CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test –2

Sub:Mechanical Measuremnts & Metorlogy				Code: 18ME46B
Date: 04/08/2022	Duration: 90 mins	Max Marks: 50	Sem: IV	Branch (sections):ME (A)

Answer any FIVE FULL questions. Good luck!

	Question paper with scheme & Solution	Marks	OBE CO	OBE RBT
1	What are comparators? Explain sigma comparator with neat sketch.	[10]	CO3	L2
Solu.	**Definition** – 2 Marks **Sigma comparator** sketch – 4 marks Explanation - 2 Marks Magnification formulae - 2 Marks			
2	Name and explain briefly the different types of fit as per BIS and show them by neat schematic diagrams.	[10]	CO2	L2
Solu.	Types – 2 marks Clearance Fit – 3 Marks Interference Fit – 3 Marks Transition Fit – 2 marks			
3	Explain LVDT & list the advantages & disadvantages of LVDT.	[10]	CO3	L1
Solu.	Sketch – 3 Marks Cases 1, 2 & 3 – 2 Marks each Output graph – 1 Mark			
4	Design a plug and ring gauge to control the production of 90mm shaft and hole part of H8e9.	[10]	CO2	L3
Solu.	Data given a) i= $0.453\sqrt{D} + 0.001D$. b) The upper deviations for 'e' shaft =-11D0.41 c) The value for standard tolerance grade IT8=25i and IT9=40i d) 90mm lies in the diameter step of 80mm and 100mm.. D & I – 2 Marks Hole limits – 2 Marks Shaft Limits – 2 Marks Design of plug gauge - 2 Marks Design of Ring gauge - 2 Marks			
5	Sketch and explain the following comparators: a) Zeiss Optimeter & b) Solex Comparators	[10]	CO3	L3

Solu.	a) Zeiss ultra optimeter Sketch – 3 Marks Explanation – 2 Marks b) Solex Comparators Sketch – 3 Marks Explanation – 2 Marks			
6	Illustrate the principle of GO and NOGO gauges. How the Taylor's principle is used in designing them?	[10]	CO2	L2
Solu.	Definition Go & No Go – 2 marks each Drawing Plug and Ring gauge – 2 Marks each Example - 2 Marks			

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1. What are comparators? Explain sigma comparator with neat sketch.

Solu.

A comparator is an instrument used for the measurement of diameters or lengths on gauges and components, using some standards.

The general principle of all these comparators is to indicate differences in size between the standard and the work being measured.

Sigma comparator:

Sigma comparator is an example of mechanical comparator with magnification in the range of 300 to 5000.

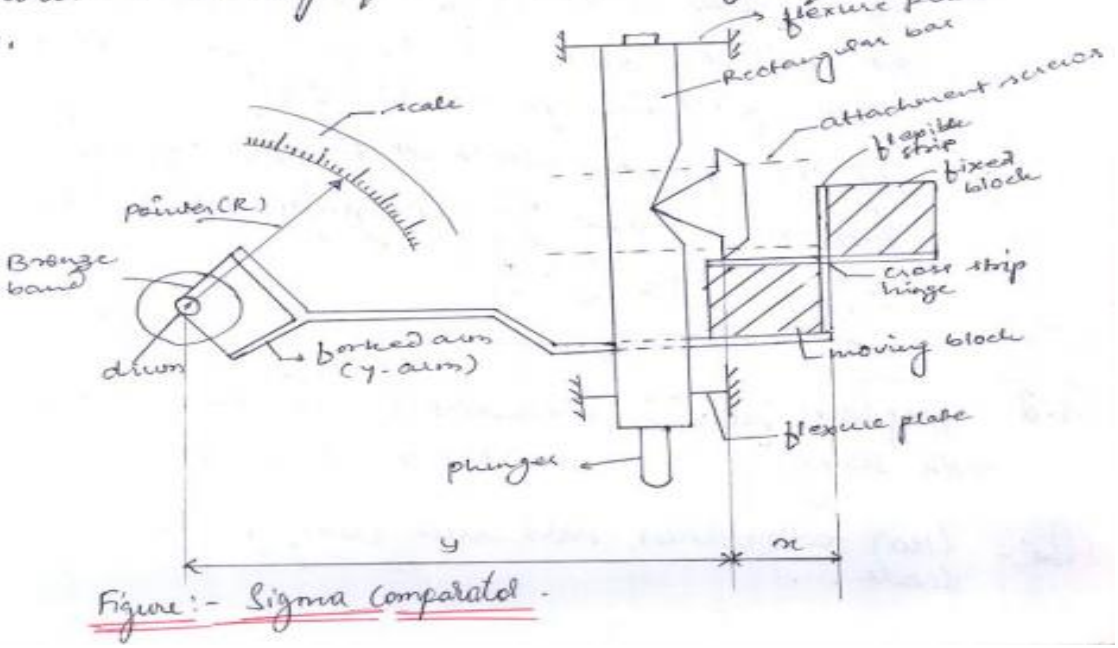


Figure :- Sigma comparator.

The plunger is attached to a rectangular bar which is supported at its upper and lower ends by flexure plates. A knife edge is fixed to the side of the rectangular bar which is bears on a moving block. The moving block and the fixed block are connected by flexible strips at right angles to each other. If the external force is applied to the moving block, it would pivot about the line of intersection of the strip. This hinge is suitably prebensioned to allow it to rotate within the range of the instrument scale. A fork arm or Y-arm attached to the moving block transmits rotary motion to the indicator driving drum through a bronze band wrapped around the drum.

magnification :-

If Y-arm is the length of the forked arm and 'X' is the distance from the knife edge to the hinge, then first magnification is Y/X.

If the pointer length is 'R' and radius of the drum is 'r' then the second stage magnification is R/r.

$$\therefore \quad M = \frac{Y}{X} \times \frac{R}{r}.$$

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

Solu. There are three types of fit

i) Clearance Fit
ii) Interference Fit
iii) Transition Fit

Types of Fits and their Designation (IS919-1963)

Depending upon the actual limits of hole or shaft, the fit may be a clearance fit, a transition fit or an interference fit.

i) Clearance fit:-

EX:- Max size of hole - 50.1mm, max size of shaft = 49.85mm

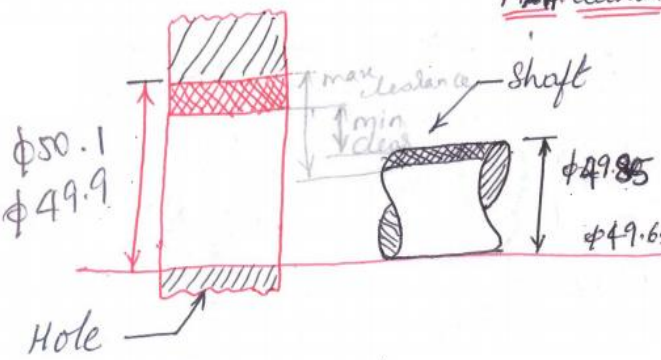
min size of hole - 49.9mm, min size of shaft = 49.65mm.

Min. clearance:- Difference b/w the min size of the hole and max size of shaft.

49.9 - 49.85 = 1.05mm.

Max clearance: Diff. b/w the max size of the hole and min size of the shaft

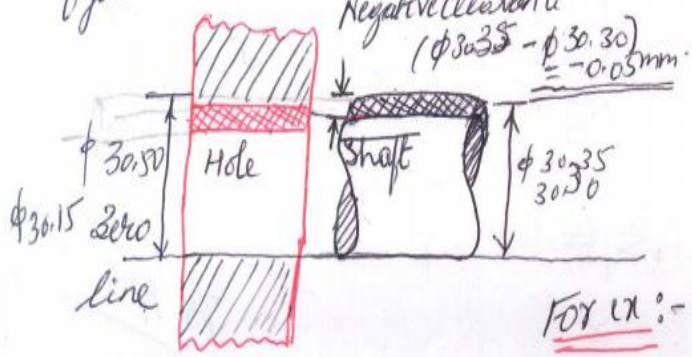
i.e., 50.1 - 49.65 = 0.45mm.



when the difference b/w the sizes of the hole and shaft before assembly is Positive then the fit is called clearance fit.

(b) Interference Fit:-

The minimum permitted diameter of the shaft is larger than the max allowable diameter of the hole as shown in figure.



The fit established when a negative clearance exists between the sizes of the hole & shaft.

For ex:- Bearing bush small end in a connecting rod.

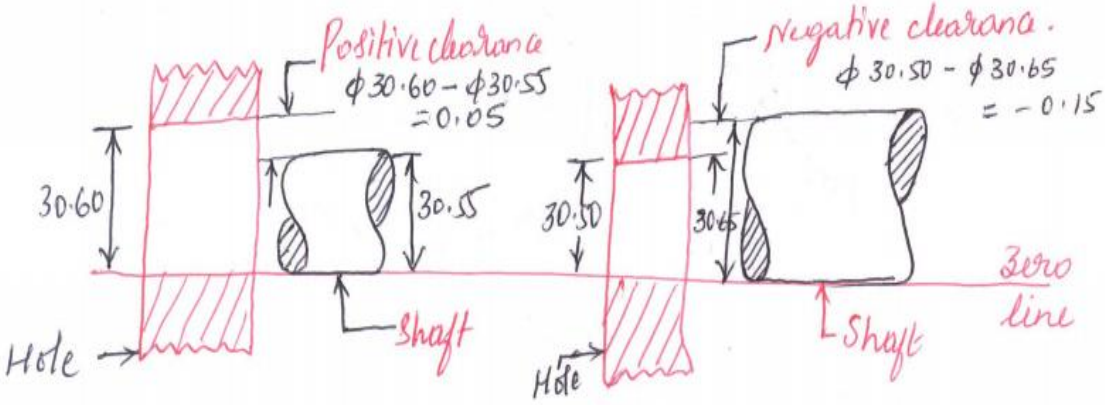
When the difference b/w the sizes of the hole and shaft before assembly is negative then the fit is called interference fit.

For ex :- Max size of hole - 49.85mm ; Max size of shaft - 50.1mm.
Min size of hole - 49.65mm ; min size of shaft - 49.9mm.

Minimum clearance :- It is the arthematical difference b/w max size of the hole and min size of the shaft before assembly.
ie., 49.85 - 49.9 = -0.05mm.

Maximum clearance :- It is the arthematical diff. b/w min size of the hole and the max size of the shaft before assembly.
ie., 49.65 - 50.1 = -0.45mm.

(iii) Transition Fit :- A fit which may provide either a clearance or interference is called Transition fit.



The dia of the largest allowable hole is greater that of the smallest shaft,
but the smallest hole is smaller than the largest shaft
so that a small positive or negative clearance exists b/w the shaft and the hole as shown in fig.

3. Explain LVDT & list the advantages & disadvantages of LVDT.

Solu.

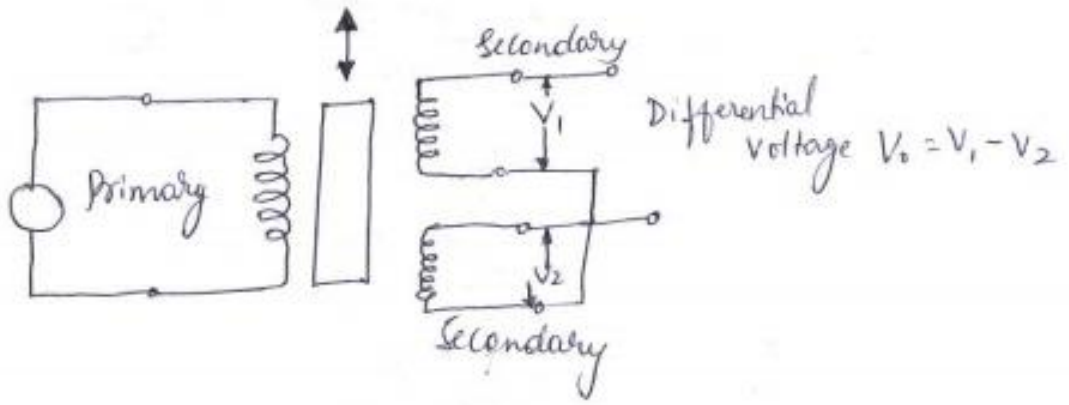


Figure :- LVDT

It is a electro-mechanical device used to convert mechanical displacement into electrical signal.

It is a transformer consisting of 3 symmetrical spaced coils wound on an insulated column.

It works on the principle of mutual inductance and consits of 1 primary coil and 2 secondary coil.

Case 1: When the core is at null position, so for no displacement, the value of output e_0 is zero as e_1 and e_2 both are equal.

ie. $E_{sec1} - E_{sec2} = 0$.

Case 2: When an external force is applied and if the steel core tends to move in the left hand direction (upwards) then the emf voltage induced in the secondary coil 1 is greater than secondary coil 2. So positive.

$\therefore E_{sec1} - E_{sec2}$ o/p.

Case 3: When an external force is applied and if the steel core moves in the right direction (downward) then the emf induced in the secondary coil 2 is greater compared to secondary coil 1.

∴ output voltage will be $E_{sec2} - E_{sec1}$

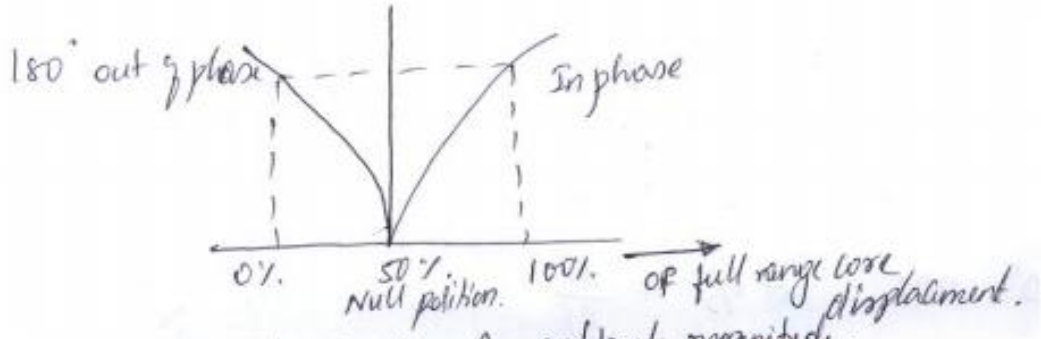


Fig: LVDT's AC output magnitude.

4. Design a plug and ring gauge to control the production of 90mm shaft and hole part of H8e9.
   Data given a) $i = 0.453\sqrt{D} + 0.001D$.
   b) The upper deviations for 'e' shaft =-11D0.41
   c) The value for standard tolerance grade IT8=25i and IT9=40i
   d) 90mm lies in the diameter step of 80mm and 100mm.

Given 90mm dia. lies b/w 80 & 100 mm.

$\therefore D = \sqrt{80 \times 100} = 89.44$ mm — 1 mark.

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

$= 2.102\mu$

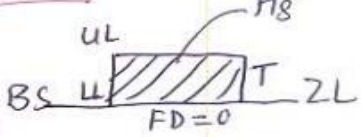
$\therefore i = 0.002102$ mm. — 1 mark

Dimensions / limits of hole are:

F.T for hole H8 ie. IT8 = 25i

$= 25(0.00210) = 0.0525$mm.

F.D for H = 0.



∴ limits are: UL = 90 + 0.0525mm

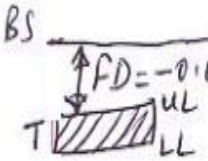
UL = 90.0525mm.

LL = 90 mm. } — 2 marks.

→ Dimensions / limits of shaft are:

F.T for 6g i.e. IT9 = 40i = 40 (0.00210)

F.T = 0.08408 mm.



F.D for 'l' $= -11(D)^{0.41} = -11(89.44)^{0.41}$

$= -69.426\mu = 0.0695$mm.

limits are:- UL = 90 − 0.0695 = 89.9305 mm

LL = 90 − (0.0695 − 0.08408) = 89.847mm } — 2 Marks

Design for hole (plug gauge) — 2 Marks.

Gauge Tolerance GT = 10% of work tolerance of hole

GT = 0.01 × 0.0525 = 0.00525 mm.

Wear allowance = 10% of GT

= 0.1 × 0.00525 = 0.000525 mm.

limits of go gauge are:

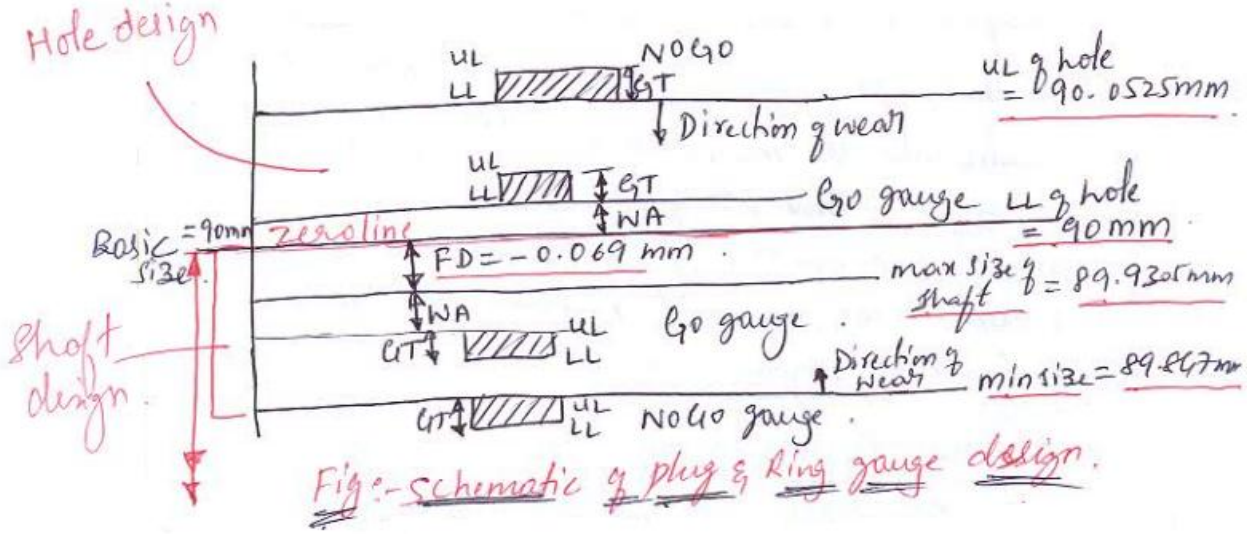
UL = 90 + 0.00525 + 0.000525 = 90.058 mm

LL = 90 + 0.000525 = 90.000525 mm. (1)

limits of No go gauge are:

UL = 90 + 0.0525 + 0.00525 = 90.0578 mm

LL = 90 + 0.0525 = 90.0525 mm. (1)



Design for shaft (Snap gauge) ——— 2marks.

GT = 10% of WT = 0.01 × 0.08408 = 0.00840mm.

WA = 10% of GT = 0.01 × 0.00840 = 0.000840mm

limit of Go gauge are:

UL = 89.9305 − 0.00084 = 89.927mm. (1)

LL = 89.9305 − (0.08408 + 0.00840) = 89.921 mm

limit of NoGo are: UL = 89.847mm

LL = 89.847 − 0.0084 = 89.838 mm. (1)

5. Sketch and explain the following comparators:

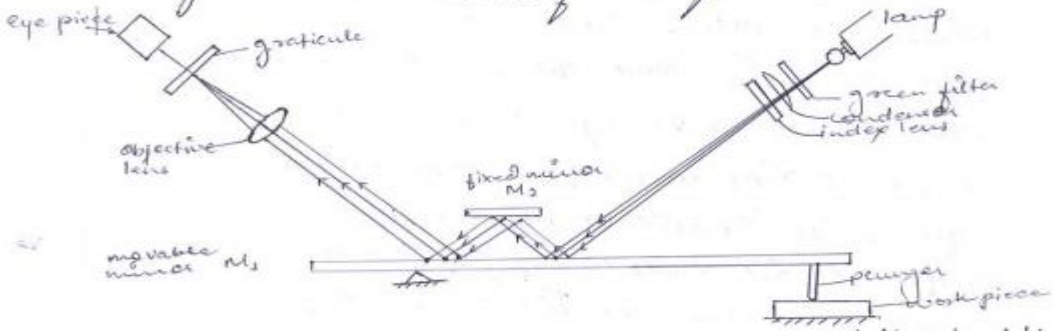
a) Zeiss Optimeter & b) Solex Comparators

Solu.

Soln:- (a) Zeiss ultra-optimeter:

This is the optical system involves double reflection of light and thus gives higher degree of magnification.

Figure shows the details of zeiss optimeter.



A lamp sends light rays through green filter to filter all rays exapts green light, which causes less fatigue to eye. The green light then passes through a condenser which makes light rays parallel and pass through via index mark which projects to a movable mirror M_1. It is then reflected to another fixed mirror M_2 and back again to the movable mirror The objective lens brings the reflected beam from the movable mirror to a focus at a transparent graticule containing a precise scale which is viewed by the eyepiece. The plunger rest on the surface which has to be measured if any deflection on the surface, it moves the plunger vertically will tilt the mirror to some angle. This causes a shift in the position of the reflected index line on the eyepiece graticule scale, which intern measure the displacement of the plunger.

Solex Comparators:

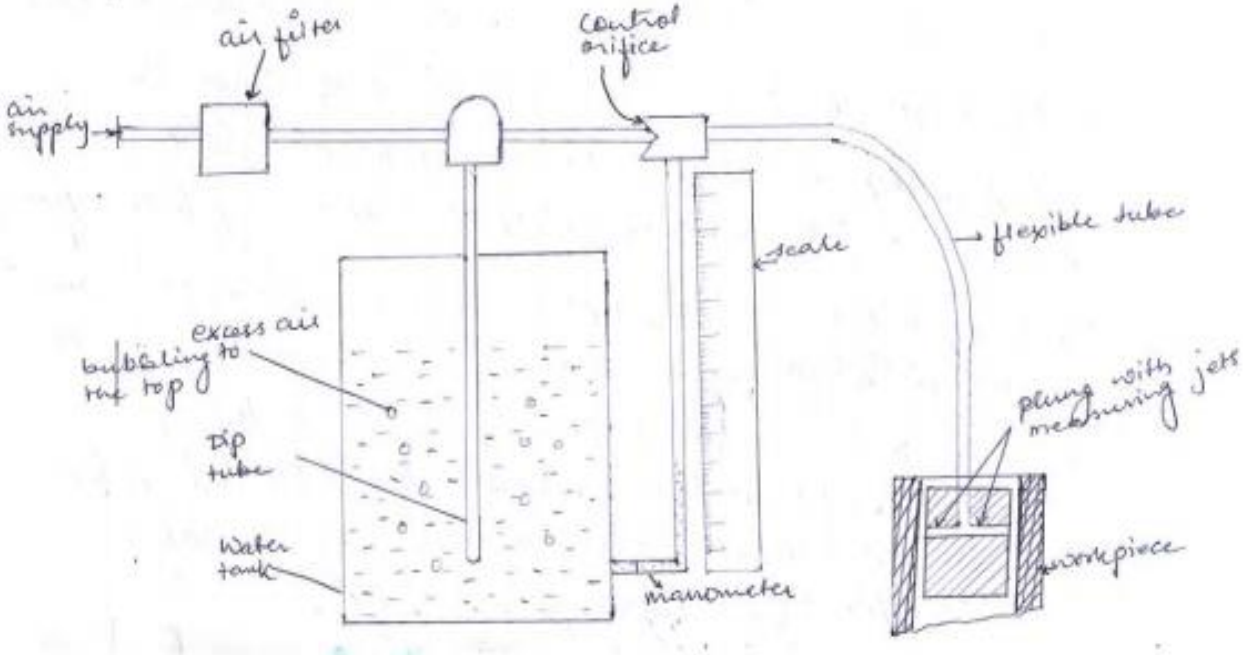


Figure – Solex pneumatic comparator

Solex uses a water manometer for the indication of back pressure.

It consists of water tank in which water is filled upto a certain level and a dip tube is immersed into it upto a depth corresponding to the air pressure required. Since air is sent at high pressure than required, some air will escape from the dip tube and bubbles to the top of the water tank. Thus the air will moving in constant pressure through control orifice. The pressure in the manometer is regulated by the relative rates to escape of air through the control orifice and the measuring jets.

If the measuring jets are completely closed, the manometer level is depressed to the bottom of the tube.

The tube is graduated linearly to show changes in the pressures resulting from changes in the internal diameter of the work being measured.

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

Solu.

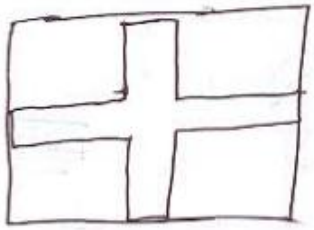
Principle of GO and NO GO gauge:

GO gauge: It represents maximum material condition i.e. max size of shaft and min size of hole. — 2M

NO GO gauge: Represents minimum material condition i.e. max size of hole & min. size of shaft. — 2M

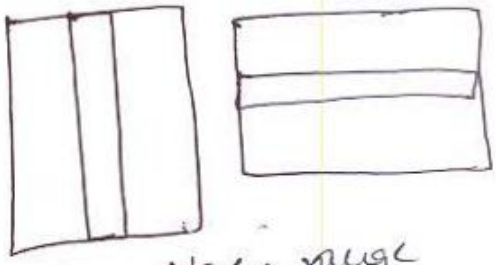
According to Taylor's principle Go gauge should check dimensions one or more at a time, whereas No Go gauge can check only one at a time.

Example:



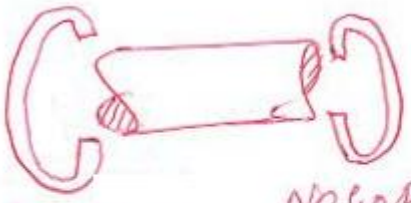
Go gauge

Check size & shape at a time.



No Go gauge

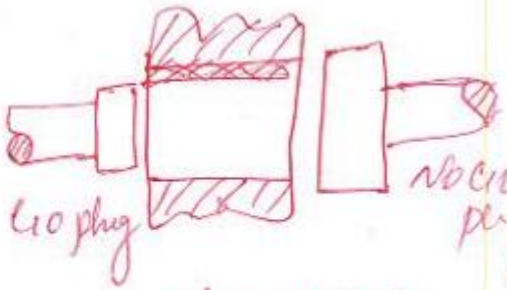
Check only one dimension at a time.



Go Ring gauge

No Go Ring gauge

Ring gauge



Go plug

No Go plug

Plug gauge.

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