CMR Institute of Technology, Bangalore
DEPARTMENT OF MECHANICAL ENGINEERING
II - INTERNAL ASSESSMENT

Semester: 4-CBCS 2018 | Date: 24 Jun 2021
Subject: MECHANICAL MEASUREMENTS AND METROLOGY (18ME46B) | Time: 01:00 PM - 02:00 PM
Faculty: Mr Puneeth Kumar | Max Marks: 50

IAT # 2 Scheme & Solution

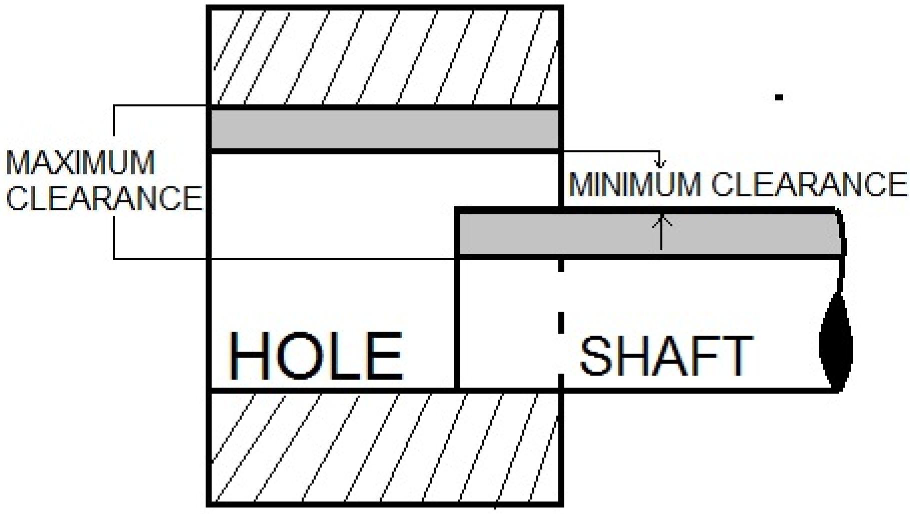
1. Name and explain briefly the different types of fit as per BIS and show them by neat schematic diagrams.

Solution: Fits are defined as how tight and loose the two components are connected. So it is a mating relationship between two components. **2M**

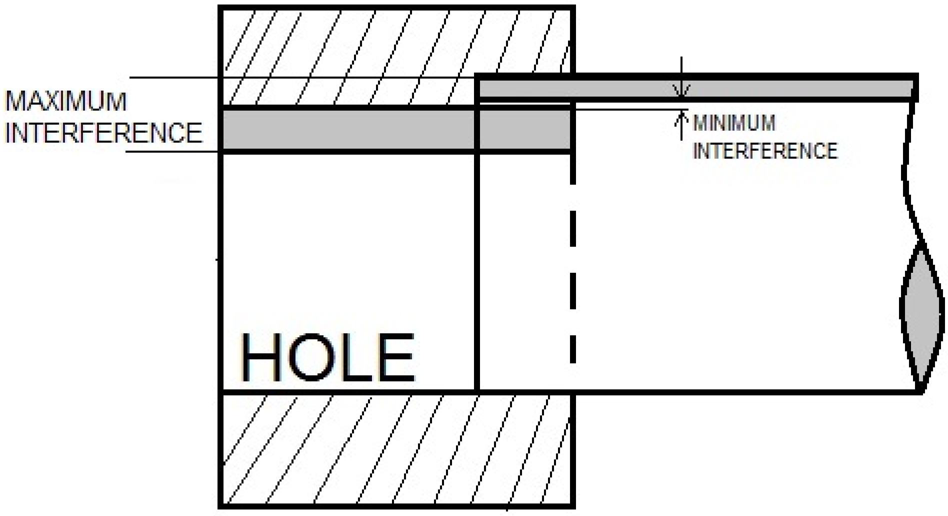
There are mainly **three types of fit** and those are:

- **Clearance Fit**
- **Interference Fit** and
- **Transition Fit** **2M**

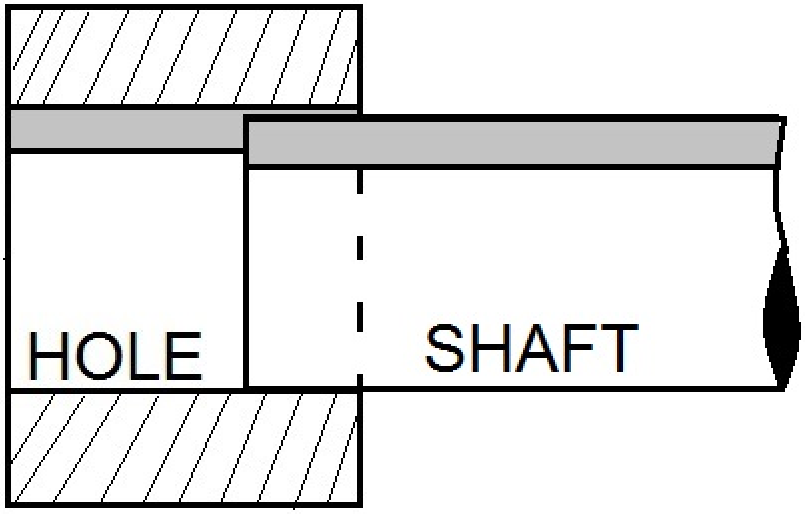
Clearance Fit: The hole is larger than the shaft and to allow the two mating parts to rotate or slide over each other, we call it as clearance fit. Clearance fit is always Positive quantity. **2M**



Interference fit: The Shaft is larger than the hole and to allow the two mating parts to rotate or slide over each other, we call it as clearance fit. To make the fits between these two, we required high force to assemble and disassemble so generally we use a hammer. Another way is by using hydraulic press we can fit the shaft into the hole. Interference fit is always negative quantity. **2M**



Transition Fit: It is also called as Push Fit. Transition fit has great precision and accurate alignment between two mating parts. Example: Shaft key. Either it can be an interference fit or clearance fit. **2M**



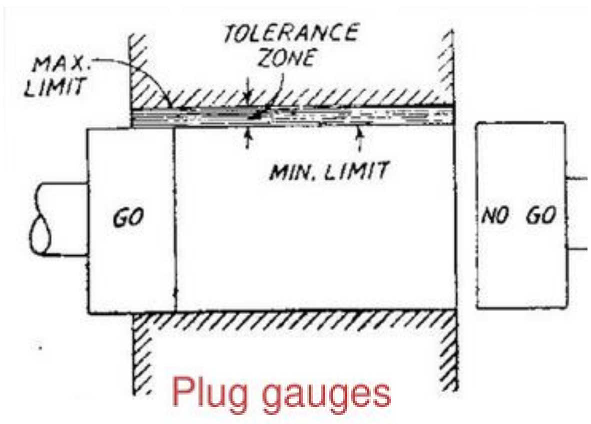
2. Illustrate the principle of GO and NOGO gauges. How the Taylor's principle is used in designing them?

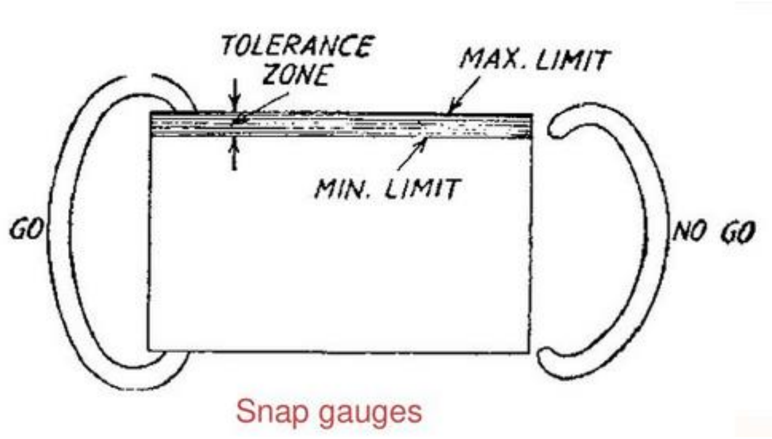
Solution: According to Taylor's principle go and no go gauges should be designated to check maximum and minimum material limit. . **2M**

- Go gauge- Limit of the two sizes which corresponds to maximum material condition.

  i.e., Upper limit of shaft and lower limit of hole.
- No Go gauge- Limit of the two sizes which corresponds to minimum material condition.

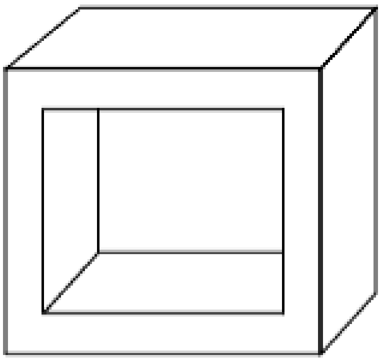
i.e., lower limit of shaft and Upper limit of hole. . **2M**

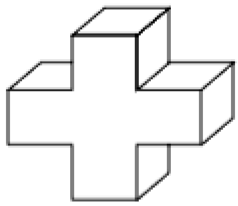




Example for Taylor's principle 4M

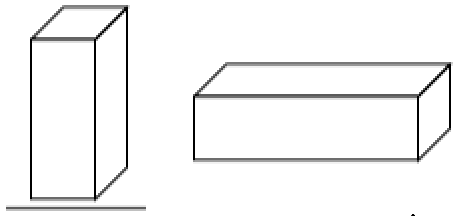
The go gauge must check the dimension as well as shape





The slot is to be checked for height and width

No go gauges must check dimension of the slot one at a time, hence two separate gauges must be used



2M

3. Explain Optical comparator with neat sketch (Zeiss ultra optimeter)

Solution:

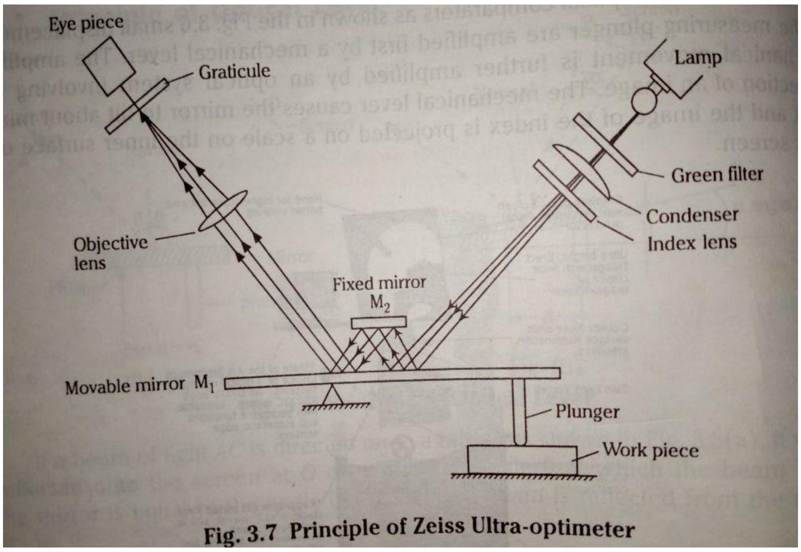


Fig. 3.7 Principle of Zeiss Ultra-optimeter

4M

Zeiss optimeter consists of:

- Light Source, green Filter, condenser, Two Reflecting Mirrors (M1, M2), plunger, objective Lens, graticule & eye piece.
- In Zeiss Ultra optimeter has two reflecting mirrors to improve the magnification.

Zeiss Ultra Optimeter Working Principle:

- The Light from the light source passes thru the green filter and condenser as shown in figure.
- The function of the Green filter is to allow only the green light and filters the remaining all colors in the light. Which cause less fatigue to eye.
- This filtered beam light passes thru the Condenser, the function of the condenser is to collect light & focus the light to the movable mirror (M1). Where the Mirror 1 is a movable mirror which is operated by the Plunger.
- The plunger is the measuring tip (Contacts to the workpiece to take the deviation). Mirror 2 (M2) is a fixed mirror.
- Once the focused light from the condenser falls on the mirror (M1) and get reflected on to the Mirror 2 (M2) and again reflected back to the Mirror 1 (M1) as shown in figure.
- Then the objective lens will collect this image and projects on to the graticule.

(Graticule is a screen is having vertical and Horizontal lines which has a precise scale on it)

- This image on the Graticule is observed by the Eye Piece and the deviation will be noted.

. **6M**

4. Design a plug and ring gauge to control the production of 90mm shaft and hole part of H8e9. Data given a) i= $0.45\sqrt[3]{D} + 0.001D$. b) The upper deviations for 'e' shaft =$-11D^{0.41}$ c) The value for standard tolerance grade IT8=25i and IT9=40i. d) 90mm lies in the diameter step of 80mm and 100mm.

Solution:

Given, 90mm H_8e_9

a. $i = 0.45\sqrt[3]{D} + 0.001D$

b. The upper deviation for 'e' shaft $= -11D^{0.41}$

c. The value for tolerance grade
IT8 = 25i and IT9 = 40i

d. 90mm lies in the dia. step of 80–100mm

$D = \sqrt{(80 \times 100)} = 89.44\text{mm}$ 1M

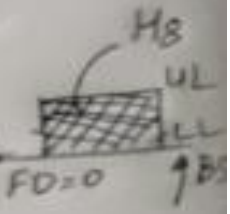
$i = 0.45\sqrt[3]{D} + 0.001D = 0.45\sqrt[3]{(89.44)} + 0.001(D)$ 1M

$i = 2.101\mu$

To find Hole limits 'H_8'

F.D for Hole H = 0

F.T for H_8 IT8 = 25i = 52.52μ
= 0.0525mm



upper limit of hole = 90+0.0525
= 90.0525mm.

Lower limit of hole = 90mm. 2M

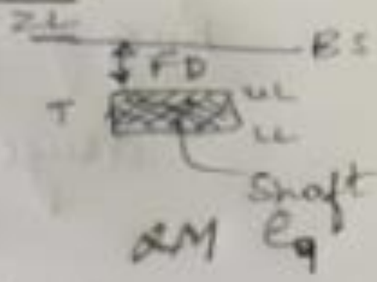
To find Shaft limits 'e_9'

F.D for Shaft $e = -11D^{0.41} = -11(89.44)^{0.41}$
$= -69.42\mu = -0.0694\text{mm}$.

$IT9 = 40i = 84.04\mu = 0.0840\text{mm}$

upper limit $= 90 - 0.069 = \underline{89.930\,mm}$

lower limit $= 90 - 0.069 - 0.0840$
$= \underline{89.846\,mm}$



2M

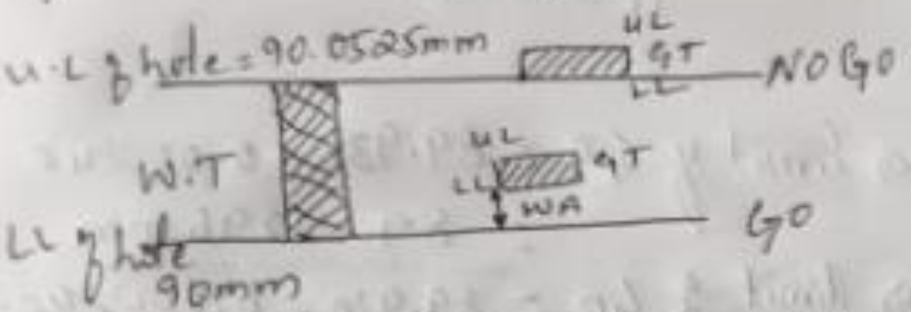
Design of Plug and Ring gauge

Plug gauge [using hole dimensions]

Gauge tolerance = 10% of work tolerance
$= 0.1 \times 0.0525 = 0.00525\,mm$

Wear allowance = 10% of GT
$= 0.1 \times 0.00525 = 0.000525\,mm.$

Go and NO Go plug limits are



upper limit of Go $= 90 + 0.000525 + 0.00525$
$= \underline{90.005775\,mm}.$

Lower limit of Go $= 90 + 0.000525$
$= \underline{90.000525\,mm}.$

upper limit of NoGo $= 90.0525 + 0.00525$
$= \underline{90.05775\,mm}.$

Lower limit of NoGo $= \underline{90.0525\,mm}.$ 2M

Ring gauge [For shaft dimensions]

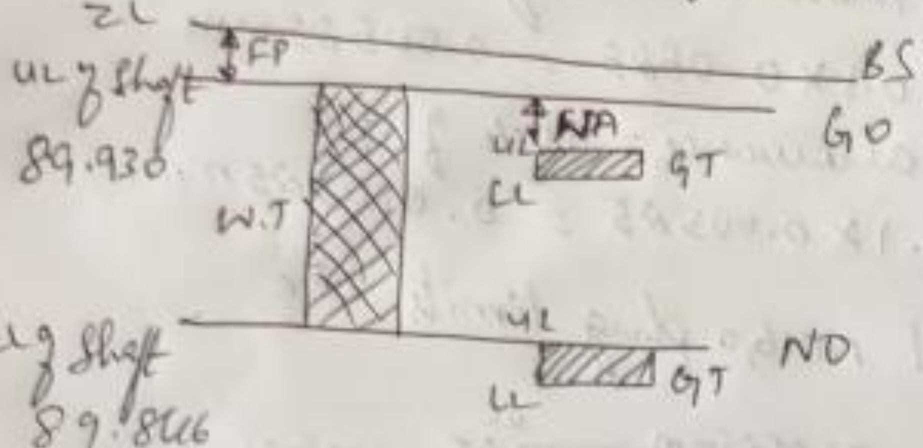
Gauge tolerance = 10% of work tolerance

= 0.1 × 0.0840 = 0.00840 mm

Wear allowance = 10% of G.T

= 0.1 × 0.00840 = 0.000840 mm.

GO and NO GO limits for Ring gauge are:



upper limit of GO = 89.930 − 0.000840

= 89.9296 mm

Lower limit of GO = 89.930 − 0.000840 − 0.00840

= 89.9207 mm.

Upper limit of NOGO = 89.846 mm

Lower limit of NOGO = 89.846 − 0.00840

= 89.837 mm. 2M

5. What are comparators? Explain Sigma comparator with neat sketch.

Solution: Comparator is an instrument used for comparing the dimensions of a component with a standard of length.

Purpose of a comparator, in general, is to detect & display the small differences b/w the unknown linear dimension & length of the standard. **2M**

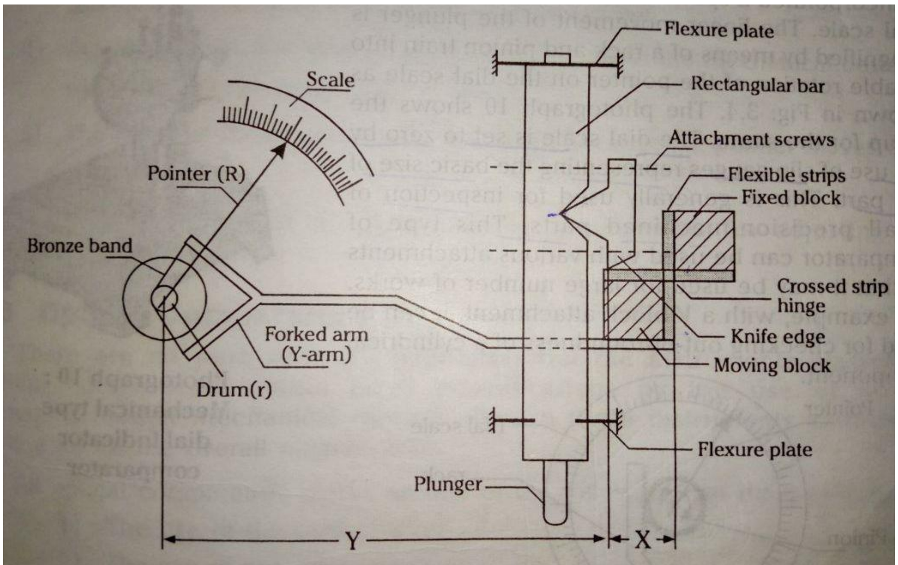


Fig. 3.3 Mechanism of Sigma Comparator

4M

➢The plunger is mounted on a pair of slit diaphragms in order to have friction less linear movement.

➢A knife edge is mounted on it and bears upon the face of the moving member of a cross strip hinge

➢The cross strip hinge consists of the moving member and a fixed member which are connected by thin flexible strips alternately at right angle to each other.

➢Once the plunger moves up, an external force is applied to the moving member, it will pivot, which cause the movement in the Y arm.

➢As the Y arm deflects, bronze band will help pointer to rotate on the scale.

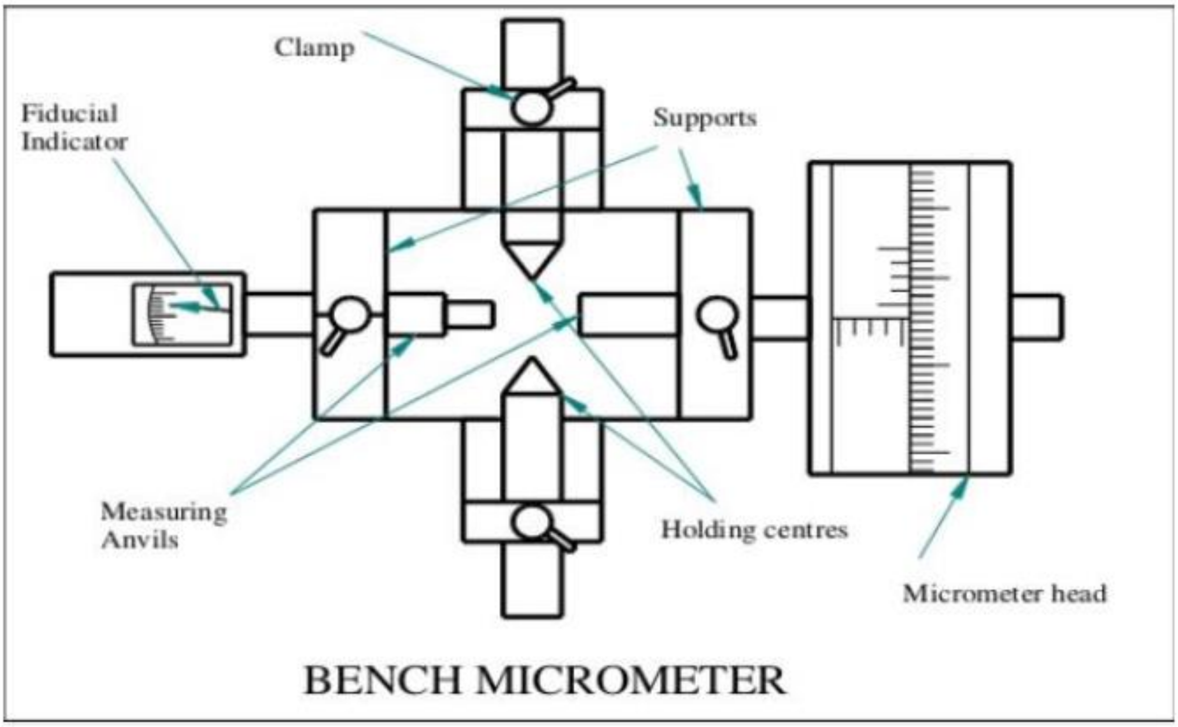
If 'b' is the length of the arm & 'a' is the distance from knife edge to hinge.
Then first stage magnification is b/a
Second stage 'R' is the pointer length & 'r' is the radius of drum, then magnification is R/r
Therefore,
Total Magnification = b/a * R/r

4M

6. Explain measurement of major and minor diameter of external thread.

Solution:

Floating carriage micrometre is used to measure major and minor diameter of the screw thread.
It is also called as bench micrometre.



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Floating carriage micrometre is used for greater accuracy for measuring the major diameter.

The fiducial indicator is used to ensure that all the measurements are made at same pressure.

A calibrated setting cylinder having approximately the same diameter as major diameter of the thread to be measured is used as setting standard.

The setting cylinder is held between the anvils and the readings of micrometres are noted then the cylinder is replaced by the threaded work piece and the new reading is noted for the same reading of fiducial indicator as in fig.

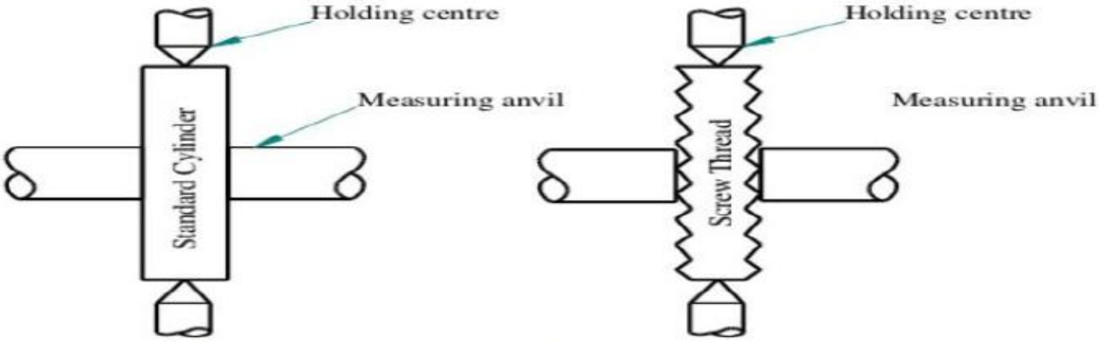
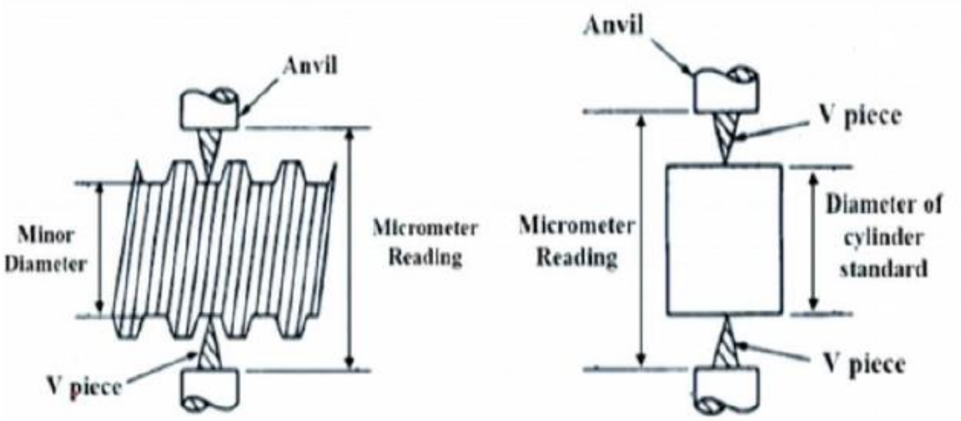


Fig – Measurement of major diameter

Major diameter = D = S ± (Rs – R)
Where,
S – Diameter of the setting cylinder
Rs – Reading over the setting cylinder
R – Reading over the Specimen

3M



Minor diameter = D = S ± (Rs – R)
Where,
S – Diameter of the setting cylinder
Rs – Reading over the setting cylinder
R – Reading over the Specimen

The threaded workpiece is mounted between the Centres of the instrument and the V pieces (prism) are placed on each side of the workpiece with their basis against the anvil of the micrometre and the micrometre reading is noted (R). Then the threaded workpiece is replaced by a standard cylinder reference and the corresponding reading Rs is taken.

3M