1 Define the term tolerance, allowance, limits & fits?

A Tolerance:- tolerance is defined as the difference between maximum and minimum limits of size for a hole or shaft. It is also the difference btw the upper and lower deviation

Allowance:- the difference between the maximum shaft size and minimum hole size is known as allowance. An allowance may be positive or negative

limits:- the two extremes of the size that are permissible in the manufacture of a part are called limits

Fits:- When two parts are to be assembled the relation resulting from the difference btw the sizes before assembly is called a fit

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2) Distinguish between line standard and end standard with examples?

A Line standards:- when the length is measured at the distance b/w the centers of a 2 engraved lines is known as line standard

Ex:- YARD, METRE, CM

→ measurement of a particular distance as engraved lines are accurately marked on it

End Standard:- the distance b/w two flat faces is to measured the measurement is known end standard

ex:- measurement by micrometer, vernier calliper, slip guage and end bars

→ the measurement is highly accurate and having very close tolerances with the standard values.

3) Enumerate the desirable characteristics of Precision measuring instrument?

A Accuracy:- it is the closeness of a measurement to the true value
→ Higher the accuracy, lower the error

Precision:- it is the closeness of multiple observations or repeatability of a measurement
→ Refers to how close a set of measurement to each other

Percentage error:- the error of measuring system is expressed as a percentage of the measuring range of the equipment

$$\text{percentage error} = \frac{\text{indicated} - \text{true value}}{\text{scale value}} \times 100$$

---

4 Differentiate b/w measuring instrument and comparator? (ii) guage and comparator

(i) Measuring instrument:- it plays a significant role, measuring instruments are used to measure the actual dimension of the workpiece

Comparators:- Comparators are used to compare the workpiece dimensions with the working standards
→ A proper magnification system is provided to accuracy

(ii) Guage:- they are used to determine the dimensions they are lies with in the given limit of size or not
→ guages will determine the amount of deviation from given size magnification is not required

Comparators:- Comparators are used to compare the workpiece dimensions with working standards
→ A proper magnification system is provided to accuracy

5 Name the different types of micrometers in Part measurement?

A micrometers are classified into the following types they are

1. Outside micrometer
2) inside micrometer
3 Depth micrometer
4 Stick micrometer
5 Specialized micrometer

6 Explain the use of optical Projector in Part measurement?

A The types of work for which this instrument is specially suitable are

1) Measurement of any complicated shapes
2 measurement the gear hubs cutter
3 The flute Spacing
4 Tooth relief concentricity
5 Measuring the helix angle in screw threads

7 Distinguish between Accuracy and Precision?

A Accuracy:- it is the closeness of a measurement to the true value
→ higher the accuracy lower the error

Precision:- It is the closeness of multiple observations or repeatability of a measurement
→ Refers to how close a set of measurement to each other.

8 Explain about Precision polygon?

A Precision polygons are basic standards for angle measurement, which are used and calibrated by the national standards laboratories in Particular

→ Precision polygons are made from hardened and stabilized steel or glass, they have lapped or polished working surfaces normal to equal division of a circle. Polygons with 12 faces at 30° intervals or 72 faces at 5° intervals are normally available.

---

9 Differentiate between roughness and waviness?

A Roughness:- Roughness includes the finest (shortest wavelength) irregularities of a surface. these irregularities combine to form surface texture. Roughness generally results form a particular production prolem or material condition.

Waviness:- waviness refers to those surface irregularities, which have greater spacing than roughness that occurs in the form of waves it may be used by vibrations, machine or work deflection warping etc. In short, it is a longer wavelength variation in the surface away from it's basic form.

---

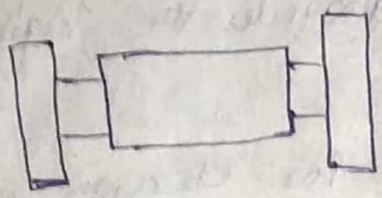
10 What are the various plug guages explain any one of them?

A

→ Plug guages are used to check the holes

→ These guages are designed in two ways 'Go' and 'NO Go' plug guages

→ The Go plug guage is the size of the low limit of the hole while the 'NO Go' plug guage corresponds to high limit of hole.



Double ended limit plug Guages

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11. Distinguish between interchangibility assembly and selective assembly with neat sketches and suitable example?

A) Interchangibility assembly:-

interchangeable parts are parts (components) that are, for practical purposes identical they are made to specifications that ensures that they are so nearly identical that they will fit into any assembly of the same type

Example we have 100 parts each with a hole and 100 shafts which have to fit into these holes

If we have interchangibility then we can make any one of the 100 shafts and fit it into any hole and be sure that the required fit can be obtained.

Selective assembly:-

Selective assembly referers to a concept where subcomponents are assembled to form final assembly which provides the high tolerance specification.

final assembly, which provides the high tolerance Specification

⇒ In selective assembly for clearance and Interference fits, the minimum value increases and maximum value decreases respectively. Where as for transition fit maximum value of clearance and Interference fit decreases

Examples

* Key
* Couplings,
* Pin Joints
* screwed fastners
* Gears
* Clutches.

---

12 Explain the important features of various type of CMM in Component Geometric feature measurement?

A The CMMs are based on the geometrical Configuration of its structure are listed as follows they are

1) Cantilever:- the Cantilever construction combines easy access and relatively small floor space requirements. it is typically limited to small and medium sized machines parts larger than the machine table can be inserted into the open side without inhibiting full machine travel.

3) Bridge type:- the bridge arrangement over the table carries the quill (z-axis) along the x axis and is sometimes referred to as a travelling bridge. it is claimed that the bridge construction provides better accuracy, although it may be offset by difficulty in making two members track in perfect alignment this is by far the most popular CMM construction.

3) Column type:- the column type machine is commonly referred to as a universal measuring machine rather than a CMM. these machines are usually considered gage room instruments rather than production floor machine. the direction of movements of the arm ~~or~~ or the constructional difference in column type with cantilever type is with x and y- axes movements

4) Gantry type:- In a gantry type arrangement arms are held by two fixed supports, other two arms are capable of sliding over the supports movements of x, y, z axes The gantry type construction is particularly suited for very large components and allows the operator to remain close to the area of inspection.

5) Horizontal type:- the open structure of this arrangement provides optimum accessibility for large objects such as dies, models and car bodies. Some horizontal arm machine are referred to as layout machines. there are some horizontal machines where the probe arm can rotate like a spindle to perform tanning operations

Tramming refers to accurate mechanical adjustment of instrument or machine with the help of tram.

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13 Explain in detail about the limit guages?

A Limit guage:-

→ Limit guages are those which has two limits of the dimensions of a part high and low and two guages are needed to check each dimension

→ For example limit guages for a hole consists of two cylindrical plugs whose sizes are made to the limiting values of the hole dimensions

→ limit guage are used for checking interference fits

→ these guages has wide application in engineering ~~Solution.~~ industries

Type of limit guage:-

Some of the most common types of fixed gauge which are described as

(1) Based on the standard and limit
   (i) Standard guage
   (ii) Limit guages (or) "go" and "not-go" guages

(2) Based on the consistency in manufacturing and inspection
   (i) working guages
   (ii) Inspection gauges
   (iii) Reference or master gauges

(3) Depending up on the elements to be checked
(i) Gauges for Checking shafts
(ii) Gauges for checking holes
(iii) Gauges for checking tapers
(iv) Gauges for checking threads
(v) Gauges for checking forms

4 According to the shape or purpose for which each is used
(i) plug (ii) Ring (iii) Snap (iv) Tapers (v) thread
(vi) Form (vii) Thickness (viii) Indicating
(ix) Air operated.

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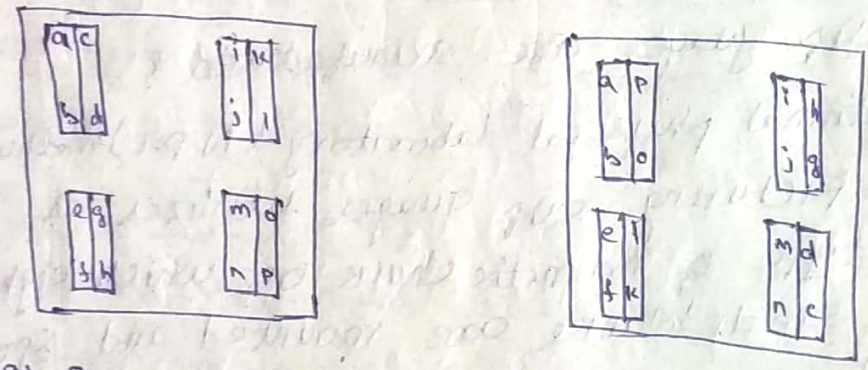
15 How slip guages are manufactured?

A The national physical laboratory (N.P.L) method of manufacturing slip guages utilizes a special type of magnetic chuck on which eight similar steel blanks are mounted and spot grounded on each face. All the blanks are made parallel to about 0.0002 mm and within about 0.001mm of size by a preliminary lapping operation. ~~The blocks are~~

→ on a solid steel chuck and final lapping process is carried on it. The lapping operation is continued until they all lie in one true plane. Now the blanks are reversed and the opposite faces are lapped again until they also lie in one true plane.

→ Now half the blanks are interchanged and turned end-on lapping again, a very high degree of parallelism and equality of size b/w the eight blanks is produced. In between the eight blanks ar wrung togther and there over all length is compared with an equivalent size standard guage therefore the individual errors are reduce to one-eight of the ~~that~~ usual end for a single block. this method produces flat and ~~net~~ blanks which are of equal size of within 0.0002 mm



(a) first arrangements (b) second arrangements.

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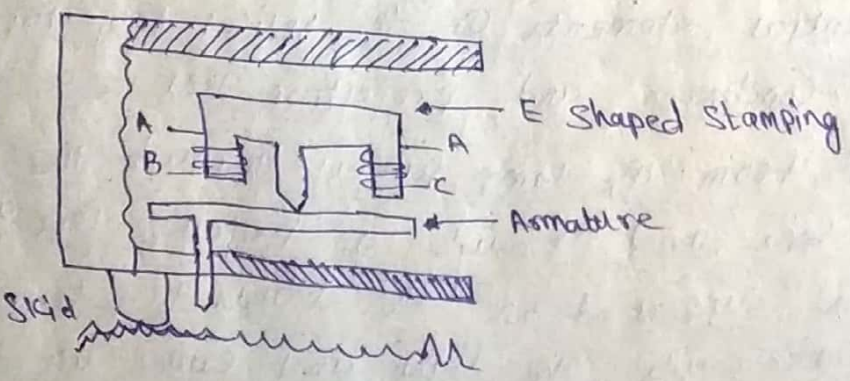
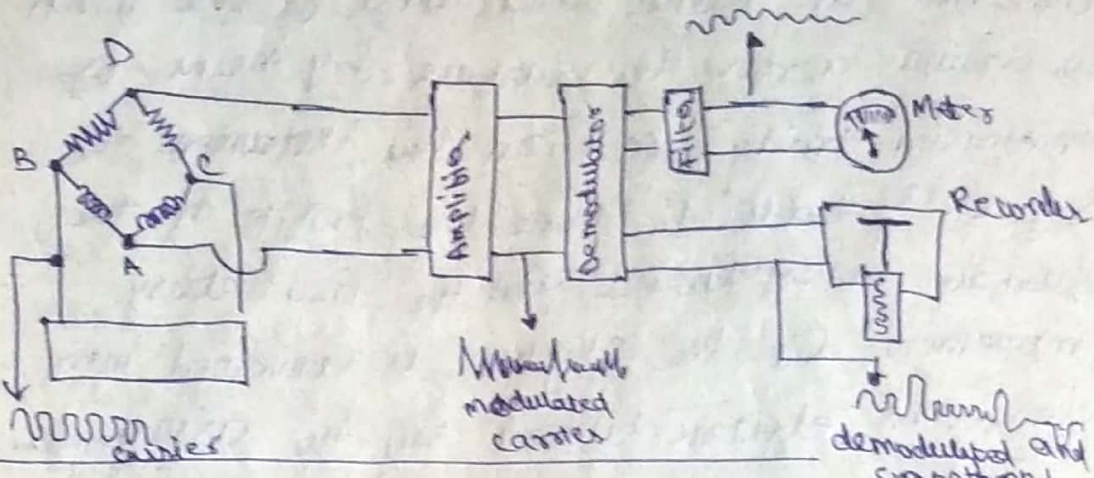
16 Explain and draw the schematic layout of "TALY SUF"?

A Taylour-Hobson talysurf is a stylus and skid type of instrument working on carrier modulating principle. Its response is more rapid and accurate as compared to tomlinson surface meter. the measuring head of this instrument consists of a sharply pointed diamond stylus of about

0.002 mm tip radius and skid or shoe which is drawn across the surface by means of motorised driving unit. In this instrument the stylus is made to trace the profile of the surface irregularities and the oscillatory movement of the stylus is converted into changes in electric current by the arrangement.

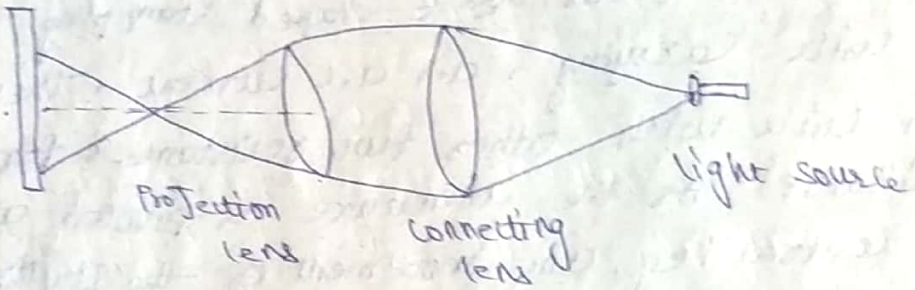
→ The arm carrying the stylus forms an armature which pivots about the centre piece of E-shaped stamping. on two legs of (our pole pieces) the E-shaped stamping there are coils carrying an a.c current. These two coils with other two resistances form an oscillator. As the armature is pivoted about the central leg, any movement of the stylus caused the air gap to vary and thus the amplitude of the original a.c current flowing in the coils is modulated. the output of the bridge thus consists of modulation only. This is further demodulated so that the current now is directly proportional to the vertical displacement of the stylus only.

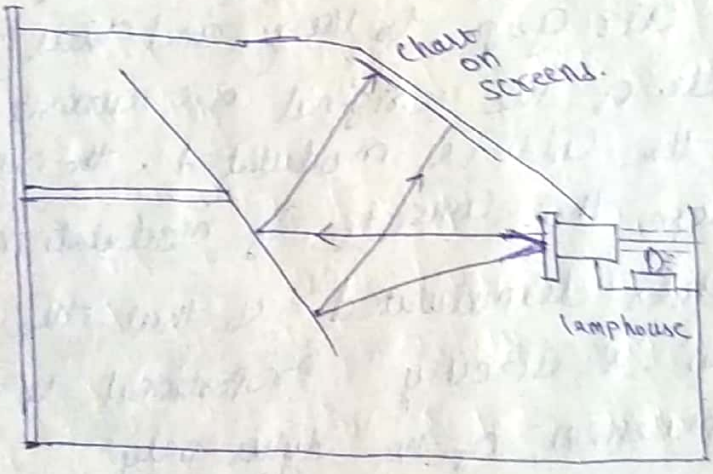




17 Explain about the Optical Projector magnification error?

A Optical Projector:-





→ The essential elements of the optical projector are lamp, Condenser and projection lens

→ The light from the lamp passes through the Condenser lens and through a projection lens the component is supported on the table b/w two lenses interrupts the light and causes an inverted magnified image to appear on the screen

→ A good optical projector must have a precise optical system and means for precise mechanical measurements

→ when the object is placed before the light source a shadow of the profile is projected at some enlarged scale on the screen the magnification usually 5-100 a light source may be tungsten lamp, filament lamp or zenon or clamp

→ micrometers in combination with dial indicators are fitted as the measuring attachments on either two or three directions

→ the mirrors must be held in accurate alignment on rigid supports.

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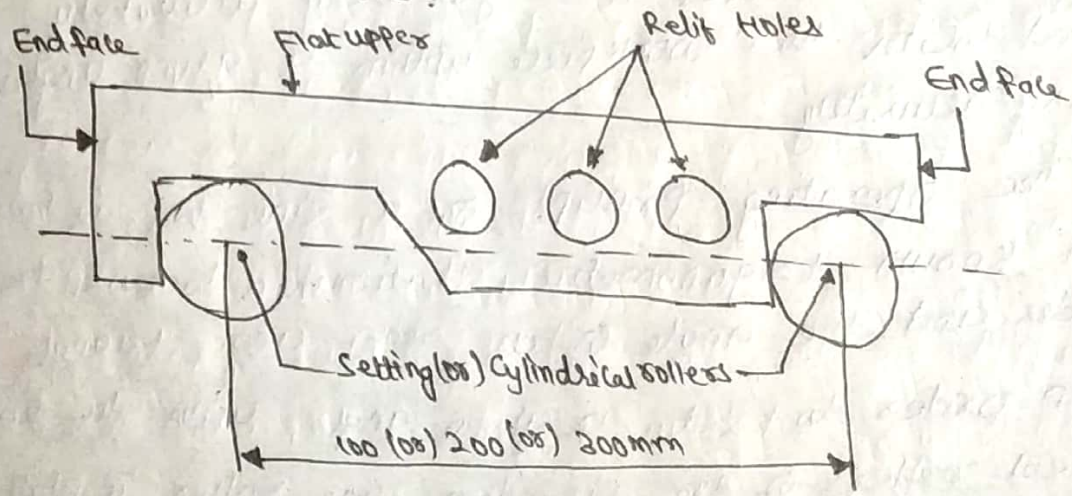
18 Explain in detail Sine bar and auto Colimeter with neat sketch?



→ The Sine bar is a tool or device that is used to measure angles with a great accuracy. It is used to measure angles precisely with an accuracy of 5' (five minutes). It is more accurate than a bevel protractor and can be used for measuring angle with in very closed limits

→ A sine bar is made up of a hardened steel beam having a flat upper surface. the bar is mounted on two cylindrical rollers. these rollers are located in cylindrical grooves specially provided for the purpose. the axes of the two rollers are parallel to each other. they are also parallel to the upper flat surface at an equal distance from it. the most commonly used sine bar has a distance of 100mm, 200mm and 300mm. Some holes are drilled in the body of the sine bar in order to reduce weight as well as facilitate handling. Sine bars are available in several designs for different applications.

Principle of sine bar:-

→ sine bar is an precision angular measuring instrument used along with slip guages. it is used to measures the angles very accurately and locate the workpiece within a given angles very accurately

→ The operating principle of a sine bar is based on known trigonometric relationship between the sides and the angle of an right angle triangle

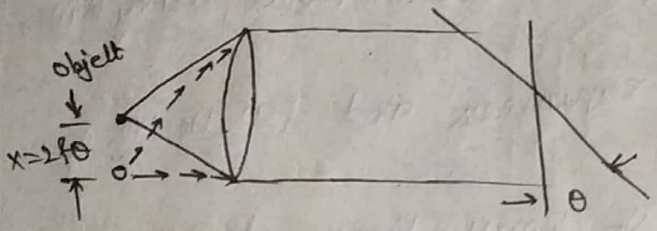
→ In order to set a given angle, with the two steel rollers of the sine bar, one roller is placed on the surface plate and the second roller is placed over the slip guage. let 'H' be the height of the slip guages and L be the distance b/w the centres of steel rollers

$$\sin\theta = \frac{H}{L}$$

$$\theta = \sin^{-1}\left(\frac{H}{L}\right)$$

→ Thus angle is measured by indirect method as a function of trignometric sine Due to this reason the instrument is so named as sine bar.

Principle Of Auto Collimator:-



f → focal length
θ → angle of inclination.

→ Auto collimator is an optical instrument used for the measurement of small angular differences changes or deflection plane surface inspection
→ If a light source is placed in the focus of collimating lens it is projected as parallel beam of light which is made to strike a plane reflector it is reflected back along it's
→ If the reflector is fitted with small angle θ a parallel beam is reflected twice that angle and is bought to the focus in the same plane as the light source at a distance of $x = 2f\theta$
→ Auto collimator is having three main parts Lighting unit, collimating lense and microscope
→ In the micro optic collimator a pair of target wires in the plain of collimating lenses is illuminated by a lamp and the condenser and their image is projected

Applications:-

1) measurement of straightness, flatness of the surface
2) Precise angular indexing in connection with polygons
3) Comparative angular measurements using master angles
4) assessment of squareness and parallelism of the component
5) measurement of small linear dimensions
6) machine tool adjustment settings.

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19 Explain the back pressure type pneumatic comparator with neat sketch?

A Back Pressure Pneumatic comparator:-

→ The back pressure is based on the use of a two orifice arrangement, Air is passed at controlled pressure into the measuring head and provides the source pressure, P_s. it passes through the control orifice O_1 into intermediate chamber. orifice O_1 is of constant size but the effective size of O_2 may be varied by the distance d. As d varies pressure P_b also changes and thus provides a measure of dimension. Thus the indicating device is a Pressure guage or manometer recording the pressure Pd blw the orifice

→ The air from it's normal source of supply, say the factory air line, is filtered and passes through the flow valve. It pressure is then reduced and maintained at a constant value by a dip tube into a water chamber the pressure value being determined by

the head of the water displaced, excess to atmosphere

→ The air at reduced pressure then passes through the control orifice and escapes from the measuring orifice the back pressure in the circuit is indicated by the head of water displaced in the manometer tube. the tube is graduated linearly to show changes of pressure resulting from change in dimension. Amplification of upto 50,000 are obtainable with this system

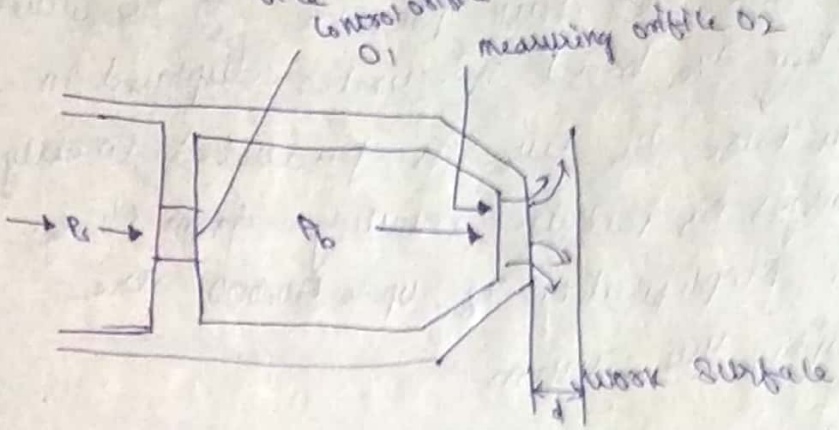
→ By suitably the diameters of O_1 and O_2 and controlling P_s, the pressure at P_b may be made to vary linearly with the effective size of O_2 over a limited portion of the curve obtained by plotting the relationship of the ratio A_2/A and P_b/P_s where A_1, A_2 are the areas of orifices O_1 and O_2 respectively

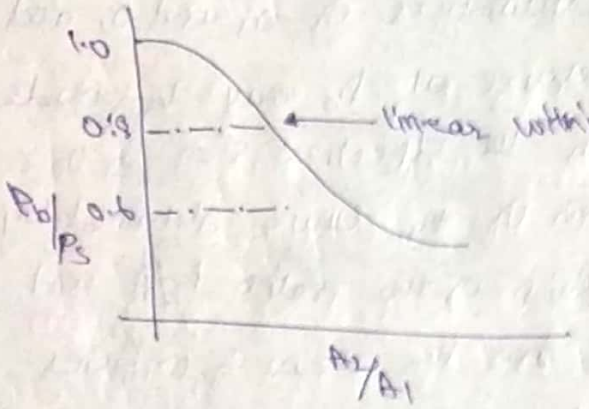
→ For value of P_b/P_s b/w approximately 0.6 and 0.8 the curve is linear with in 1% and it is these values that are used in the design of such comparators for the relative diameter of orifice

→ If we consider the linear portion of the curve i.e b/w the values of 0.6 and 0.8 for P_b/P_s it's law may be written as

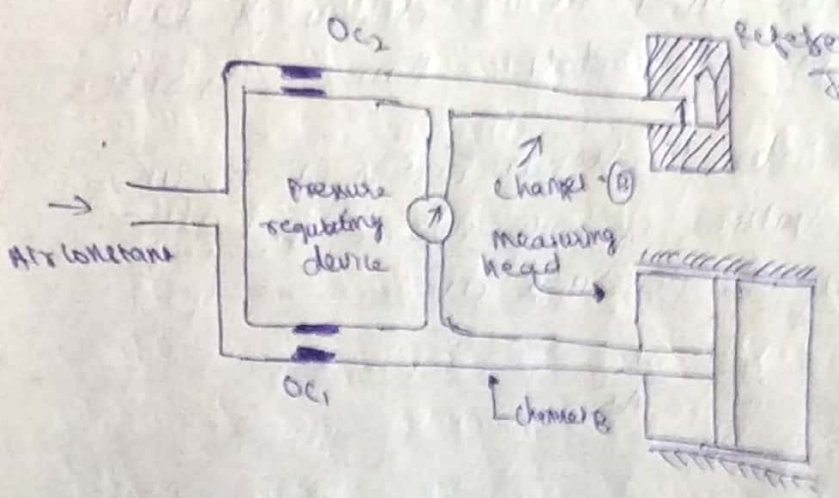
$$P_b/P_s = a - \frac{bA_2}{A_1}$$

→ The Pneumatic magnification is proportional to the input pressure and inversely proportional to the area of the square of the diameter of the control orifice





Q) Explain the working principle of differential Pneumatic comparator with neat sketch.



Pneumatic differential comparator

→ It is a balanced circuit type of pneumatic air gauge the pressure (usually a compressed air from the source at constant pressure flows in 2 channels each of which has controlled orifices air flows through the measuring head of the workpiece or the master setting

→ The restriction of the workpiece builds up back pressure and at the other half air is flowing through other controlled orifice to the reference jet

→ By closing or opening the valve of the reference jet and the pressure in the space b/w the controlled orifice and the reference jet to match the back pressure which is sensed by a pressure indicated device fitted across the 2-channels

→ The zero setting is done for the master work whose dimensions are exactly as per the sizes

→ Any variation in the dimension will cause the change in the back pressure in the channel-A which is different from that of the mean pressure that was set in channel-B

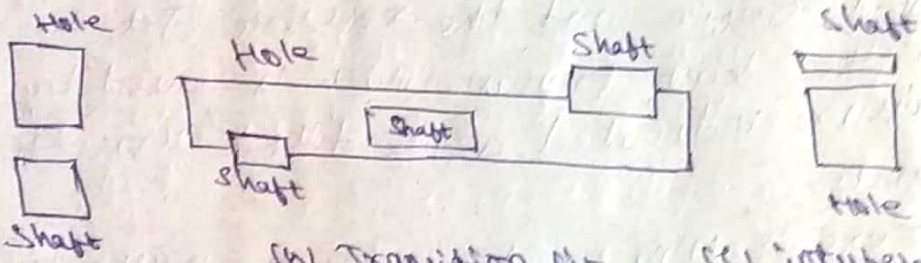
→ The diff of the pressures in the two channels indicated by the pressure indicating device which can be directly calibrated in terms of variation in dimension with master dimensions

→ The instrument is based on differential pressure in 2 channels that why it is called as differential comparator.

23 Explain the shaft basis and hole basis system with neat sketch and examples?

A Hole basis system:-

A Hole based system is a system in which the limits on the hole are kept constant and a series of fits are obtained by varying the limits on the shafts. In this system, lower deviation of hole is zero i.e the low limit on the shaft is same as basic size. the high limit of the hole and the two limits of size for the shaft are varied to give desired type of fit



(a) Clearance fit (b) Transition fit (c) interference fit

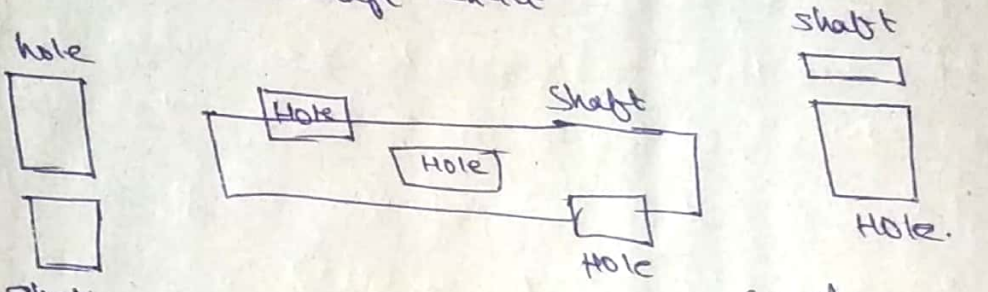
The hole basis system is commonly used because it is more convenient to make correct holes of fixed sizes, since the standard drills, taps reamers, and broaches etc. are available for producing holes and their sizes are not adjusted

Shaft basis system:-

In the shaft basis system, the size of the shaft is kept constant and different fits are obtained by varying the size of the hole shaft basis system is used when the ground bars or drawn bars are readily available these bars do not require further machining and fits are obtained by varying sizes of the hole.

→ In this system the upper deviation (fundamental deviation) of shaft is zero, i.e the high limit of the shaft is same as basic size and the various fits are obtained by varying the low limit of shaft and both the limits of the hole.

→ it is not suitable for mass production as it is inconvinient, time consuming and a costly affair to produce a shaft exact



(a) Clearance fit

(b) Transition fit

(c) Clearance fit.