USN	1	C	R							

Internal Assesment Test –2

Sub:Mechanical Measuremnts & Metorlogy				Code: 15ME46B
Date: 16/04/2018	Duration: 90 mins	Max Marks: 50	Sem: IV	Branch (sections):ME (A & B)

Answer any FIVE FULL questions. Good luck!

		Marks	OBE CO	OBE RBT
1	What are comparators? Explain any one type of mechanical comparator with neat sketch.	[10]	CO3	L2
2	Design a plug and ring gauge to control the production of 90mm shaft and hole part of H_8e_9. 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.	[10]	CO2	L3
3	Explain measurement of minor diameter of internal thread with neat sketch.	[10]	CO4	L2
4	Explain measurement of effective diameter using 2 wire method.	[10]	CO4	L2
5	Sketch and explain the following comparators: a) Zeiss Optimeter & b) Solex Comparators	[10]	CO3	L3
6	With a neat sketch explain the principle of pneumatic comparator and also explain back pressure gauge.	[10]	CO3	L2
7	Illustrate the principle of GO and NOGO gauges. How the Taylor's principle is used in designing them?	[10]	CO2	L2

Internal Assesment Test - 2

Sub: Mechanical Measurements & Metrology

Sub code: 15ME46B

Date: 16/04/2018.

Scheme and Solution.

Q1. What are comparators? Explain any one type of mechanical comparator. — 10 marks.

Soln:- Comparator is an instrument used for comparing the dimensions of the component with a std. of length. Purpose of a comparator is to detect and display the small differences b/w the unknown linear dimensions and length of std. — 2 marks

Any one type of mechanical comparator.

Johansson Mikrokator: It is a type of mechanical comparator, which is used to check the small deflections when the plunger moves by a small distance upward direction the bell crank lever turns to the right hand side. This exerts a force on the twisted strip and it causes a change in its length by making it further twist and untwist. Hence the pointer at the centre rotates by some amount. Magnification upto 5000 X can be obtained by this comparator.

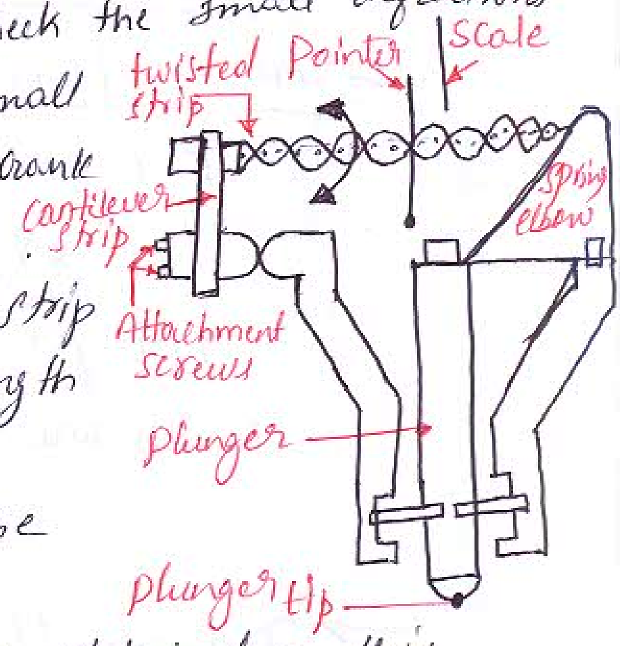


Fig: Johansson mikrokator

Explanation - 4 marks

Sketch - 4 marks.

Q2. Design a plug and ring gauge to control the production of 90mm shaft and hole pair of $H_8 e_9$. Data given:

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

b) The UD for 'e' shaft $= -11D^{0.41}$

c) The value of std. tolerance unit $IT8 = 25i$ & $IT9 = 40i$

d) 90 mm lies b/w 80 & 100mm. — 10 Marks.

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

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

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

$= 2.102 \mu$

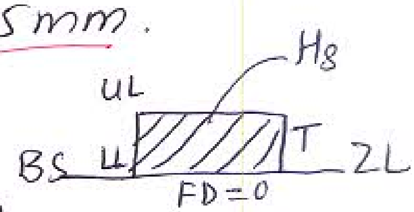
$\therefore i = 0.002102$ mm. — 1 Mark

→ Dimensions / limits of hole are:

F.T for hole H_8 ie. $IT8 = 25i$

$= 25(0.00210) = 0.0525$ mm.

F.D for $H = 0$.



$\therefore$ limits are: $UL = 90 + 0.0525$ mm

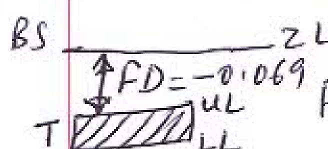
$UL = 90.0525$ mm.

$LL = 90$ mm. } - 2 Marks.

→ Dimensions / limits of shaft are:

F.T for e_9 ie. $IT9 = 40i = 40(0.00210)$

F.T $= 0.08408$ mm.



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

$= -69.426\mu = 0.0695$ mm.

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

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

Design for hole (plug gauge) — 2 Marks

Gauge Tolerance GT = 10% of work tolerance of hole

$GT = 0.01 \times 0.0525 = 0.00525$ mm.

Wear allowance = 10% of GT

$= 0.1 \times 0.00525 = 0.000525$ 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

$LL = 90 + 0.05255 = 90.0525$ mm. (1)

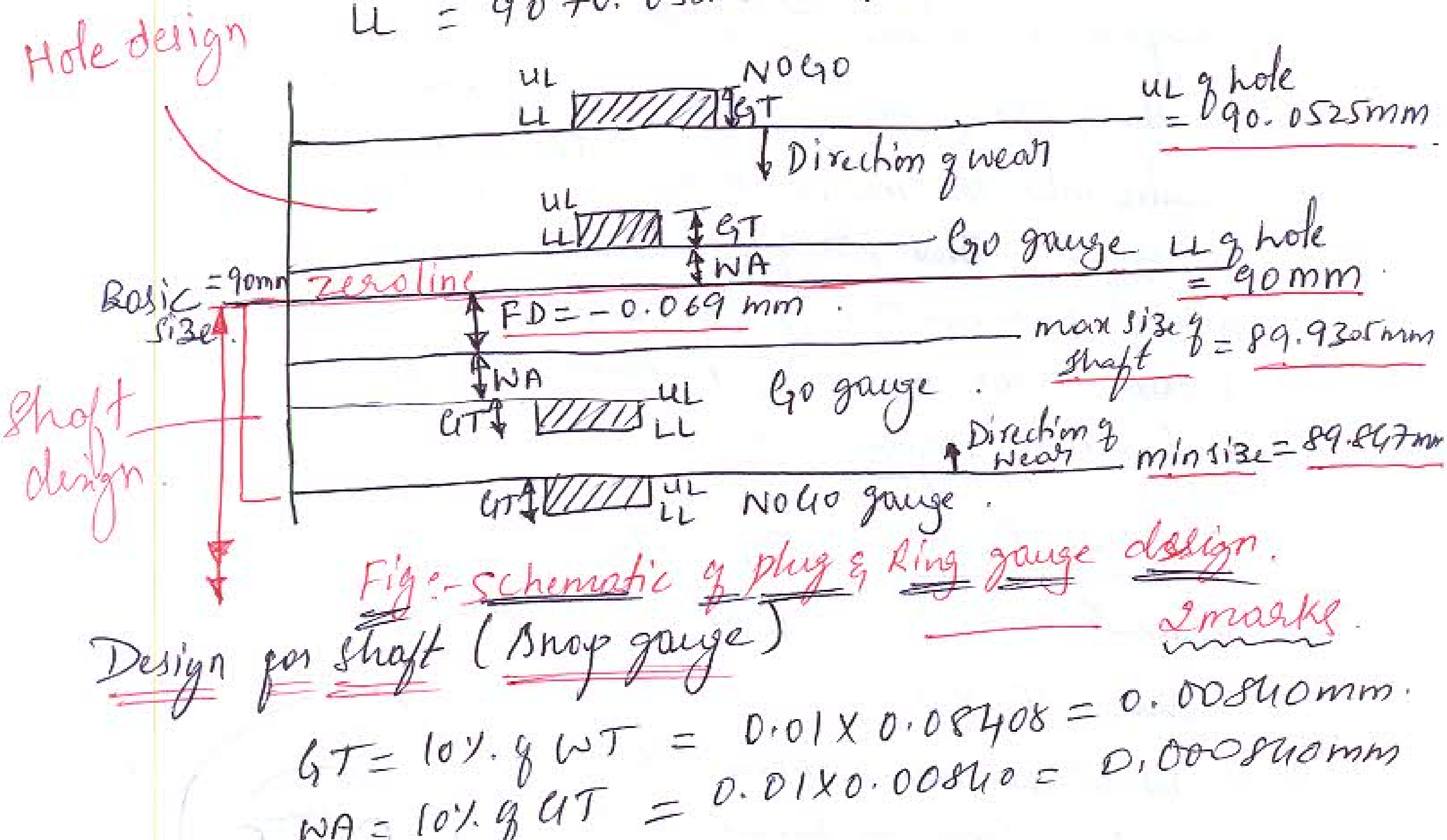


Fig:- Schematic of plug & Ring gauge design.

Design for shaft (Snap gauge) — 2 marks

$GT = 10\%$ of $WT = 0.01 \times 0.08408 = 0.00840$ mm.

$WA = 10\%$ of $GT = 0.01 \times 0.00840 = 0.000840$ mm

Limits of Go gauge are:

$UL = 89.9305 - 0.00084 = 89.927$ mm (1)

$LL = 89.9305 - (0.00084 + 0.00840) = 89.921$ mm

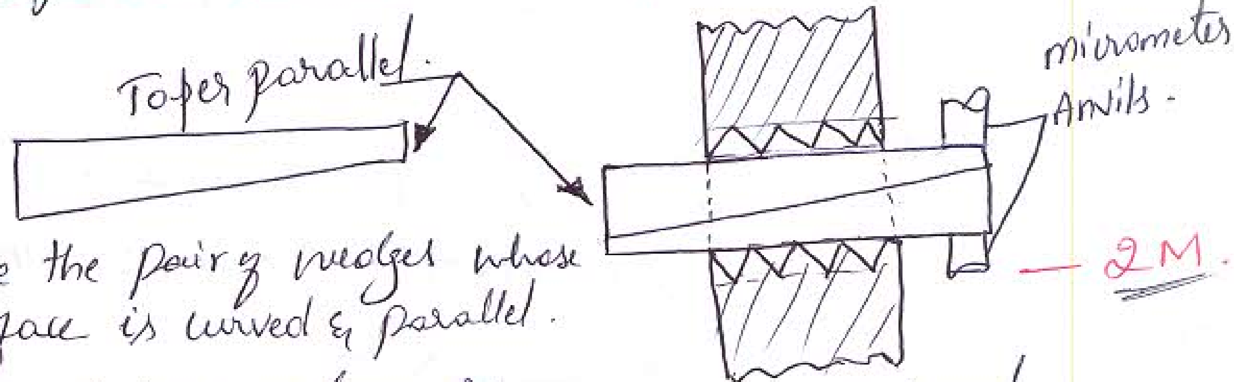
Limits of NoGo are: $UL = 89.847$ mm

$LL = 89.847 - 0.0084 = 89.838$ mm. (1)

Q.3. Explain measurement of minor diameter of internal thread with neat sketch. — 10 marks.

Sol:- Measurement of internal thread minor diameter can be measured in two different methods
i) By Taper parallels & ii) By using std. Rollers.

i) By Taper parallels. Skt - 2 Marks. Exp. - 3 Marks

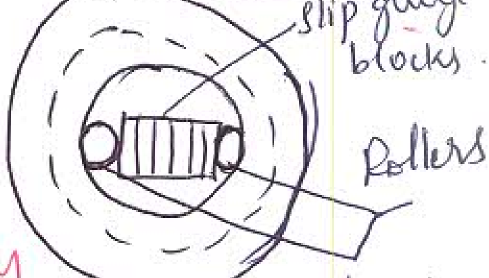


— 2M.

Fig:- Internal thread. (Taper parallels)

These are the pair of wedges whose outer surface is curved & parallel.
When the pair of wedges are inserted into the internal dia of a thread, ~~the wedges will be~~ adjusted according to internal or minor dia of the thread. Then the anvils are placed on the wedges & measure the dia. using micrometer as shown in figure above. — 3M

ii) Using Rollers :- In order to measure minor dia. of internal thread a pair of std. rollers are used as shown in figure. — 2 M.



In the internal thread minor diameter the std. rollers are placed and what ever the gap b/w the rollers on the either ends, the slip gauge combination will be placed. — 3M

∴ Minor dia = length of slip + 2 × dia of rollers.

Measurement of Internal thread using (1) std. Rollers.

Q. 4. Measurement of effective diameter using 2 wire method. — 10 marks.

Soln:- Effective diameter can be measured with the help of floating carriage micrometer. Here in FCM, there are two methods to find effective dia. 2-wire and 3-wire method.

Two-Wire method.

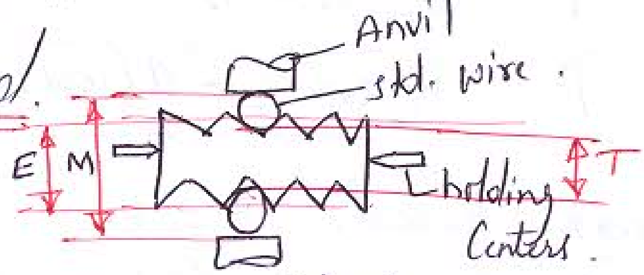


Fig-1

Where E - Effective dia

M - dimension over the wires

T - dimension under the wires.

W.K.T using FCM ⇒ Effective dia $E = T + P$

where T is dimension under the wires & P - constant

$\therefore P = E - T$ — (i) — 2 marks

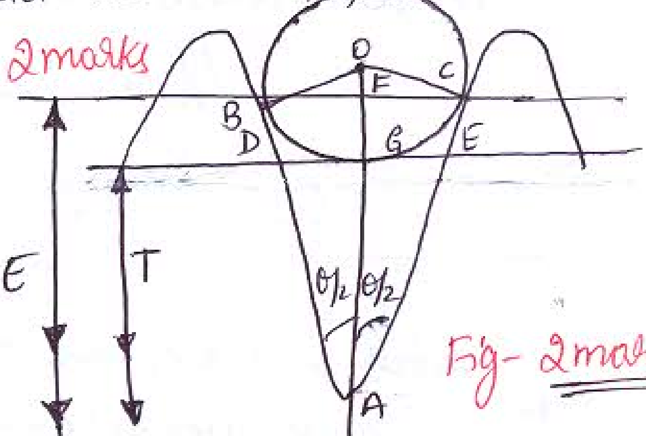


Fig - 2 marks

Fig - 2

From fig-2, $E - T = FG$

$FG = AF - AG$ — — — (ii)

From Δ^le OAB

$\sin\theta/2 = \frac{OB}{OA}$ (W.K. $OB = r = d/2$ from fig-2)

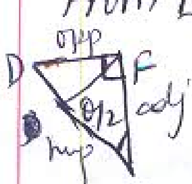
$OA = d/2 \csc\theta/2$ ($\because 1/\sin\theta/2 = \csc\theta/2$)

$AG = OA - OG$

$\therefore AG = d/2 \csc\theta/2 - d/2$ ($\because OG = OB = d/2$)

$AG = d/2(\csc\theta/2 - 1)$

From Δ^le ADF



$\cot\theta/2 = \frac{AF}{DF} \Rightarrow AF = DF \cot\theta/2$

$AF = P/4 \cot\theta/2$ ($\because DF = P/4$ from fig-2)

Sub. AF and AG in eq (2)

$$FG = P/4 \cot \theta/2 - d/2 (\operatorname{cosec} \theta/2 - 1)$$ — 2 marks.

By considering wire on both the ends of the thread $P = 2 \times FG$

$$\therefore P = 2[P/4 \cot \theta/2 - d/2(\operatorname{cosec} \theta/2 - 1)]$$

$$\boxed{P = P/2 \cot \theta/2 - d(\operatorname{cosec} \theta/2 - 1)}$$ — 2 Marks

For metric thread. $\theta = 60°$

$$P = P/2 \cot \theta/2 - d(\operatorname{cosec} \theta/2 - 1)$$

$$P = 0.866\, p - d.$$ — 1 mark

For Whitworth thread $\theta = 55°$

$$C = P/2 \cot 55/2 - d(\operatorname{cosec} 55/2 - 1)$$

$$C = 0.96\, p - 1.165 d.$$ — 1 mark

Q.5. Sketch and explain the following comparators
a) Zeiss ultra optimeter and ii) Sigma comparator — 10 marks.

Soln:-

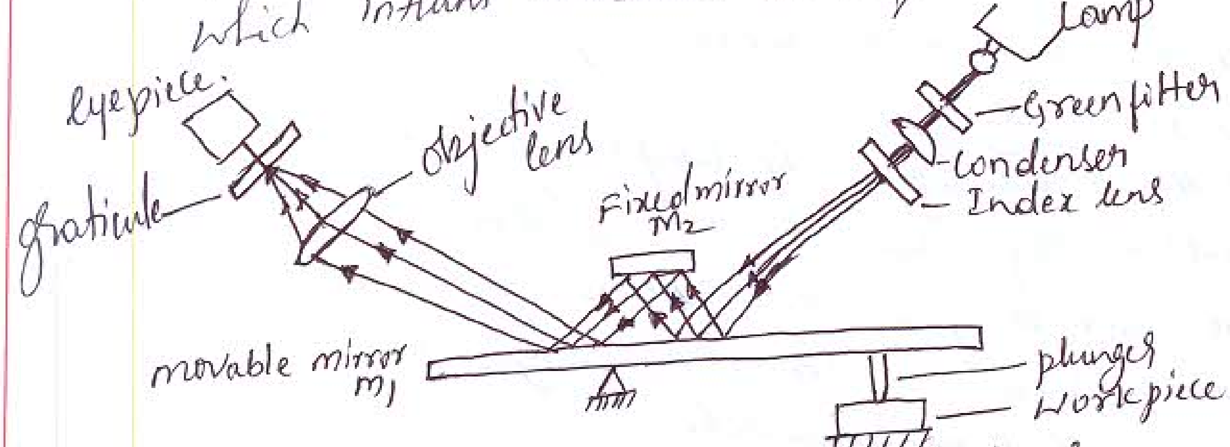
(a) Zeiss ultra optimeter

The optical system of this instrument involves double reflection of light and gives the high degree of magnification.

Fig shows the set up, the light rays pass through green filter to filter all rays except green light, which causes less fatigue to eye. The green light then passes through a condenser which via an index mark projects it on to a movable mirror M_1. It is then reflected

to another fixed mirror M_2 and again to the first
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.

If there is any deflection on the plunger will tilt the mirror. This causes a shift in the position of the reflected index line on the eye piece graticule scale, which inturns measures the displacement. — 3 marks

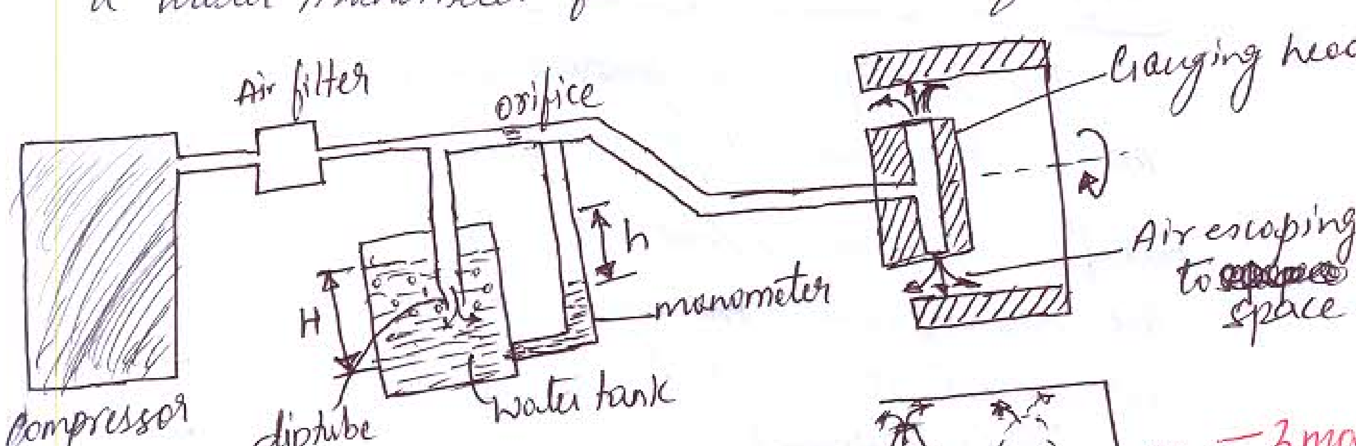


— Skt — 2marks

Figure: Principle of Zeiss optimeter

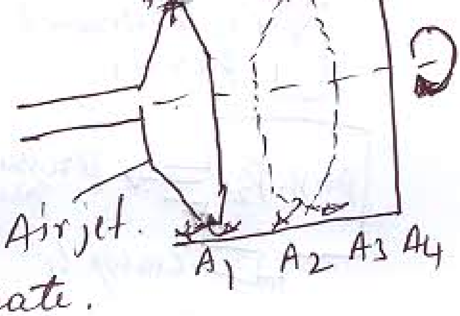
(b) Solex pneumatic gauge

The solex comparator is a device employing a water manometer for the indication of back pressure.



— 3marks

To determine the roundness of the job, the job is rotated along the jet axis, if there is no variation is obtained the we can say job is accurate.

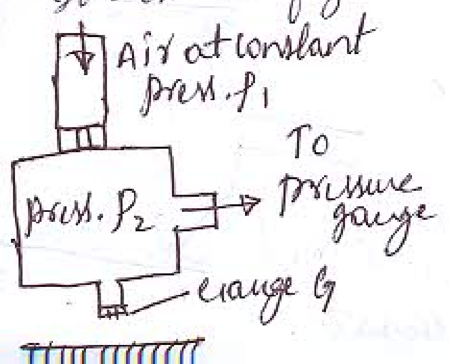


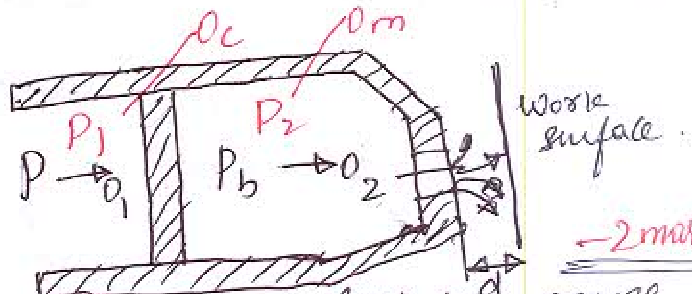
It consits of a water tank in which is filled upto a certain level and a dip tube is immersed into it upto a depth corresponding to the air pressure required. Since the air is sent at ~~high~~ pressure than the required, some air will escape from the dip tube and bubbles to the top of the water tank. Thus the air moving towards the control orifice will be at the desired constant pressure. The air pass through the control orifice and escapes from the measuring jets.
If the measuring jet is completely closed, the manometer level is depressed to the bottom of the tube.
The tube is graduated linearly to show changes in the pressure results from changes in internal dia of the work being measured. — 2 marks.

Q.6. With a neat sketch explain the principle of back pressure pneumatic comparator & Back pressure gauge. — 10 marks.

Soln:- Principle of back pressure gauge.

The principle of ~~pneum~~ pneumatic gauging in the back pressure type comparator is as follows
Air flow from a constant pressure source flows to the atmosphere through two orifices O_c & O_m as shown in figure. — 2 marks.



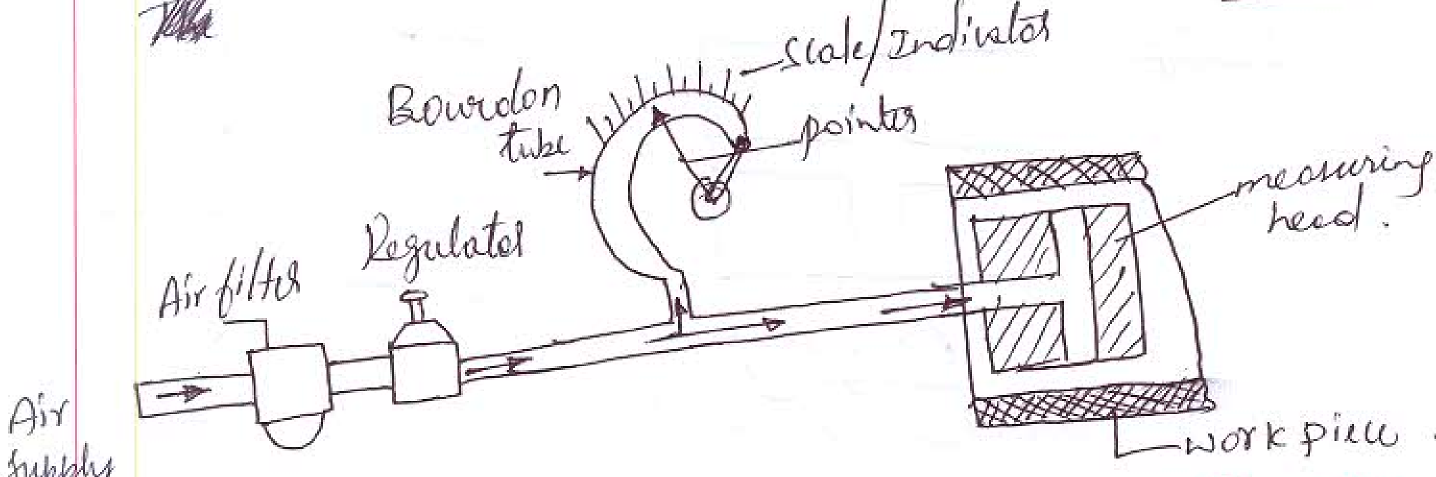


— 2 marks

Fig: Working of Back pres. gauge

P_1 is the pressure on the first orifice and P_2 is the pressure b/w the two orifices.
P_2 becomes equal to P_1 when O_m is blocked and tends to zero as O_m is increased indefinitely.

In the basic back pressure circuit, a bourdon tube, bellows or a diaphragm deflects according to the back pressure changes built up in the circuit when the workpiece is placed over the measuring head. The deflection is amplified by a lever and gear arrangement and indicated on a dial. — 3 marks.



— 3 marks.

Fig:- Back pressure circuit.

Q.7. Illustrate the principle of Go and NoGo gauges. How the Taylor's principle is used in designing them. — 10 MARKS

Soln:- 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. — 2 M

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

According to Taylor's Go and NoGo limit gauges should be designed to determine the maximum & minimum material limits.

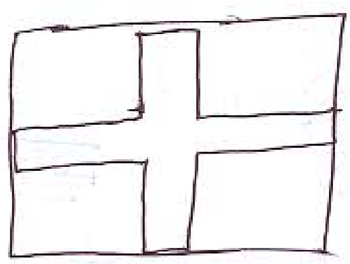
Go limits - corresponds to max. material condition. i.e. lower limit of hole & upper limit of shaft

NoGo limits - corresponds to minimum material condition i.e., upper limit of hole & lower limit of shaft

— 2 marks.

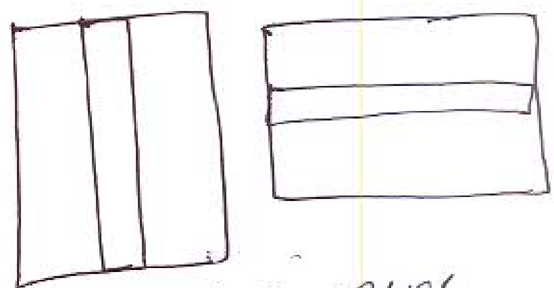
According to Taylor's principle Go gauge should check dimensions one or more at a time, where as NoGo gauge can check only one at a time.

Example:



Go gauge

check size & shape at a time.



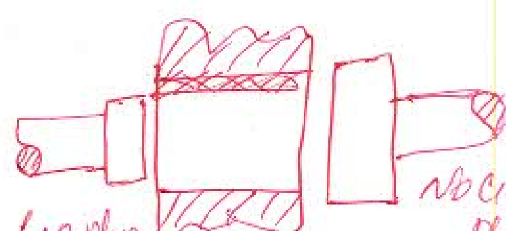
NoGo gauge

check only one dimension at a time.

GO Ring gauge

NOGO Ring gauge

Ring gauge



Go plug

NOGO plug.

Plug gauge.

— 4 marks.