# LABORATORY MANUAL

## III Year B. Tech I- Semester

## MECHANICAL ENGINEERING

## MANUFACTURING TECHNOLOGY LAB

## R18A0386


**MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

(Autonomous Institution-UGC, Govt. of India)
Secunderabad-500100,Telangana State, India.
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# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

**DEPARTMENT OF MECHANICAL ENGINEERING**

## B. Tech LAB TIME TABLE

YEAR:_____SEMESTER:_____SECTION:_____ NAME OF THE LAB: ________________________________

| Day/ Period | **1** 9.20 AM – 10.20AM | **2** 10.20 AM – 11.10AM | **3** 11.10 AM – 12.00 PM | **4** 12.00 PM – 12.50 PM | 12.50 PM 01.30 PM | **5** 1.30 PM – 2.20 PM | **6** 2.20 PM – 3.10 PM | **7** 3.10 PM – 3.50 PM |
|---|---|---|---|---|---|---|---|---|
| **MON** | | | | | | | | |
| **TUE** | | | | | | | | |
| **WED** | | | | | **L U N C H** | | | |
| **THU** | | | | | | | | |
| **FRI** | | | | | | | | |
| **SAT** | | | | | | | | |

LAB FACULTY :

TECHNICIAN (S) :

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# VISION

- To Become An Innovative Knowledge Center In Mechanical Engineering Through State Of The Art Teaching –Learning And Research Practices, Promoting Creative Thinking Professionals.

# MISSION

- The Department Of Mechanical Engineering Is Dedicated For Transforming The Students Into Highly Competent Mechanical Engineers to meet the needs of the industry, by strongly focusing in the fundamentals of engineering sciences for achieving excellent results in their professional pursuits.

# QUALITY POLICY

- To Pursuit Global Standards Of Excellence In All Our Endeavors Namely Teaching, Research And Continuing Educations And To Remain Accountable In Our Core And Support Functions, Through Processes Of Self-Evaluation And Continuous Improvement.

- To Create A Midst of Excellence For Imparting State Of Art Education, Industry-Oriented Training Research In The Field Of Technical Education.

## (R18A0386) MANUFACTURING TECHNOLOGY LAB

**Course Objectives:**

1. To learn the Step turning and taper turning and thread cutting on lathemachine
2. Practical exposure on Flat Surface machining, Shaping, Slotting, Milling, drillingand grinding operations.
3. Student able to learn about Mechanical parameter measuringsystems.
4. Student able to learn about different alignmenttechniques.
5. To learn the measurement of the Angle and taper s by Bevel protractor, Sinebar,etc.

**PART A: MACHINE TOOLS**

1. To perform various lathe operations such as plain turning, stepturning, taper turning knurling and chamfering on a givenmaterial made of mildsteel.
2. To perform milling operation on the given specimen to accuratedimensions.
3. To perform v and dovetail machining & u-cut on the given workpiece on shaping machine.
4. To perform drilling, counter drilling, boring, counter sinking and tapping operations on drillingmachine.
5. To perform cylindrical&surface grinding operations for the givenspecimen.
6. To make a slot on the given aluminum work piece by slottingmachine.

**PART B: METROLOGY**

1. To measure bore diameters by internal micrometers and dial boreindicators.
2. Measure the addendum and dedendum of the gear tooth using gear tooth verniercalip
3. To measure the pitch length and pitch angle using Tool maker'smicroscope.
4. To measure the angle and taper measurements by Bevel protractor and Sinebar.
5. To find the flatness of surface plate using spiritlevel.
6. To perform Thread measurement by Two wire/ Three wiremethod.

Note: Total 10 Experiments are to be conducted

**CourseOutcomes:**

1. Demonstrate the working principle and parts of different machine tools used in machineshop.
2. Inspect machine tools whether properly aligned ornot.
3. Create stepped surface using shaper and keyways using milling machine, perform different turningoperations.
4. Apply the procedures to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness by using differentinstruments.
5. Measure effective diameter of thread profile using differentmethods.

# CONTENTS

## PART-A MACHINE TOOLS

### EXP: 1 STEP TURNING AND TAPER TURNING ON LATHE

**AIM:** To perform Step turning and Taper turning operations on the given work piece

**MATERIAL REQUIRED:** Mild steel rod of 25 mm diameter and 100 mm long.

**TOOLS REQUIRED:** Vernier calipers, steel rule, spanner, chuck spanner, and H.S.S. single point cutting tool.

**SPECIFICATION OF LATHE:**

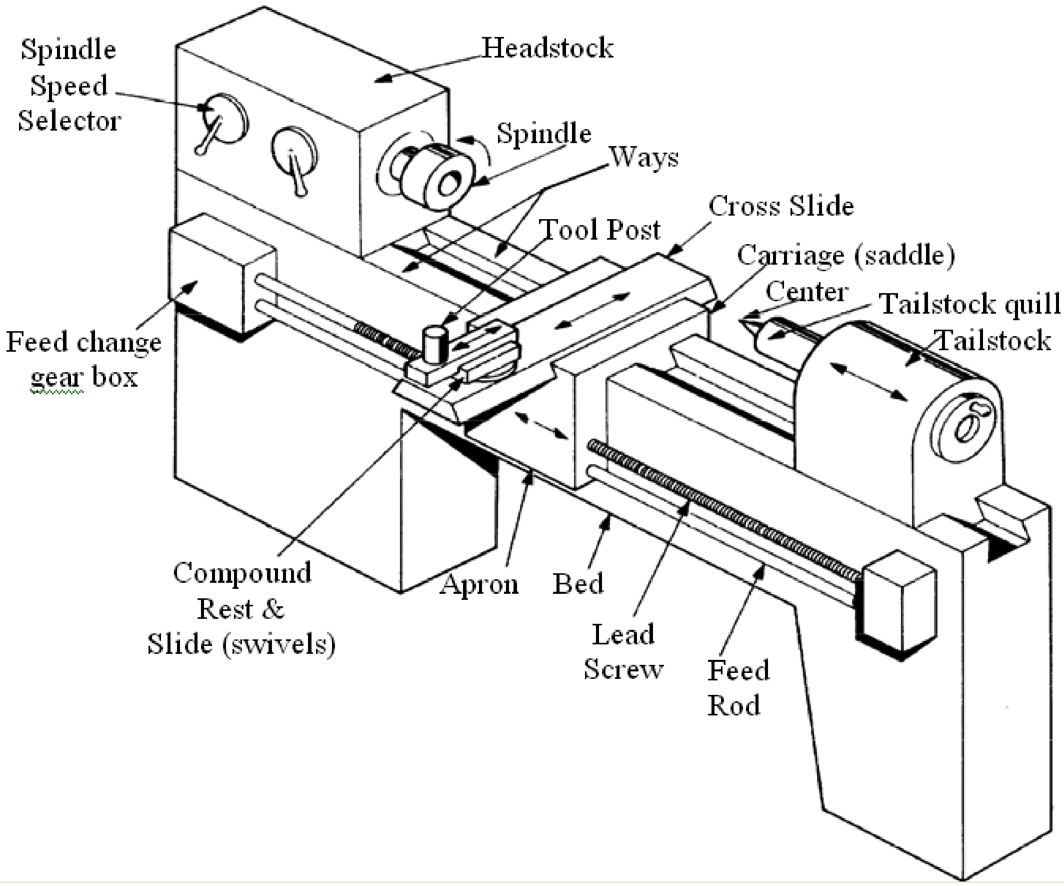
| | |
|---|---|
| Length of bed | 1390 mm |
| Width of bed | 200 mm |
| Height of centers | 165 mm |
| Admit between centers | 700 mm |
| Lead screw pitch | 4TPI |
| Power of the motor | 1 h.p. |

**THEORY:**

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the later help securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surfaces, at right angles to the axis of rotation. It can also produce tapers and bellows etc.

**OPERATION CHART:**

| S NO. | SEQUENCE OF OPERATIONS | CUTTING TOOL USED |
|---|---|---|
| 1. | Facing | H.S.S Single Point tool |
| 2. | Rough turning | H.S.S Single Point tool |
| 3 | Finish turning | H.S.S Single Point tool |
| 4 | Step turning | Parting tool |
| 5 | Taper turning | H.S.S Single Point tool |
| 6 | Knurling | Knurling tool |
| 7 | Chamfering | H.S.S Single Point tool |




**PROCEDURE:**

**1.** The work piece and HSS single point cutting tool are securely held in the chuck and tool post respectively.

**2.** Operations such as facing, rough turning and finish turning are performed on a given mild steel bar one after the other in sequence up to the dimensions shown. Then the step turning is performed using partingtool.

**3.** Then the compound rest is swiveled by calculated half taper angle and taper is generated on the work piece. Rotation of the compound slide screw will cause the tool to be fed at the half-taper angle.

**4.** HSS single point cutting tool is replaced by the knurling tool and knurling operation is performed at the slowest speed of thespindle.

**5.** The knurling tool is replaced by the HSS single point tool again; the work piece is removed from the chuck and re fixed with the unfinished part outside the chuck. This part is also rough turned, finish turned and facing is done for correctlength.

**6.** Finally, the chamfering is done at the end of the workpiece.

**OBSERVATIONS:** (a) Record the following in a tabular form:

**Machine Tool Specifications (Table A)**

| Machine | Type &Make | Size | Speed given to | | Feed given to | | Type of Surface Produced |
|---|---|---|---|---|---|---|---|
| | | | Tool | Work | Tool | Work | |
| lathe | | | | | | | |

**Speed and Feed Data (Table B)**

| No. | Lathe | |
|---|---|---|
| | Speed | Feed |
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |

**PRECAUTIONS:**

**1.** Operate the machine at optimalspeeds

**2.** Do not take depth of cut more than 2mm.

**3.** Knurling should be done at slow speeds and apply lubricating oil whileknurling

**4.** Care should be taken to obtain the requiredaccuracy.

**RESULT:**

**APPLICATIONS:**

| **Applications** | **Description** |
|---|---|
| Woodturning | Used to make wooden objects such as ornate table legs, baseball bats, wooden bowl, and platters; operators use a variety of tools to form |
| Metalworking | Used to create precision parts; most often associated with a multistep process requiring different tools for each step |
| Metal Spinning | A process where metal spins on a spindle, while the operator works it with tools; an automated process |
| Acrylic Spinning | Involves spinning acrylic on a spindle to form items from acrylic; most often used in the making of the top pieces for trophies |
| Thermal Spraying | Combines the rotating spindle with the painting process; the paint sticks to the stock viaprocesses involving heating the paint materials |

**ADVANTAGES:**
One advantage of a lathe machine is that it can perform very detailed and intricate designs.

**DIS-ADVANTAGES:**
One disadvantage of a lathe machine is that these machines are more expensive than other types of machines used to produce this type of work.

## EXP.2: THREAD CUTTING AND KNURLING ON LATHE

**AIM**: To perform V-thread cutting on a lathe forming right hand and left hand metric threads.

**MATERIAL REQUIRED**

Mild steel bar of 24 mm diameter and 100 mm length

**TOOLS AND EQUIPMENT**

H.S.S. single point cutting tool, Grooving tool, Threading tool thread gauge, Outside caliper, Chuck key, Tool post key, Steel rule.

**OPERATION CHART**

| S no. | Sequence of Operations | Cutting tool used |
|---|---|---|
| 1. | Facing | H.S.S Single Point cutting tool |
| 2. | Rough turning | H.S.S Single Point cutting tool |
| 3 | Finish turning | H.S.S Single Point cutting tool |
| 4 | Step turning | H.S.S Single Point cutting tool |
| 5 | Grooving | Grooving tool |
| 6 | Thread cutting | Threading tool |
| 7 | Chamfering | H.S.S Single Point cutting tool |

**PRINCIPLE OF THREAD CUTTING**

The principle of thread cutting is to produce a helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job is revolved between centers or by a chuck. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece. The lead screw of the lathe, through which the saddle receives its traversing motion, has a definite pitch. A definite ratio between the longitudinal feed and rotation of the head stock spindle should therefore be found out so that the relative speeds of rotation of the work and the lead screw will result in the cutting of a screw of the desired pitch. This is affected by change gears arranged between the spindle and the lead screw or by the change gear mechanism or feed box used in a modernlathe.

**Calculation of change-wheels, metric thread on English lead screw:**

To calculate the wheels required for cutting a screw of certain pitch, it is necessary to know how the ratio is obtained and exactly where the driving and driven wheels are to be placed. Suppose the pitch of a lead screw is 12 mm and it is required to cut a screw of 3 mm pitch, then the lathe spindle must rotate 4 times the speed of the lead screw that is

$$\frac{\text{Spindle turn}}{\text{Lead screw turn}} =$$ Means that we must have

$$\frac{\text{Driver teeth}}{\text{Driven teeth}} =$$ Since a small gear rotates faster than a larger one with which it is connected.

Hence we may say,

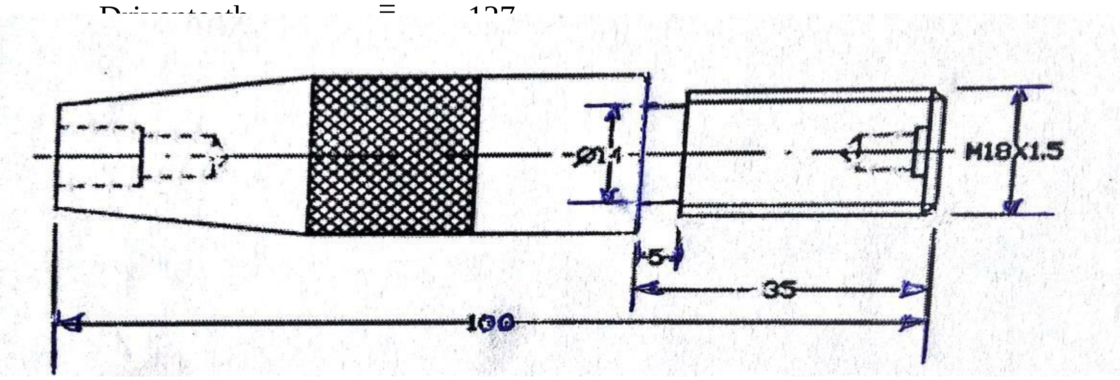
$$\frac{\text{Driverteeth}}{\text{Driventeeth}} = \frac{\text{lead screw turn pitch of the screw to becut}}{\text{spindle turn pitch of the lead screw}}$$

In BRITISHSYSTEM

$$\frac{\text{Driverteeth}}{\text{Driventeeth}} = \frac{\text{Threads per inch on lead screw}}{\text{Threads per inch onwork}}$$

Often engine lathes are equipped with a set of gears ranging from 20 to 120 teeth in steps of 5 teeth and one translating gear of 127 teeth. The cutting of metric threads on a lathe with an English pitch lead screw may be carried out by a translating gear of 127 teeth.

$$\frac{\text{Driverteeth}}{\text{Driventeeth}} = \frac{5\,p\,n}{127}$$

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This is derived as follows:

$$\frac{\text{Driverteeth}}{\text{Driventeeth}} = \frac{\text{pitch of the work}}{\text{pitch of theleadscrew}} = \frac{p}{(1/n)x(127/5)} = \frac{pn}{127}$$

$$\text{Since, pitch} = \frac{1}{\text{No. of threads per inch}}$$

**THREAD CUTTING OPERATION:**

In a thread cutting operation, the first step is to remove the excess material from the work piece to make its diameter equal to the major diameter of the screw thread. Change gears of correctsize are then fitted to the end of the bed between the spindle and the lead screw. The shape or form of the thread depends on the shape of the cutting tool to be used. In a metric thread, the included angle of the cutting edge should be ground exactly $60^0$.The top of the tool nose should be set at the same height as

the center of the work piece. A thread tool gauge is usually used against the turned surface to check the cutting tool, so that each face of the tool may be equally inclined to the center line of the work piece as shown.

The speed of the spindle is reduced by one half to one – fourth of the speed require for turning according to the type of the material being machined and the half – nut is then engaged. The depth of cut usually varies from 0.05 to 0.2 mm is given by advancing the tool perpendicular to the axis of the work.

After the tool has produced a helical groove up to the desired length of the work, the tool is quickly withdrawn by the use of the cross slide, the half-nut disengaged and the tool is brought back to the starting position to give a fresh cut. Before re-engaging the half-nutit is necessary to ensure that the tool will follow the same path it has traversed in the previous cut, otherwise the job will be spoiled. Several cuts are necessary before the full depth of thread is reached arising from this comes the necessity to “pick-up” the thread which is accomplished by using a chasing dial or thread indicator.

**Chasing dial or thread indicator**

The chasing dial is a special attachment used in modern lathes for accurate “picking up” of the thread. This dial indicates when to close the split of half nuts. This is mounted on the right end of the apron. It consists of a vertical shaft with a worm gear engaged with the lead screw. The top of the spindle has a revolving dial marked with lines and numbers. The dial turns with the lead screw so longthe half nut is notengaged.

If the half-nut is closed and the carriage moves along the dial stands still. As the dial turns, the graduations pass a fixed reference line. The half-nut isclosed for all even threads when any line on the dial coincides with the reference line. For all odd threads, the half-nut is closed at any numbered line on the dial determined from the charts. If the pitch of the thread to be cut is an exact multiple of the pitch of the lead screw, the thread is called even thread, if otherwise the thread is oddthread.

In a chasing dial, the rule for determining the dial division is: In case of metric threads, the product of the pitch of lead screw and the no. of teeth on the worm wheel must be an exact multiple of the pitch of the threads to be cut. In case of English threads, the product of the threads per inch to be cut and the number of teeth on the worm wheel must be an exact multiple of the number of threads per inch of the lead screw. For example, if the pitch of the lead screw is 6 mm and the worm wheel has 15teeth.

The product will be 90. so any pitch which is exactly divisible by 90, such as 1, 1.25, 2.25,3,3.75,4.5,5,6,7.5,9,10,15,30,45,90 may be picked up when any line of the dial coincides with the reference line.

**Right hand and left-hand thread:**

If the bolt advances into the nut when rotated in clockwise direction, the thread is called right-hand thread. When cutting a right-hand thread the carriage must move towards the head stock.

If the bolt advances into the nut when rotated in counter-clockwise direction, the thread is called left-hand, for a left hand thread the carriage moves away from the head stock and towards the tail stock. The job moves as always in the anti-clock wise direction when viewed from the tail stock end. The direction at which the carriage moves in relation to lathe head stock is controlled by means of the tumbler gears or bevel gear feed reversing mechanism.

**PROCEDURE:**

The work piece and HSS single point cutting tool are fixed in chuck and tool post respectively.

**1.**Operations such as facing, rough turning finish turning and step turning are performed on the given mild steel bar one after the other in sequence up to the dimensions shown.

**2.**Single point cutting tool is replaced by a grooving tool and grooving operation is performed at half of the normal spindlespeed.

**3.**The grooving tool is replaced by a threading tool. Right hand and left handmetric threads are cut on the work piece up to the required length at 1/4$^{th}$of the normal speed of thespindle.

**4**Threading tool replaced by a single point cutting tool again and finally chamfering is done at right end of the work piece at normal spindlespeed.

**PRECAUTIONS:**

1. Low spindle speeds should be used for accurate threads in thread cuttingoperation.
2. Ensure correct engage and dis-engage ofhalf-nut.
   Plenty of oil should be flowed on the work and tool during thread cutting

**OBSERVATIONS:** Record the following in a tabular form:

**Machine Tool Specifications (Table A)**

| Machine | Type &Make | Size | Speed given to | | Feed given to | | Type of Surface Produced |
|---|---|---|---|---|---|---|---|
| | | | Tool | Work | Tool | Work | |
| lathe | | | | | | | |

**Speed and Feed Data (Table B)**

| No. | Lathe | |
|---|---|---|
| | Speed | Feed |
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |

**RESULT:**

**ADVANTAGES:**
One advantage of a lathe machine is that it can perform very detailed and intricate designs

**DISADVANTAGES:**
One disadvantage of a lathe machine is that these machines are more expensive than other types of machines used to produce this type of work.

**VIVA QUESTIONS:**

1. What is alathe?
2. What are the various operations can be performed on alathe?
3. What are principle parts of thelathe?
4. What are the types ofheadstock?
5. State the various parts mounted on thecarriage?
6. What are the four types of toolpost?
7. What is anapron?

## EXP.3 MACHINING FLAT SURFACE USING SHAPER MACHINE

**AIM**: To perform V and Dovetail machining & U-cut on the given work piece.

**MATERIALS REQUIRED:** Mild steel / Cast iron / Cast Aluminum.

**MACHINE REQUIRED**: Shaping machine

**MEASURING INSTRUMENTS:**

Vernier calipers,

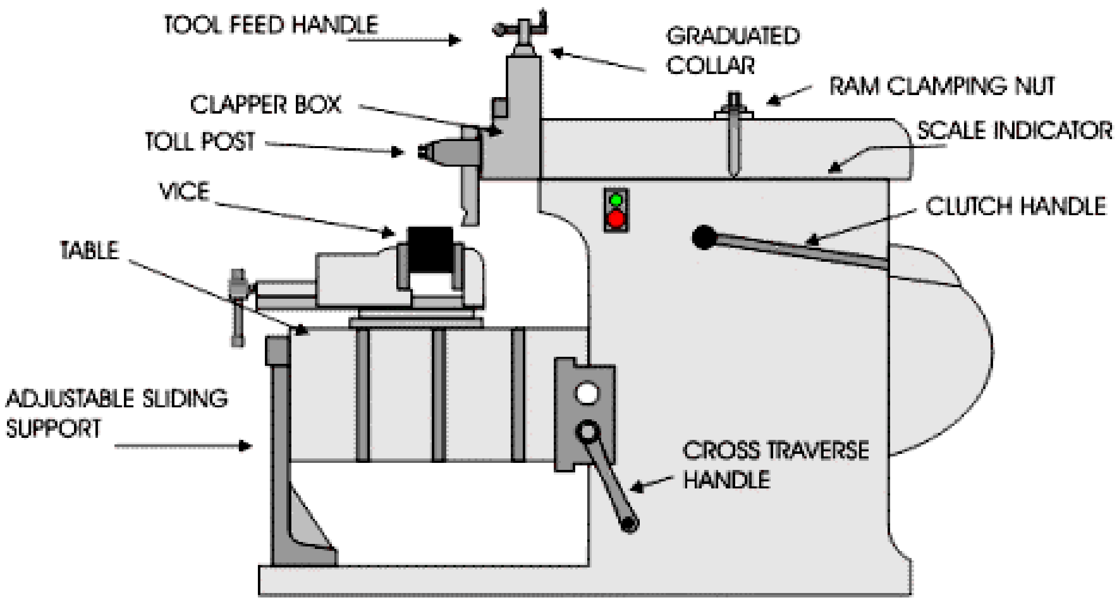
Vernier height gauge,

Dial indicator,

Required steel ball.

**CUTTING TOOLS**

H.S.S tool bit, V-tool, Plain tool, Grooving tool.




**OBSERVATION** Record the following in a tabularform:

### Machine Tool Specifications (Table A)

| Machine | Type &Make | Size | Speed given to | | Feed given to | | Type of Surface Produced |
|---|---|---|---|---|---|---|---|
| | | | Tool | Work | Tool | Work | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Shaper M/c. | | | | | | | |

**Speed and Feed Data (Table 2)**

| No. | Shaper M/c. | |
|---|---|---|
| | Speed | Feed |
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| | | |

**PROCEDURE:**

1. Run the machine at low speed and observe the motions, which control the shapes of the surfaces produced. Note particularly the features, which control the geometrical form of the surface.
2. Learn the names of the major units and the components of each machine. Record these details (Table A). (Please ensure that the main isolator switch is off and check that the machine cannot be inadvertently started. Do not remove guards). Use the manufacture's handbook for details that cannot be inspected.
3. Record the obtainable speed and feed values (TableB).
4. Note down the special features of the speed and feed control on eachmachine.
5. Measuring ofspecimen.
6. Fixing of specimen in the machine vice of the shapingmachine
7. Giving the correct depth and automatic feed for the slot is to bemade.
8. Check the slot with the Vernier calipers & precision measurement by slip gauges at theend.

**PRECAUTIONS:**

1. The shaping machine must be stopped before setting up or removing the workpiece
2. All the chips should be removed from thecutter.

**RESULTS:**

**ADVANTAGES:**

1. Single point cutting tools used in shaper are expensive these tools can be easily grounded to any desirable shape.

2. Shaper set-up is very quick and easy and can be readily changed from one job toanother.

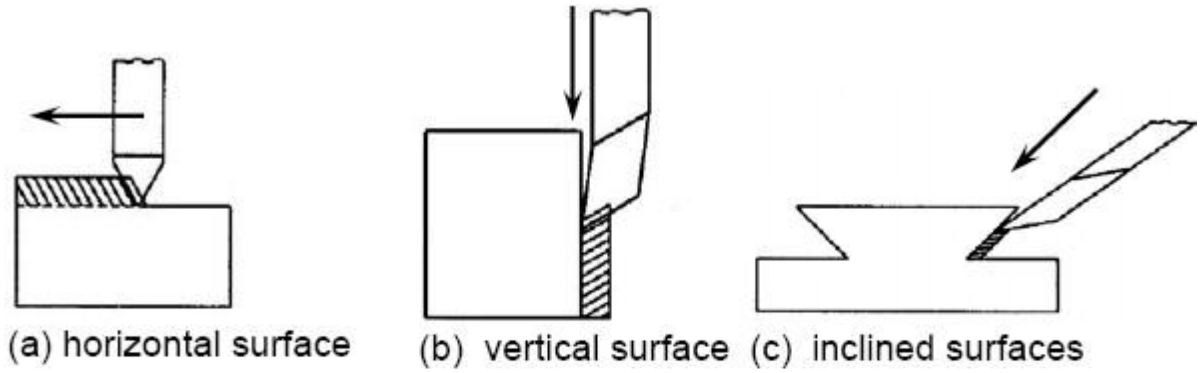
**DIS ADVANTAGES:**

1. The shaper is unsuitable for generating the flat surfaces on very large parts because of limitations on the stroke and overhang theram.

2. The primary motion is accomplished by rack and pinion drive using a variable speedmotor.

**APPLICATIONS:**

A shaper machine is a cutting machine that cuts a linear tool path using a linear relative motion between a single-point cutting tool and the piece of work. This type of machine is usually used to machine flat, straight surfaces, although it is also able to perform more complex tasks including the machining of dovetail slides, gear teeth and internal spline, keyways in the boss of either gears or pulleys and many other forms of work that take advantage of the machines linear relative motion.




**VIVA QUESTIONS:**

1. Mention the applications of gear shapingprocess?
2. What are the limitations of gearhobbing?
3. What isshaper?
4. List any four important parts of aShaper?
5. How the feed & depth of cut is given to theshaper?
6. Mention any four-shaperspecification?
7. How the planer differs from theshaper?

## EXP: 4 DRILLING AND TAPPING

**AIM:** To drill the given work piece as required and then to perform to make, counter boring, countersinking and tapping operations

**MATERIALS REQUIRED:** mild steel specimen, coolant (oil and water mixture), lubricant oil, nut and bolt.

**MACHINE REQUIRED**: Drilling machine

**MEASURINGINSTRUMENTS:** Vernier calipers

**CUTTINGTOOLS:**

Button pattern stock,
Dies,
Drill bits,
Hand taps,
Tap wrench.

**MARKING TOOLS:** Dot punch

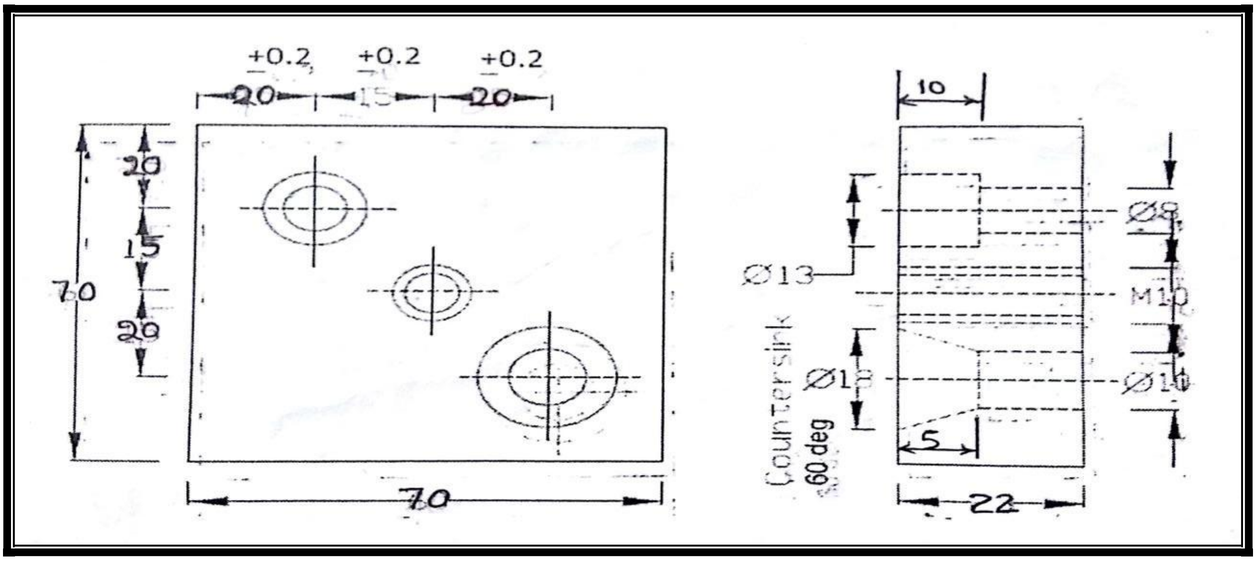
**Work holding fixtures:**

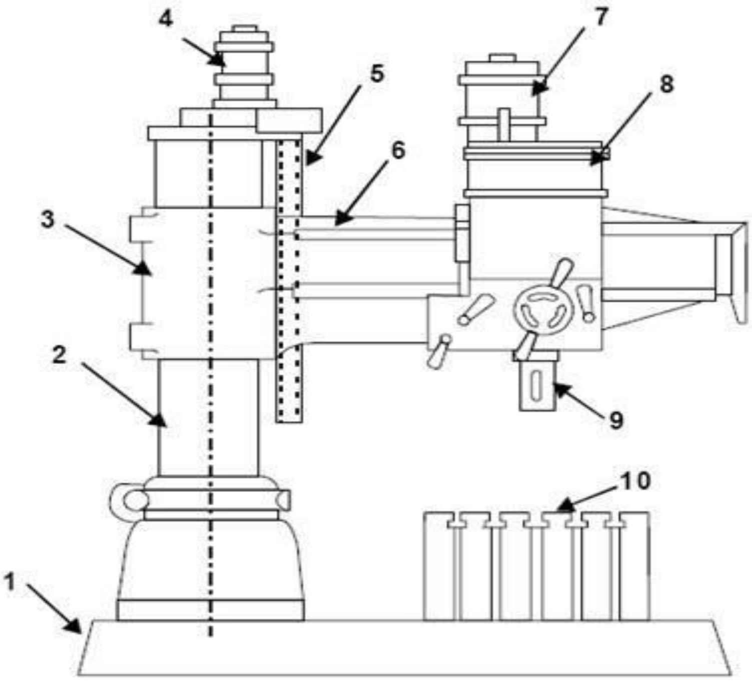
Bench vice,V-Block

**Miscellaneoustools:**

Brush, Allen Keys

**DIAGRAM:**






**PARTS OF RADIAL DRILL:**

1. Base
2. Column
3. Radial arm
4. Motor for elevating screw
5. elevating screw
6. Guide ways
7. Motor for driving spindle
8. Drill head
9. Drill spindle
10. Table

**OBSERVATION**

Record the following in a tabular form:

**Machine Tool Specifications (Table A)**

| Machine | Type &Make | Size | Speed given to | | Feed given to | | Type of Surface Produced |
|---|---|---|---|---|---|---|---|
| | | | Tool | Work | Tool | Work | |
| Drilling m/c | | | | | | | |

**Speed and Feed Data (Table B)**

| No. | Drilling M/c. | |
|---|---|---|
| | Speed | Feed |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| | | |

**SEQUENCE OF OPERATIONS:**

1. Run the machine at low speed and observe the motions, which control the shapes ofthe surfaces produced.
2. Note particularly the features, which control the geometrical form of thesurface.
3. Learn the names of the major units and the components of each machine. Record these details (Table A). (Please ensure that the main isolator switch is off and check that the machine cannot be inadvertently started. Do not remove guards). Use the manufacture's handbook for details that cannot beinspected.
4. Record the obtainable speed and feed values (TableB).
5. Note down the special features *of* the speed and feed control on eachmachine,

6.Mark the center of hole and centerpunching

7.Drillbid

$$D_d = d_h - p$$

Where,

1. $D_h$ - dia. of thehole,
2. $d_d$ – dia. of drillbit,
3. p =pitch

8.Use the suitable drill size for required tapping

D=Dia. of tap

Tap Drill size = (D-1.3p)+0.2 – for metric threads

9.Chamfering of specimen

10.Use the sequential tapping as tap set 1, 2, and 3

11.Internal taping of drilled specimen

12. Filling of specimen on which external threading to bedone

13. Measuring the diameter of the specimen & choosing of dies according toit

14.Dying operation (external threading) of thespecimen.

**PRECAUTIONS:**

1. Coolant has to be sued whiledrilling
2. Lubricating oil has to be used to get smooth finish whiletapping.

**RESULT:**

**ADVANTAGES:**

1. The universal movements of the tool head permit the drill tool located at any desired position over the stationary workpiece.
2. Possible to work on odd shaped jobs and to drill larger diameterholes.
3. Accurate precision drilling ispossible.

**DISADVANTAGES:**

1. A skilled worker is amust.
2. Only small size holes can bedrilled.

**APPLICATIONS:**

1. Origination and / or enlargement of existing straight through or stepped holes of different diameter and depth in wide range of work materials – this is the general or common use of drilling machines
2. Making rectangular section slots by using slot drills having 3 or four flutes and 1800 coneangle
3. Boring, after drilling, for accuracy and finish or prior toreaming
4. Counter boring, countersinking, chamfering or combination using suitable tools.

**VIVA QUESTIONS:**

1. What is meant bydrilling?
2. What is gang -drillingmachine
3. Mention any four specification of drillingmachine?
4. List any four machining operations that can be performed on a drillingmachine?
4. What are the different ways to mount the drillingtool?

**PART B: ENGINEERING METROLOGY**

**EXP. 1:**
**MEASUREMENT OF LENGTHS, HEIGHTS, DIAMETERS BY VERNIER CALIPERS MICROMETERS ETC**.

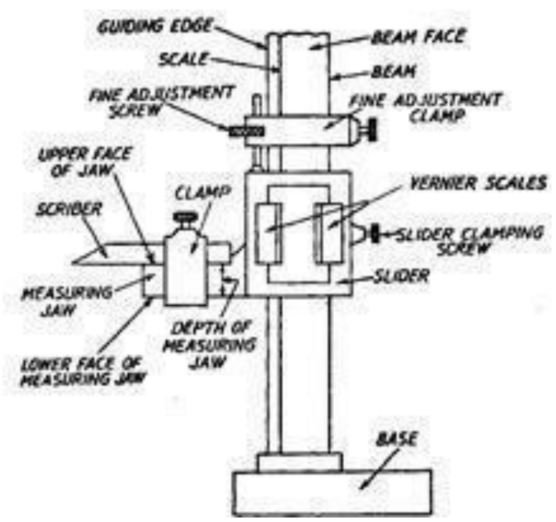
**AIM:** 1. To measure the height of the object using vernier height gauge.
2. To measure the depth of the object using Depthgauge.
3. To measure the diameter of the object using Verniercalipers.

## INSTRUMENTS USED:

1. Surface Plate 2. Vernier height gauge 3. Specimens 4.DepthGauge

## THEORY: VERNIER HEIGHT GAUGE:

Vernier height gauge is a sort of Vernier calipers equipped with a special with a base and other attachment, which make the instrument suitable for height measurement. Along with the sliding jaw assembly arrangement is provided to carry a removableclamp.
The upper and lower surfaces of the measuring jaws are parallel to the base, so that it canbe used for measurements over or undersurfaces.
The vernier height gauge is mainly used in the inspection of parts and layout work. The vernier height gauge can be used to scribe lines at a certain distance above the surface with a scribing attachment in place of measuring jaw. Dial indicators can also be attached in the clamp and many exact measurements can be made as it exactly gives the indication when the dial tip is touching the surface. Surface plates as datum surface are used for the above measurements.



**PROCEDURE:**

1. Place the object and the vernier height gauge on thesurfaceplate.
2. Note the value on the scale when the moving jaw is touching the bottom of the object.
3. Take the moving /sliding jaw to the top of the object and note down the valueonthe scale.
4. The difference between 3&2 will give the height of theobject.

**VERNIER DEPTH GAUGE:**

Vernier Depth Gauge is used to measure the depth of holes, slots and recesses, to locate center distances etc. It consists of

1. A sliding head having flat and true base free fromcurveswaviness.
2. A graduated beam known as main scale. The sliding head slides overthegraduated beam.
3. An auxiliary head with a fine adjustment and aclampingscrew.
4. A beam is perpendicular to the base in both direction and its ends square and flat. The end of the sliding head can be set at any point with fine adjustment locked and read from the Vernier provided onit.

**PROCEDURE:**

1. Held the base on the referencesurface.
2. Lower the beam into the hole until it contacts the bottom surface ofthehole.
3. Make final adjustment with fineadjustmentscrew.
4. Tighten the clamping screw and remove the instrument from the hole andtakethe reading in the same wayasvernier.
5. Leastcount= -------------- mm.

| S.NO. | Main scale reading MSR(mm) | Vernier Scale ReadingVSR(mm) | Measured reading = mm MSR+ (VSR*L.C) |
|---|---|---|---|
| | | | |

## PRECAUTIONS:

1. The height gauges should be kept in their case when notinuse.
2. Measuring jaws should behandledcarefully.
3. While using the Dept gauge, it should be ensured that the reference surface, on which the depth gauge is rested, is satisfactorily true, flatandsquare.

## RESULT:

- The heights of the given objects measured by vernierheight gauge aretabulatedabove.
- The depth of the holes measured by Vernier depth gauge is tabulatedabove.

## ADVANTAGES :

- Height gauges may also be used to measure the height of an object by using the underside of the scriber asthedatum.
- The datum may be permanently fixed or the height gauge may have provision to adjust the scale, this is done by sliding the scale vertically along the body of the height gauge by turning a fine feed screw at the top of the gauge; then with the scriber set to the same level as the base, the scale can be matchedtoit.
- This adjustment allows different scribers or probes to be used, as well as adjustingfor any errors in a damaged orresharpenedprobe.

## APPLICATIONS:

- These are used to mark out lines and widely used on surface plates and on machine tables.
- The height gauge with an indicator attachementis used for checking forsurfaceholes.
- The height is scribe attachment is used to mark reference lines and location on castings andforgings.
- Ideal for marking and measuring work for molds, jigs,andtooling.
- Sliding main carriage for fast,easyadjustment.
- Easy to read scale using 3x magnifyinglens.
- Carbide tippedscribe.
- Made of stainless steel for rust protection.
- Dial Indicator mounting arm accepts φ6mm, φ8mm,and dovetailtypeindicators.

## VIVA-VOICE QUESTIONS:

- What is the difference between vernier height gauge, vernier depth gauge,andvernier caliper?
- A height gauge is a measuring device used either for determining the height of objects, or for marking of items to beworkedon.
- What is the purpose of vernierheightgauge?
- What is the least count of vernierheightgauge?
- What are the various types of linearmeasuringinstrumen

**EXP:2**

**MEASUREMENT OF BORES INTERANAL MICROMETERS AND DIAL BORE INDICATORS.**

**AIM:**

The objective is to familiarize students with the use of vernier calipers, Micrometer screw gauges. The write –up for this experiment will be submitted at the end of the laboratory period. Drawings of the parts to be measured in the lab are available from the Teaching Assistant for the purposes of dimensioning. No aids other than calculators are allowed to be used.

## THEORY:

Least Count – the smallest degree by which two measurements may be differentiated with a particular instrument; generally considered to be of the same order as the smallest division in the instruments‘scale.

The Least Count is a measure of the accuracy of a measuring instrument.

## VERNIER CALLIPERS:

A vernier caliper consists of a rule with a main engraved scale and a movable jawwithan engraved vernier scale. The main scale is calibrated in centimeters (cm) with a millimeter (mm) leastcount, and the movable vernier scale that divides the least count on the main scale in to 50 equal sub-divisions. The span of the upper jaw is used to measure the inside diameter of an object such as hollow cylinders or holes. The leftmost mark on the vernier scale is the zero mark, which is often unlabeled. The measurement is made by closing the jaws on the object to be measured and reading where the zero mark on the vernier scale falls on the main scale. The first two significant figures are read directly from the main scale. This is known as the main scalereading.

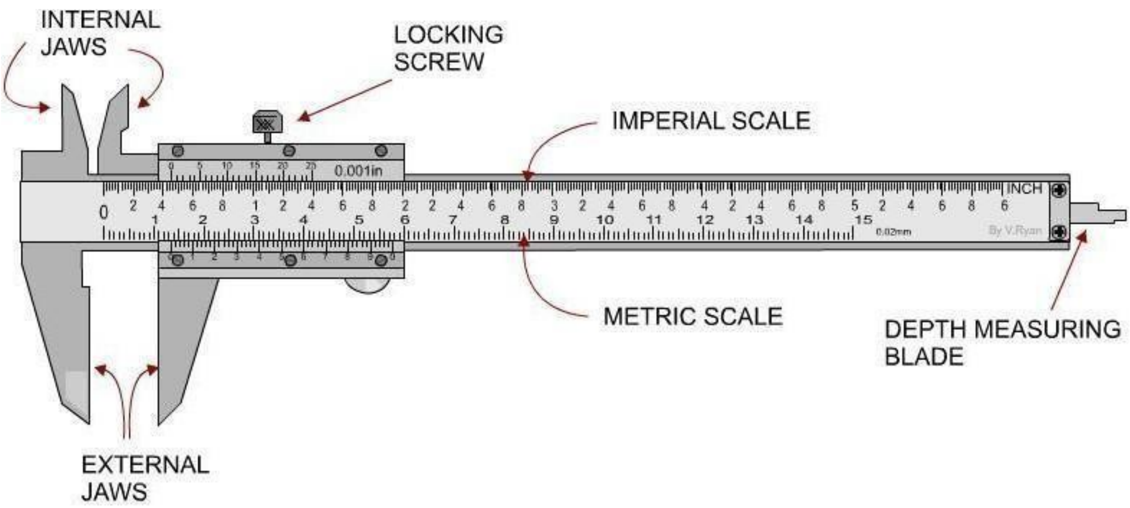
The next significant figure is the fractional part of the smallest subdivision on the main scale (in this case, mm). If a vernier mark coincides with a mark on the mainscale, then the mark number is the fractional part of the main scale division. Before making a measurement, the zero of the verniercalliper should be checked with the jaws completely closed. It is possible that the caliper not being properly will produce systematic error. In this case, a zero correction must be made for each reading. The least of the vernier caliper is calculatedbyequation

A large range of measurements can be made using the one measuring device. Against The majority of vernier calipers do not provide sufficient accuracy for close tolerance measurements.

In the machining process, we use verniercallipers or a micrometer for taking measurements. General analog vernier calipers can measure with the minimum unit of 1/20 mm. Several types of digital vernier calipers can measure with the minimum unit of1/100mm.

1) $\text{LeastCount} = \dfrac{\text{Value of the smallest division on main scale}}{\text{Number of divisions on vernier scale}}$

2) Measurement = Main scale reading + conceding vernier scale division×Leastcount




**PROCEDURE:**

Least Count:

Least count is the minimum distance which can be measured accurately by the Instrument. Least Count of Vernier Caliper is the difference between the value of main scale division and Vernier ScaleDivision.

Thus Least Count = (Value of Smallest Division on Main Scale)- (Value of Smallest Division on Vernier Scale) = 1-49/50 = 0.02 mm. (or) Least Count = (Value of Minimum Division on the Main Scale)/ (Number of Division on Vernier Scale ) = 1/50 = 0.02 mm

The given component is fixed between the jaws firmly, i.e.. in between fixed jaw and movable jaw.

The reading is to be noted down. Procedure for taking the Reading:

1. After closing the jaws on the work surface, take the readings from the main as well as Vernier Scale. To obtain the reading , the number of divisions on the main scale is firstreadoff.

_Ihe Vernier Scale is then examined to determined which of its division coincide or most coincident with a division on the main scale.

2. Before using the instrument should be checked by zero error. The zero line onVernierScale

should coincide with zero on the main scale.

3. Then take the reading in mm on main scale to the left of zero onslidingscale.

4. Now Count the no. of divisions on Vernier Scale from zero to a line which exactlyCoincides with any line on themainscale.

Thus total reading = [ Main scale reading ] + [No. of divisions with a division on Main Scale ] X Least Count. ( OR ) TR = MSR + VC X LC

5. Take the reading for4times.

## OBSERVATIONS :

| S. No | MSR | VSR | Total Reading= MSR+ (VSRXLC) |
|---|---|---|---|
| | | | |

## MICROMETER SCREW GAUGE:

### THEORY:

A micrometer consists of a movable spindle (jaw) that advances toward another parallel-faced jaw, called an anvil, by rotating the thimble. The thimble rotates over an engraved sleeve or barrel that is mounted on a solid frame. Most micrometers are equipped with a ratchet, at the far right in figure 2, which allows slippage of the screw mechanism when a small constant force is exerted on the jaw. This permits the jaw to be tightened on an object with the same amount of force each time. The axial main scale on the sleeve is calibrated in mm and the thimble scale is the vernier scale and is usually divided into increments of 0.01mm.

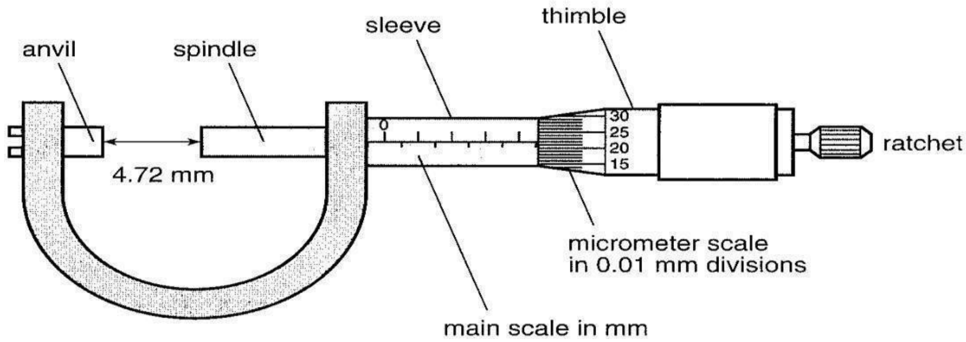
The pitch of a screw is the distance between two consecutive screw threads and is the lateral linear distance the screw moves when turned through one rotation. The axial line on the sleeve main scale serves as a reading line. If a micrometer does not have 0.5 mm divisions on the main scale, you must determine whether the thimble is in its first rotation or second. If it has 50 divisions on the thimble and completes 1 mm in two rotations, each division on the thimble gives0.01mm.

Measurements are taken by noting the reading *x* on the main scale of the sleeve. Note the position of the edge of the thimble on the main scale and the position of the reading line on the thimble scale. Multiply this reading with 0.01 mm and add to x

3) Least Count = Pitch (Distance between two consecutive threads of screw) ÷ Numberof divisions onthimblescale
4) Measurement = Main scale reading + coinciding thimble scale division×Leastcount

## How to Use a Micrometer

When close tolerances are required, measurements are taken with a micrometer due to its superior accuracy over a vernier caliper. The micrometer as can measure with the minimum unit of 1/1000mm.




## PROCEDURE:

The work piece is held between the 2 anvils without undue pressure.

This is Accomplished by having a retched drive to turn the thimble when the anvils contact each other directly or indirectly through work piece placed in between the ratchet tips over the screw cap without moving the screw forwards and thus avoids unduepressure.

Least Count = Pitch of the screw/ No. of Divisions on Circular Scale. If Pitch of screwis mm and Circular Scale has 50 divisions on it, then Least Count = 0.5 / 50 ~0.01mm

In measuring, the dimension of work piece the main scale upto the leveled edge of thimble andno. of divisions of thimble scale to axial line on barrel are observed addition of twogivenresult.

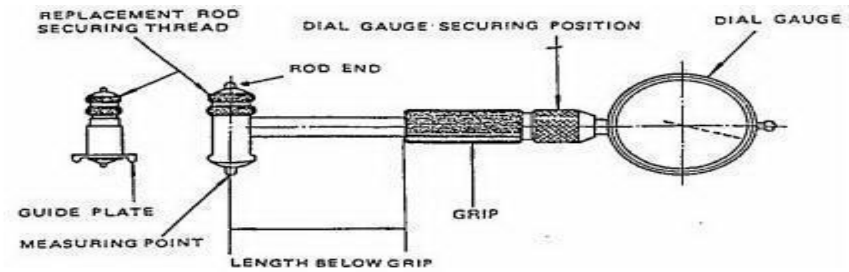
## OBSERVATIONS:

| S.No | PSR | HSR | PSR+(HSRXLC) | READINGS |
|---|---|---|---|---|
| | | | | |

**BORE DIAL GAUGE:**

**THEORY:**

It is used for measuring internal diameter of a hole, which is machined. The bore dial gauge consists of one fixed measuring head and one movable measuring head. The movement of the movable measuring rod is transmitted to dial indicator by push rod through a spring actuated hinged member. Thus the horizontal movement of the rod is transmitted into vertical direction gives indication of variatopn of size. The calibrated rods are made in different sizes and sometimes number of short rods threaded at the ends are used in combination to get different desiredlengths




## PROCEDURE:

The measuring head is placed in contact with the surface of hole & movement of measuring head contact point is transmitted to the amplifying mechanism by the calibrated rods and its shown on the dial indicator. These calibrated rods are located in tabular supports between the head and dial units. The readings from dial indicator are tabulated

## OBSERVATIONS:

| S.NO | DIAMETER | TRIAL 1 | TRIAL 2 | AVERAGE | MEASURED DIAMETER |
|---|---|---|---|---|---|
| | | | | | |

Note: Please avoid dropping the tools as this can lead to irreparable damage to the precision instruments. The tools are coated with a light film of oil to prevent corrosion. Please do not remove this oil. A cloth has been provided to clean your hands after use.

## RESULTS:

The specifications of the given component are measured with vernier caliper, outside micrometer & bore dial gauge.

## ADVANTAGES OF VERNIER CALIPER

-  Vernier Calipers are precision measuring instruments with a higher accuracylevel.

-  It is one of the best caliper to measure least count of any object. However there are certain number of advantages and disadvantages about these instruments which are discussedbelow.

-  Vernier Caliper is very important tool in manufacturing industry and has lot of benefits.

-  Precision&accuracyaretwohallmarksofVerniercalipers,thisinstrumenthasrobust tendency to give precise and accurate measurements of variousdimensions.

-  **TwinScales:**

  Main or primary scale and Vernier or secondary scale are constructed together into the measuring equipment, an additional measuring gadget like a ruler or tape measure is not needed.

-  **Adaptability forMeasurements:**

  Vernier calipers can be used for variety of applications. It can measure inner, outer, steps and depth dimensions of any geometrical objects.

-  **Strength:**

  Majority of manufacturers make Vernier calipers by using pure stainless steel to give strength and durability. As we know stainless steel have a higher strength & corrosion protection and hence by following standard manufacturing processes, Vernier Calipers can sustain for a lifetime.

-  **Price:**

  Vernier calipers are very common, there are many suppliers available in the market. Therefore the prices are very competitive now and these are readily available in cheap prices as well.

## DISADVANTAGES OF VERNIER CALIPER

-  Good Vision IsNeeded:

  As quite evident, the Vernier scale of a Vernier caliper is significantly small component. With improper vision or improper angle of vision it is quite difficult to properly read or identify measurements. To avoid such mistakes normally Good vision or a right light with magnifying glass would be recommended while taking readings.

- Learning A VernierCaliper:

  All of us know that the Vernier scale is a specialized precision measuring tool; user should make an effort to learn how to read from a Vernier caliper before going to take measurements.

- Prospect OfErrors:

  While acquiring several numbers of measurements, user might end up committing error. To avoid this prospect of errors extra attentiveness is needed.

- Availability OfAlternates:

  Digital calipers are best alternate to Vernier calipers that can yield more accurate values with no prospect of errors as in manual Vernier Calipers

## ADVANTAGES OF MICROMETER:

- More accurate thanrules.
- Greater precision thancalipers.
- No
- parallaxerrorRelativelyinexpens
- ive.

  Endmeasurement

## DISADVANTAGES OF MICROMETER:

- Short measuringrange
- End measurementonly
- Single puroseinstrument.
- Limited wear area of anvil and spindletip.

## APPLCATIONS:

- It can be used to measure diameter of a wire, thickness of a thin metal sheet,etc
- These instrument are used to check round work piecesaccurately.
- It is also used to check wall thickness of thepipe.

**VIVA-QUESTIONS:**

- What is the least count of a Vernier caliper having 20divisions on Vernier scale, matching with 19 divisions of main sale?
- What type of micrometer is used for measuring longer internallength?
- How to maintain constant pressure inmicrometer?
- What is the purpose of adjusting nuts in amicrometer?
- What is the range of dial boregauge?
- What is the least count of digitslverniercaliper?
- Explain briefly about the different types ofmicrometers?
- What is the least count of a micrometer and how is itdetermind?
- What are VernierCalipers?
- What is Micrometer?
- What is the Least Count of Vernier & Outside Micrometer?
- What are applications of Vernier & Outside Micrometer?
- What are the errors in Vernier & Outside Micrometer?
- Compare Vernier & Outside Micrometer .
- What are the precautions required during use of inside micrometer & dial Boreindicator.
- Which one is more precise when compared to inside micrometer & dial boreIndicator.
- What are the applications of inside micrometer & dial bore indicator?
- How do you find the least count of inside micrometer?
- What are the other instruments for measuring bores?

EXPERIMENT NO. 3:

## ANGLE MEASUREMENT USING BEVEL PROTACTOR & SINE BAR

**AIM:**

To measure the angle of the given wedge using Sine bar & Bevel Protractor

## INSTRUMENTS USED:

1. Sine bar 2. Work piece 3. Dial Gauge 4. Slip gauges 5.BevelProtractor.

## SINE BAR:

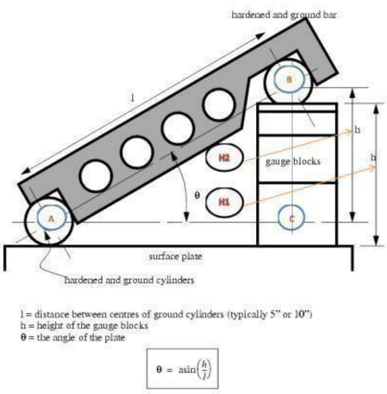
**THEORY:**

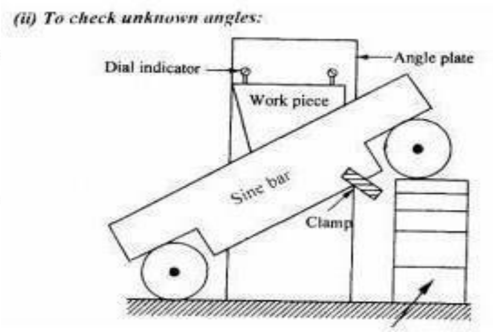
The sine principle uses the ratio of the length of two sides of a right triangle in deriving a given angle. The accuracy with which the sine principle can be put to use is dependent in practice, on some form of linear measurement. The sine bar in itself is not a complete measuring instrument. Sine bars in conjunction with slip gauges constitute a very good device for the precise measurement of angles. The arrangement is based on the fact that for any particular angle θ the sides of a right angledtriangle will have precise ratio,i.e,

$$\mathbf{Sin\theta = h/l}$$

If **h** and **l** could be measured accurately, θ can be obtained accurately. The value of h isbuilt-up by slip gauges and value _l‘ isconstant for a given sine bar.

Sine bars are used either to measure angles very accurately or for locating any work to a given angle within very close limits. Sine bars are made from high carbon, high chromium, corrosion resistant steel, hardened, ground and stabilized. Two cylinders ofequal diameter are attached at the ends. The axes of these two cylinders are mutually parallel to each other and also parallel to and at equal distance from the upper surface of the sine bar. The distance between the axes of the two cylinders is exactly 100,200and

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## PROCEDURE:

1. Place the work piece/wedge above the sine bar and make it horizontal withthebase.
2. The dial gauge is then set at one end of the work moved along the upper surfaceof the component.
3. If there is any variation in parallelism of the upper surface of the component andthe surface plate, it is indicated by thedialgauge.
4. The combination of the slip gauges is so adjusted that the upper surface is truly parallel with thesurfaceplate.
5. Note down the values of theslipgauges.
6. Calculate the angle using theformula.

$$\theta = \sin^{-1}(h/l)$$

7. Repeat the procedure 3 or 4 times and taketheaverage.

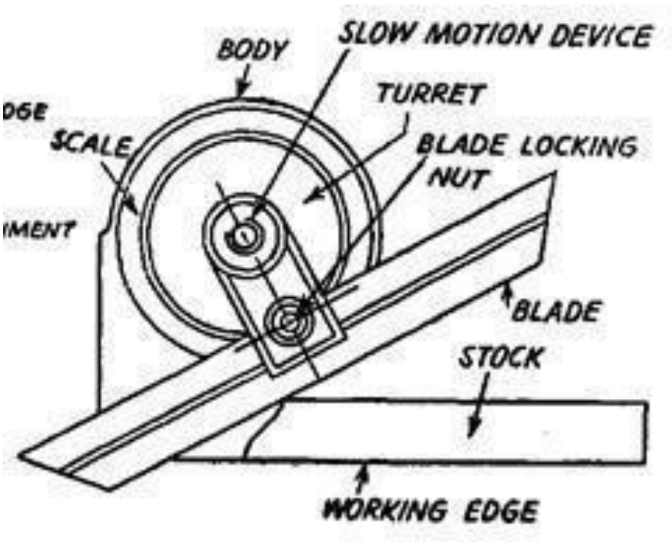
## OBSERVATIONS:

| S.No. | HEIGHT(h) | LENGTH(l) | ANGLE |
|---|---|---|---|
| | | | |

## BEVEL PROTRACTOR:

A universal bevel protractor is used to measure angles between two planes. This consists of stem, which is rigidly attached to main scale and a blade, which is attached to the Vernier scale and can be rotated to read angles. To improve the accessibility, the blade can also slide.

The least count is calculated by knowing the value of the smallest division on the main scale and number of division on the Vernier scale. It should be noted that the divisions on the main scale is in degrees and that the fractional divisions of degrees are minutes (i.e. with 60 minutes/degree, denoted). To measure angle between two planes, rest the stem on one of the planes (reference plane). Rotate the blade such that blade is flush with second plane. Readings are taken after ensuring that the stem and blade are in flush with the two planes. Lock the protractor at this point and note sown thereadings.




**OBSERVATIONS:**

| S.NO. | ANGLE MEASURED |
|---|---|
| | |

**PRECAUTIONS:**

1. The sine bar should not be used for angle greater than$60^0$ in because any possible error construction is accentuated at thislimit.
2. A compound angle should not be formed by mis-aligning of work piece with the sine bar. This can be avoided by attaching the sine bar and work against anangleplate.
3. As far as possible longer sine bar should be used since using longer sine bars reduces manyerrors.

**RESULT:**

1. The angle of the given specimen measured with the sinebaris
2. The angle of the given specimen measured with the BevelProtractoris