ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

(Accredited by NAAC, Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)

ANGUCHETTYPALAYAM, PANRUTI – 607 106.

DEPARTMENT OF MECHANICAL ENGINEERING

Name	:	
Course Name	:	METROLOGY AND DYNAMICS LABORATORY
Course Code	:	ME 3581
Year/Sem	:	III/V
Regulation	:	2021
Department	:	MECHANICAL ENGINEERING

ME8581 METROLOGY AND MEASUREMENTS LABORATORY **L T P C**
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UNIT – I METROLOGY

LIST OF EXPERIMENTS

1. Calibration and use of linear measuring instruments – Vernier caliper, Micrometer, Vernier height gauge, depth Micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.
7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.

UNIT – II DYNAMICS LABORATORY

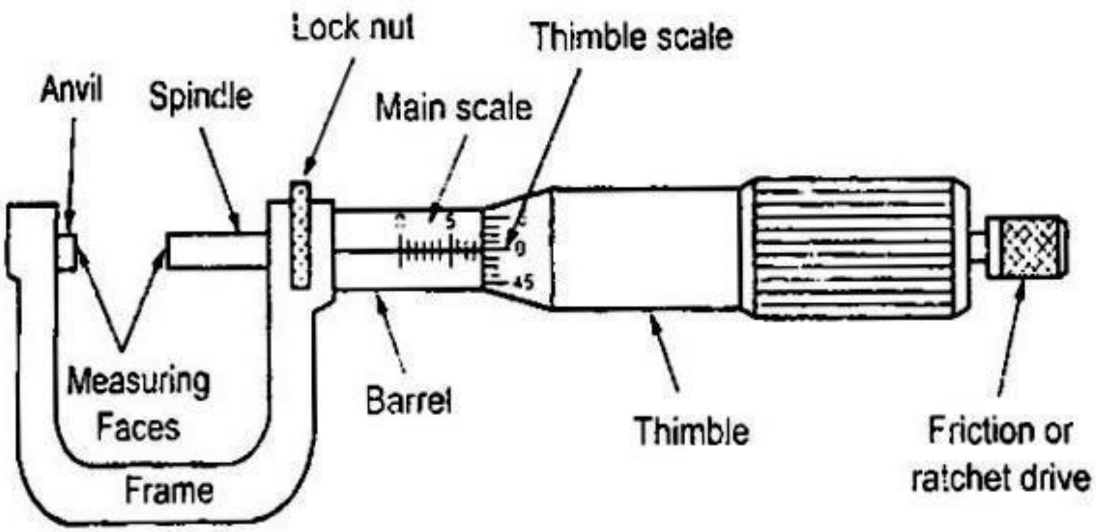
LIST OF EXPERIMENTS

1. Study of gear parameters.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom spring-mass system.
6. Torsional Vibration (Undamped) of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment on Watts Governor.
9. Experiment on Porter Governor.
10. Experiment on Proell Governor.
11. Experiment on motorized gyroscope.
12. Determination of critical speed of shafts.

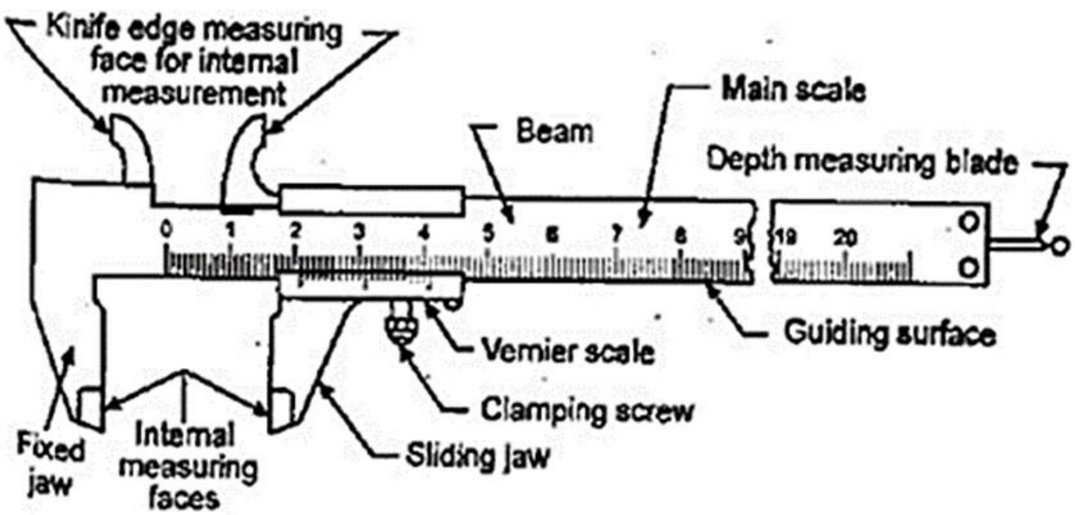
TOTAL: 60 PERIODS

CONTENT

METROLOGY LABORATORY



Outside Micrometer



Vernier Caliper

1. STUDY OF MICROMETER AND VERNIER CALIPER

AIM:

To study the use of micrometer and Vernier caliper.

APPARATUS REQUIRED:

1. Micrometer
2. Specimens

THEORY:

MICROMETER:

The micrometer is a linear measuring instrument. The micrometer has an accurate screw consisting of 10 to 20 threads per cm. This screw rotates inside a fixed nut. The end of the screw acts as one measuring tip and fixed anvil acts as other measuring tip. Threads are cut for certain length on screw and it is left to free remaining portion called sleeve. The spindle moves towards the fixed anvil or away from it by rotating the thimble.

The spindle is placed inside the barrel in such a way to freely to slide over the barrel. The barrel is firmly fixed with the frame.20 divisions per cm are made in the barrel. This is the lead screw for one complete revolution. But the thimble has 25 divisions around the circumference. So each revolution is again divided into 25 divisions. Therefore, each division is equal to 0.01mm. So its least count is 0.01mm

VERNIER CALIPER:

The Vernier instruments generally used in workshop and engineering metrology have comparatively low accuracy. The line of measurement of such instruments does not coincide with the line of scale. The accuracy therefore depends upon the straightness of the beam and the squareness of the sliding jaw with respect to the beam. To ensure the squareness, the sliding jaw must be clamped before taking the reading. The zero error must also be taken into consideration. Instruments are now available with a measuring range up to one meter with a scale value. So its least count is 0.02mm

RESULT:

The uses of Micrometer and Vernier caliper are studied.

TABULATION:

Least count=0.01mm   Range = 0 - 25mm

Sl. No.	Main Scale Reading (M.S.R) (mm)	Pitch Scale Division (P.S.D) (Div)	Correct Reading CR=MSR+(PSD×LC) (mm)	Mean
1				
2				
3				
4				
5				

Model Calculation:

Correct Reading CR = MSR + (PSD×LC)

=

=

2. (a) CALIBRATION OF MICROMETER

Aim:

To calibrate the outside micrometer using slip gauge

Instruments Required:

1. Micrometer stand
2. Outside Micrometer
3. Slip gauge

Specifications:

1. Outside micrometer
2. Range=0-25mm
3. Graduations=0.01mm

Procedure:

1. The micrometer is checked for zero error.
2. The given slip gauge is held between the faces of the anvil and spindle.
3. The spindle is moved by rotating the thimble until the anvil and spindle touches the surface of the component.
4. Fine adjustment is made by ratchet. The main scale reading and thimble scale reading are noted.
5. Two are more reading are taken at different places of the component.
6. The readings are tabulated and calculated.

Results:

Thus, the outside micrometer using slip gauge was calibrated.

TABULATION:

Least count=0.01mm Range = 0 - 25mm

Sl. No.	Main Scale Reading (M.S.R) (mm)	Pitch Scale Division (P.S.D) (Div)	Correct Reading CR=MSR+(PSD×LC) (mm)	Mean
1				
2				
3				
4				
5				

Model Calculation:

Correct Reading CR = MSR + (PSD×LC)

=

=

2. (b) MEASUREMENT OF EXTERNAL DIMENSION USING MICROMETER

Aim:

To measure the external dimension of an object using outside micrometer.

Instruments Required:

1. Micrometer stand
2. Outside Micrometer
3. Workpiece

Specifications:

1. Outside micrometer
2. Range=0-25mm

Procedure:

1. The micrometer is checked for zero error.
2. The given workpiece is held between the faces of the anvil and spindle.
3. The spindle is moved by rotating the thimble until the anvil and spindle touches the surface of the component.
4. Fine adjustment is made by ratchet. The main scale reading and thimble scale reading are noted.
5. Two are more reading are taken at different places of the component.
6. The readings are tabulated and calculated.

Results:

Thus, the external dimension of an object is measured using outside micrometer.

Tabulation:

Least count=0.02mm

S.NO	VERNIER READING (mm)			Mean (mm)
	MSR (mm)	VSD	CR = (MSR + (VSDXLC)) (mm)	
1				
2				
3				
4				
5				

Model Calculation:

Correct Reading CR = MSR + (VSD×LC)

=

=

3. (a) CALIBRATION OF VERNIER CALIPER

Aim:

To calibrate the Vernier caliper by using slip gauge

Instruments Required:

1. Vernier Caliper
2. Slip gauge

Specifications:

1. Vernier Caliper
2. Range=0-25mm

Procedure:

1. Vernier caliper is cleaned with a cloth.
2. The clamping screws are loosened.
3. The given component is fixed in both the two jaws.
4. The component should be perfectly holded.
5. The thickness is measured with the external jaws.
6. The length of the component is measured by adjusting the movable jaws.
7. The procedure is repeated for all the components. At least three readings should be taken and then average will give the accurate measurement

Results:

Thus, the Vernier caliper has calibrated using slip gauge.

Tabulation:

Least count=0.02mm

S.NO	VERNIER READING (mm)			Mean (mm)
	MSR (mm)	VSD	CR = (MSR + (VSDXLC)) (mm)	
1				
2				
3				
4				
5				

Model Calculation:

Correct Reading CR = MSR + (VSD×LC)

=

=

3. (b) MEASUREMENT OF EXTERNAL DIMENSIONS USING VERNIER CALIPER

Aim:

To measure the external dimension of an object by using Vernier caliper.

Instruments Required:

1. Vernier Caliper
2. Workpiece

Specifications:

1. Vernier Caliper
2. Range=0-25mm

Procedure:

1. Vernier caliper is cleaned with a cloth.
2. The clamping screws are loosened.
3. The given component is fixed in both the two jaws.
4. The component should be perfectly holded.
5. The thickness is measured with the external jaws.
6. The length of the component is measured by adjusting the movable jaws.
7. The procedure is repeated for all the components. At least three readings should be taken and then average will give the accurate measurement

Results:

Thus, the external dimension of an object by using Vernier caliper.

TABULATION:

Least count=0.02 mm Range = 0 - 25mm

Sl. No.	Specimen's Name & Specification Slip Gauge	Main Scale Reading (M.S.R) (mm)	Verni er Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Error
1					
2					
3					
4					
5					

Model Calculation:

Correct Reading CR = MSR + (PSD×LC)

=

=

4. (a) CALIBRATION OF DEPTH GAUGE

Aim:

To calibrate the Depth gauge using slip gauge

Instruments Required:

1. Depth Gauge
2. Slip gauge

Specifications:

1. Depth Gauge
2. Range=0-25mm
3. Graduations=0.01mm

Procedure:

1. The depth gauge is checked for zero error.
2. The given slip gauge is held between the faces of the Flat surface and spindle.
3. The spindle is moved by rotating the thimble until the Flat surface and spindle touches the surface of the component.
4. Fine adjustment is made by ratchet. The main scale reading and thimble scale reading are noted.
5. Two are more reading are taken at different places of the component.
6. The readings are tabulated and calculated.

Results:

Thus, the depth gauge using slip gauge was calibrated.

TABULATION:

Least count=0.02mm Range = 0 - 25mm

Sl. No.	Main Scale Reading (M.S.R) (mm)	Vernier Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Mean
1				
2				
3				
4				
5				

Model Calculation:

Correct Reading CR = MSR + (VSD×LC)

=

=

4. (b) MEASUREMENT OF DEPTH USING DEPTH GAUGE

Aim:

To measure the depth of an object using depth micrometer.

Instruments Required:

1. Stand
2. Depth Gauge
3. Workpiece

Specifications:

1. Depth Gauge
2. Range=0-25mm

Procedure:

1. The micrometer is checked for zero error.
2. The given workpiece is held on the table and spindle is inserted into the hole of an object.
3. The spindle is moved by rotating the thimble until the anvil and spindle touches the bottom surface of the component.
4. Fine adjustment is made by ratchet. The main scale reading and thimble scale reading are noted.
5. Two are more reading are taken at different places of the component.
6. The readings are tabulated and calculated.

Results:

Thus, the depth of an object is measured using depth gauge.


X: -51.206
Y: -24.462
Z: 17.735

5. (a) STUDY OF PROFILE PROJECTOR

AIM:

To study the use of profile projector

APPARATUS REQUIRED:

1. Profile Projector
2. Specimens

THEORY:

Profile projector has a high degree of precision and the magnification is obtained with the help of light beams which have the advantage of being straight and the profile. Therefore, suffer less wear during usage than the mechanical type. This is to magnify parts of very small size of the complex configuration that required accurate and enlarged profile.

This comparator has a lamp. The light rays from the projection lens fall on the mirror. The mirror reflects the light rays on the screen. The specimen is placed on the table between these condensing and projecting lenses. The projecting lens magnifies the profile of the specimen. The mirror again magnifies this image. The magnified image fall on the screen. The screen is a transparent glass. A magnified master drawing specimen profile is placed over the screen. The projected image of the specimen profile is compared with the master drawing.

This type of optical comparator is used for inspecting small parts like screw threads, gear teeth, saw teeth, cutting tool, needles, camp profiles, etc.

Different magnification can be obtained by adjusting the projection lens and the position of the mirror.

RESULT:

The uses of profile projector are studied

Tabulation:

Sl.No	DESCRIPTION	INITIAL READING (mm)	FINAL READING (mm)	ACTUAL READING A.R = I.R – F.R (mm)	MEAN = A.R / No of Reading taken (mm)
1	Major Diameter				
2	Minor Diameter				
3	Pitch				
4	Helix angle				

5. (b) MEASURMENT OF THREAD PARAMETER USING PROFILE PROJECTOR

AIM:

To measure thread parameter of a given screw thread using profile projector.

APPARATUS REQUIRED

1. Profile projector
2. Specimen

SPECIFICATION

Contour projector magnification accuracy = ±0.1%

Micrometer Head = 0-25 mm

Least Count = 0.1 mm

Color illuminator = 150/250 W Halogen

Magnification = 10x, 20x, 50x lenses

PROCEDURE

1. The required Magnification adapter is fixed in the center projector.
2. The flat specimen is placed on the glass plate and perfectly focused on the screen.
3. The profile of specimen is traced on a tracing paper is fixed on the screen using pencil.
4. Then the angle between the two-reference surface and dimension are measured using table micrometer and the Rota table screen circular scale and are tabulated

RESULT:

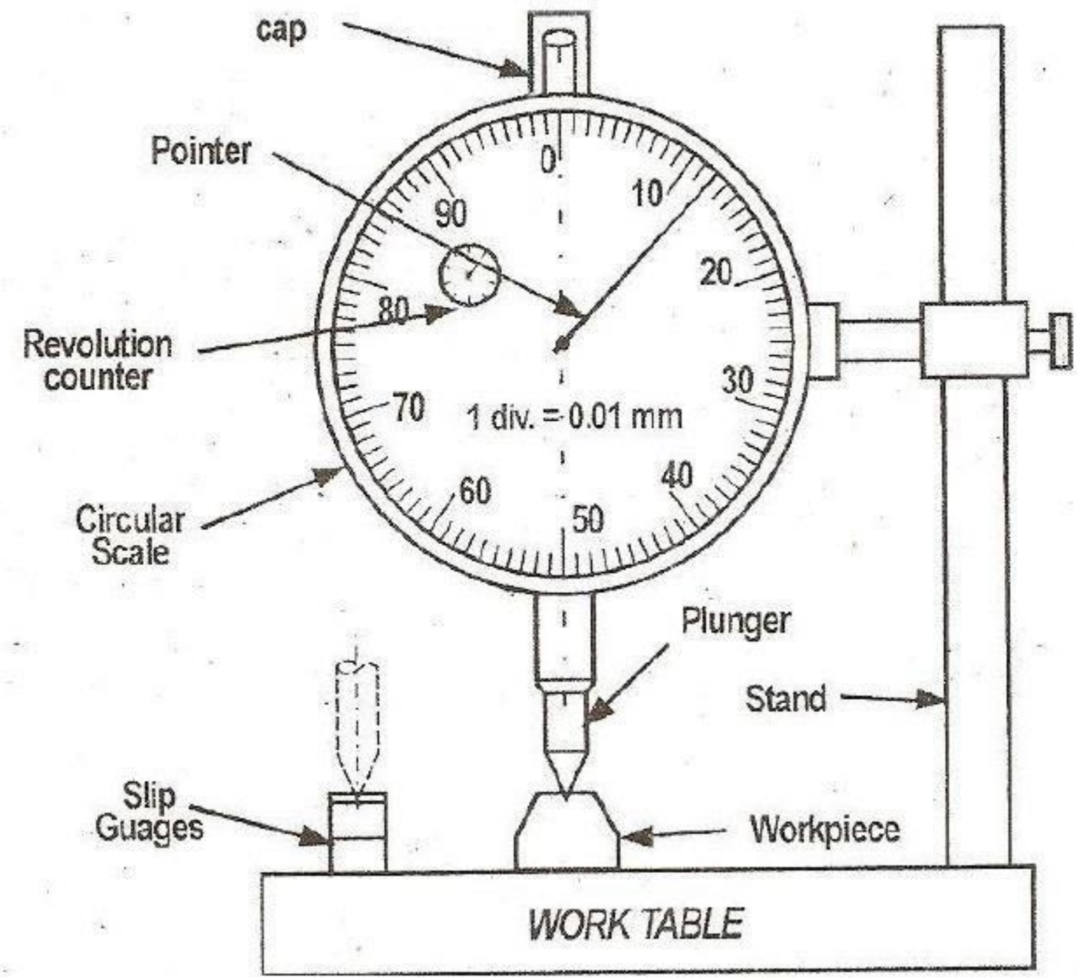
The diameter, pitch and angle of thread for the given specimen are found out.

Major diameter =

Minor diameter =

Pitch of screw =

Angle of thread =



Mechanical Comparator

6. (a) STUDY OF MECHANICAL COMPARATOR

AIM:

To study the use of mechanical comparator

THEORY:

MECHANICAL COMPARATOR

Comparator is one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions. Comparator normally will not show the actual dimensions of the work piece. They will be showing only the deviation in size.

Mechanical comparator employs mechanical terms for magnifying small deviations. The method of magnification small movements of the indicator in all mechanical comparators is effected by means of levers gear trains or a combination of these elements. Mechanical comparators are available having magnifications from 300 to 5000 to 1. These are mostly used for inspection of small parts machined to closed limits.

RESULT:

The use of mechanical comparator is studied

TABULATION L.C = 0.01 mm

SL.NO	DEFLECTION (Div.)	TOLERANCE (mm)	ALLOWANCE (mm)	DECISION
1				
2				
3				
4				
5				

6. (b) CHECKING THE LIMITS OF DIMENSIONAL TOLERANCE USING MECHANICAL COMPARATOR

AIM:

To check the height of a mechanical component with standard dimension component using Mechanical comparator

APPARATUS REQUIRED

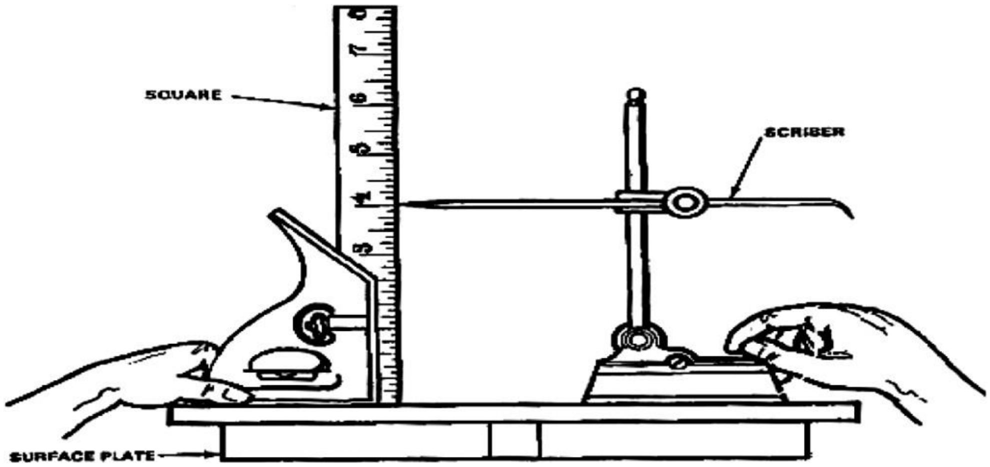
1) Slip gauge set
2) Mechanical comparator
3) Surface plate
4) Vernier caliper
5) Dial indicator

PROCEDURE

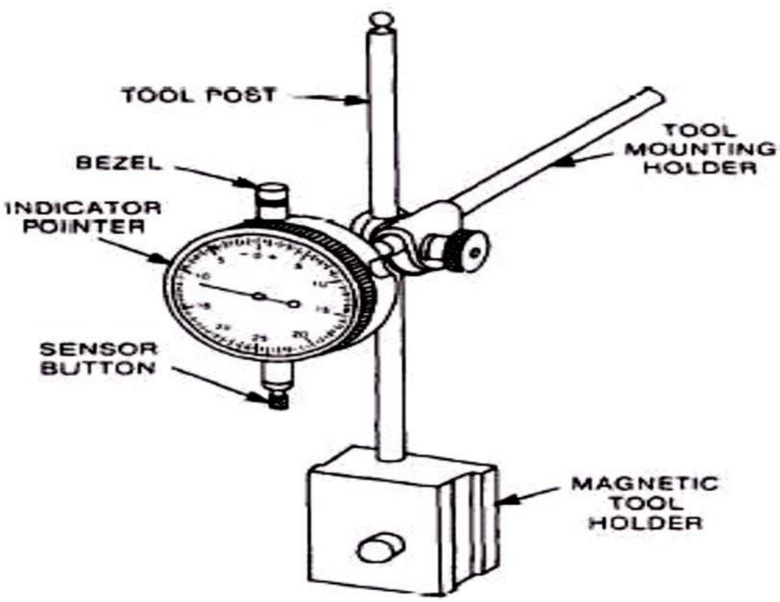
1. Clean the instruments and its accessories by fine cotton cloths
2. Measure the basic size of the given specimen by using Vernier Caliper
3. Place the slip gauge on the mechanical comparator
4. Now set the basic size of the work piece in the mechanical comparator and set the dial indicator in zero position and remove the slip gauge from the mechanical comparator
5. The given specimen is placed under the plunger of mechanical comparator and note down the variation in height of the component is noted from reading of dial.
6. Tabulate the readings

RESULT

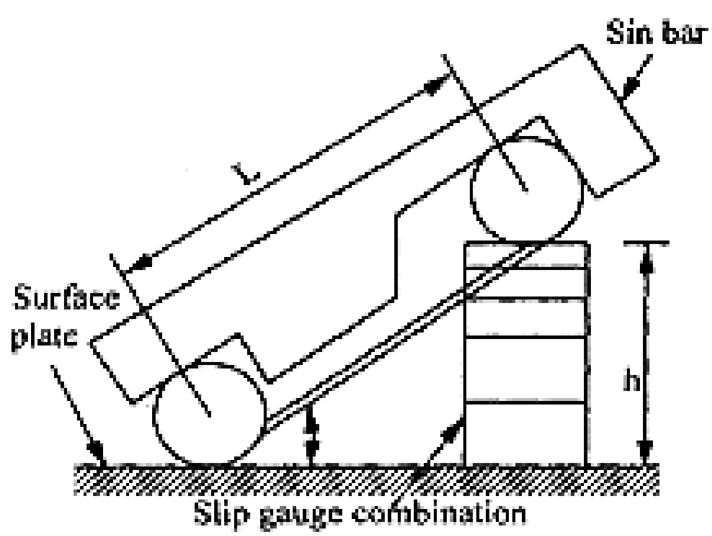
The dimension of the specimen was checked by using mechanical comparator.



Surface plate



Dial Gauge



Sine Bar

7. (a) STUDY OF SINE BAR

AIM:

To study about Sine bar

THEORY:

SURFACE PLATE

The foundation of all geometric accuracy and indeed of all dimensional measurement in workshop is surface plate. It is a flat smooth surface sometimes with leveling screws at the bottom.

Uses:

- ✓ It is used as a base in all measurements

DIAL GAUGE

The dial gauge has got 2 hands. The short hand reads in mm. One complete revolution of long hand reads one mm. The plunger of the dial gauge has to be placed on the surface whose dimension has to be read.

Least Count = One division of the circular scale with long hand.

Uses:

It is used as a mechanical comparator.

SINEBAR

A sine bar consists of a hardened, precision ground body with two precision ground cylinders fixed at the ends. The distance between the centers of the cylinders is precisely controlled, and the top of the bar is parallel to a line through the centers of the two rollers. The dimension between the two rollers is chosen to be a whole number (for ease of later calculations) and forms the hypotenuse of a triangle when in use.

When a sine bar is placed on a level surface the top edge will be parallel to that surface. If one roller is raised by a known distance, usually using gauge blocks, then the top edge of the bar will be tilted by the same amount forming an angle that may be calculated by the application of the sine rule.

RESULT:

The detailed about sine bar is studied

TABULATION:

SL.NO	SPECIMEN	SLIP GAUGE READING (mm)	THEORETICAL ANGLE (Deg)	EXPERMENTAL ANGLE (Deg)
1				
2				

Model Calculation:

(i) Theoretical Value:

Diameter of bigger end D = 20 mm

Diameter of Small end d = 10 mm

Length L = 150 mm

$$tan\,\theta = \frac{D-d}{l}$$

$$\theta = tan^{-1}\frac{D-d}{l}$$

$$\theta = tan^{-1}$$

$$\theta =$$

(ii) Experimental value:

Height (h) =

$$Sin\theta = \frac{h}{l}$$

$$\theta = sin^{-1}\left(\frac{h}{l}\right)$$

$$\theta = sin^{-1}(\quad)$$

$$\theta = {}^\circ$$

7. b) MEASUREMENT OF TAPER ANGLES USING SINE BAR

AIM

To measure the taper angle of the given specimen using sine bar

APPARATUS REQUIRED

1. Surface plate,
2. Dial gauge with stand,
3. Sine bar,
4. Slip gauge,
5. Specimen

FORMULA

1. Experimental angle of the work piece

$$\text{Sine } \theta = \frac{h}{L}$$

Where,

θ = Taper angle in deg.

h = Total height (thickness) of the slip gauges in mm

L = Standard length of the sine bar in mm = 150mm

2. Theoretical angle of the work piece

$$\text{Tan}\theta = \frac{(D-d)}{L}$$

Where,

D = Diameter of the bigger end in mm

d = Diameter of the smaller end in mm

l = Length of the work piece in mm

PROCEDURE

1. The taper angle of the specimen is first found out approximately with the help of a bevel protractor.
2. The sine bar is set at this angle on the surface plate with the help of the slip gauges as shown in the figure.
3. The specimen is placed on the Sine bar so that its top taper surface is parallel to the surfaceplate.

4. The parallelism is checked and adjusted by increasing or decreasing the height level of the slip gauges, so that there should be no deflection in the long hand of the digital gauge when the spindle of the dial gauge is moved over the specimen surface.

5. The total height (thickness) of the slip gauges is noted down.

6. Trial readings are taken by placing the specimen at different points of the sine bar surface.

RESULT:

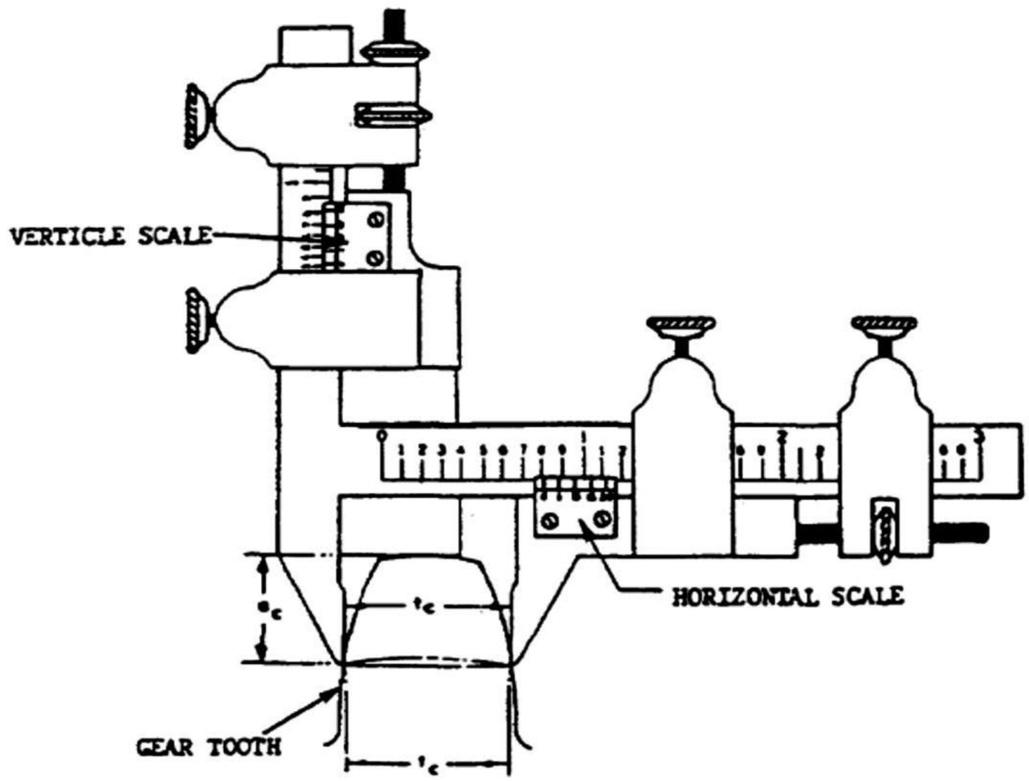
The taper angles of the given specimens are calculated using sine bar.

For specimen 1 taper angle

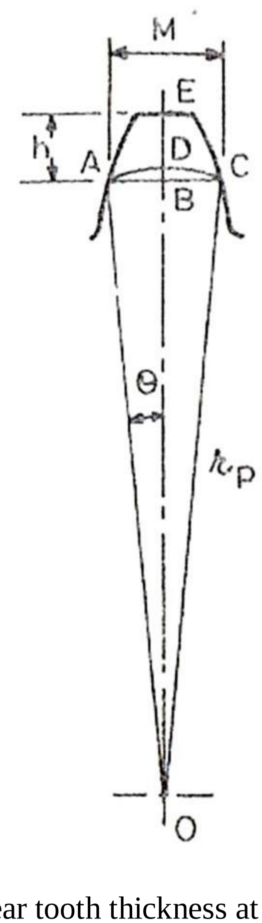
1. By theoretically =
2. By experimentally =

For specimen 2 taper angle

1. By theoretically =
2. By experimentally =



Gear tooth Vernier caliper



Gear tooth thickness at pitch line

8. (a) STUDY OF GEAR TOOTH VERNIER

AIM:

To study about the gear tooth Vernier

APPARATUS REQUIRED

1. Gear tooth Vernier,
2. Gear specimen.

THEORY:

GEAR TOOTH VERNIER

The tooth thickness is defined as the length of the arc of the pitch circle between opposite faces of the same tooth. Most of the time a gear Vernier is used to determine the tooth thickness. Asthe tooth thickness varies from top to bottom, any instrument for measuring on a single tooth must

1. Measure the tooth thickness at a specified position on the tooth.
2. Fix that position at which the measurement is taken.

The gear tooth Vernier, therefore, consists of a Vernier caliper for making the measurement M, combined with a Vernier depth for setting the dimension h at which the measurement M is to beaffected.

TERMINOLOGY OF SPUR GEAR

Pitch surface: The surface of the imaginary rolling cylinder (cone, etc.) that the toothed gear may be considered to replace.

Pitch circle: A right section of the pitch surface.

Addendum circle: A circle bounding the ends of the teeth, in a right section of the gear.

Root (or Dedendum) circle: The circle bounding the spaces between the teeth, in a right section of the gear.

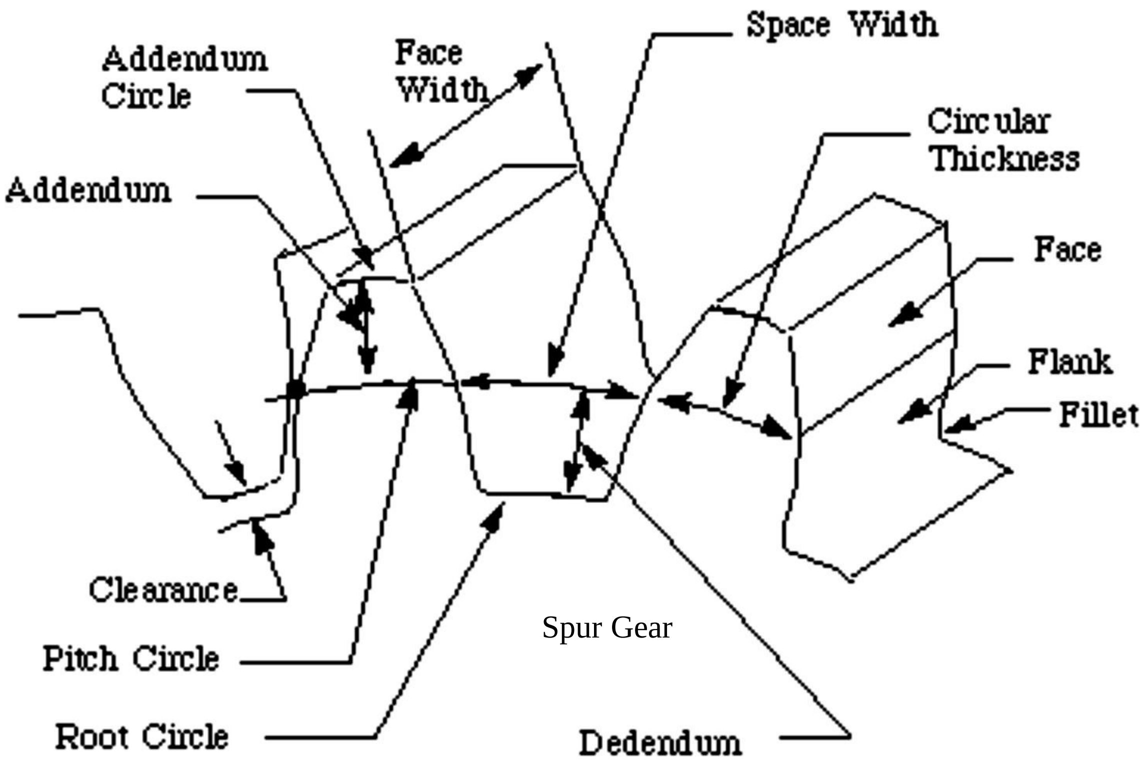
Addendum: The radial distance between the pitch circle and the addendum circle.

Dedendum: The radial distance between the pitch circle and the root circle.

Clearance: The difference between the dedendum of one gear and the addendum of the mating gear.

Face of a tooth: That part of the tooth surface lying outside the pitch surface.

Flank of a tooth: The part of the tooth surface lying inside the pitch surface.


Space Width
Addendum
Circle
Face
Width
Circular
Thickness
Addendum
Face
Flank
Fillet
Clearance
Pitch Circle
Root Circle
Dedendum

Spur Gear

Circular thickness: (also called the tooth thickness) the thickness of the tooth measured on the pitch circle. It is the length of an arc and not the length of a straight line.

Tooth space: The distance between adjacent teeth measured on the pitch circle.

Backlash: The difference between the circle thickness of one gear and the tooth space of the mating gear.

Circular pitch: The width of a tooth and a space, measured on the pitch circle.

Diametral pitch P: The number of teeth of a gear per inch of its pitch diameter. A toothed gear must have an integral number of teeth. The circular pitch, therefore, equals the pitch circumference divided by the number of teeth. The diametral pitch is, by definition, the number of teeth divided by the pitch diameter.

Module m: Pitch diameter divided by number of teeth. The pitch diameter is usually specified in inches or millimeters; in the former case the module is the inverse of diametral pitch.

Fillet: The small radius that connects the profile of a tooth to the root circle.

Pinion: The smaller of any pair of mating gears. The largest of the pair is called simply the gear.

Velocity ratio: The ratio of the number of revolutions of the driving (or input) gear to the number of revolutions of the driven (or output) gear, in a unit of time.

Pitch point: The point of tangency of the pitch circles of a pair of mating gears.

Common tangent: The line tangent to the pitch circle at the pitch point.

Line of action: A line normal to a pair of mating tooth profiles at their point of contact.

Path of contact: The path traced by the contact point of a pair of tooth profiles.

Pressure angle: The angle between the common normal at the point of tooth contact and the common tangent to the pitch circles. It is also the angle between the line of action and the common tangent.

Base circle: An imaginary circle used in involute gearing to generate the involutes that form the tooth profiles.

RESULT:

The gear tooth Vernier are studied

TABULATION: L.C = 0.02 mm

SL.NO	No of Gear tooth (Z) (Nos)	Main Scale Reading (mm) M.S.R	Vernier Scale Reading (mm) V.S.R	Actual reading =M.S.R+(V.S.R×L.C) (mm)	Mean Tooth Thickness (mm)
1					
2					

Model Calculation:

Module m = $\frac{D}{Z+2}$=

Pitch Circle Diameter = z× m =

Thickness of gear tooth (t) = m ×$\frac{\pi}{2}$ =

Addendum n = $m + \frac{t^2}{4D}$=

8. (b) MEASUREMENT OF GEAR TOOTH DIMENSIONS USING GEAR TOOTH VERNIER

AIM:

To measure gear parameters for the given spur gear by gear tooth Vernier.

APPARATUS REQUIRED

1. Gear tooth Vernier,
2. Gear specimen.

FORMULA USED:

1. Module m = $\frac{D}{z+2}$

   Where,

   D = Outside diameter of the gear in mm

   Z = No of Teeth

2. Pitch circle diameter = z.m
3. Thickness of gear tooth = m $\times \frac{\pi}{2}$
4. Addendum h = m +$t2/_{4D}$

PROCEDURE

1. The gear tooth Vernier has one horizontal and vertical slide. Each slide can be moved independently using screws. For measuring chordal thickness, first the vertical slide is set to the height ‘h’ which is the vertical height measured from the chord at pitch point to the crest of the tooth.
2. Initially the number of teeth is counted and pitch circle diameter is calculated using the formula. Then addendum is calculated using the formula.

   It may be also calculated as follows

   h = m [1+ Z (1- cos 90/Z)/2]

3. After setting the height ‘h’ in the vertical slide, the slide is locked position. Then the slide is made to rest over the crest of the gear tooth. The horizontal slide is touching the side of the gear tooth. Now the chordal thickness is measured from the horizontal vernier scale.

RESULT:

The gear tooth thickness is found out and compared with theoretical value using gear tooth vernier

GEAR 1:

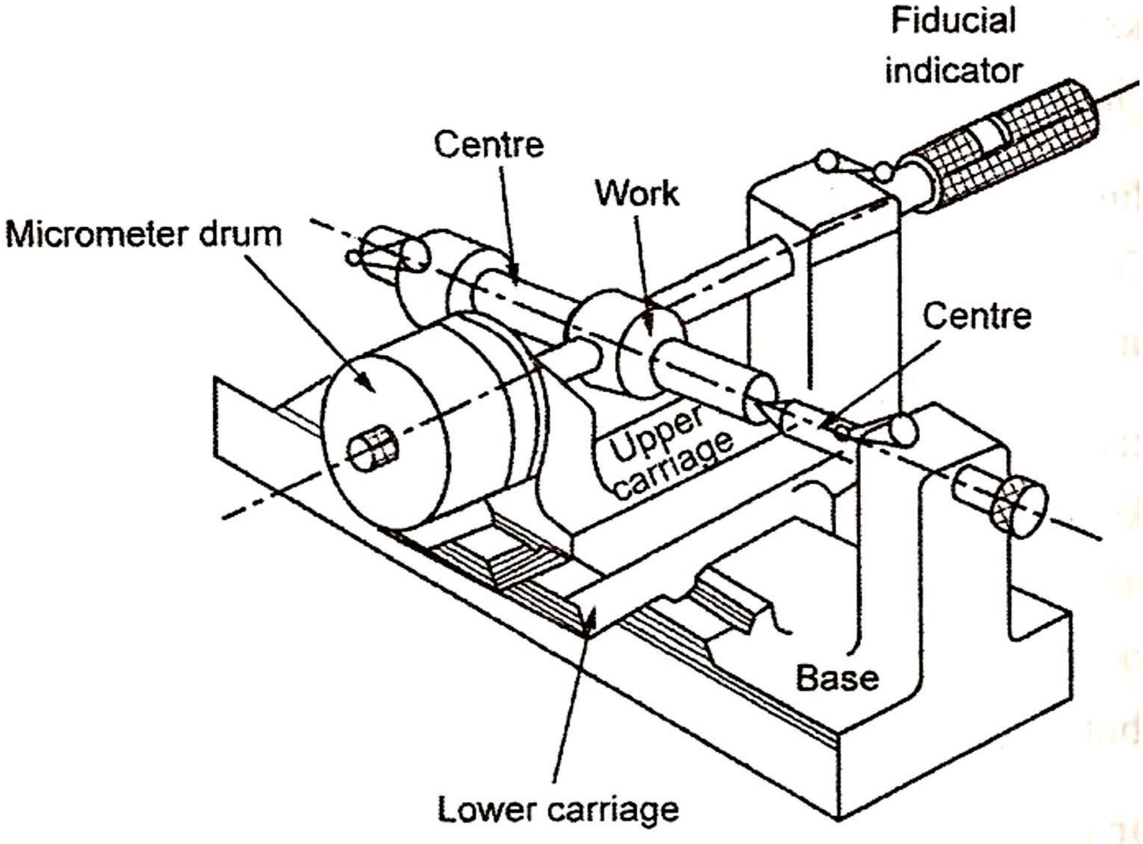
Theoretical Value =

Experimental value =

GEAR 2:

Theoretical Value =

Experimental value =



Floating Carriage Micrometer

9. (a) STUDY OF FLOATING CARRIAGE MICROMETER

AIM:

To study the use of floating carriage micrometer

SPECIFICATIONS

1. Weight of the machine: Approx. 25kg.
2. L x W x H: Approx. 350mm x 150mmx 140mm
3. List count of micrometer: 0.001 mm
4. Standard micrometer or electronic type.
5. Electronic Micrometer has digital display and Std.
6. Dial type Fiducial Indicator with 0.01mm standard dial.
7. Admit between centres 200 mm
8. Max Diameter capacity 100mm

THEORY:

FLOATING CARRIAGE MICROMETER

In order to ensure the manufacture of screw threads to the specified limits laid down in the appropriate standard it is essential to provide some means of inspecting the final product. For measurement of internal threads thread plug gauge is used and to check these plug gauges Floating Carriage Micrometer is used for measuring Major, Minor and Effective diameter.

Measuring machine shown in the figure has ―Base with two small and one big adjustable support knobs provided for leveling the assembled unit. Base has two parallel integrals ―V‖ grooves one short and other long. Long groove is for guide pegs located at the bottom of ―Intermediate Piece‖ or ―Carriage‖ (B) and smaller for a ball. One more ―V‖ pair is in the Centre of the base, which is provided for accommodating ―Centers‖ (E) to hold work piece. Carriage has two parallel ―V‖ grooves, one to accommodate two balls and other to accommodate one ball. Underneath the floating top (C) there is one ―V‖ groove on one side and flat portion on other side. Digital Micrometer is in one bracket (with less width) and dial type fiducial on the other side lever is provided to tighten it.

RESULT:

The floating carriage micrometer are studied

9.(b) MEASUREMENT OF THREAD PARAMETERS BY USING FLOATING CARRIAGE MICROMETER

AIM

To measure the major diameter, minor diameter & effective diameter of external screw threads by using floating carriage micrometer.

APPARATUS REQUIRED

1. Floating carriage micrometer.
2. Specimen
3. Prism
4. Wire
5. Cylinder.

FORMULA

Major Diameter Measurement:

$OD = D + (R_S \sim R)$

Where,

D = Diameter of setting master in mm.
R_S = Micro meter reading over setting master in mm.
R = = Micro meter reading over threaded W/P or gauges, +/ – is determined by relative size of master & work piece in mm.

Minor Diameter Measurement:

$ID = D - (R \sim R_O)$

Where,

D = Diameter of setting master in mm.
C = Core or minor diameter of work piece in mm.
R_P = Reading over master & prism in mm.
R = Reading over master & prism in mm

Measurement of effective diameter by using 2 wire method:

$E = T + P$

$T = D + (R_W \sim R_{OW})$

Where,

E = Effective or pitch diameter in mm.
T = Measured dimension using cylinder in mm.
R_W = Reading measured over setting master with wire in mm.
R_{OW} = Reading measured over work piece over wire in mm.

TABULATION:

S.NO	DESCRIPTION	SPECIMEN	MAIN SCALE READING (mm)	PITCH SCALE READING (mm)	OBSERVED READING (mm) O.R=M.S.R + (P.S.R ×L.C)	Actual Reading (mm)
1	Major Diameter	Setting Component				
		Workpiece				
2	Minor Diameter	Setting Component				
		Workpiece				
3	Effective Diameter	Setting Component				
		Workpiece				

Calculation:

1. **Major Diameter**: OD = D + (R_S~ R)

   Where:D = Rs = and R =

   OD =

   OD =

2. **Minor Diameter**:ID = D + (R~ R_O)

   Where: D = , Ro = and R =

   OD =

   OD =

3. **Effective Diameter:**E = T+P

   Where P = (0.86603 ×P) – W = (0.86603 ×2) – 1.35 = 0.3820 mm^2

   T = D + (Rw~ R_{Ow})

   Where: D = , R_w = and R_{ow} =

   T =

   Therefore E = T+P

   E =

P = (0.86603 x p) – W

W =Mean diameter of cylinder wire used = 1.35 mm

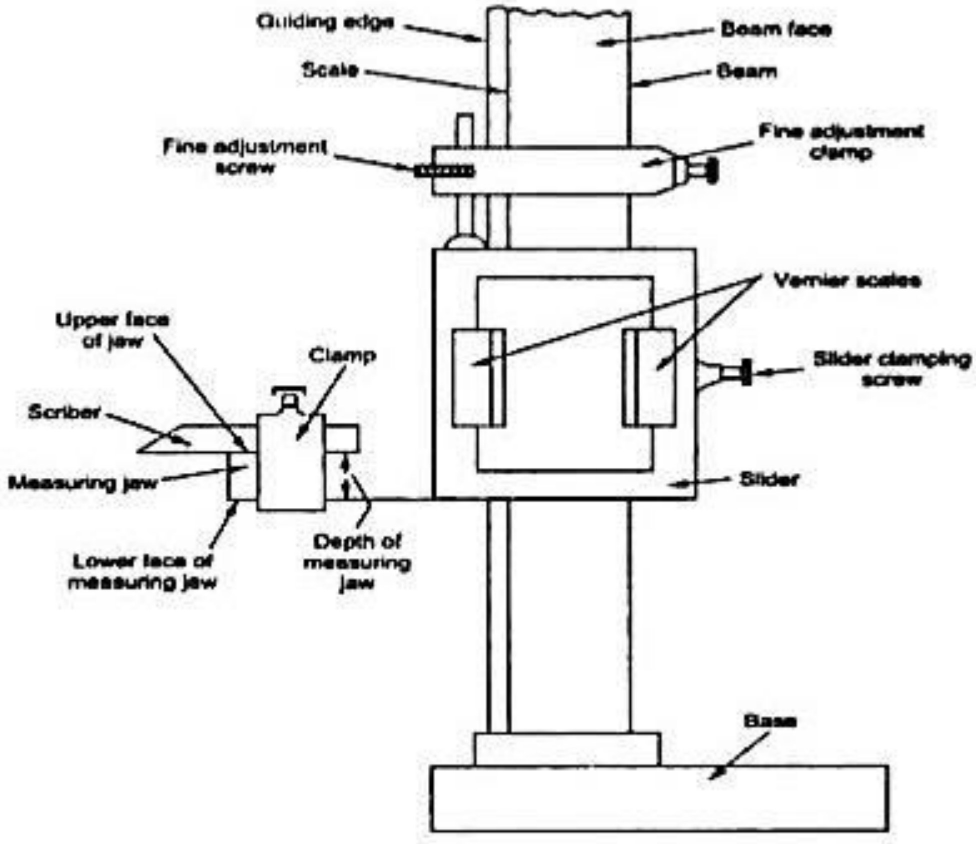
p = Pitch of thread = 2 mm

PROCEDURE

1. The setting master is held b/w center and taken the reading at the diameter say R_S.
2. The master cylinder is then replaced by a threaded work piece and R is taken.
3. Take the reading on micrometer and indicator in such a way that radius portion of prism touches master.
4. The cylinder or wire should be chosen so that when placed b/w the threads, they should contact about halfway down the flanks.

Result:

Thus, the thread parameters of a screw thread are measured using floating carriage micrometer



Vernier height gauge

10. (a) STUDY OF VERNIER HEIGHT GAUGE

AIM:

To study the precision measuring instrument such as Vernier height gauge.

APPARATUS REQUIRED:

1. Dial gauge
2. Standard slip gauge
3. Specimens

THEORY:

VERNIER HEIGHT GAUGE:

The Vernier height gauge gives a direct reading and is designed for the accurate measurement and marking off vertical height above a surface plate datum. It can also be used to measure differences in heights by taking the Vernier scale reading at each height and determining the difference by subtraction. A major advantage of the Vernier height gauge is that it contains its own measuring scale, capable of direct measurement to a fraction of millimeter usually 0.02mm.

The height gauge has a solid base. A vertical beam is mounted over the base. The vertical has main scale graduations. A slider slides up and down along the beam. The slider has s Vernier scale. The slider can be locked using a clamping screw. The slider can be adjusted accurately using a fine adjustment screw. The slider has the measuring jaw integral with it. A scriber is clamped to the measuring jaw.

RESULT:

The use of Vernier height gauge is studied.

TABULATION:

Least count=0.02mm

S.NO	VERNIER HEIGHT GAUGE READING (mm)				SLIPGAUGE READINGS (mm)	ERROR (mm)
	MSR (mm)	VSC	VSR (mm)	TR =M.S.R + (V.S.R		
1						
2						
3						
4						
5						

Model Calculation:

Correct Reading CR = MSR + (VSD×LC)

=

=

10. (b) CALIBRATION OF VERNIER HEIGHT GAUGE

AIM:

To calibrate the Vernier height gauge using slip gauges

INSTRUMENTS REQUIRED

1. Vernier height gauge
2. Slip gauge

FORMULAUSED:

TR =MSR+ (VSCXLC)

Where, TR-Total Reading

MSR-Main Scale Reading

VSC-Vernier Scale Coincide

LC-Least Count

PROCEDURE:

1. Vernier height gauge is cleaned with a cloth.
2. The clamping screws are loosened.
3. The given component is fixed in both the two jaws.
4. The component should be perfectly holded.
5. The height is measured with the external jaws.
6. The height of the component is measured by adjusting the movable jaws.
7. The procedure is repeated for all the components.
8. At least three readings should be taken and then average will give the accurate measurement.

RESULT:

Thus, the Vernier height gauge was calibrated by using slip gauge.

TABULATION: L.C = 0.02 mm

S.NO	SPECIMEN	MAIN SCALE READING M.S.R (mm)	VERNIER SCALE READING V.S.R (mm)	OBSERVED READING (mm) =M.S. R + (V.S.R ×L.C)	Result
1	Step : 1				
2	Step : 2				
3	Step : 3				

Model Calculation:

Correct Reading CR = MSR + (VSD×LC)

=

=.

10. (c) MEASUREMENT BY USING VERNIER HEIGHT GAUGE

AIM

To determine the height of the given specimen by using the precision measuring instruments like Vernier height gauge.

APPARATUS REQUIRED

1. Surface plate,
2. Vernier caliper,
3. Micrometer.
4. Dial gauge,
5. Standard slip gauge,
6. Vernier Height Gauge.

FORMULA

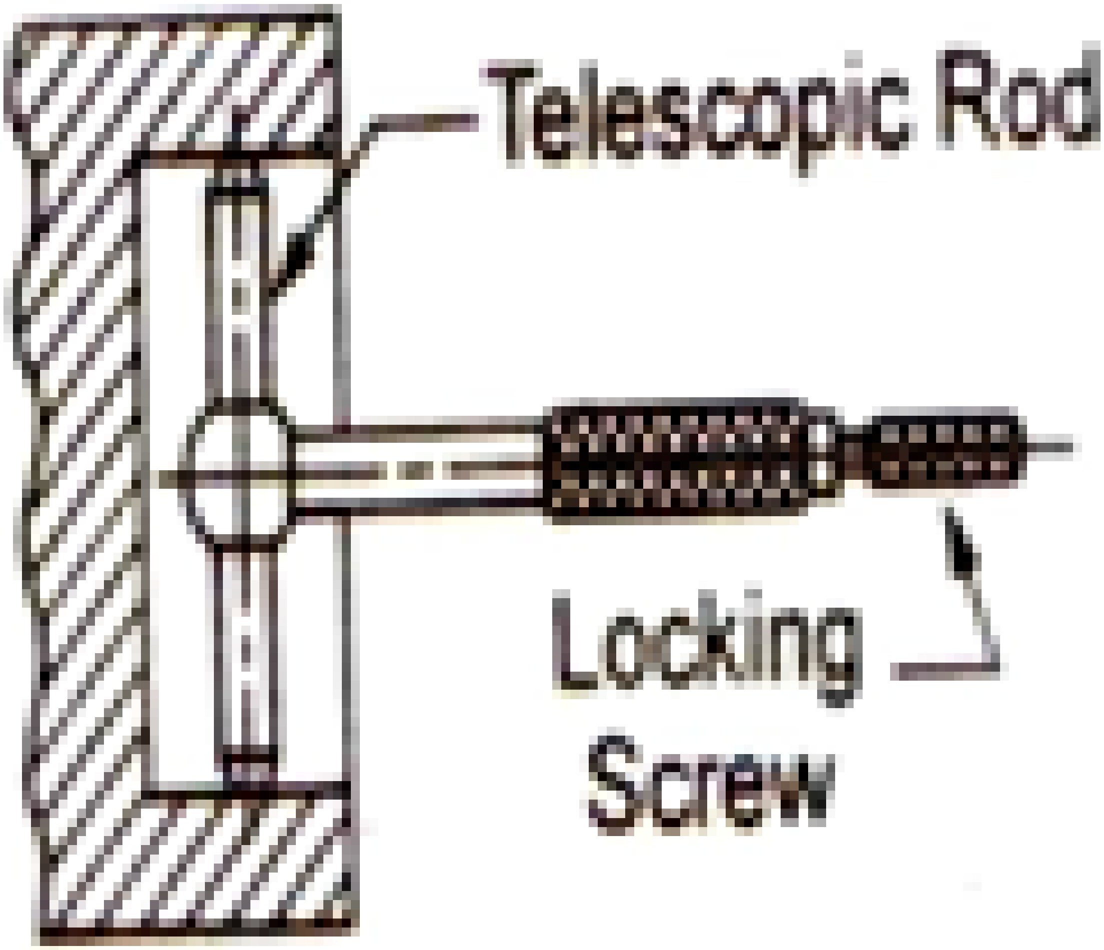
Least Count = 1 Main Scale Division – 1 Vernier Scale Division in mm Vernier Scale Reading = Vernier Scale Coincidence X Least Count in mmTotal Reading = Main Scale Reading + Vernier Scale Reading in mm

PROCEDURE:

- Clean the main scale, Vernier scale and measuring jaws of the Vernier height gauge withfine cotton cloth
- The Vernier height gauge is checked for zero
- Place the job in the surface plate
- Place the measuring jaw such that it touches the surface to be measured from the smoothsurface
- Measure the main scale reading and Vernier scale coincidence of the Vernier height gauge

RESULT:

The measurement of given specimen is carried out using Vernier height gauge.



Telescopic Gauge

11. (a) STUDY ABOUT THE USES OF TELESCOPIC GAUGE

AIM:

To study about the uses of telescopic gauge

APPARATUS REQUIRED:

1. Telescopic gauge
2. Vernier caliper
3. Micrometer
4. Specimen

THEORY:

Telescopic Gauge

The telescopic gauge is used for the measurement of internal diameter of a hole during machining operation. It consists of a handle and two plungers, one telescopic into the other and both under spring tension. Ends of the plungers have spherical contacts. The plunger can be locked in position by turning a knurled screw at the end of the handle. To measure the diameter of a hole, the plungers are first compressed and locked in position. Next, the plunger end is inserted in the hole and allowed to expand the opposite edges. Finally, they are locked in place, taken out of the hole, and measured by an outside micrometer

RESULT:

The uses of telescopic gauge are studied.

TABULATION:

S.NO	SPECIMAN	MAIN SCALE READING M.S.R(mm)	PITCH SCALE READING P.S.R(mm)	OBSERVED READING (mm) =M.S.R + (P.S.R ×L.C)	MEAN =O.R / No of readings taken (mm)

11. (b)MEASUREMENT OF BORE DIAMETER USING TELESCOPIC GAUGE

AIM:

To measure the bore diameter of the hollow work piece by using telescopic gauge

APPARATUS REQUIRED:

1. Telescopic gauge
2. Vernier caliper
3. Micrometer
4. Specimen

FORMULAE

MICROMETER:

Pitch Scale Reading = Pitch Scale Coincidence x Least Count

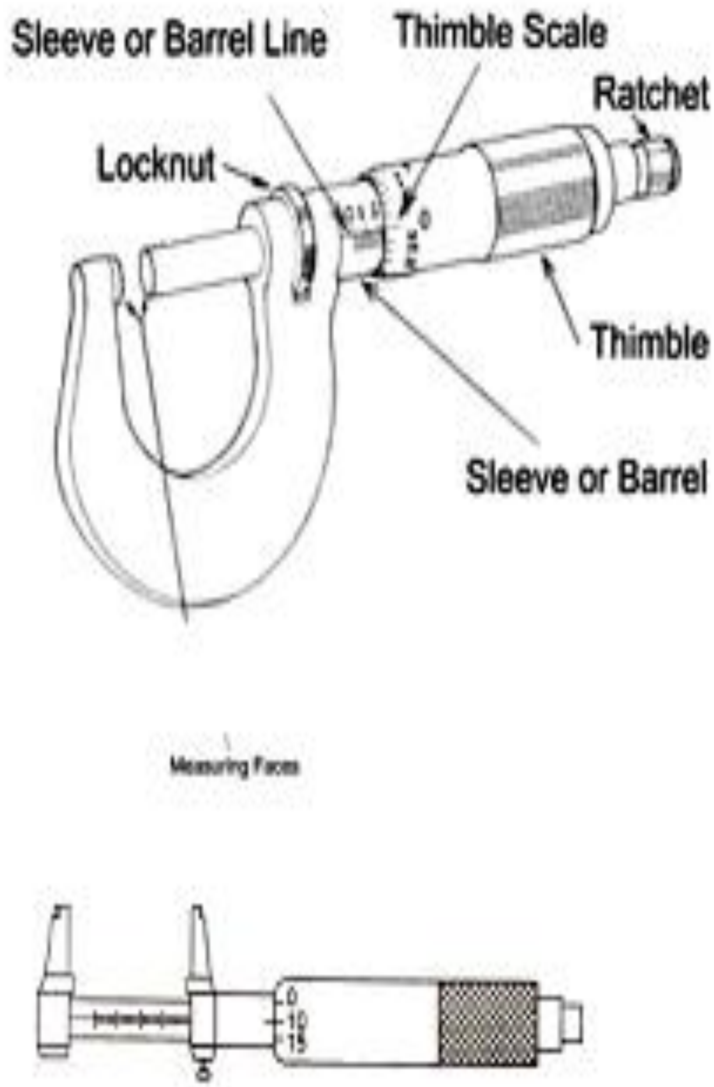
Total Reading = Head Scale Reading + Pitch Scale Reading

PROCEDURE:

1. Range of the instruments is noted down.
2. The work piece is placed on the surface plate and set the measuring instrument for zero
3. To measure the diameter of a hole, the plungers are first compressed and locked in position
4. Next, the plunger end is inserted in the hole and allowed to expand the opposite edges
5. Finally, they are locked in place, taken out of the hole, and measured by an outside micrometer

RESULT

The precision measuring instruments are studied and compared. The diameter of work pieces is determined by using



Outside Micrometer & Inside Micrometer

12. STUDY OF INSIDE MICROMETER

AIM:

To study the precision measuring instrument such as Vernier caliper and Vernier height gauge.

APPARATUS REQUIRED

1. Surface plate,
2. Vernier caliper,
3. Micrometer

MICROMETER

Outside micrometer:

An outside micrometer is shown. It consists of two scales, main scale and thimble scale. While the pitch of barrel screw is 0.5 mm the thimble has graduation of 0.01 mm. The least count of this micrometer is 0.01 mm.

The micrometer requires the use of an accurate screw thread as a means of obtaining a measurement. The screw is attached to a spindle and is turned by movement of a thimble or ratchet at the end. The barrel, which is attached to the frame, acts as a nut to engage the screw threads, which are accurately made with a pitch of 0.05mm. Each revolution of the thimble advances the screw 0.05mm. On the barrel a datum line is graduated with two sets of division marks.

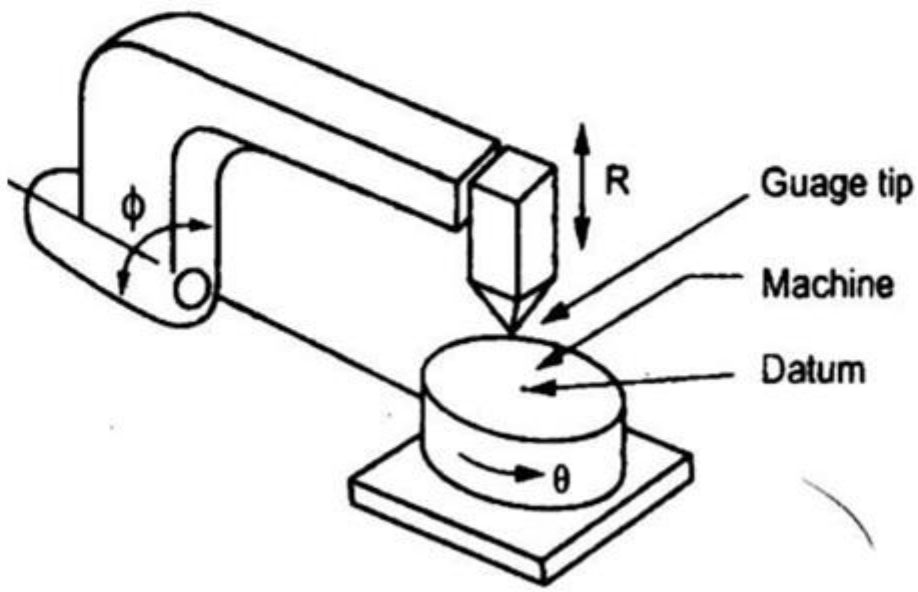
Inside micrometer:

Inside micrometer is used for measuring internal dimensions.it has mainly four parts such as measuring head, extension rods, spacing collars and handle. The range of instrument is varied by using different lengths of the extension rods and spicing collars. The selection of extension rod is based on nearest 1cm and connected in the micrometer head. One micrometer head is held tightly against the bore but the surface adjusted till the correct feel is sensed. Inside micrometer can also be used as a height gauge with suitable arrangements to measure inside diameter of the cylinders, rings etc.

The range of inside micrometer are 25-150, 150-300,300 – 450 and 450 – 600mm. Usually, the extensions rods are made of hardened materials up to 800HV but measuring faces are brazed with tungsten carbide or other hard material to reduce wear and tear. But before putting into operation, the measuring faces are lapped to ensure high precision and good surface finish. Spacing collars are used to obtain fine adjustments in its range. Detachable handles are used in inside micrometer.

RESULT:

The uses of micrometer are studied.


R
Guage tip
Machine
Datum
ϕ
θ

13. STUDY OF USES OF CO ORDINATE MEASURING MACHINE

AIM:

To measure thread parameter of a given screw thread using coordinate measuring machine.

APPARATUS REQUIRED

1. Coordinate measuring machine
2. Specimen

THEORY:

Measuring machines are used for measurement of length over the outer surfaces of a length bar or any other long member. The member may be either rounded or flat and parallel. It is more useful and advantageous than vernier calipers, micrometer, screw gauges etc. the measuring machines are generally universal character and can be used for works of varied nature. The co-ordinate measuring machine is used for contact inspection of parts. When used for computer-integrated manufacturing these machines are controlled by computer numerical control. General software is provided for reverse engineering complex shaped objects. The component is digitized using CNC, CMM and it is then converted into a computer model which gives the two surface of the component. These advances include for automatic work part alignment on the table. Savings in inspection 5 to 10 percent of the time is required on a CMM compared to manual inspection methods.

RESULT:

The uses of CMM are studied

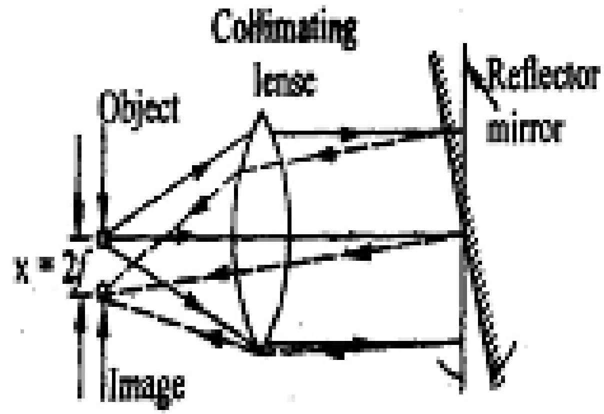


Fig 2.25 Auto-Collimator

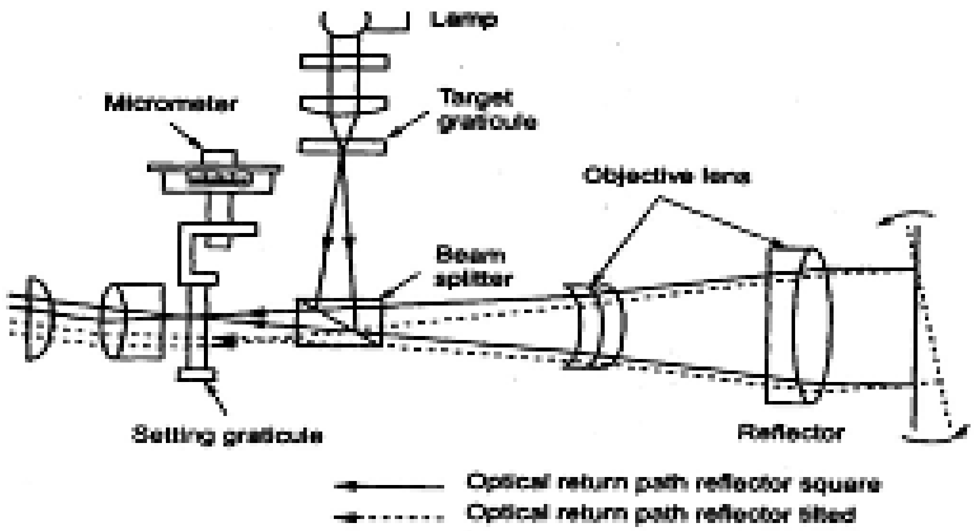


Fig 2.26 Line diagram of an injected graticule auto-collimator

14. (a) STUDY OF AUTO COLLIMATOR

AIM:

To study about the uses of autocollimator.

APPARATUS REQUIRED:

1. Collimator Unit
2. Base
3. Plain Reflector
4. Optical Source

THEORY:

AUTO- COLLIMATOR

Auto-collimator is an optical instrument used for the measurement of small angular differences, changes or deflection, plane surface inspection etc. For small angular measurements, autocollimator provides a very sensitive and accurate approach. An autocollimator is essentially an infinity telescope and a collimator combined into one instrument

Basic principle

If a light source is placed in the flows of a collimating lens, it is projected as a parallel beam of light. If this beam is made to strike a plane reflector, kept normal to the optical axis, it is reflected back along its own path and is brought to the same focus. The reflector is tilted through a small angle '0'. Then the parallel beam is deflected twice the angle and is brought to focus in the same plane as the light source.

RESULT:

The uses of autocollimator are studied

TABULATION:

SL.NO	TEST SURFACE LENGTH (mm)	AUTOCOLLIMATOR READING (mm)

14. (b) MEASUREMENT OF ANGLE BY USING AUTO COLLIMATOR

AIM:

To test the angle of the given object.

APPARATUS REQUIRED:

1. Collimator Unit
2. Base
3. Plain Reflector
4. Optical Source

SPECIFICATION:

Objective focal length	=	300mm
Objective clear aperture	=	25mm
Barrel diameter	=	38mm
Barrel length	=	200mm
Eyepiece magnification	=	10X
Measuring range	=	25 minutes
Read out	=	direct gratitude ATP
Dimensions of base	=	Solid lagged C.I base (75mm*250mm)
Flatness of base	=	As per ISI stander's

PROCEDURE:

1. Switch on the light and observe the measuring gratitude through eyepiece.
2. The smallest division of liner scale is 1 minute.
3. Bring the plain reflector in front of autocollimator to get a reflected.
4. Depending upon variation in surface position of target will change on measuring scale.
5. There upon the position of intersection point of cross bar line will measuring gratitude is the deviation in minute.
6. Using micrometer provided for eyepiece we can measure the function up to 10 seconds

RESULT:

Thus, the angle of a given workpiece and graph was plotted.