Comparator: A comparator is a precision instruments and it is used for comparing the component dimension with a working standard. In general, three main parts of comparater are as under:

1. Sensing devices
2. Magnification devices
3. Display unit

→ Sensing devices commonly used is a plunger or stylus senses the changes in length or flatness or any other dimensions.

→ The magnification devices are also called amplifying system. It may be mechanical, optical, pneumatic electronics etc.

→ Display unit provides suitable outputs or readings A scale or pointer is generally used as display system

Types of Comparater:-

1. Mechanical comparater
2. Electrical comparater
3. Electronic comparater
4. Optical comparater
5. Pneumatic comparater.

Mechanical Comparater

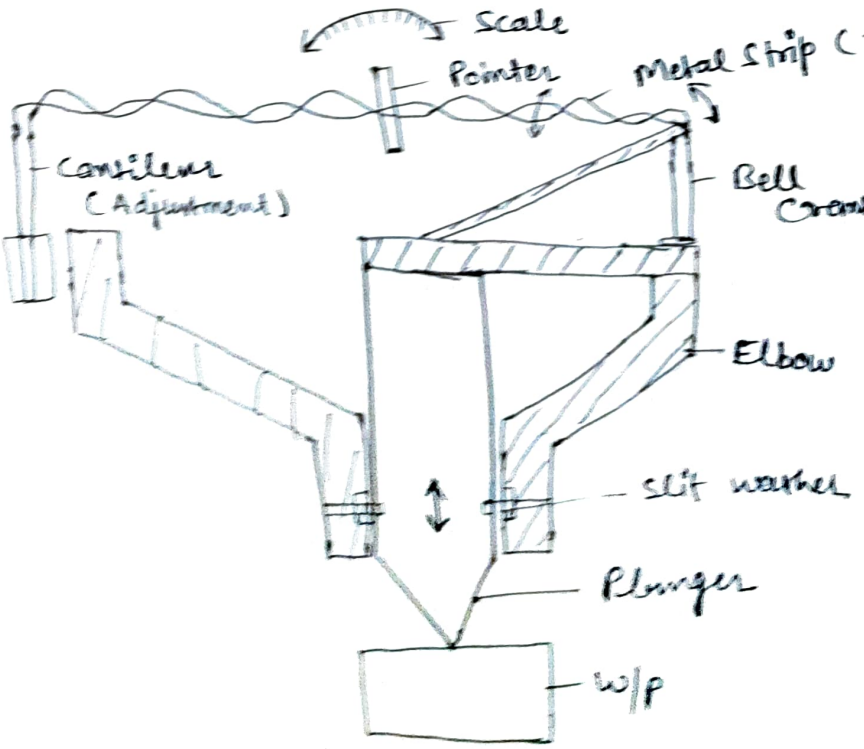
Mechanical comparater employs mechanical means for magnifying small deviation. The method of magnifying small movement of the indicater in all mechanical comparater are effected by means of lever, Gears trains or combination.

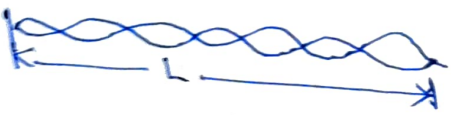
→ Used for inspection of small parts machined to close limits.

→ Types of mechanical comparater

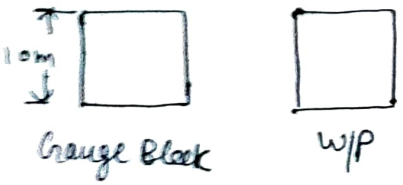
1. Dial Gauge
2. Reed type
3. Sigma Comparater
4. Lever type Comparater
5. Johnsson Mikrokator

→ Johnsson Mikrokater



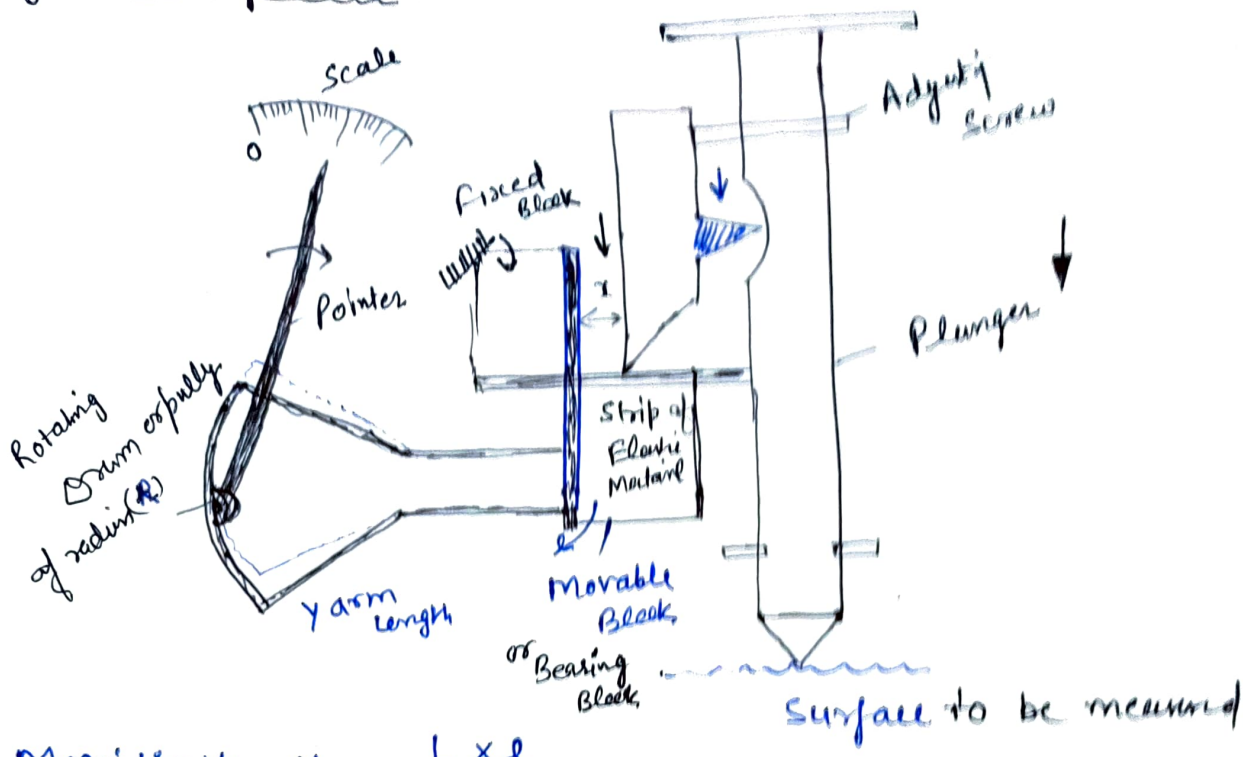


$$\frac{d\varphi}{dL} \propto \frac{L}{w^3 \times n}$$



Comparision with Gauge Block.

Sigma Comparator:



Magnification $M = \frac{L \times l}{x \cdot R}$

$\uparrow M \propto L \uparrow$ and $\uparrow M \propto l \uparrow$ and $\uparrow M \propto \frac{1}{x \downarrow}$

$\uparrow M \propto \frac{1}{R \downarrow}$

It is a mechanical comparator does not require any power source and it is more powerful & strong with other comparator. It have basically linkange assembly.

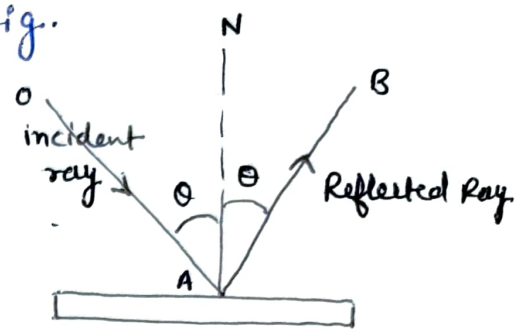
The range of instruments available provides magnification of 300 to 5000, the most sensitive models allowing scale estimation of the order of 0.0001 mm to be made.

Advantages:

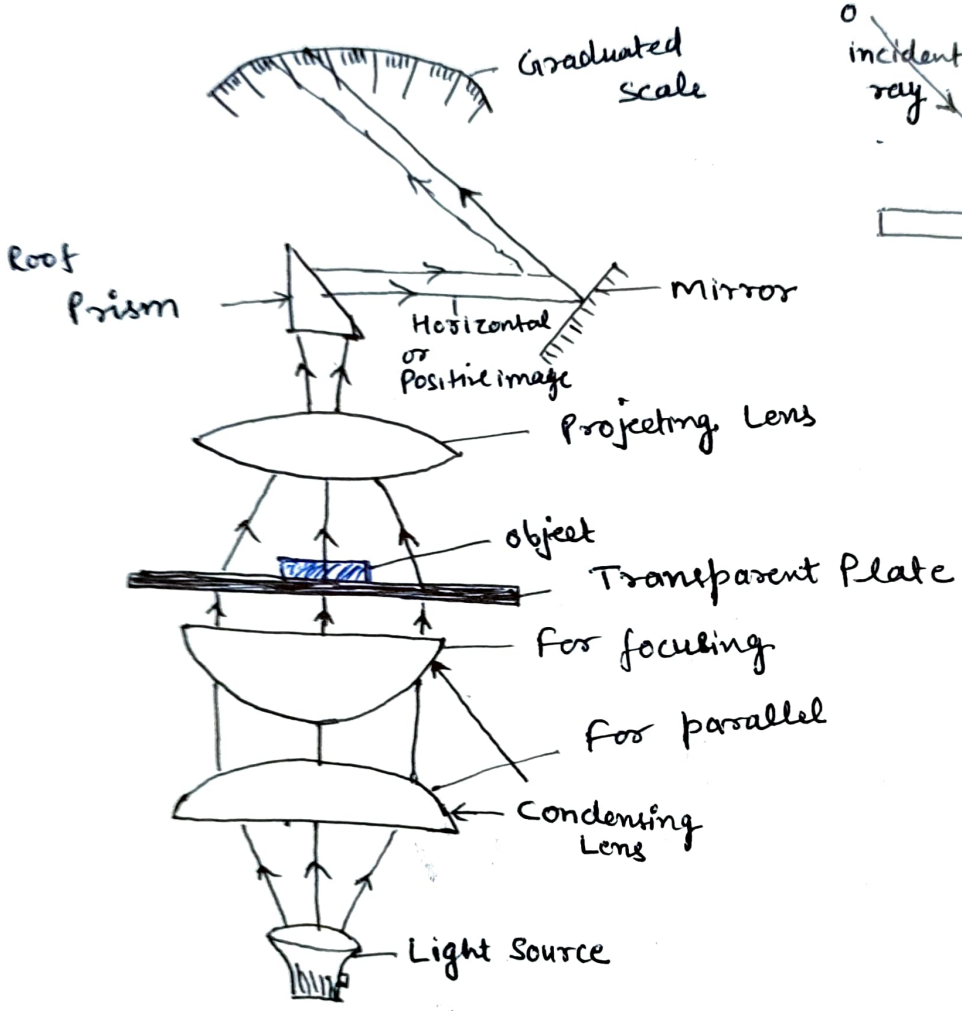
1. Safety
2. No Parallax
3. Fine Adjustment possible.
4. Robust & compact
5. No need of external Power Source.

Optical comparator :-

In these comparator, the edge of the shadow is projected on the curved graduated scale to indicate the comparison measurement. The optical principle adopted is that of 'optical lever' which is shown in fig.



Optical Principle

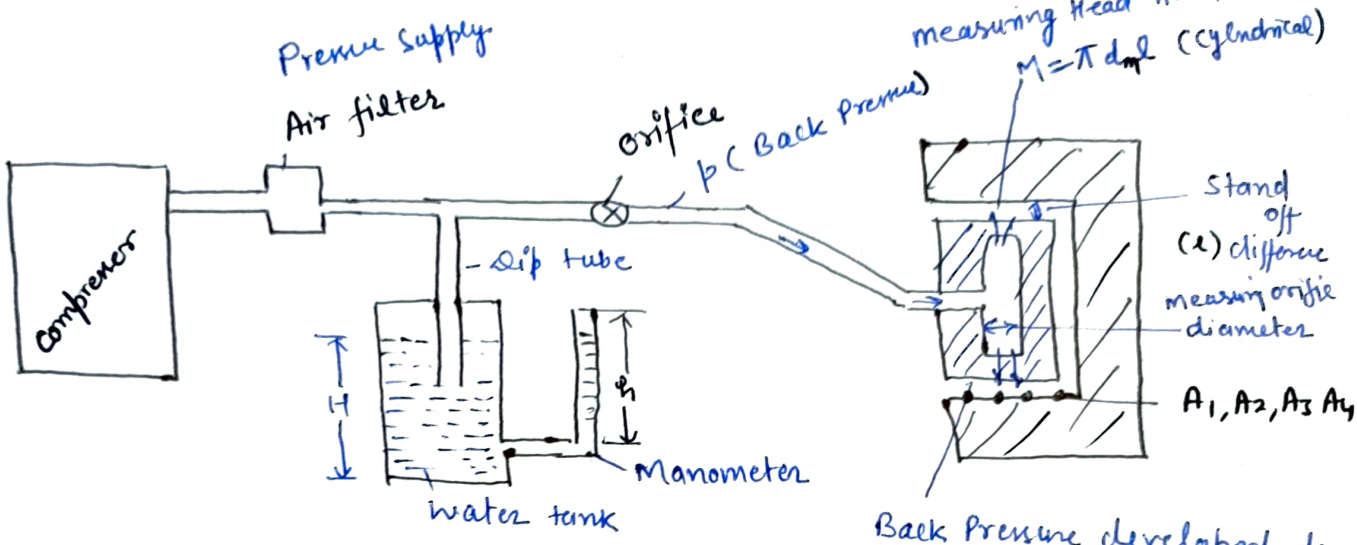


Optical Comparator

We can easily measure any linear movement on scale with magnification.

- → High accuracy since very few moving part.
- → High magnification, hence suitable for precise measurement
- → Illuminated scale

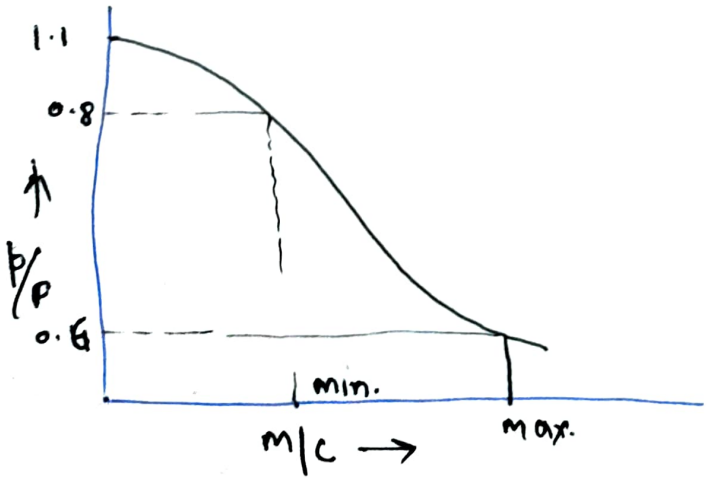
Pneumatic comparator:- Pneumatic means air or compressed air. In this, we have to measure the dimension of a component with the help of pressure difference or variation in back pressure.



Constant Pressure supply to maintain the sensitivity of Instruments.

$$\frac{p}{P} = A - b\left(\frac{M}{C}\right) \qquad \text{where } C = \frac{\pi}{4} d^2 \text{ Area of orifice}$$

$$A = 1.1$$



$$0.6 = 1.1 - \frac{b}{C} M_{max.}$$

$$0.8 = 1.1 - \frac{b}{C} M_{min.}$$

$$\frac{M_{max.}}{M_{min.}} = \frac{5}{3}$$

Range = $M_{max.} - M_{min.}$

- Pneumatic comparator utilize the variation in the air pressure or velocity as an amplifying medium. A jet or jet of air are applied to surface being measured.

Numerical :-

Design a workshop type Go - Not - Go Plug gauge suitable for 25 H7, with following information.

1. 25 mm lies in the diameter step of 18-30 mm
2. $i = 0.45 \sqrt[3]{D} + 0.001 D$
3. $IT7 = 16i$

→ $D = \sqrt{18 \times 30} = 22.23$

$i = 0.45 \sqrt[3]{22.23} + 0.001 \times 22.23 = 1.307$ micron

$IT7 = 16i = 1.307 \times 16 = 21$ micron

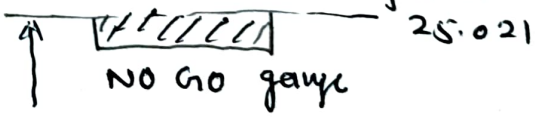
High limit of Hole = 25.021

Low limit " " = 25.00

Tolerance = 0.021

Now gauge tolerance = 10 % of W.P.

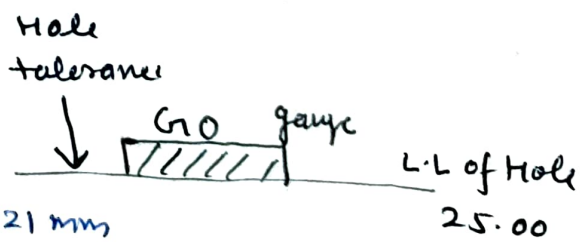
$0.021 \times 0.1 = 0.0021$ mm



Go gauge

Lower limit = L.L of Hole = 25.00

Upper " = 25.00 + 0.0021 = 25.0021 mm



NO-Go gauge

Upper limit = 25.021

low limit = 25.021 − 0.0021 = 25.0189 mm

Go $25^{0.0021}_{0.000}$ NO Go $25^{+0.021}_{0.0189}$:-

Problem on Fits & Tolerance:-

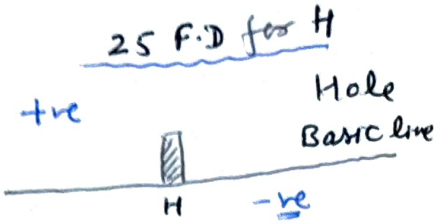
50 H7 g6 Basic Size = 50

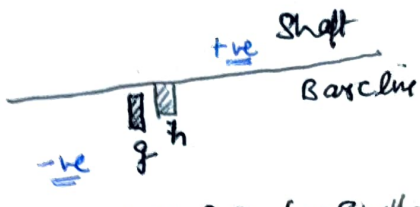
H → Fundamental deviation (F.D) for Hole
g → Fundamental " " Shaft

7 → IT Grade for tolerance (Hole)
6 → IT " " " (Shaft)

Total IT Grade available = 18

F.D. → Closer limit to Basic line





Geometric Mean diameter (D)

$$D = \sqrt{30 \times 50} = 38.72 \text{ mm}$$

(Acc. to table)

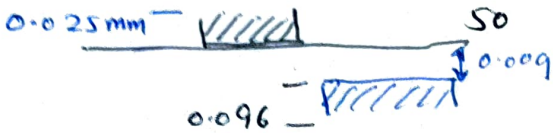
i = Tolerance grade factor

$$= 0.45 \times \sqrt[3]{D} + 0.001 D$$

$$= 0.45 \times \sqrt[3]{38.72} + 0.001 \times 38.72$$

$$= 1.56 \mu$$

$$= 0.00156 \text{ mm}$$



F.D. (H) = 0

FD (Shaft) = -0.009

From table $= -2.5 D^{0.34}$

$= -8.66 \mu = -0.00866 \text{ mm} = -0.009 \text{ mm}$

IT7 = 16i = 16 × 0.00156 = 0.025 mm

IT6 = 10i = 0.016 mm