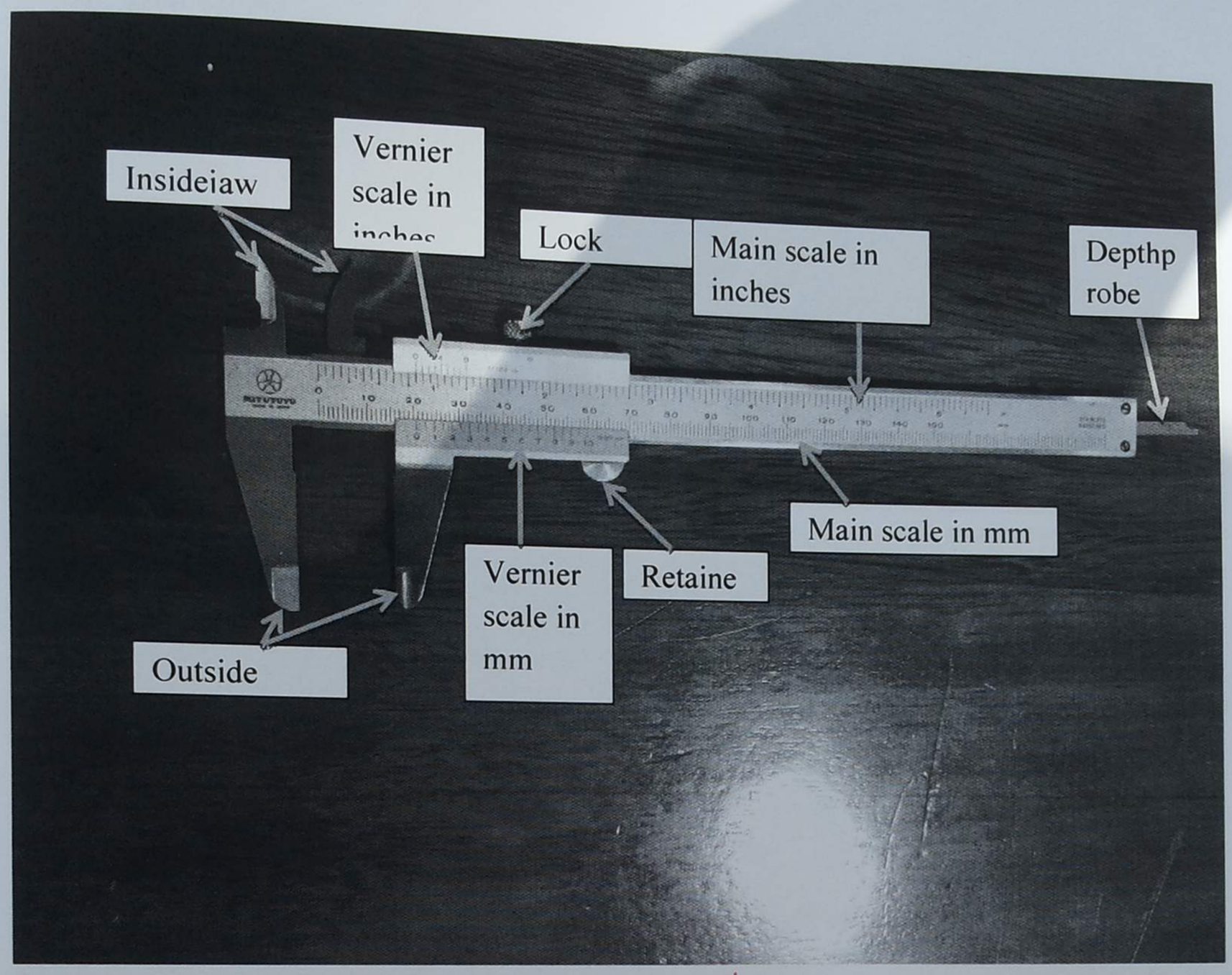

Figure 3: the verniercaliper .

How to use it :

- Put the object between the caliper jaws .
- Close them slowly on it to avoid any damage it the object.
- Tit the lock screw and make sure the caliper is just touches the surface then take it away from the object .
- Write the main scale reading in the proper dimension needed.
- Write the vernier scale reading and multiply it by the scale of the vernier .
- Sum the two readings together to get the wanted quantity .

4. Dial caliper :

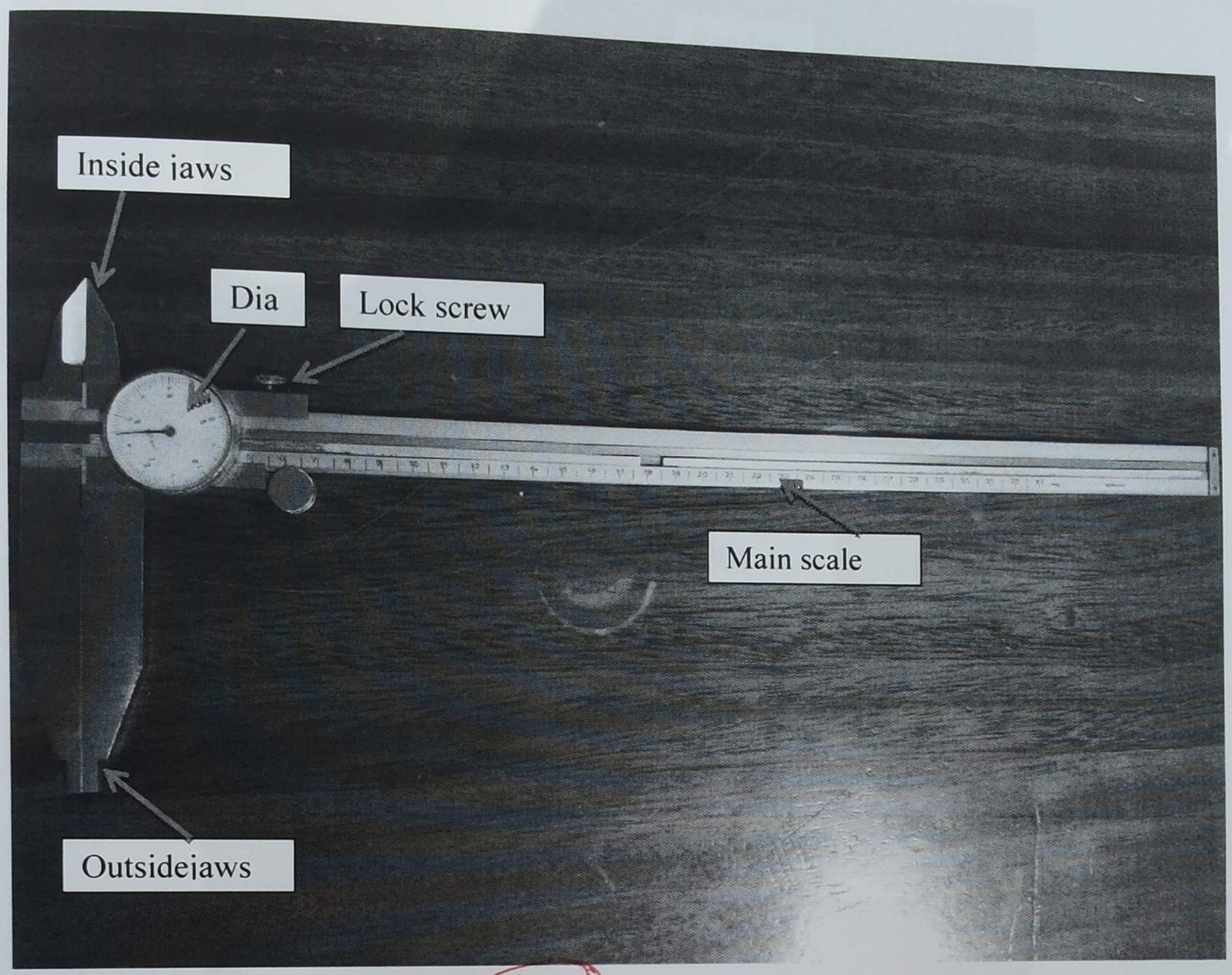

Figure4: the dial caliper .

How to use it :

- Place the object between the caliper jaws.
- Close it gently on it .
- Make sure the axis of the object is perpendicular to the caliper.
- Write the main scale reading and the dial reading (multiply it with the scale used).
- Sum the two reading to get the measured quantity .

5. Depth gauge micrometer:

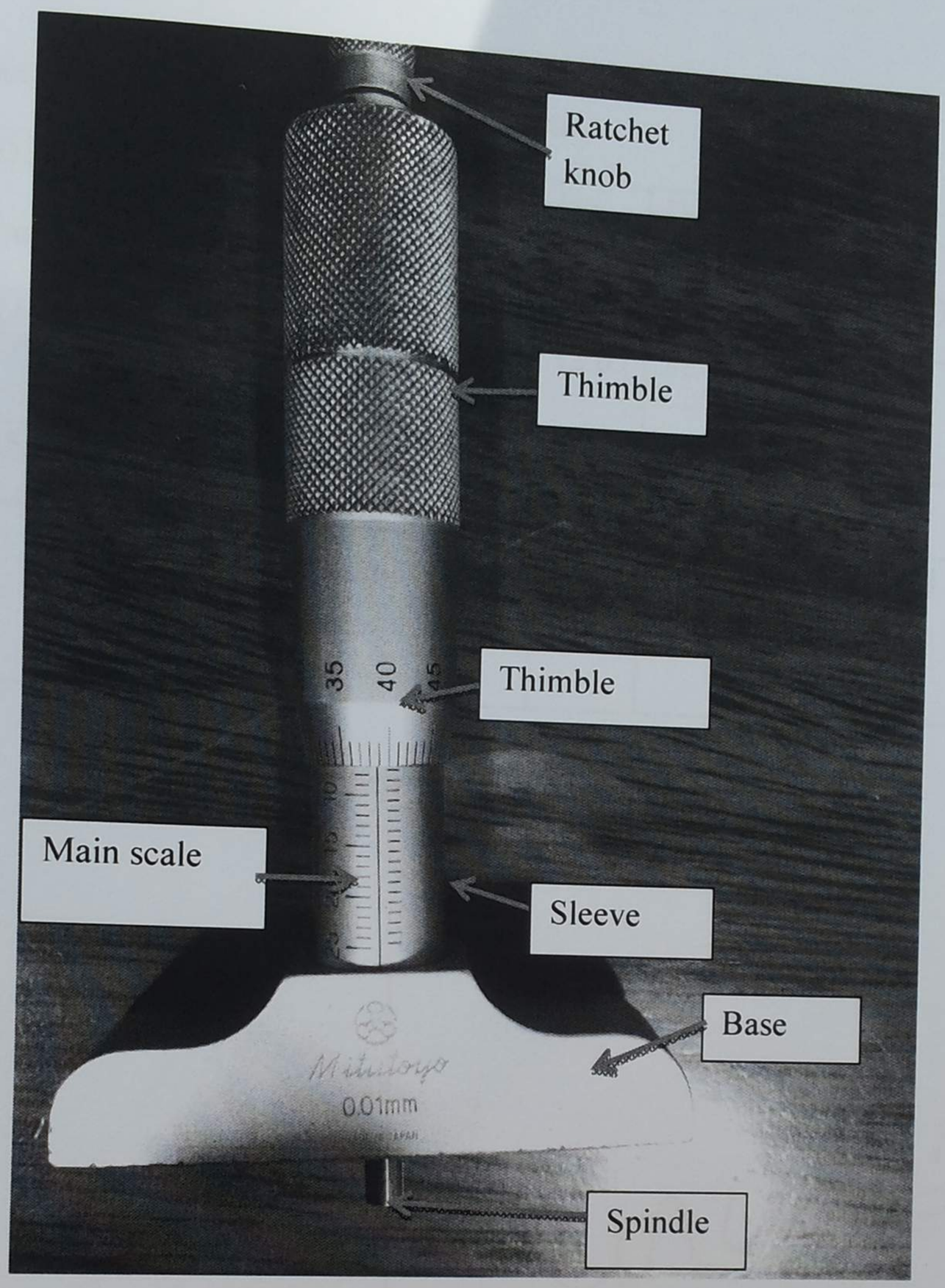

Figure 5: the depth gauge micrometer.

How to use :

- Put the work piece on the base of the depth micrometer.
- Turn the thimble until the spindle reach the surface of the work piece that its depth is to be measured .
- Take the reading on the main and the thimble (multiply it by the scale) scales.
- Sum the two readings to get the needed quantity.

Data observed :

Table (1): Data observed from different instruments .

Measuring instrument	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	Da (mm)	Db (mm)	Dc (mm)	Dd (mm)	H1 (mm)	H2 (mm)	H3 (mm)	H4 (mm)	H5 (mm)
Vernier caliper	20	24.2	30.3	42.45	8.5	8.5	12.05	21.7	15	14.1	14.2	13.2	73
Micrometer	21.43	25.18	30.21	42.29	-	-	-	-	-	-	-	-	-
depth gauge micrometer	-	-	-	-	-	-	-	-	14.88	13.31	14.55	12.51	72.42

unused space !!

sample of calculation

measuring the small outer daimeter of the specimen (D1) by:

First : micrometer

calculate the accuracy of micrometer

$$\text{accuracy} = \frac{\text{smallest division on the main scale}}{\text{number of division on thimble scale}}$$

$$= \frac{0.5}{50}$$

$$= 0.01$$

now

D1 = main reading + accuracy * thimble reading

$$= 21 + (0.01)(43)$$

$$= 21.43 \text{ mm}$$

next : using vernier caliber

calculate the accuracy of vernier caliber

$$\text{accuracy} = \frac{\text{smallest division on the main scale}}{\text{number of division on the vernier scale}}$$

$$= \frac{1}{20}$$

$$= 0.05$$

now

D1 = main reading + accuracy * number of division at which vernierscale is lined up with main scale

$$= 20 + 0(0.05)$$

$$= 20 \text{ mm}$$

measuring the first depth of the specimen (H1) by

first : vernier caliber

calculate the accuracy of vernier caliber

$$\text{accuracy} = \frac{\text{smallest division on the main scale}}{\text{number of division on the vernier scale}}$$

$$= \frac{1}{20}$$

$$= 0.05$$

now

$H1$ = main reading + accuracy * number of division at which vernier scale is lined up with main scale

$= 15 + 0.05(0)$

$= 15\ mm$

next : using depth gauge micrometer

calculate the accuracy of depth gauge micrometer

$$\text{accuracy} = \frac{\text{smallest division on the main scale}}{\text{number of division on the vernier scale}}$$

$$= \frac{0.5}{50}$$

$$= 0.01$$

now

$H1$ = main reading + accuracy * vernier reading

$= 14.5 + 38(0.01)$

$= 14.88\ mm$

Results and discussion:

Caliper:

1. Dose the caliper conform to abbe's principle of alignment?

Vernier caliper does not conform because the graduations are not on the same axis as the measurement.

2. Calculate the error of a vernier caliper?

The reading error =least count of main scale/ number of divisions on vernier scale.

=1 mm/20 = 0.05 mm

3. What is the function of the sliding blade of the caliper?

It slides so we can open the jaws of the caliper as wide as the distance measured thus changing the place of the pointer to take a reading as well as moving the varinier scale.

4. What is a direct reading instrument, dose it apply on calipers?

Instrument calibrated so that a given quantity to be measured can be read directly off the scale without the need of a multiplying constant, and the caliper is one of these direct reading instruments.

5. What are the sources of error in reading?

1- The vernier is not set at zero when it's closed. (zero error)

2- Misalignment of the measured object.

3- Thermal expansion caused by temperature deference between the caliper and the work piece.

6. What could happen if the locking screw is not used when measuring a distance with the vernier caliper?

It used to lock the caliper at a desired measurement so that you can compare measurements easily, so if it not exists we will measure a fault distance because of the ability of the caliper to move.

7. Is the reading taken from a caliper in an inside measurement of an object is final? In this case is a caliper considered to be comparator?

No, so it is not considered a comparator.

8. Is the vernier line standard or end standard?

   Line standard.

9. What are the advantages of caliper over micrometer?

A vernier caliper is easy to use, quick, simple to operate, used for long measurement range and used to measure inside, outside length and depth in one instrument. But micrometer is a one device for one purpose.

Micrometer:

1. How many screw threads are in each micrometer?

The spindle of an ordinary metric has 2 threads per millimeter, and thus one complete revolution moves the spindle through a distance of 0.5 millimeter.

2. Does the external micrometer obey the abbe's principle?

Yes. micrometer conforms to abbe's principle because the graduations are located along the same axis as the measurement.

3. What is the total length approached by moving barrel when it rotates a complete rotation?

   0.50 mm

4. Over tightening the micrometer, will only do damage to the micrometer, or any other gage you may be using. Explain?

It will damage the screw threads and the nut threads and thus not moving properly and giving more error in the readings.

5. Can this micro. Be used as comparator?

   Yes it can be used as comparator.

6. The accuracy of the micrometer depends on the accuracy of the screw threads, Explain?

The accuracy of the micrometer will be governed primarily by the following two factors:

The degree of calibration of the spindle movement, which will be affected by the lead errors of the screw; the effect is a usually cumulative, and increase the length of the spindle travel.

7. What are the factors governing the estimated reading?

The accuracy of a micrometer is derived from several fundamental factors. The most significant factors are:

1- Thread accuracy
2- Flatness of measuring faces.
3- Parallelism between the faces
4- Rigidity of the frame which holds anvil and spindle

8. What are the sources of error in reading in micrometer?
   1- The anvils may not be truly flat.
   2- Lack of parallelism of anvils at some or at parts of the scale.
   3- Setting of zero reading may be inaccurate.
   4- Inaccurate reading following the zero
   5- Inaccurate reading shown by fractional division on the thimble
   6- Wearing in the threads.
   7- Tightening the screw too much.

9. Is the spindle rotating or non-rotating type?

   Non-rotating spindle.

Summery and conclusion:

In this experiment three different measurement tools were used: vernier caliper, micrometer and depth gauge micrometer.

Vernier caliper was used to measure the inner and outer diameter and the depth of the specimen.

Micrometer was also used to measure the outer diameter but with high accuracy.

Micrometer cannot measure large diameters (micrometer has small range of readings) .

Depth gauge micrometer was also used to measure the depth of the specimen.

Dial caliper was not used because it was damage.

Source of error:

1-misalignment of the specimen when using micrometer.

2-the lock of the micrometer was missing and that cause thimble to move and that cause change in readings.

3-the devices were not checked if calibrated correctly.

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