SRM VALLIAMMAI ENGINEERINGCOLLEGE
(An Autonomous Institutions)

SRM Nagar, Kattankulathur– 603203

DEPARTMENT OF MECHANICAL ENGINEERING

NBA ACCREDITED

Lab Manual

V SEMESTER

ME 3566 - Metrology and Measurements Laboratory

Regulation–2023

Academic Year 2026–27

Prepared by

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SRM VALLIAMMAIENGINEERING COLLEGE
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SRMNagar,Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

ME3566 METROLOGY AND MEASUREMENTS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

1. Demonstrate the calibration of simple linear measuring instruments used in manufacturing industries.
2. Demonstrate the important linear measurements carried out in manufacturing industries.
3. Demonstrate the important angular measurements carried out in manufacturing industries.
4. Demonstrate the important Form measurements carried out in manufacturing industries.
5. Demonstrate the measurement of prismatic components using contact and noncontact methods and surface metrology.

LIST OF EXPERIMENTS:

1. Calibration of vernier calliper using gauge blocks and measurement of given samples.
2. Calibration of micrometer using gauge blocks and measurement of given samples using micrometer.
3. Calibration of dial gauge using given gauge blocks.
4. Calibration of vernier height gauge using gauge blocks and measurement of given sample using vernier height gauge.
5. Calibration of vernier depth gauge using gauge blocks and measurement of given sample using vernier depth gauge.
6. Measurement of bore diameter of given samples using Bore gauge.
7. Measurement of bore diameter of given samples using telescopic gauge
8. Measurement of linear dimensions of given sample using Comparator.
9. Measurement of angles using sine bar.
10. Measurement of gear parameters using gear tooth vernier.
11. Noncontact (Optical) measurement using Profile projector.
12. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge, dial gauge and depth gauge– using gauge blocks
2. Measurement of linear dimensions using Mechanical Comparators
3. Measurement of angular dimensions using Sine bar
4. Measurement of screw thread parameters using gear tooth vernier caliper
5. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments Noncontact (Optical) measurement using Profile projector

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ME3566 - METROLOGY AND MEASUREMENTS LABORATORY

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SL. NO.	NAME OF EQUIPMENTS	QUANTITY
1	Micrometer	5 Nos.
2	Vernier Caliper	5 Nos.
3	Vernier Height Gauge	2 Nos.
4	Vernier depth Gauge	2 Nos.
5	Slip Gauge Set	1 No.
6	Gear Tooth Vernier	1 No.
7	Sine Bar	1 No.
8	Profile Projector	1 No.
9	Mechanical Comparator	1 No.
10	Dial Gauge	2 Nos.
11	Bore Gauge	1 No.
12	Telescopic Gauge	1 No.

ME3566	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2										2	3	2		
CO2	3											2	3			
CO3	3											2	3			
CO4	3				2							2	3			
CO5	3				2							2	3			
Average	3				1							2	3			

(1-LOW, 2-MEDIUM, 3-HIGH)

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ME3566 - METROLOGY AND MEASUREMENTS LABORATORY

Cycle – 1

- Calibration and Measurement of given specimen by using **Vernier caliper**
- Calibration and Measurement of given specimen by using **Micrometer**
- Calibration and Measurement of given specimen by using **Dial gauge**
- Calibration and determine the height of the given specimen by using **Vernier Height gauge**
- Calibration and determine the height of the given specimen by using **Vernier Depth gauge**
- Measurements angle using **sine bar**

Cycle – 2

- Measurements of gear tooth dimensions by using **Gear Tooth Vernier**
- Measurements of thread parameters **profile projector**
- Measurement of linear dimensions of given sample using **Mechanical Comparator.**
- Bore diameter measurement using **telescopic gauge**
- Bore diameter measurement using **Bore gauge**
- Surface finish measurement using **surface Roughness Tester**

DEPARTMENT OF MECHANICAL ENGINEERING

REG NO	
SUBJECT	ME 3566 METROLOGY AND MEASUREMENTS LABORATORY
BRANCH	MECHANICAL ENGINEERING
YEAR \ SEM	III & V
REGULATION	2023
ACADEMIC YEAR	2026-2027

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ME 3566 METROLOGY AND MEASUREMENTS LABORATORY

OBJECTIVES:

To familiar with different measurement equipment's and use of this industry for quality inspection

LIST OF EXPERIMENTS:

1. Calibration of vernier calliper using gauge blocks and measurement of given samples.
2. Calibration of micrometer using gauge blocks and measurement of given samples using micrometer.
3. Calibration of dial gauge using given gauge blocks.
4. Calibration of vernier height gauge using gauge blocks and measurement of given sample using vernier height gauge.
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11. Noncontact (Optical) measurement using Profile projector.
12. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

TOTAL: 45 PERIODS

OUTCOMES

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge, dial gauge and depth gauge– using gauge blocks
2. Measurement of linear dimensions using Mechanical Comparators
3. Measurement of angular dimensions using Sine bar
4. Measurement of screw thread parameters using gear tooth vernier caliper
5. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments Noncontact (Optical) measurement using Profile projector

Ex. No: 1a ***Date:***

CALIBRATION AND MESUREMENT OF
(Vernier Caliper / Micrometer / Dial Gauge)

AIM

To study and calibrate the Vernier caliper, Micrometer, and Dial gauge.

APPARATUS REQUIRED

Surface plate

Vernier caliper

Micrometer

Dial gauge

Slip gauges

SPECIFICATION

Vernier caliper	Range: 0-300 'mm'	L. C:0.02 'mm'
Micrometer	Range: 0-25 'mm'	L. C:0.01 'mm'
Dial gauge	Range: 0-10 'mm'	L. C:0.01 'mm'

STUDY

1. Vernier Caliper

The Vernier caliper has one 'L' shaped frame with a fixed jaw on which Vernier scale is attached. The principle of Vernier is that when two scale divisions slightly different in sizes can be used to measure the length very accurately.

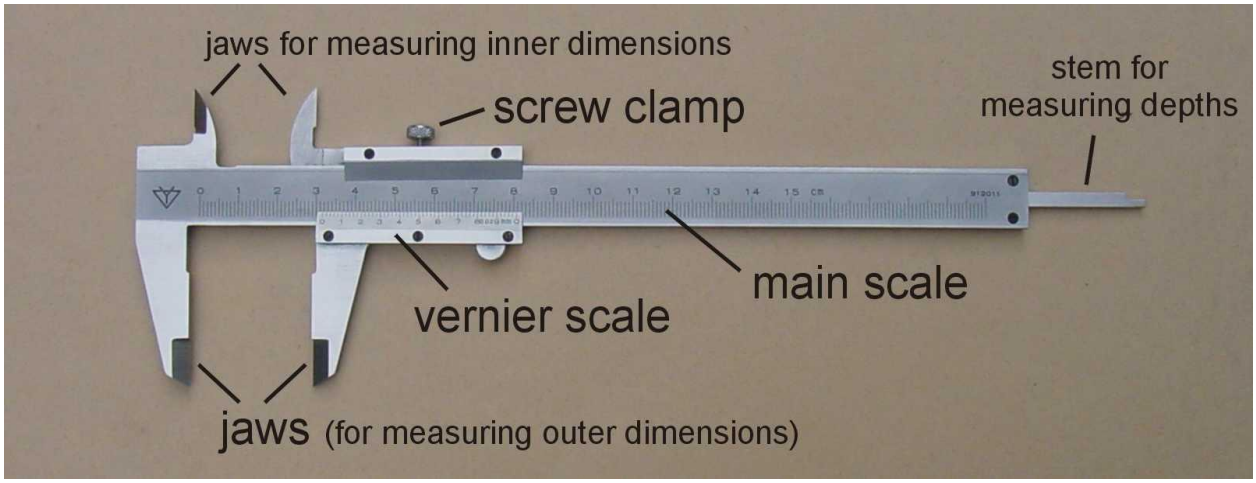


Fig: VERNIER CALIPER

Least Count is the smallest length that can be measured accurately and is equal to the difference between a main scale division and a Vernier scale division.

LEAST COUNT = 1 Main scale division – 1 Vernier scale division

Uses:

- It is used to measure the external diameter, the internal diameter and the length of the given specimen.

2. Micrometer

The micrometer has an accurate screw having about 10 to 20 threads/cm and revolves in a fixed nut. The end of the screw is one tip and the other is constructed by a stationary anvil.

LEAST COUNT = Pitch scale division / Number of threads
Pitch scale division = Distance moved / number of rotation

Uses:

- Outside micrometer is used to measure the diameter of solid cylinder.
- Inside micrometer is used to measure the internal diameters of hollow cylinders and spheres.

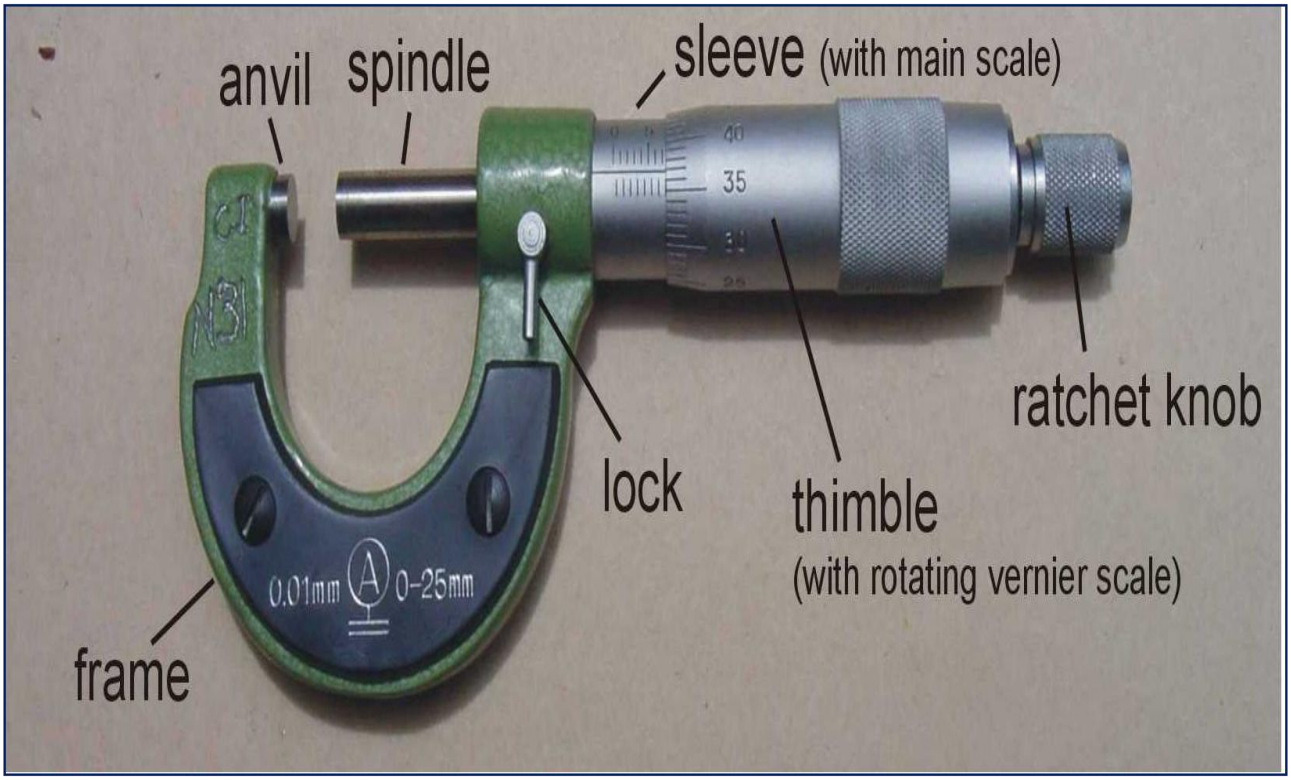


Fig: MICROMETER

3. **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.

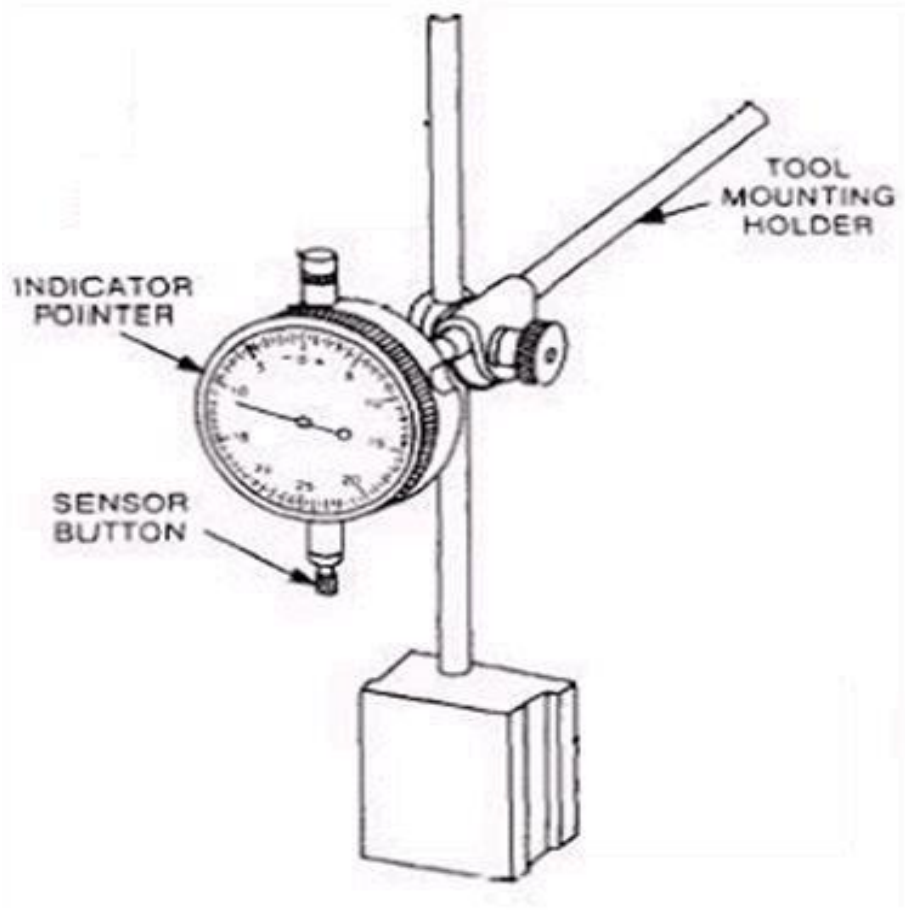


Fig: DIAL GAUGE

4. **Slip gauges**

They are rectangular blocks hardened and carefully stabilized. The surfaces are highly polished to enhance wringing. It is used as a reference standard for transferring the dimensions of unit of length from primary standard. It is generally made up of high carbon, high chromium hardened steel.

Uses:

- These are accurate and used as comparator.

5. **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

Procedure for Calibration:

1. The range of the instruments is noted down.
2. Within that range, slip gauges are selected.
3. The measuring instrument is placed on the surface plate and set for zero and the slip gauges are placed one by one between the measuring points (jaws of the instruments.)
4. The slip gauge (actual) readings and the corresponding (observed) readings in the measuring instruments are noted down and tabulated.

FORMULA USED:

1) MD = [MSR + (VSC X LC)]

MD-Measured Dimension
MSR-Main Scale Reading

VSC-Vernier Scale coincide
LC-Least Count

2) ERROR= Slip gauge reading - Measured Dimension

TABULATION (Vernier Caliper Using Slip Gauge)

S.NO	Least Count of vernier = 0.02mm					
	Slip gauge reading 'mm'	Vernier Caliper Reading 'mm'				Error
		MSR	VSC	VSR = VSC X LC	MD = MSR + VSR	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

TABULATION (Micrometer using Slip gauge)

Least Count of micrometer = 0.01mm						
Sl. No	Slip gauge reading 'mm'	Main scale Reading (MSR) in 'mm'	Thimble scale division (TSD)	Thimble scale reading(TSR) =TSD X Least count in 'mm'	Measure dimension (MD) in 'mm'	Error(mm)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

TABULATION (Dial Gauge using Slip gauge)

Least Count of dial gauge= 0.01mm				
Sl.no	Slip gauge reading (mm)	Dial gauge reading (mm)		Error
		Initial valve in (mm)	Final valve in (mm)	
1				
2				
3				
4				
5				

CACULATION:

GRAPHS

Slip gauges reading Vs Measured Dimension
Slip gauge reading Vs Error

Result:

The precision measuring instruments are studied and calibrated.

Viva Questions

1. What is Relative error?

Relative error is defined as the results of the absolute error and the, value of comparison used for calculation of that absolute error. The comparison may be true value or conventional true value or arithmetic mean for series of measurement.

2. Classify the errors.

The errors can be classified into1. Static errors - Reading errors- Characteristic errors,- Environmental errors2. Loading errors3. Dynamic error.

3. What is the basic Principle of measurement?

It is the physical phenomenon utilized in the measurement. If energy kind of quantity measured, there must be a unit to measure it. So this will give the quantity to be measured in number of that unit.

4. What are the applications of Legal metrology?

1.Industrial Measurements.2. Commercial transactions.3. Public health and human safety ensuring.

5. What is the need of inspection?

To determine the fitness of new made materials, products or component part and to compare the materials, products to the established standard.

6. What are the important elements of measurements?

The important elements of a measurement is

1. Measurand.
2. Reference.
3. Comparator.

7. What is LEGAL METROLOGY?

Legal metrology is part of Metrology and it is directed by a National Organization which iscalled "Notional service of Legal Metrology". The main objective is to, maintain uniformity ofmeasurement in a particular country.

8. What are the considerations while manufacturing the slip gauges?

The following additional operations are carried out to obtain the necessary qualities in slipgauges during manufacture.1. First the approximate size of slip gauges is done by preliminary operations.2. The blocks are hardened and wear resistant by a special heat treatment process.3. To stabilize the whole life of blocks, seasoning process is done.4. The approximate required dimension is done by a final grinding process.

9. How do you calibrate the slip gauges?

Comparators are used to calibrate the slip gauges.

10.List the various linear measurements?

(i)Length.(ii) Heights and(iii) Thickness.

Ex. No: 2 ***Date:***

CALIBRATION AND MEASUREMENT OF VERNIER HEIGHT GAUGE

AIM

To calibrate and determine the height of the given specimen by using Vernier Height gauge.

APPARATUS REQUIRED

- Vernier Height gauge,
- Work piece,
- Surface plate.

PROCEDURE

1. Clean the main scale, Vernier scale and measuring jaws of the Vernier Height gauge
2. The vernier height gauge is checked for zero error
3. Place the job in Surface plate.
4. Place the measuring jaw such that it touches the surface to be measured from the Smooth surface
5. Measure the main scale reading and Vernier scale coincidence of the Vernier Height gauge

FORMULA

MD = [MSR + (VSC X LC)]

- MD-Measured Dimension
- MSR-Main Scale Reading
- VSC-Vernier Scale Coincide
- LC-Least Count

TABULATION (Vernier Heigh gauge Using Slip Gauge)

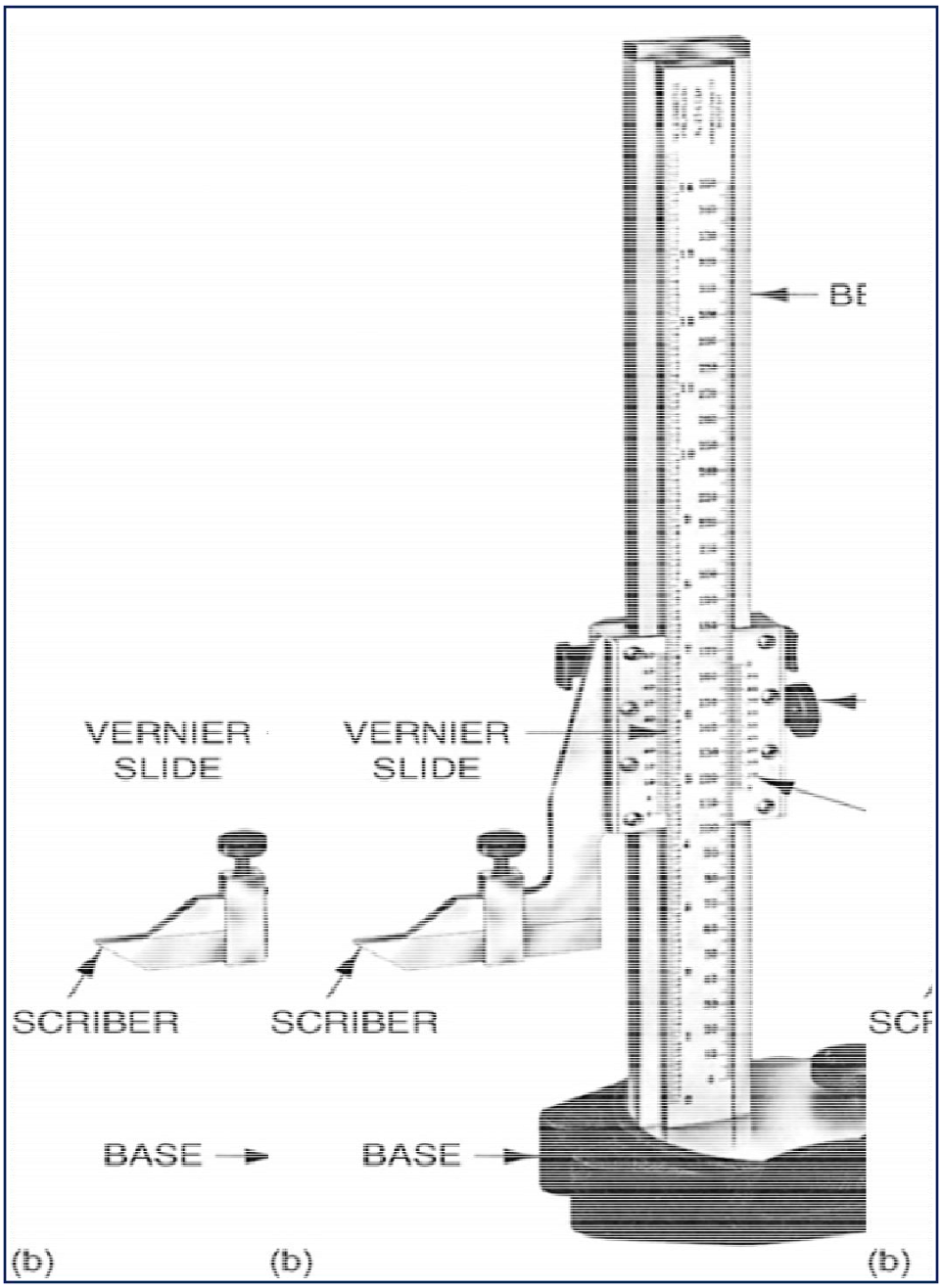


Fig: VERNIER HEIGHT GAUGE

TABULATION (Vernier Height Gauge)

Least count = 0.02mm					
S.NO	Specimen Details	Main scale reading (MSR) (mm)	Vernier Scale coincidence (VSC)	Vernier scale reading (VSR) = VSC X LC (mm)	Measured Dimension= (MD) in (mm)
1					
2					
3					
4					
5					

CALCULATION

Graph

Main scale reading Vs Measured Dimension

RESULT

The precision measuring instruments are studied and calibrated.

.

Viva Questions

1. What is Relative error?

Relative error is defined as the results of the absolute error and the, value of comparison used for calculation of that absolute error. The comparison may be true value or conventional true value or arithmetic mean for series of measurement.

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11. How do you calibrate the slip gauges?

Comparators are used to calibrate the slip gauges.

12.List the various linear measurements?

(i)Length.(ii) Heights and(iii) Thickness.

Ex. No:3 ***Date:***

CALIBRATION AND MEASUREMENT OF VERNIER DEPTH GAUGE

AIM

To calibrate and determine the Depth of the given specimen to accuracy using Vernier Depth gauge

APPARATUS REQUIRED

- Vernier depth gauge
- Surface plate
- Work piece

PROCEDURE

1. The depth gauge is checked for Zero error
2. It is placed on the surface Plate
3. Thus the given specimen is placed on the surface plate
4. The work piece is placed inside the measuring jaw of the instrument
5. The main scale reading and vernier scale reading are noted
6. The readings are tabulated.

FORMULA USED

MD = [MSR + (VSC X LC)]

MD-Measured Dimension
MSR-Main Scale Reading

VSC-Vernier Scale
Coincide LC-Least Count

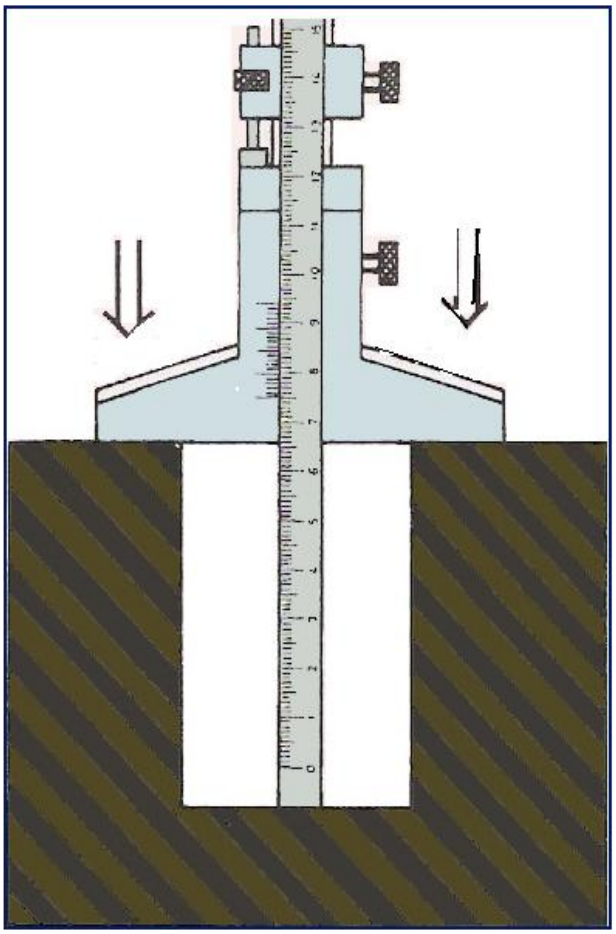


Fig: Vernier Depth Gauge

TABULATION (Vernier Depth Gauge)

Least count = 0.02mm					
S. No	Specimen Details	Main scale reading (MSR) (mm)	Vernier Scale coincidence (VSC)	Vernier scale reading (VSR) VSC X LC (mm)	Measured Dimension = MSR + VSR (mm)
1					
2					
3					
4					
5					

CALCULATION

Graph

Main scale reading Vs Measured Dimension

RESULT

The precision measuring instruments are studied and calibrated.

Viva Questions

1. What is Range of measurement?

The physical variables that are measured between two values. One is the higher calibration value H, and the other is Lower value L, The difference between H, and L, is called range.

2. What is Resolution?

The minimum value of the input signal is required to cause an appreciable change in the output known as resolution.

3. Differentiate between sensitivity and range with suitable example.

Example: A Instrument have a scale reading of 0.01mm to 100mm. Here, the sensitivity of the instrument is 0.0l mm i.e. the minimum value in the scale by which the instrument can read. The range is 0.01 to 100mm i.e. the minimum to maximum value by which the instrument can read.

4. Deflne system error and correction.

Error: The deviation between the results of measured value to the actual value. Correction: The numerical value which should be added to the measured value to get the correct result.

5. Define: Measurand.

Measurand is the physical quantity or property like length, diameter, and angle to be measured.

6. Define: Deterministic Metrology.

The metrology in which part measurement is replaced by process measurement. The new techniques such as 3D error compensation by CNC systems are applied.

7. Define over damped and under damped system

Over damped - The final indication of measurement ii approached exponentially from one side.

Under damped - The pointer approach the position corresponding to final reading and makes a number of oscillations around it.

8. Give any four methods of measurement

- Direct method.
- Indirect method.
- Comparison method.
- Coincidence method.

9. Give classification of measuring instruments.

- Angle measuring Instruments.
- Length measuring Instruments.
- Instruments for surface finish.
- Instruments for deviations.

10 .Define True size:

True size is Theoretical size of a dimension

Ex. No: 4 ***Date:***

MEASUREMENT OF GEAR PARAMETERS USING GEAR TOOTH VERNIER

AIM

To measure gear parameter by gear tooth Vernier.

APPARATUS REQUIRED

Gear tooth Vernier, Gear specimen,(SPUR GEAR),Vernier Caliper.

SPECIFICATION

Gear tooth Vernier Range =	Horizontal	= 0-40 mm
	Vertical	= 0-20 mm
	L.C	= 0.02 mm

FORMULA

1.	W	=	NM sin (90/N)
2.	d	=	$\frac{NM}{2}\left(1+\frac{2}{N}-\cos\left(\frac{90}{N}\right)\right)$
3.	m	=	$\frac{D}{(N+2)}$
4.	% ERROR	=	(Ws – W) / (Ws)

Where ,

W = Chordal width of tooth in mm

D = Chordal addendum of gear in mm

M = Module of gear in mm

N = No. of teeth

D = outside Dia in gear in mm

W = chordal thickness mm

PROCEDURE

1. The N, D of the given gear block are measured.
2. The module m' it then calculated.
3. Theoretical values of 'W' and'd' are computed.
4. Theoretical values of 'W' is set in horizontal Vernier scale of gear tooth Vernier and corresponding actual' value scale.
5. Theoretical values of 'c' is set and 'W' is measured along
6. Horizontal scale.
7. This procedure is repeated for 5 teeth and value tabulated.

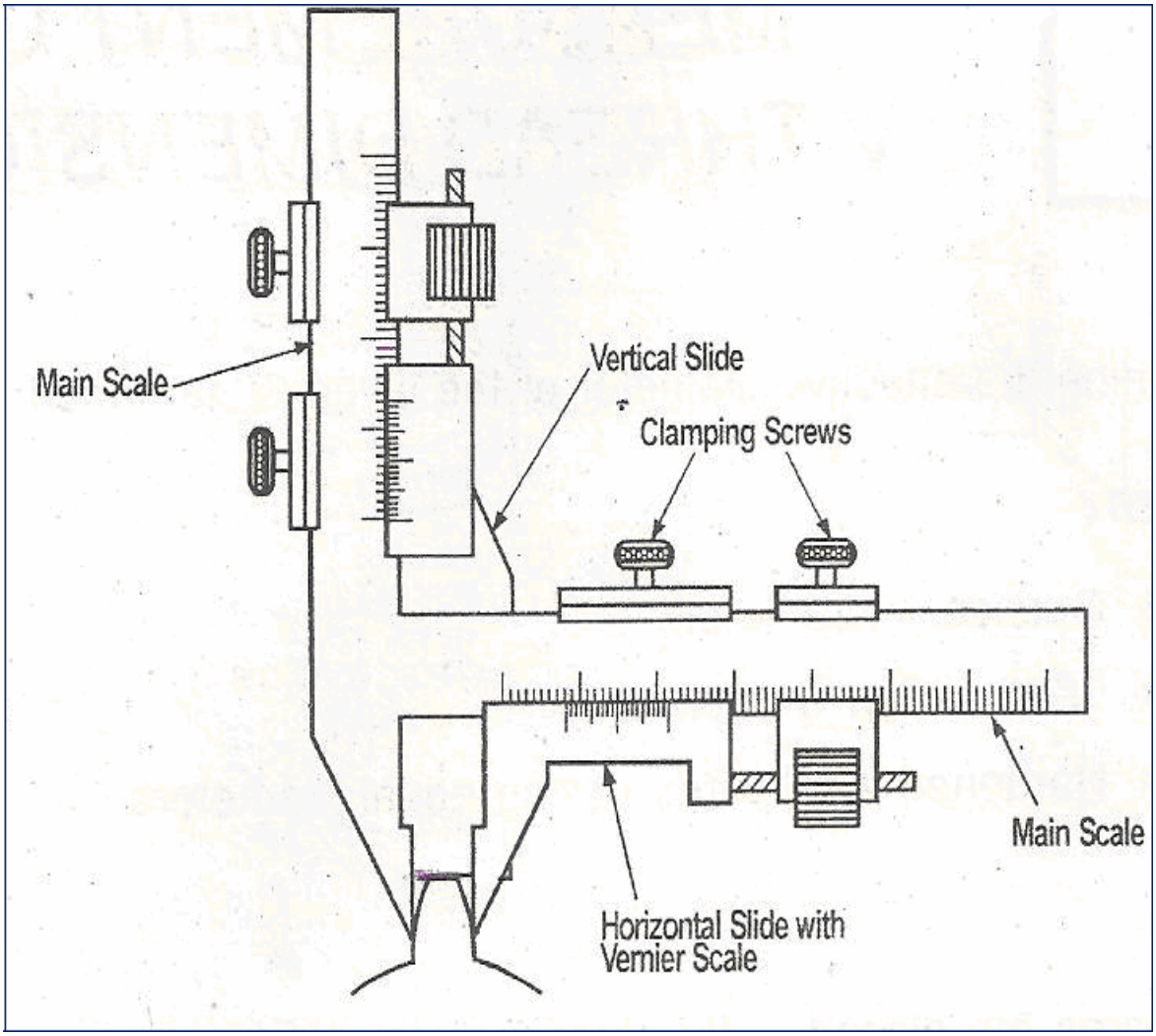


Fig: GEAR TOOTH VERNIER

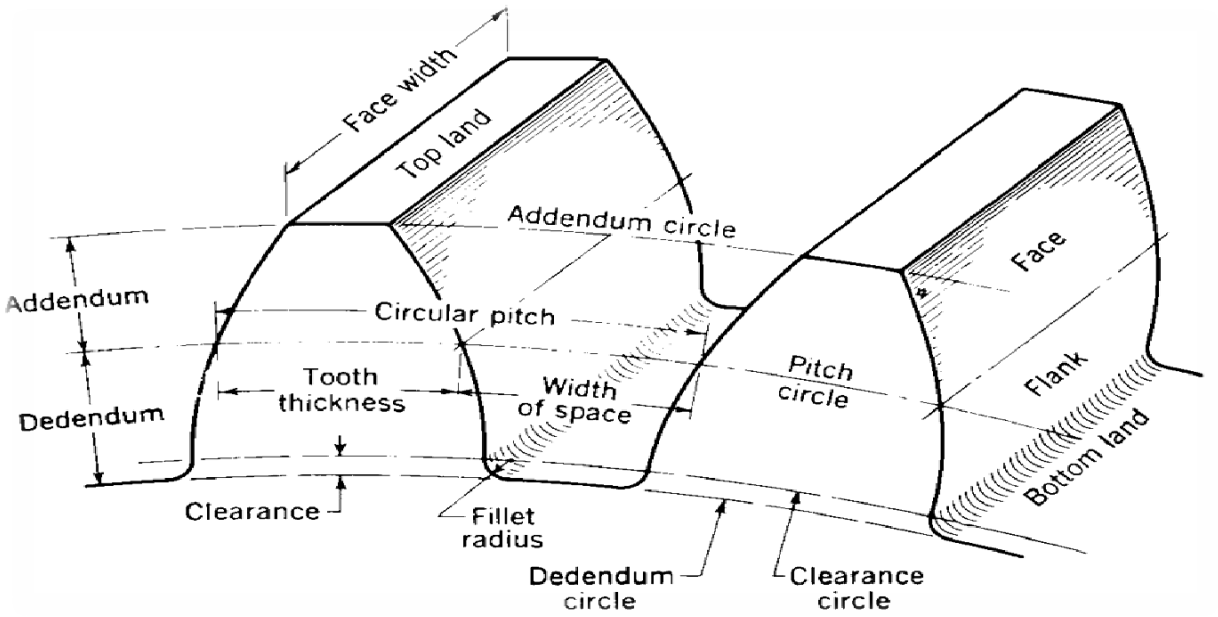


Fig: NOMENCLATURE OF GEAR

OUTSIDE DIAMETER OF G EAR

TRIAL	OUT SIDE DIAMETER 'D' mm	
	GEAR 1	GEAR 2
1		
2		
3		
4		
5		
AVERAGE		

TABULATION

SL. NO	SPECIMEN	NO. OF TEETH (N)	OUTER DIAMETER (OD) "mm"	CHORDAL Depth d "mm"	CHORDAL THICKNESS (W) "mm"				STANDARD CHORDAL THICKNESS Ws "mm"	ERROR(%) Ws – W / Ws
					T1	T2	T3	AVG		
1	GEAR 1									
2	GEAR 2									

CALCULATION

RESULT

Thus the chordal thickness and addendum of gear is measured using gear tooth Vernier.

Viva Questions

1. Define: Module.

Module= pitch circle diameter/ number of teeth.

2 **Define: Lead angle**.It is the angle between the tangent to the helix and plane perpendicular to the axis ofcylinder.

2 **What are the various methods used for measuring the gear tooth thickness?**

(i) Gear tooth Vernier.(ii) Constant chord method.(iii) Base tangent method.(iv) Measurement over pins.

4. Name four gear errors.

(i) Pitch error.(ii) Alignment error.(iii) Composite error.(iv) Thickness error.66. Name the method used for checking the pitch of the gear.(i) Step by step method.(ii) Direct angular measurement.

5. What are the direct angular measurements methods?

1. Profile checking: a) Optical projection method. b) Involutes measuring method.2. Thickness measurement: a) Chordal thickness method. b) Constance chord method.

6. Define: constant chord.

Constant chord is the chord joining those points, or opposite Aces of the tooth.

7. Give the formula for measuring radius of circle. R = (I - d)28d

Where, R=Radius of the job I = Distance between the balls d = Diameter of pins.

8. What are the two methods used in measuring radius of concave surface? a) Edges are well defined. b) Edges are rounded up.

9. What is interferometer?

Interferometer is optical instruments used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.

10. Name the different types of interferometer?

1) NPL flatness interferometer.2) Michelson interferometer.3) Laser interferometer.
4) Zesis gauge block interferometer.

Ex. No: 5 ***Date:***

ANGULAR MEASUREMENT USING SINE BAR

AIM

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

APPARATUS REQUIRED:

Sine bar

Work Piece

Surface plate

Dial gauge with stand

FORMULA:

$\sin \vartheta = H/L$

Where,

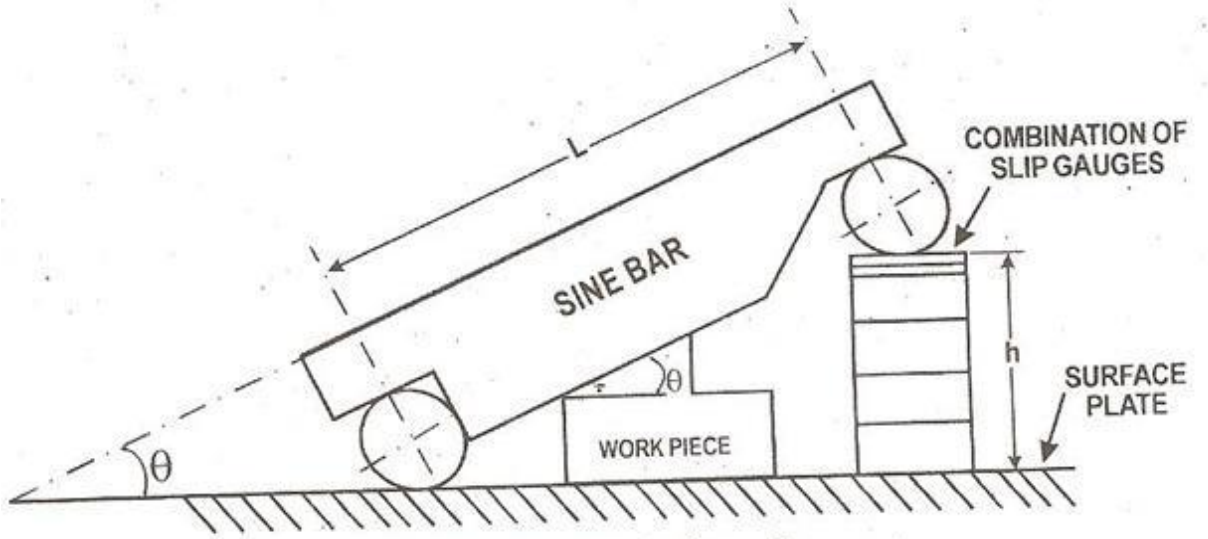
H - Height of the slip gauge

L - Distance between the centers

ϑ - Inclined angle of the specimen

PROCEDURE

1. The given component is placed on the surface plate.
2. One roller of sine bar is placed on surface plate and bottom surface of sine bar is seated on the taper surface of the component.
3. The combination of slip gauges is inserted between the second roller of sine bar and the surface plate.
4. The angle of the component is then calculated by the formula given above.



Measurement of angle Using Sine bar

TABULATION (Sine Bar)

S. No	Length of the sine bar (L) "mm"	Height of the combination of slip gauge (H) "mm"	Taper Angle (ϑ) in 'degree'
1			
2			

CALCULATION

RESULT

Thus the angle in the work pieces were Determined using Sine bar

Angle measured in work piece ,1 =---------- 'degree'

Angle measured in work piece ,2 =---------- 'degree'

Viva Questions

1. List out any four angular measuring instrument used in metrology

(i) Angle gauges (ii) Divided scales (iii) Sine bar with slip gauges (iv) Autocollimator (v) Angle dekkor

2. List out any four angular measuring instrument used in metrology

(i) Angle gauges (ii) Divided scales (iii) Sine bar with slip gauges (iv) Autocollimator (v) Angle dekkor

3. Differentiate between sensitivity and range with suitable example.

Example: An Instrument has a scale reading of 0.01mm to 100mm. Here, the sensitivity ofthe instrument is 0.0lmm i.e. the minimum value in the scale by which the instrument can read. The range is 0.01 to 100mm i.e. the minimum to maximum value by which the instrument can read.

4. Define system error and correction.

Error: The deviation between the results of measured value to the actual value. Correction: The numerical value which should be added to the measured value to get the correct result.

5. Define: Measurand.

Measurand is the physical quantity or property like length, diameter, and angle to be measured.

6. Define: Deterministic Metrology.

The metrology in which part measurement is replaced by process measurement. The new techniques such as 3D error compensation by CNC systems are applied.

7. Define over damped and under damped system.

Over damped - The final indication of measurement ii approached exponentially from one side. Under damped The pointer approach the position corresponding to final reading and makesa number of oscillations around it.

8. Give any four methods of measurement

1. Direct method.2. Indirect method.3. Comparison method.4. Coincidence method.

9. Give classification of measuring instruments.

1. Angle measuring Instruments.2. Length measuring Instruments.3. Instruments for surface finish.4. Instruments for deviations.

10. Define True size.

True size is Theoretical size of a dimension**.**

Ex. No: 6 ***Date:***

MEASUREMENT OF THREAD PARAMETERS USING PROFILE PROJECTOR

AIM

To measure the thread parameter of given screw thread using Profile projector

APPARATUS REQUIRED

Profile projector
Specimen

PARAMETER TO BE MEASURED

Major and Minor diameter
Depth and Pitch of thread
Addendum and dedendum.

THEORY

Minor diameter

It is the diameter of an Imaginary co-axial cylinder which would touch the root of external or internal thread.

Major Diameter

It is the diameter of an imaginary co-axial cylinder which would touch the crest of external or internal thread.

Depth

The distance between the crest and root of the thread is called Depth of Thread

Pitch of Thread

The distance measured parallel to the axis from a point on a thread to the Corresponding next point

Addendum

For external thread it is the radial distance between major and pitch cylinders.

Dedendum

For external thread it is the radial distance between the Pitch and Minor cylinders
For internal thread it is the radial distance between major and Pitch cylinders

Helix angle

The helix angle is made by the thread at the pitch line with axis

PROCEDURE

1. Clean the instrument and its accessories by fine cotton cloth
2. Clamp the specimen in between the jaws present in the profile Projector
3. Switch on the power and adjust the degree of magnification in profile projector
4. The magnification depends upon the distance between the Local plane of the lens and the screen
5. Bring the specimen image to the screens axis by adjusting the micrometer and rotation of screen
6. Now the parameters of threads are measured and tabulate the read.

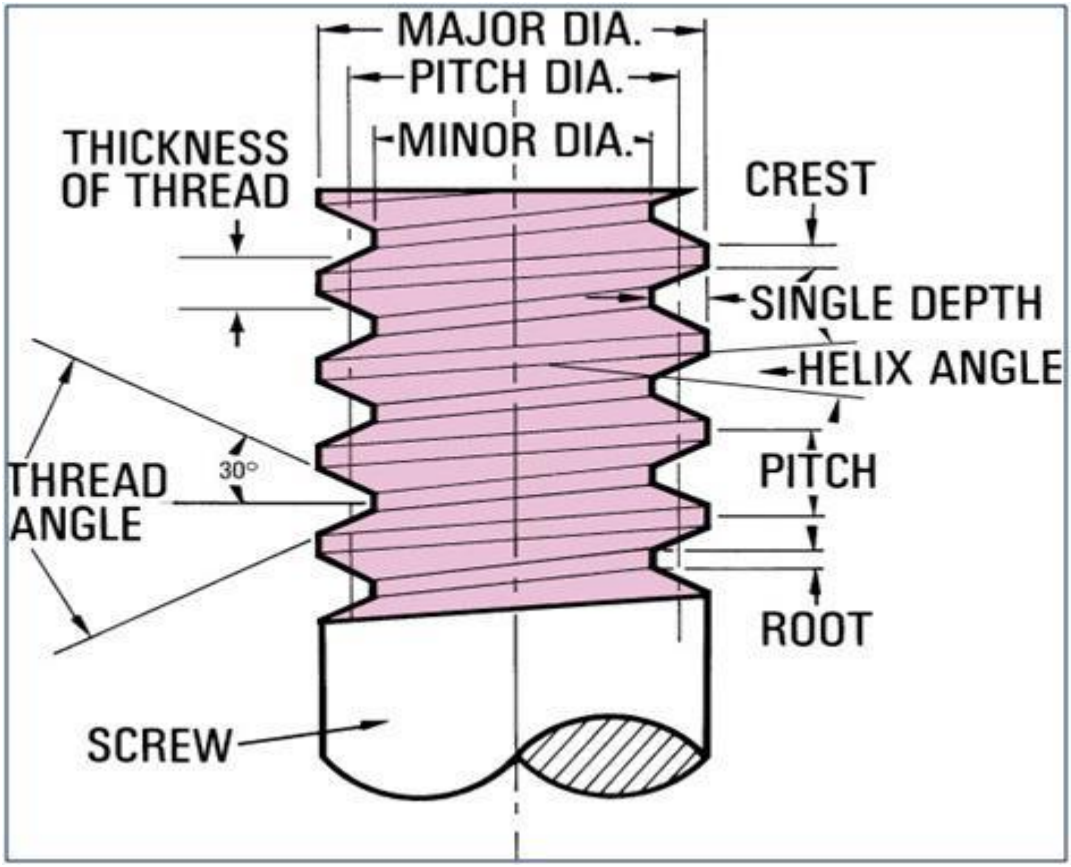


Fig: Nomenclature Of Thread

TABULATION (Taper Angle)

S.No	Initial angle degree	Final angle degree	difference degree	Average degree
1				
2				

TABULATION (Thread Parameters)

Sl.no	Dimension to be measured	Initial point (B) mm	Final point (C) mm	Difference (D) mm
1	PITCH			
2	DEPTH			
3	MAJOR DIAMETER			
4	MINOR DIAMTER			

RESULT

Thus the thread parameters of given screw thread was found using profile projector

Major diameter of the screw = ----------'mm'

Minor diameter of the screw = ----------'mm'

Pitch of screw = ----------'mm'

Depth of screw = ----------'mm'

Angle of thread = ----------'degree'

Viva Questions

1. What is wavelength?

The distance between two crust or two rough is called the wavelength

2. What the different are types of geometrical tests conducted on machine tools?

1. Straightness, 2. Flatness, 3. Parallelism, equi-distance and coincidence.

3. What is Response Time?

The time at which the instrument begins its response for a change measured quantity.

4. Define Repeatability.

The ability of the measuring instrument to repeat the same results g the act measurements for the same quantity is known as repeatability.

5. Explain the term magnification.

It means the magnitude of output signal of measuring instrument time's increases to make it more readable.

6. Classify the Absolute error.

The absolute error is classified into1. True absolute error.2. Apparent absolute error.

7. What is Response Time?

The time at which the instrument begins its response for a change measured quantity.

8. What are the two methods used in measuring radius of concave surface?

a) Edges are well defined. b) Edges are rounded up.

9. Name the various types of pitch errors found in screw?

(i) Progressive error. (ii) Drunken error. (iii) Periodic error.(iv) Irregular errors.

10**. Define: constant chord.**

Constant chord is the chord joining those points, or opposite Aces of the tooth.

Ex. No: 7 ***Date:***

SETTING UP OF COMPARATORS FOR INSPECTION (MECHANICAL COMPARATOR)

AIM:

To check the height of the machined component with standard dimensioned component using Mechanical comparator.

TOOLS REQUIRED:

- Slip gauge set
- Mechanical comparator
- Surface plate
- Work Piece

PROCEDURE:

1. The slip gauges are built up to the given weight of the component.
2. Dial gauge with stand is placed on the surface plate.
3. The built up gauge is placed under the plunger.
4. The indicator is set to zero.
5. The built up gauge is removed.
6. The given machined component is placed under the plunger.
7. The variation in the height of the component is noted from the reading of the dial.

Dial gauge :

Dial gauges divided in two categories, type1 &type2for general engineering purpose depending upon the movement of the plunger. These are manufactured in two grades, grade a and grade b, with total plunger movement or lift of 3,5 and 10mm. Type1 dial gauge has the plunger movement parallel tip the plane of dial and type 2 has the plunger movement perpendicular to the plane of dial.

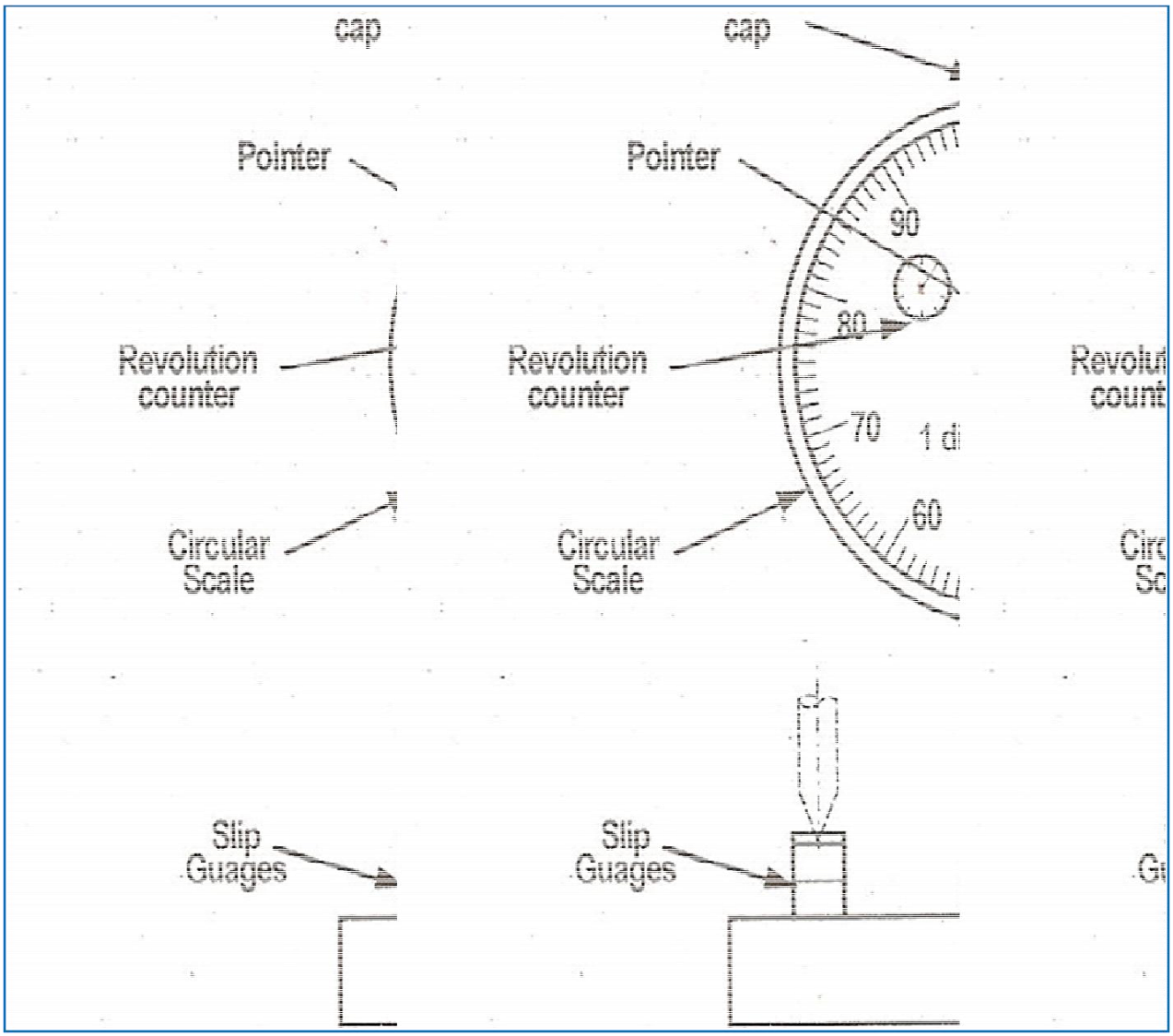


Fig: Mechanical comparator

TABULATION: (Least count of Mechanical comparator= 0.01 mm)

Sl.no	Specimen	Actual size slip gauge (mm)	Mechanical comparator reading (mm)		Actual size Work piece (mm)	Error	Result
			SCR	LCR			
1	I						
2	II						
3	III						
4	IV						

RESULT:

Thus the height of the machined component with standard dimensioned component using Mechanical comparator.

1.List out any four angular measuring instrument used in metrology.

(i) Angle gauges.(ii) Divided scales.(iii) Sine bar with slip gauges.(iv) Autocollimator.(v) Angle dekkor.

2.Classify the comparator according to the principles used for obtaining magnification.

The common types are

(i) Mechanical comparators.
(ii) Electrical comparators.
(iii) Optical comparators.
(iv) Pneumatic comparators.

3.What are comparators?

Comparators are one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions.

4. How the mechanical comparator works?

The method of magnifying small movement of the indicator in all mechanical comparators are effected by means of levers, gear trains or a combination of these elements.

5. State the best example of a mechanical comparator.

A dial indicator or dial gauge is used as a mechanical comparator.

6. Define least count and mention the least count of a mechanical comparator.

Least count. - The least value that can be measured by using any measuring instrument known as least count. Least count of a mechanical comparator is 0.0 1 mm.

7. How the mechanical comparator is used?

State with any one example. Let us assume that the required height of the component I s 32.5mm. Initially, this height is built up with slip gauges. The slip gauge blocks are placed under the stem of the dial gauge. The pointer in the dial gauge is adjusted to zero. The slip gauges are removed- Now, the component to be checked is introduced under the stem of the dial gauge. If there is any deviation in the height of the component, it will be indicated by the pointer.

8. State any four advantages of reed type mechanical comparator.

(i) It is usually robust, compact and easy to handle.(ii) There is no external supply such as electricity, air required.(iii) It has very simple mechanism and is cheaper when compared to other types.(iv) It is suitable for ordinary workshop and also easily portable.

9. Mention any two disadvantages of reed type mechanical comparator.

(i) Accuracy of the comparator mainly depends on the accuracy of the rack and pinion arrangement. Any slackness will reduce accuracy.(ii) It has more moving parts and hence friction is more and accuracy is less.

10. What are the major types of on electrical comparator?

An electrical comparator consists of the following three major parts such as (i) Transducer.(ii) Display device as meter.(iii) Amplifier.

Ex.No: 8 ***Date:***

BORE DIAMETER MEASUREMENT USING TELESCOPIC GAUGE

AIM

To measure the bore diameter using given telescopic gauge.

APPARATUS REQUIRED

- Telescopic gauge
- Work piece
- Vernier caliper

PROCEDURE

1. Clean the given work piece to be measure
2. Select the telescopic gauge and insert into the cylinder bore.
3. Selected the telescopic gauge from the telescopic gauge set.
4. Unlock the telescopic gauge and inserted into the cylinder bore.
5. Measure the distance of telescopic gauge by using vernier caliper.
6. Tabulate the given readings.

TABULATION Bore Diameter Measurement Using Telescopic Gauge

S.No	Telescopic Gauge range (mm)	Vernier Scale Reading			Bore Diameter (mm)
		MSR	VSC	VSR	

RESULT

Thus the given bore diameter is to be measure by using of telescopic gauge.

Viva Questions

1. Define Actual Size

Actual size = Size obtained through measurement with permissible error.

2. What is Hysteresis?

All the energy put into the stressed component when loaded is not recovered upon unloading. So, the output of measurement partially depends on input called hysteresis.

3. Differentiate accuracy and Uncertainty with example.

Accuracy - Closeness to the true value. Example: Measuring accuracy is ± 0.02mm for diameter 25mm.Here the measurement true values lie between 24.98 to25.02 mm
Uncertainty about the true value = ± 0.02mm

4. Define Span.

The algebraic difference between higher calibration values to lower calibration value. Example: In a measurement of temperature higher value is 200*C and lower value is 1500^0 C means span = 200 - 150 = 50^0C.

5. Differentiate between precision and accuracy.

Accuracy - The maximum amount by which the result differ from true value. Precision - Degree of repetitiveness. If an instrument is not precise it will give different results for the same dimension for the repeated readings.

6. What is Scale interval?

It is the difference between two successive scale marks in units.

7. What is Response Time?

The time at which the instrument begins its response for a change measured quantity.

8. Define Repeatability.

The ability of the measuring instrument to repeat the same results g the act measurements for the same quantity is known as repeatability.

9. Explain the term magnification.

It means the magnitude of output signal of measuring instrument time's increases to make it more readable.

10. Classify the Absolute error.

The absolute error is classified into1. True absolute error.2. Apparent absolute error.

Ex.No: 9 ***Date:***

BORE GAUGE

AIM

To measure the cylinder bore using bore gauge.

APPARATUS REQUIRED

1. Cylinder block
2. Bore gauge
3. Vernier caliper

PROCEDURE

1. Measure the bore using vernier caliper to get the gross reading of the bore.
2. Select and install the suitable anvil and washers
3. Make a zero adjustment of the bore gauge using inside measuring jaw of the vernier caliper.
4. After the zero adjustment is done insert the bore gauge into the bore and observe the measurement and record the data.

TABULATION (Bore Gauge)

S. No	Bore Gauge		Dial Gauge			Cylinder Size
	Anvil	Washer's	SCR	VSR	TR= SCR+VSR	

RESULT

Thus the bore measurement by using of bore gauge.

Viva Questions

1. Write the advantages of machine vision system.

(i) Reduction of tooling and fixture cash.(ii) Elimination of need for precise part location.(iii) Integrated auto mation of dimensional verification(iv) Defect detection.

2. Define machine vision.

Machine vision can be defined as a means of simulating the image recognition and analysiscapabilities of the human system with electronic and electromechanical techniques.

3. Define grayscale analysis.

In these techniques, discrete areas or windows are formed around only the portions of theimage to be inspected. For determining if brackets are present, high intensity lighting ispositioned. This type of discrete area analysis is a powerful tool and can be used forinspection of absence, correct part assembly, orientation, part, integrity, etc.

4 Mention the advantages of CMM.

(i) The inspection rate is increased.(ii) Accuracy is reduced.(iii) Operator's error can be minimized. Skill of the operator is reduced.(iv) Reduction in calculating, recording and set up time.(v) No need of GO/NOGO gauges. (vi) Reduction of scrap and good part rejection.

5. Mention the disadvantages of CMM.

(i) The table and probe may not be in perfect alignment.(ii) The stylus may have run out.(iii) The stylus movin g in z- axis may have some perpendicularity errors.(iv) Styius while moving in x and y direction may not be square t o each other.(v) There may be errors in digital system .

6. Mention the application of CMM.

(i) CMM's to find application in automobile., machine to,,electronics, space andmany other large companies.
(ii) These are best suited for the test and inspection Of test equipment, gauges andtools.
(iii) For aircraft and space vehicles of hundred Percent inspections is carried out byusing CMM.
(iv) CMM can be used for determining dimensional accuracy of the component.
(v) CMM can also be used for sorting tasks to achieve optimum pacing ofcomponents within tolerance limits.

7. Describe the features of a flexible inspection system.

(i) A powerful computer serves as a real time processor to handle part dimensional data and as a multi 'programming system to perform such tasks as manufacturing process control.(ii) The terminal provides interactive communication with personnel Computer where the programmes are stored.(iii) Input devices microprocessor based gauges and other inspection devices are used in CMM.

8. What are load cells?

Load cells are devices for the measurement of force through indirect methods

9.State any four advantages of reed type mechanical comparator.

W It is usually robust, compact and easy to handle.
W There is no external supply such as electricity, air required.

10. Classify pneumatic comparators.

(i) Flow or Velocity type. (ii) Back pressure type

Ex.No: 10 ***Date:***

SURFACE FINISH MEASURING EQUIPMENT

AIM

To measure the surface roughness of the given specimen using roughness testing device.

APPARATUS REQUIRED

Surface roughness tester Work piece

TECHNICAL PARAMETERS

Measurement parameters (R_a , R_Z)

Traversed length l = 6 mm

Cut off length = 0.25 + 0.80 mm

Measuring range = 2.5 mm

R_a = 0.05 – 6.5 N/m

R_Z = 0.1 -50 N/m

PROCEDURE

1. Clean the given work piece to be measure.
2. Switch on the device and the device is leading to work with screen displaying the measuring parameters and cut off length of the previous test.
3. Before starting the pickup choose the desired parameter R_a (or) R_Z and proper cutoff length 2.5, 0.8, 0.25
4. After switch on the devices lighting press the select button and choose R_a (or) R_Z lighting press select button and choose l_1, l_2, l_3 (0.25, 0.8, 2.5)
5. After the parameter and cut-off length are taken measurement may start.
6. The measurement end's and the screen display the measured value.

TABULATION (Surface Finish Measuring Equipment)

S.No	Parameter	Cut off length	Roughness Value (N/m)

RESULT

Thus the surface roughness of the given specimen is using roughness tester device.

Viva Questions

1. What are the factors affecting surface roughness?

a) Vibrations. b) Material of the work piece. c) Tool d) Machining type.

2. What are the methods used for evaluating the surface finish?

a) Peak to valley height method. b)The average roughness method. c) Form factor method.

3. Define fullness and emptiness in form factor.

Degree of fullness (K)= area of metal /Area of enveloping rectangle Degree of emptiness = 1K.

4. What are the methods used for measuring surface roughness?

a) Inspection by comparison b) Direct instrument measurements.

5. What are the stylus probe instruments?

a) Profile meter .b) Taylor Hobson Talysurf. c) Tomlinson surface meter.

6. Define: Straightness of a line in two planes.

A line is said to be straight over a given length, of the variation of the distance of its points from two planes perpendicular to each other and parallel to the direction of a line remaining with in the specified tolerance limits.

7. Define: Roundness.

Name the four measurement of roundness. It is a surface of revolution where all the surfaces intersected 'by any plane perpendicular to a common axis in case of, cylinder and cone. a. Heart square circle. b. Minimum radial separation circle. c. Maximum inscribed circle. d. Minimum circumscribed circle.

8. Name the devices used for measurement of roundness.

1. Diametral.2. Circumferential confining gauge.3. Rotating on center.4. V-Block.5. Three point probe.6. Accurate spindle.

9. What is run out?

Run out. -Total range of reading of a fixed indicate Or with the contact points applied to a Surface rotated, without axial movement, about 3 fixed axis.

10. Explain briefly the three important fields of machine vision system?

Inspection: it is the ability of an automated vision system to recognize well-defined pattern and if these pattern match these stored in the system makes machine vision ideal for inspection of raw materials, parts, assemblies etc.

Ex. No: 11 ***Date:***

ANGULAR MEASUREMENT USING SINE CENTER

AIM

To measure the taper angle of the given specimen using sine center method.

APPARATUS REQUIRED

Sine Center

Slip gauge

work piece

FORMULA USED

$\sin \theta = -$

PROCEDURE

1. Clean the surface plate, Sine Center and Slip gauges using fine cotton cloth.
2. Place the Job in the smooth flat surface.
3. Place the sine bar in such a manner that the Lower surface of the Sine bar.
4. Was uniformly touches the surface whose angle to be measured.
5. Calculate the angle using the Formula

$\sin\theta = h/L$

Where,

h - Vertical height of the slip gauge

L - Length of the sine Center

TABULATION

S. No	Length of the sine center (L) "mm"	Height of the combination of slip gauge (h) "mm"	Taper Angle (α) in 'degree'
1			
2			



Fig: SINE CENTER

CALCULATION

RESULT

Thus the angle in the work pieces was determined using Sine center.

Angle measured in work piece, 1 = ----------'degree'
Angle measured in work piece, 2 = ----------'degree'

Ex. No: 12 ***Date:***

ANGULAR MEASUREMENT USING BEVEL PROTRACTOR

AIM

To measure the angle in the given work piece using Bevel Protractor.

APPARATUS REQUIRED

Work piece

Bevel Protractor

PROCEDURE

1. Clean the Bevel protractor with the fine cotton cloth.
2. The work piece whose angle to be measured is placed between the stock and the blade.
3. Note down the main scale reading and Vernier scale coincidence.
4. Tabulate the readings.

FORMULA

Least Count = 5 mins



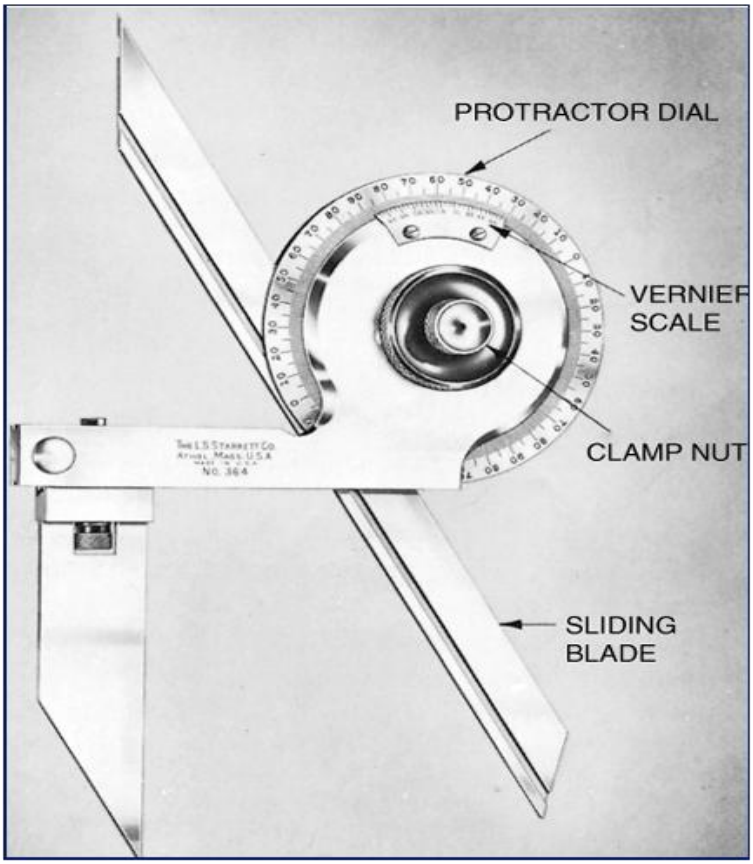


Fig: BEVEL PROTRACTOR

TABULATION (Work Piece 1)

S.NO	Least count = 5 mins			
	Main scale reading (MSR) 'deg'	Vernier scale coincidence (VSC) 'div'	Vernier Scale reading (VSC X LC) 'mins'	Total reading = (MSR + VSR) 'deg'
1				
2				
3				
4				
5				
			AVERAGE	

TABULATION (Work Piece 2)

S.NO	Least count = 5 mins			
	Main scale reading (MSR) 'deg'	Vernier scale coincidence (VSC) 'div'	Vernier Scale reading (VSC X LC) 'mins'	Total reading = (MSR + VSR) 'deg'
1				
2				
3				
4				
5				
			AVERAGE	

RESULT

The angle of the given work piece was measured using Bevel protractor

Angle of the given work piece1 = ----------'degree'

Angle of the given work piece2 = ----------'degree'

Ex. No: 13 ***Date:***

TEMPERATURE MEASUREMENT

AIM:

To measure temperature using thermometer and RTD, thermocouple.

APPARATUS REQUIRED:

Temperature indicator
Electric kettle water
Thermocouple
Thermometer
RTD

FORMULA USED:

Error = T1– T4

$$\% \text{ Error} = \frac{\text{Error}}{T4} \times 100$$

Where ,

T1 is the actual temperature.
T4 is the thermocouple indicated temperature.

PROCEDURE:

1. Clean the instrument and its accessories by fine cotton cloth.
2. Check connection made and switch on the instrument by rocker switch.
3. The display glows to indicate is on.
4. Allow the instruments in on position for 10 minutes for initial warm up.
5. Fill around 3/4th full of water to the kettle and place the thermometer and thermocouple Inside the kettle.
6. Note down the initial water temperature from the thermometer. Adjust the initial set potentiometer in the front panel till the display reads initial water temperature
7. Switch on the kettle and wait till the water boils note down the thermometer reading and set Potentiometer till the display reads boiling water temperature.
8. Remove the thermometer and temperature sensor from the Kettle and change the water and replace
9. The thermometer reading and set final set potentiometer till the display reads boiling water Temperature
10. Switch on the kettle and note down the reading for every 10 º interval and tabulate the readings

TABULATION:

S.NO	Actual temperature °C	Indicated temperature °C			Error (T1-T4)	% Error
	Thermometer (T1)	Thermocouple (T2)	RTD (T3)	Average temp (T4)		
1						
2						
3						
5						
6						
7						
8						
9						
10						

CALCULATION:

Graph:

Actual Temperature (Thermometer) Vs Indicator Temperature (RTD, Thermocouple)

RESULT:

Thus the measure temperature using thermometer and RTD, thermocouple.

Ex. No: 14 ***Date:***

FORCE MEASUREMENT USING LOAD CELL

AIM:

To measure the force using load cell apparatus.

APPARATUS REQUIRED

Force measurement trainer Kit (LOAD CELL) Weight
Force indicator

FORMULA USED:

Error = Calculated force – Indicated force

$$\% \text{ Error} = \frac{\text{Error}}{\text{Calculated force}} \times 100$$ (**Maximum** force = 9.81)

$$F = m \times g \ (N)$$

Where,

m = Mass (kg)
g = Gravity (m/s^2)

PROCEDURE:

1. Clean the instrument and its accessories by fine cotton cloth.
2. Check connection made and switch on the instrument by rocker switch at the front panel.
3. The display glows to indicate is ON.
4. Allow the instrument is on ON position for 10 mins for initial warm-up
5. adjust the potentiometer in the front panel till the display reads Zero
6. Apply the ON load sensor using the weight blocks and note down the readings.
7. The Maximum load carrying capacity of a Sensor is 1 kg

TABULATION :(FORCE)

S.NO	ACTUAL LOAD (kg)	CALCULATED FORCE F = m x g (N)	INDICATED FORCE (N)	ERROR	% ERROR
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

CALCULATION

Graph:

Observed Force Vs Calculated
Force Observed Force Vs Error

Result:

Thus the force measurement by using load cell.