GIET UNIVERSITY GUNUPUR, ODISHA

Incorporated by Act 23 of Govt. of Odisha and under approval of UGC & AICTE
Accredited by NAAC with a CGPA of 3.28/4 at *A+ Grade*
Seven UG Programs CSE, ME, CHE, AEIE, ECE, BT & EEE Accredited by NBA
Gunupur - 765022, Dist.- Rayagada, Odisha, INDIA www.giet.edu

DEPARTMENT OF MECHANICAL ENGG .

1ST YEAR

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
	Engineering Workshop	0	0	4	2

Pre - Requisite:

Course Educational Objectives

CEO1	To develop an appreciation for the importance of safety, ethics, and sustainability in engineering practice.
CEO2	To develop practical skills and knowledge in the field of mechanical engineering, including the ability to use hand and machine tools, read technical drawings, and fabricate simple components.

Course outcomes: At the end of the course, the student will be able to:

CO1	Familiarity on various safety precautions in a workshop setting, including the ability to identify potential hazards and risks, and to develop appropriate safety measures to mitigate those risks.
CO2	Understanding of the various hand and machine tools used in fitting and the ability to select the appropriate tool for a given task.
CO3	Gain knowledge of the various components and working principles of a standard center lathe machine and developing skills in preparing a cylindrical job using a lathe machine, including facing, taper turning, step turning, and knurling operations.
CO4	Acquire skills in preparing different types of joints, including lap joint, butt joint, corner joint, and T-joint, using electric arc welding and oxy-acetylene gas welding.
CO5	Develop an understanding of the principles and techniques of calibration, including the ability to calibrate various instruments, such as LVDT, load cell, and thermocouple, using appropriate tools and techniques.
CO6	Acquire skills in surface roughness testing, including the ability to determine the surface roughness of various components using appropriate instruments and techniques.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2		2											
CO3	2		2											
CO4	2		2											
CO5	2		2											
CO6	2		1											
Avg.	2		1.5											

EXPERIMENT-2

AIM OF THE EXPERIMENT:

To study different hand tool and machine tool used in fitting.

INTRODUCTION:

In Fitting shop unwanted material is removed with the help of hand tools. It is done for mating, repair and manufacturing purposes. Commonly used tools in fitting shops are hacksaw, files, chisels, etc.

TOOLS USED IN FITTING SHOP:

1. **CLAMPING TOOLS:** Clamping tools are used for holding the job firmly during various fitting operations.

   a) **Bench vice:** It is a common tool for holding the jobs. It consists of cast iron body and iron jaws .The jaws are opened up to required length, job is placed in the jaws and is fully tightened with handle.

   b) **Leg vice:** It is stronger then bench vice and used for heavy work.

   c) **Hand vice:** It is used to grip very small objects.

   d) **Pipe vice:** It is used to hold pipes. It grips the pipe at four places and is fixed on bench or can be grouted.

2. **MEASURING AND MARKING TOOLS:**

   a) **Try Square:** It is used for checking squareness of two surfaces. It consists of a blade made up of steel which is attached to base at 90°.

   b) **Scriber and Surface Gauge** – It is used for marking of lines parallel to a surface. Scriber mounted on a vertical bar is called surface gauge.

   c) **Dot Punch** – It is used for marking dotted lines. Angle of punching end is 60°.

   d) **Centre Punch** – It is like a dot punch used to mark the centre of hole before drilling. Angle of punch end is 90°.

   e) **Surface Plate** – Surface plate is used for testing the flatness, trueness of surface, its upper face is planned to form a very smooth surface.

   f) **Angle Plate** – It consists of cast iron in which two ribs of metal are standing at right angle to each other, used for holding and supporting the jobs.

   g) **'V' Block** – It is used for supporting as well as marking of round jobs.

h) **Steel Rules** – It is made up of stainless steel and marked in inches or millimetres, available in various sizes ½ ft to 3 ft.

i) **Vernier Calliper** – It is a precision instrument used for measuring lengths and diameters. Minimum dimension that can be expressed on vernier calliper is known as least count which is usually 0.001 or 0.02 mm.

j) **Micrometer** – It is used for measuring diameters or thickness of any Job. The graduation on micrometers is available in inches as well as in millimetres.

k) **Dial Indicator** – A round gauge in which a pointer moves over a graduated scale. The movement is magnified through links. It is used to check the run out or ovality of Jobs.

l) **Dividers** – Dividers have two legs having sharp feet. It is used for marking arcs, dividing a line or transferring the dimensions.

m) **Callipers:** it is generally used to measure the inside or outside diameters. There are two types of callipers.

I. Outside callipers

II. Inside callipers

CUTTING TOOLS:

These tools are used to remove the materials

1. **Hacksaw** – It is used of cutting of flats, rods etc. The blade of hacksaw is made up of high carbon steel and frame is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The teeth of hacksaw blades are generally forward cut. There are two types of hacksaw frames, fixed frames and adjustable frame. The material to be cut with hacksaw is clamped in a vice. The hacksaw should be moved perfectly straight and horizontal.
2. **Files** – It is used to remove material by rubbing it on the metal. Classification of files.
   - i) **Size** – The length of file varies from 4 inch to 14 inch.
   - ii) **Shape** – The shapes available are flat, square, round, half-round, triangular etc.
   - iii) **Cuts** – Single and Double Cut.
   - iv) **Grade** – Rough - 20 Teeth per inch
     Bastard - 30 Teeth per inch
     Second Cut - 40 Teeth per inch

Smooth – 50-60 Teeth per inch

Dead Smooth - 100 Teeth per inch

Rough and Bastard files are used for rough cutting, smooth and dead smooth files are used for finishing work. Files should be used in perfect horizontal position. Pressure should be applied on the forward stroke only. Work is held in a vice.

3. **Chisels** – They are used for chipping away the material from the work piece. Commonly used forms of chisels are flat, cross cut, half round, and diamond point chisels. Flat chisel is used for chipping a large surface. Cross cut chisel is used for grooving. Half round chisel is used to cut oil-grooves. Diamond point chisel is used for chipping plates.

STRIKING TOOLS:

Hammers are the only tools used for striking in fitting shop like chipping, fitting, punching etc. Main types of hammer

- Ball Peen Hammer
- Straight Peen Hammer
- Cross Peen Hammer
- Gold Smith Hammer

MISCELLANEOUS TOOLS:

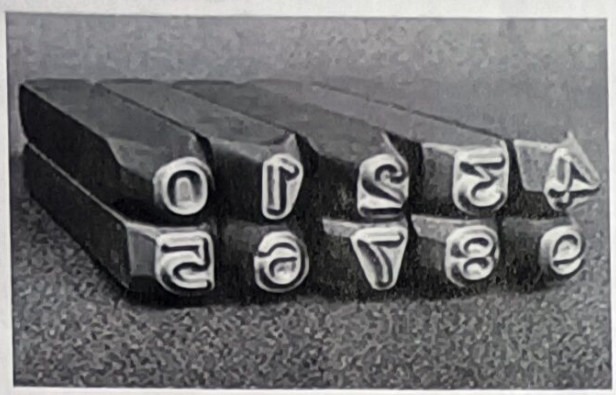
Drill – It is used for making round holes. Twist drill is most commonly used for making holes.

Reamer – It is used to finish the drilled hole to accurate size.

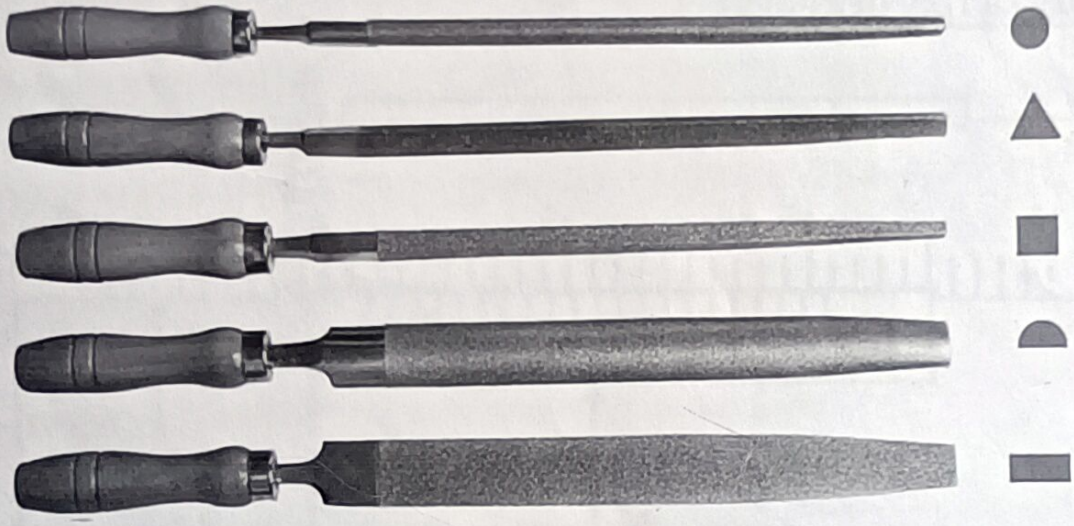
Taps – It is used for making internal threads. Tap is hold by the tap holder, normally it comes in a set of three, taper Tap, Intermediate Tap, and Plug Tap.

Die – It is used for making external threads. Die is hold by the die holder, normally it comes in different size based on the thread.

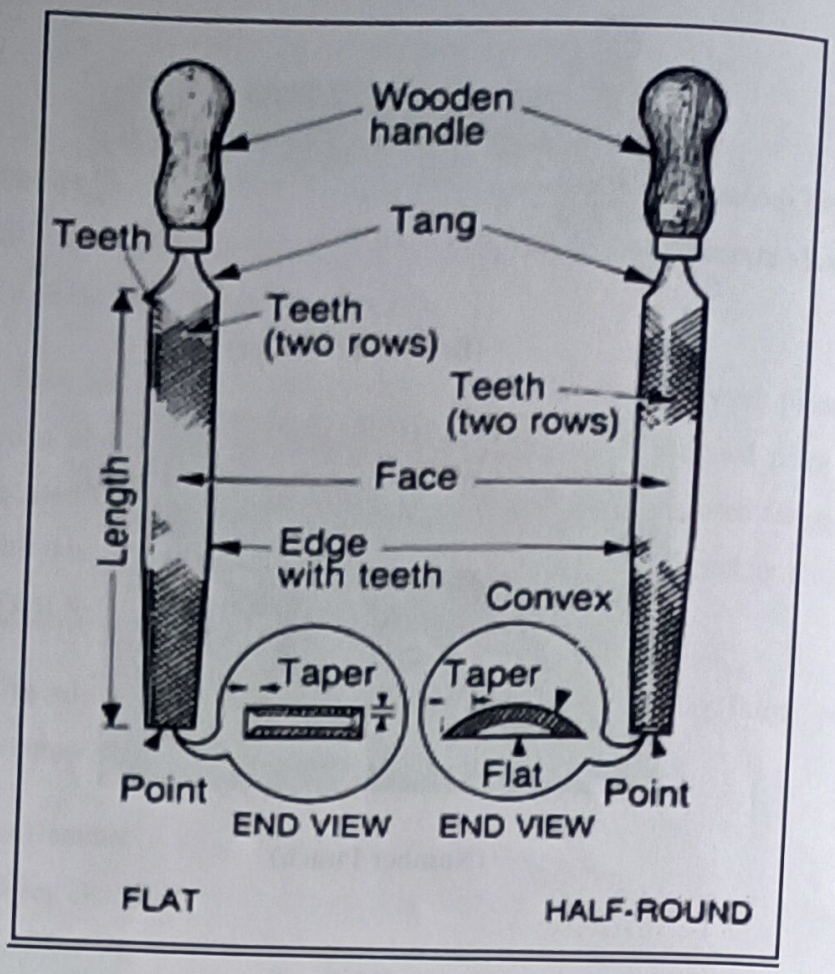
(Ball peen hammer)

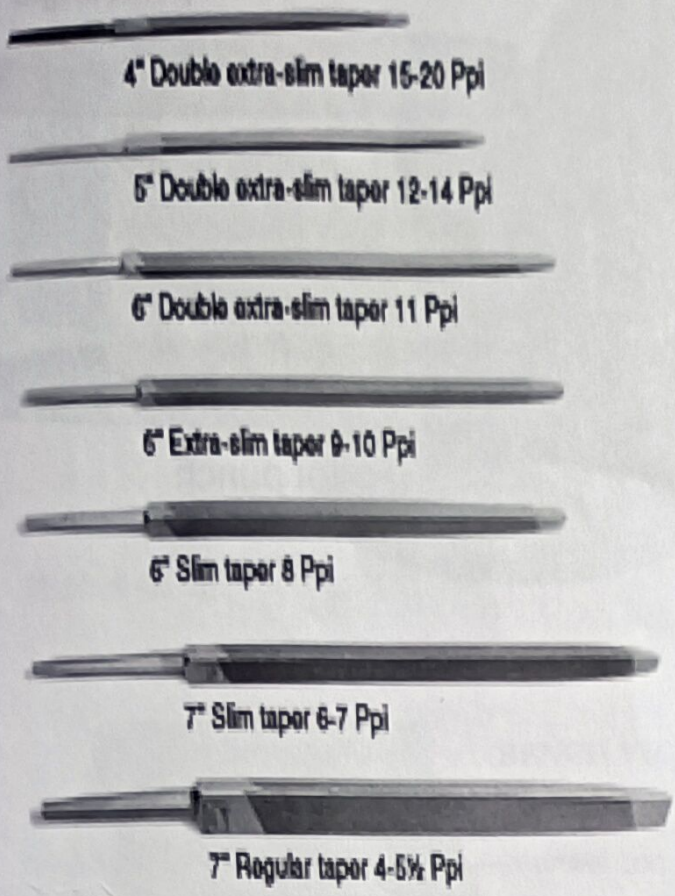


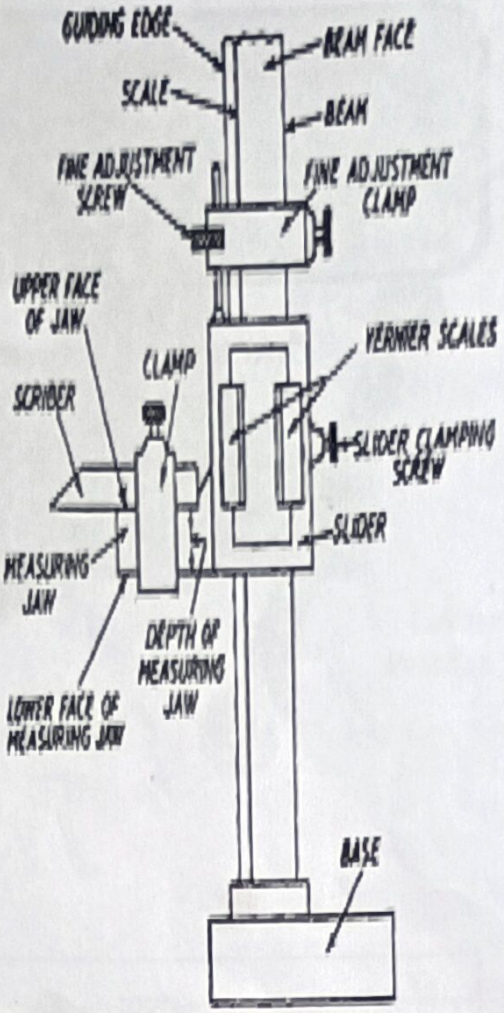
(Number Punch)



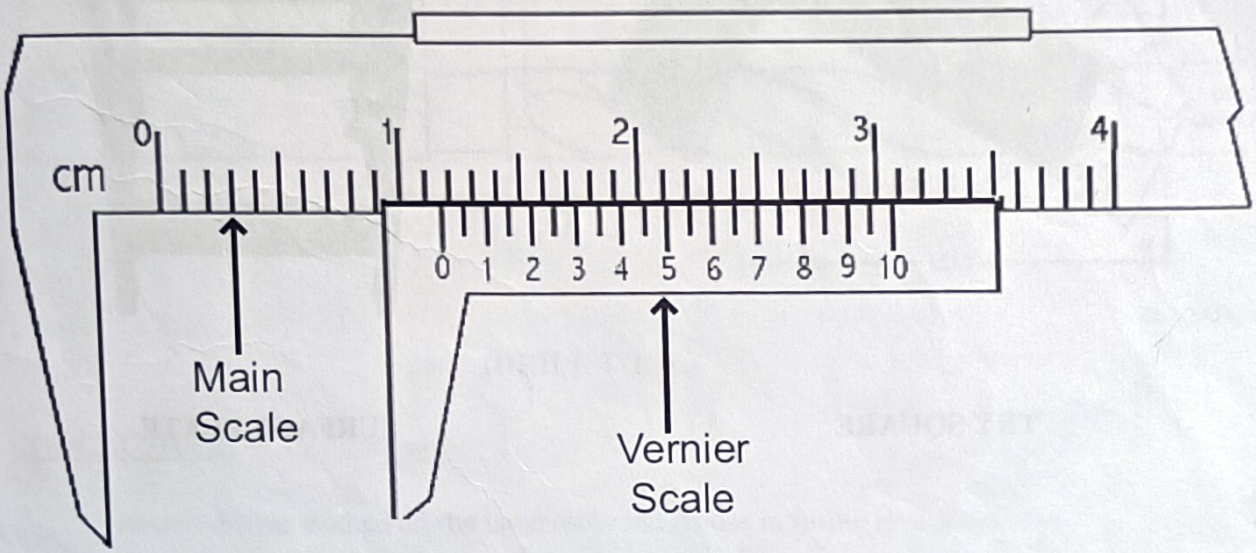
(DIFFERENT TYPES OF FILES)


Wooden handle
Teeth
Tang
Teeth (two rows)
Teeth (two rows)
Length
Face
Edge with teeth
Convex
Taper
Taper
Point
END VIEW
Flat
END VIEW
Point
FLAT
HALF-ROUND

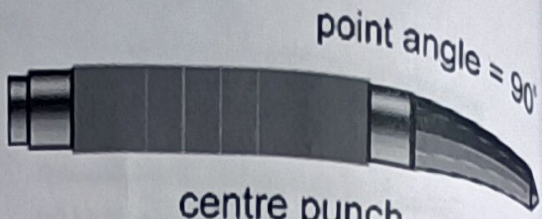




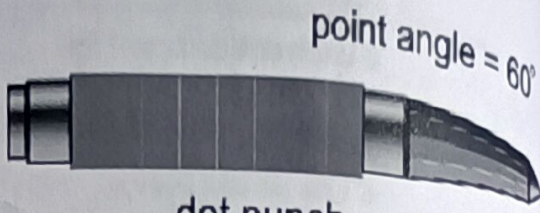
VERNIER HEIGHT GAUAGE



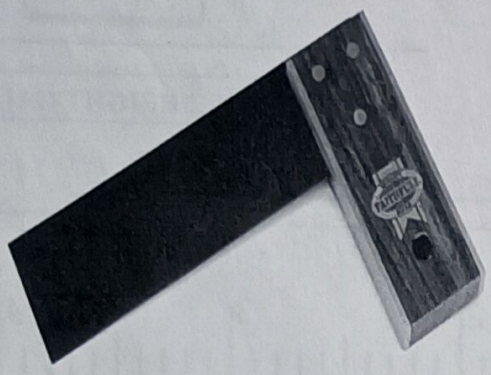
HACKSAW



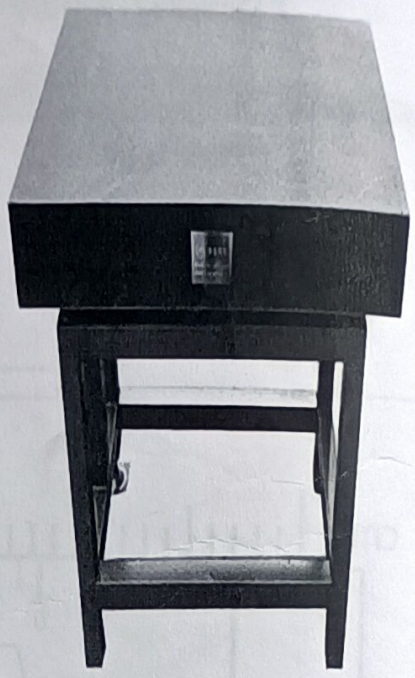
centre punch



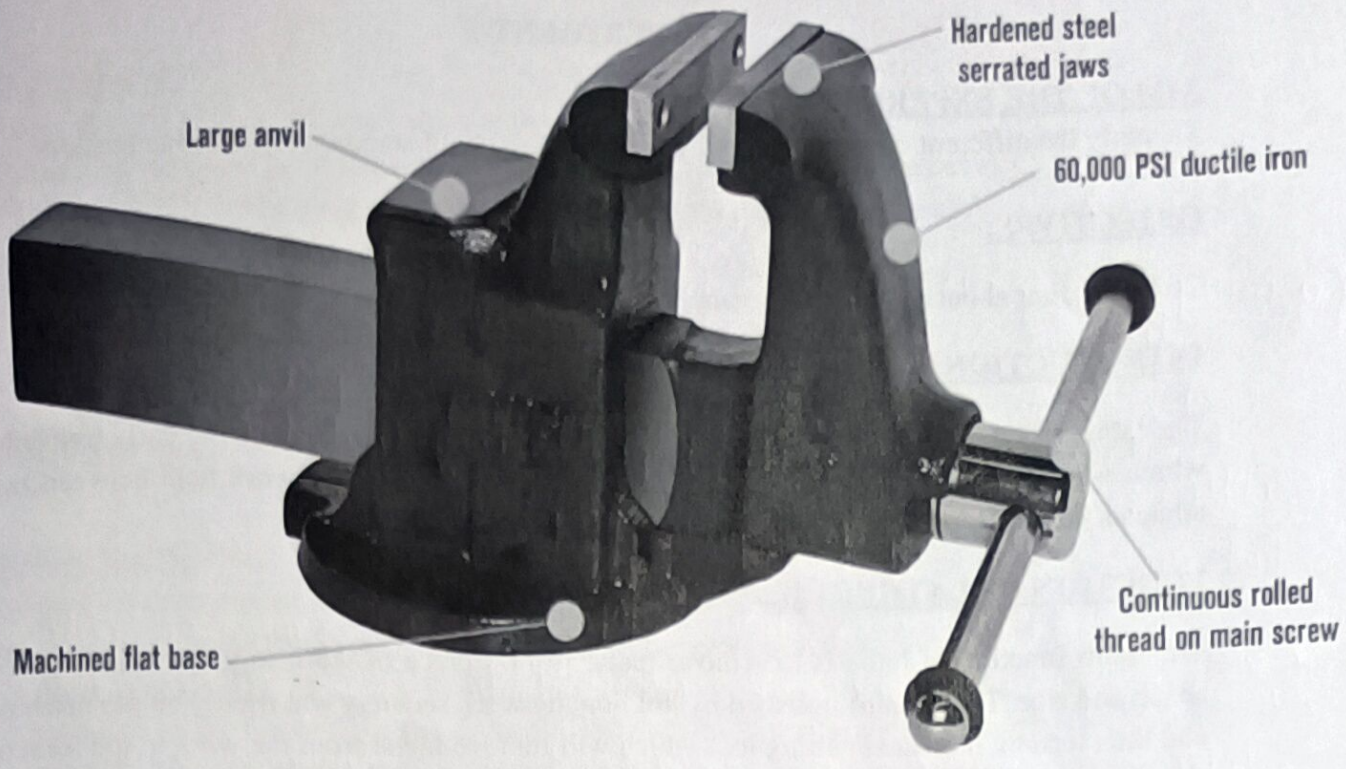
dot punch



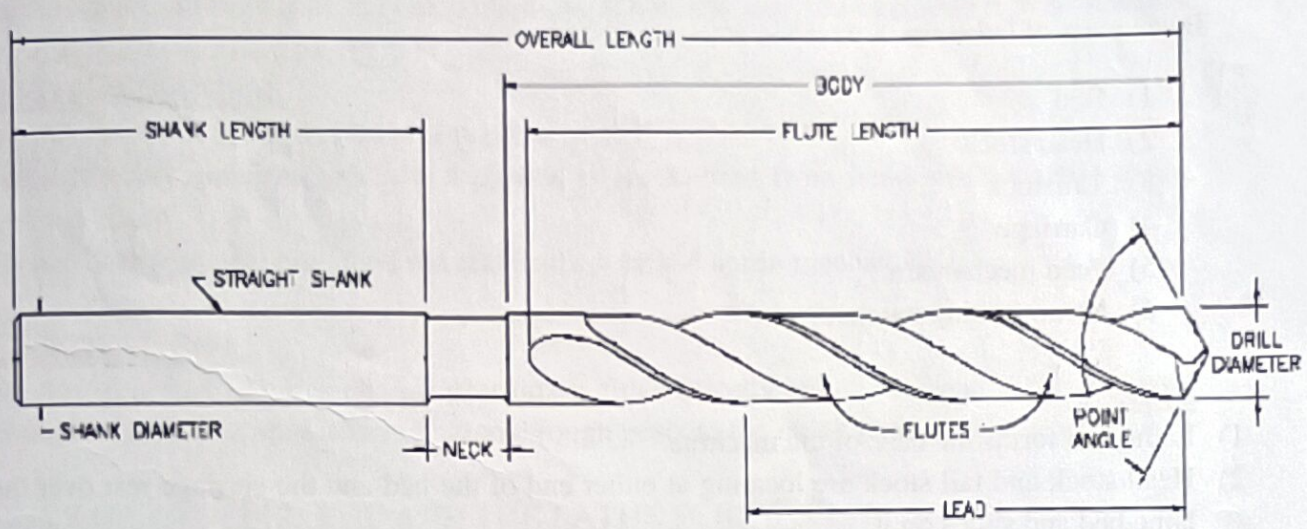
TRY SQUARE



SURFACE PLATE



(BENCH VICE)



(DRILL TOOL)

CONCLUSION:

Hence we have studied all the hand tools and its use in fitting operation.

EXPERIMENT-3

AIM OF THE EXPERIMENT:

To study the different components and working principle of standard centre lathe machine.

OBJECTIVES:

To be familiar about the different components of standard centre lathe machine.

INTRODUCTION:

The lathe is one of the oldest machine tools and came into existence from the early free lathe which was then a novel device for rotating and machining piece of work held between two adjacent centres.

FUNCTION OF LATHE:

The main function of lathe is to remove metal from a piece of work to give it the required shape and size. This is accomplished by holding the work securely and rigidly on the machine and then turning it against cutting tool which will remove metal from the work in the form of chips.

DESCRIPTION:

Basic parts of lathe are

1) Bed
2) Head stock
3) Tailstock
4) Carriage
5) Feed mechanism
6) Screw cutting mechanism

BED:

1) Lathe bed forms the base of the machine
2) Head stock and tail stock are locating at either end of the bed and the carriage rest over the lathe bed and slides on it.
3) It should be sufficiently rigid to prevent reflection under tremendous cutting pressure transmitted through the tool post and carriage to the lathe bed.
4) It must be massive with sufficient depth and width to absorb vibration.

HEAD STOCK:

1) Head stock is secured permanently on the inner ways at the left hand end of the lathe bed.
2) It provides the mechanical means of rotating the work at multiple speeds.
3) It comprises essentially a hollow spindle and mechanism for driving and altering the spindle speed.

TAILSTOCK:

1) Tailstock is located on the inner ways at the right hand end of the bed.
2) It supports the other end of the work when it is being machined between centres.
3) It holds a tool for performing operation such as drilling, reaming, taing etc.

CARRIAGE:

1) It has several parts to serve the support, move and control the tool.
2) It consists saddle, cross-slide, compound rest, tool post and apron.

SADDLE: A saddle is a H-shaped casting that fit over the bed and slides along the guide ways.

CROSS-SLIDE:

The cross-slide comprises a casting machine on the underside for attachment to the saddle and carriers on the surface (upper) for the tool post or compound rest.

COMPOUND REST:

It is mounted on the top of the cross slide and has circular base graduated in degrees it is used for obtaining angular cut and shot and tapers as well as convenient positioning of the tool to the work.

TOOL POST:

This is located on the top of the compound rest to hold the tool and to enable it to be adjusted to a convenient working position.

FEED MECHANISM:

1) The movement of the tool relative to work is termed as feed.
2) It has different units through which motion is transmitted from head stock spindle to the carriage.
3) It consists of feed gear box, feed rod and lead screw and apron mechanism.

FEED GEAR BOX:

The feed gear box of quick change gear box is fitted directly below the head stock assembly power from the lathe spindle transmitted through gears to the quick change gear box.

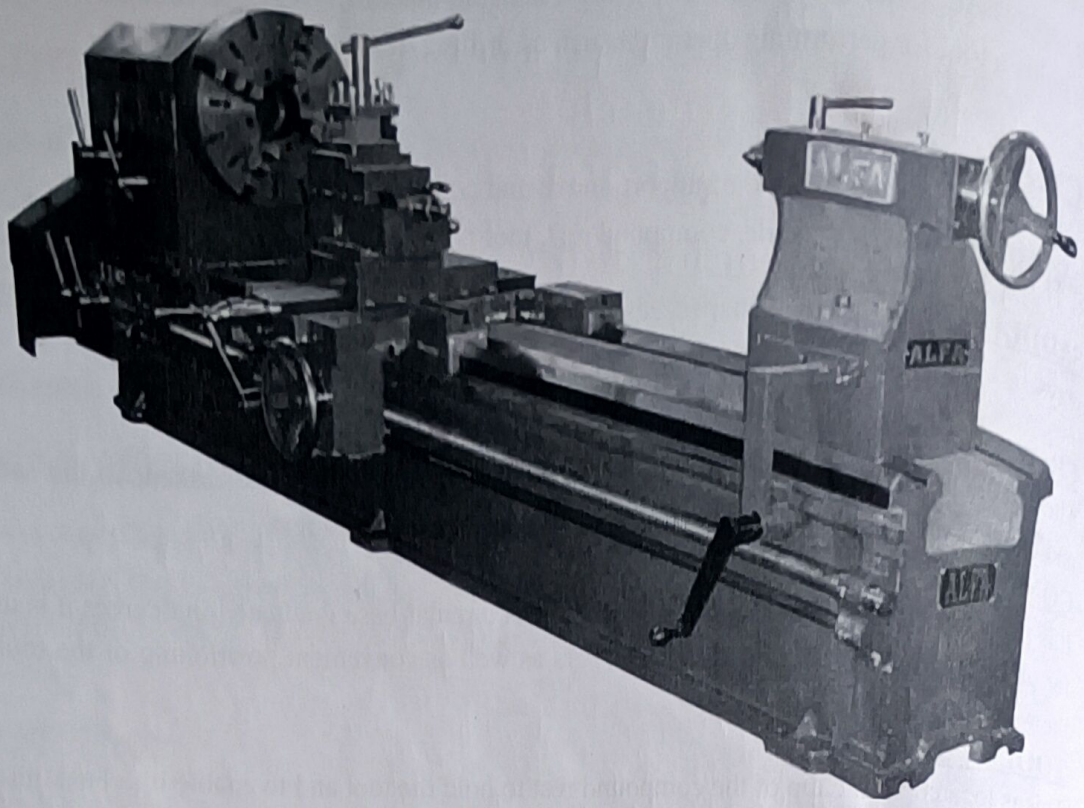
DRIVE OF THE FEED ROD AND THE LATHE SCREW:

The motion is transmitted from the spindle through the gear and change gear to the shaft on which 12 gears are keyed.

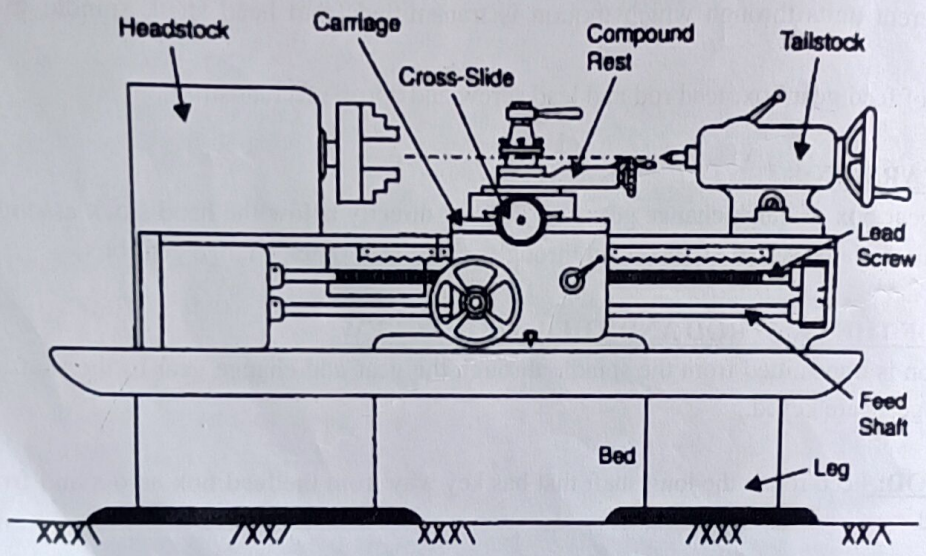
FEED ROD: Feed rod is the long shaft that has key way from the feed box across and front of the bed.

LEAD SCREW: The lead screw is a long threaded shaft need as master screw and is brought into operation only when threads has to be cut.

LATHE DIAGRAM:



(3D- diagram of standard centre lathe)



(2D- diagram of lathe machine)

THREAD CUTTING MECHANISM:

- The rotation of the lead screw is used to transverse the tool along the work to produce the screw thread.
- The half nut mechanism makes the carriage to engage or disengage with the lead screw.
- It comprises a pair of half nuts capable of moving in or out of mesh with the lead screw.

LATHE CENTRE:

It is a tool that has been ground to a point to accurately position a workpiece on an axis. They usually have an included angle of 60°, but in heavy machining situations an angle of 75° is used

CONCLUSION:

From this above experiment we knew different components and working principle of standard centre lathe machine. Now a days high speed heavy duty production standard centre lathe machine tool is used in workshop and industries.

EXPERIMENT-4

AIM OF THE EXPERIMENT:

To prepare a cylindrical job with different operation (Facing, Taper Turning, Step Turning, Knurling) by Lathe machine

MATERIAL REQUIRED:

Mild steel rod (Length: 100 mm , Diameter: 32 mm)

APPARATUS REQUIRED:

1) Power hacksaw
2) Vernier caliper
3) Steel rule
4) File
5) Lathe machine with all the arrangements

OBJECTIVES:

To be familiar and perfect about the various operations

SEQUENCE OF OPERATIONS:

1) Centering
2) Measuring & marking
3) Facing
4) Plain turning
5) Chamfering
6) Parting
7) Thread cutting
8) Knurling
9) Checking

OPERATION CHART:

SL 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

TYPES OF OPERATION:

FACING OPERATION:

Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis.

ROUGH TURNING OPERATION:

Rough turning is the operation of removal of excess material from the work piece in a minimum time by applying high rate of feed and heavy depth of cut.

FINISH TURNING OPERATION:

It requires high cutting speed, small feed, and a very small depth of cut to generate a smooth surface. The depth of cut ranges from 0.5 to 1 mm and feed from 0.1 to 0.3 mm per revolution of the work piece.

STEP TURNING:

Is the operation of making different diameters of desired length. The diameters and lengths are measured by means of outside calliper and steel rule respectively.

TAPER TURNING:

A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length. In a lathe, taper turning means to produce a conical surface by gradual reduction in diameter from a cylindrical work piece.

The amount of taper in a work piece is usually specified by the ratio of the difference in diameters of the taper to its length. This is termed as the conicity designated by the letter 'K'.

$K = (D-d)/L$

Where, D = Large diameter of taper in mm
d = small diameter of taper in mm
L = length of tapered part in mm

A taper may be turned by any one of the following methods:

a) Form tool method
b) Tail stock set over method
c) Swiveling the compound rest and
d) Taper turning attachment

Taper turning by swivelling the compound rest:

This method employs the principle of turning taper by rotating the work piece on the lathe axis and feeding the tool at an angle to the axis of rotation of the work piece. The tool mounted on the compound rest is attached to a circular base, graduated in degrees, which may be swivelled and clamped at any desired angle. Once the compound rest is set at the

desired half taper angle, rotation of the compound slide screw will cause the tool to be fed at that angle and generate a corresponding taper.
The setting of the compound rest is done by swivelling the rest at the half taper angle.

This is calculated by the equation.

$$\text{Tan } \alpha = (D-d) / 2L$$

Where α = Half taper angle

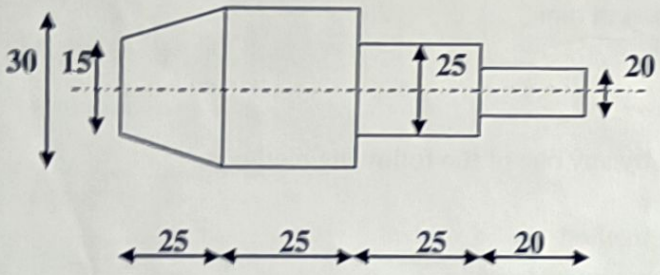
KNURLING:

Knurling is the process of embossing a diamond shaped pattern of the surface of a work piece. The purpose of knurling is to provide an effective gripping surface on a work piece to proven it from slipping when operated by hand. Knurling is performed by a special knurling tool which consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers are pressed against the revolving surface of work piece to squeeze the metal against the multiple cutting edges, producing depressions in a regular pattern on the surface of the work piece.
Knurling is done at the slowest speed and oil is flowed on the tool and work piece.
Knurling is done at the slowest speed and oil is flowed on the tool and work piece to dissipate heat generated during knurling. The feed varies from 1 to 2 mm per revolution.

CHAMFERING:

Chamfering is the operation of bevelling the extreme end of a work piece. This is done to remove the burrs, to protect the end of the work piece from being damaged and to have a better look. The operation may be performed after the completion of all operations. It is an essential operation after thread cutting so that the nut may pass freely on the threaded work piece.

DIAGRAM:



(All dimensions are in mm with Tolerance- ±0.05)

PROCEDURE:

1) The work piece is fixed on a 3 jaw self centering chuck or four jaw chuck with sufficient over hang.
2) Adjust the belt pulleys to run the job at a required cutting speed.
3) Fix the cutting tool in a tool post and give the feed and depth of cut of the cutting tool.

4) Perform facing, plain turning, chamfering operations to get the required dimensions
5) Using the v- cutting tool and parting off tool to perform the step turning operation to require dimensions.
6) Using the method of taper turning by swiveling the compound rest perform the taper turning operation.
7) Check the dimensions using a outside calipers and replacing the parting tool by thread cutting tool in the tool post.
8) Reduce the speed of the spindle by engaging the back gear mechanism in the head stock.

PRECAUTIONS:

1) The chuck key must be removed from the chuck before the spindle is switched on.
2) Apply the cutting fluids to the tool and work piece properly.
3) The cutting tool point should exactly resemble the shape of the thread.
4) To avoid pitch errors the machining should be done properly

CONCLUSION:

We have done this experiment successfully and known various operations performed in a lathe machine and prepared a job with proper dimension.

EXPERIMENT-5

AIM OF THE EXPERIMENT:

To study and demonstrate the configurations and know the working principle of horizontal shaper machine.

APPARATUS REQUIRED:

Standard shaper machine

THEORY:

Shaper is a reciprocating type of machine tool which is primarily used for generating flat surface. Shaper is type of machine tool it can use linear relative motion between work piece and a single point cutting tool to a machine in linear tool path. In shaper machine, rotary movement of the drive is converted into reciprocating movement by the mechanism contained within the column of machine. The ram holding tool gets reciprocating movement. In standard shaper metal is removed in the forward cutting stroke, while return stroke goes idle and no metal is removed during this period. To reduce the tool machining time it is necessary to reduce the time taken by the return stroke. Thus the shaper mechanism should be so designed that it can allow the ram holding the tool to move at a comparatively slower speed during the forward cutting stroke, the cutting speed depending upon the type of material and machining condition, whereas during return stroke it can allow the ram to move at a faster rate to reduce the idle return time. This mechanism is known as quick return mechanism.

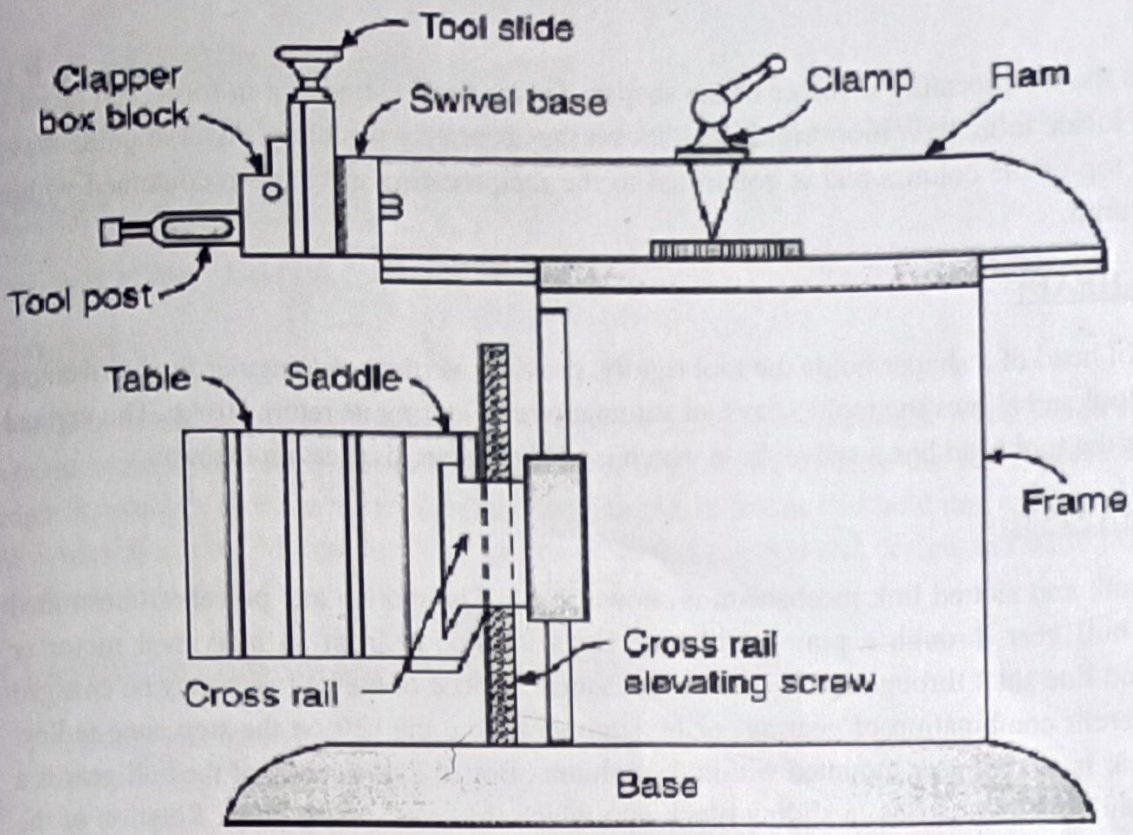
BASIC COMPONENTS:

BASE:

Base is the necessary bed or support required for all machine tools . Base may be rigidly bolted to the floor of the shop or on the bench according to the size of machine. It is made up of cast iron to resist vibration and take up high compressive load.

COLUMN:

Column is a box like casting mounted upon the base. It encloses the ram driving mechanism. Two accurately machined guide ways are provided on the top of the column on which the ram can reciprocates. The front vertical face of the column which serves as the guide ways for the cross rail is also accurately machined.



(Components of standard shaper machine)

CROSS RAIL:

The cross rail is mounted on the front vertical guide ways of the column. It has two parallel guide ways on its top in the vertical plane that are perpendicular to the ram axis. The table may be raised or lowered to accommodate different size of jobs by rotating an elevating screw which cause the cross rail to slide up and down on the vertical face of the column.

SADDLE:

Saddle is mounted on the cross rail which holds the table firmly on its top. Crosswise movement of the saddle by rotating the cross feed screw by hand or power causes the table to move sideways.

TABLE:

Table which is bolted to the saddle receives crosswise and vertical movements from the saddle and cross rail. It is a box like casting having T-slots both on the top and sides for clamping the work.

RAM:

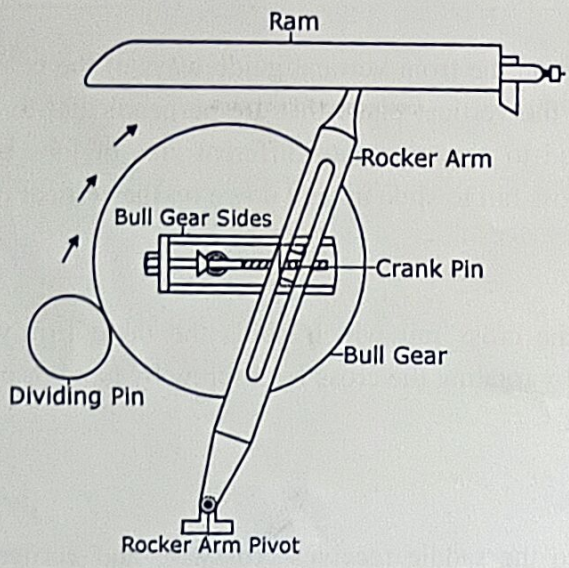
Ram is the reciprocating member of the shaper. This is semi-cylindrical in form and heavily ribbed inside to make it more rigid. It slides on the accurately machined dovetail guide ways on the top of the column and is connected to the reciprocating mechanism contained within the column.

TOOLHEAD:

The tool head of a shaper holds the tool rigidly, provides vertical and angular feed movement of the tool and allows the tool to have an automatic relief during its return stroke. The vertical slide of the tool head has a swivel base which is held on a circular seat on the ram.

MECHANISM:

The crank and slotted link mechanism is shown in fig. The motion and power is transmitted to the bull gear through a pinion which receives its motion from an individual motor or overhead line shaft through speed control mechanism. Speed of the bull gear may be changed by different combination of gearing or by simply shifting the belt on the step cone pulley. Bull gear is a large gear mounted within the column . Bolted to the centre of the bull gear is a radial slide which carries a sliding block into which the crank pin is fitted. Rotation of the bull gear will cause the crank pin to revolve at a uniform speed .Sliding block which is mounted upon the crank pin is fitted within the slotted link . The slotted link which is also known as the rocker arm is pivoted at its bottom end attached to the frame of the column. Thus the rotary motion of the bull gear is converted into reciprocating movement of ram.



(Crank and slotted link Mechanism)

CONCLUSION:

From this above experiment we knew different components and working principle of shaper machine.

EXPERIMENT-5

AIM OF THE EXPERIMENT:

To study the configurations and the working principle of Universal Milling Machine.

APPARATUS REQUIRED:

Universal Milling Machine

THEORY:

A milling machine is a machine tool that removes metal from the work piece which is feed against multipoint cutter. The cutter rotates at a high speed because the multi point cutting edges it removes metal at a very fast rate. Milling machine can also hold one or more number of cutters at a time. Milling machine can be classified into general design and wide range of work and capacities.

CLASSIFICATION OF MILLING MACHINE:

1) Column and Knee type
   - i) Hand milling machine
   - ii) Plain milling machine
   - iii) Universal milling machine
   - iv) Omniversal milling machine
   - v) Vertical milling machine

UNIVERSAL MILLING MACHINE:

A universal milling machine can be distinguished from a pain milling machine in that table of universal milling machine is mounted on a circular swivelling base which has degree of graduation .The table can be swivelled about a vertical axis and set an angle other than right angle to the spindle. Universal milling machine in addition to three movement as incorporated in a plain milling machine the table may have a fourth movement when it is feed at an angle to the milling cutter. The capacity of universal milling machine is considerably increased by the use of special attachments such as dividing head or index head, vertical milling attachment, rotary attachment, slotting attachment. This machine can produce spur, spiral, bevel gears, twist drills, reamers.

BASIC COMPONENTS:

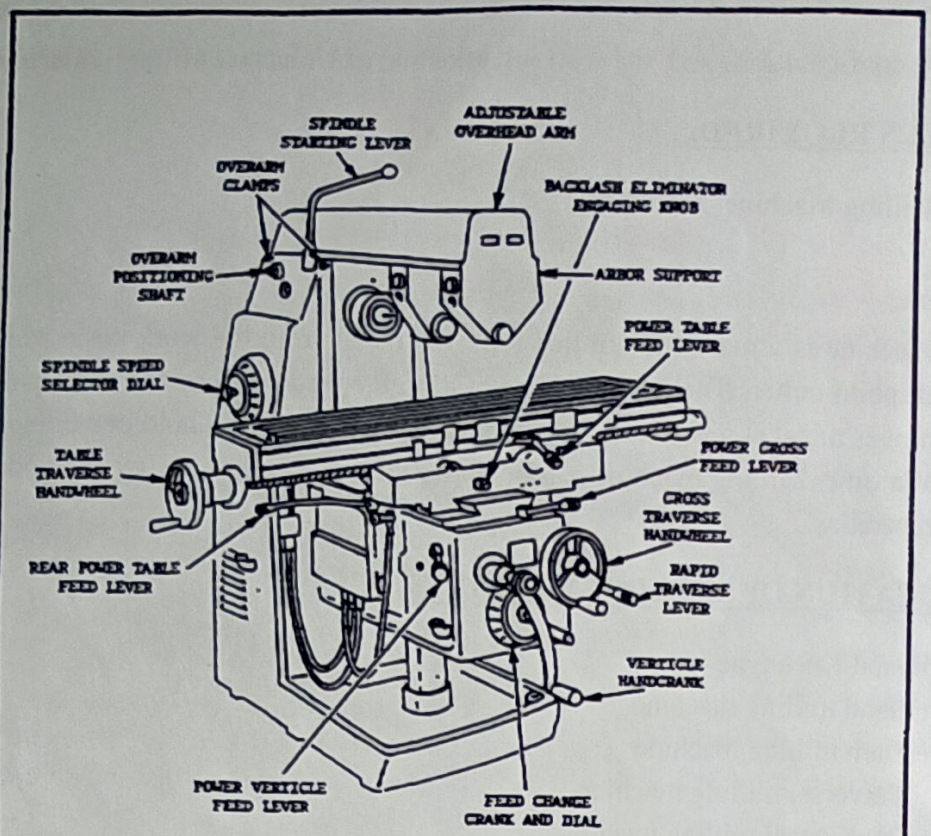


FIG:1 UNIVERSAL MILLING MACHINE

BASE:

The base of the machine is a grey iron casting accurately machined on its top and bottom surface and serves as a foundation member for all the other parts which rest upon it. It carries the column at its one end.

COLUMN:

The column is the main supporting frame mounted vertically on the base. Column is box shaped, heavily ribbed inside and houses all the driving mechanisms for the spindle and table feed. The front vertical face of the column is accurately machined and it is provided with dovetail guide ways for supporting the knee. The top of the column is finished to hold an over arm that extends outward at the front of the machine.

KNEE:

Knee is a rigid grey iron casting that slides up and down on the vertical ways of the column face. The adjustment of height is effected by an elevating screw mounted on the base that also supports the knee.

TABLE:

The table rests on ways on the saddle and travels longitudinally. The top of the table is accurately finished and t-slots are provided for clamping the work and other fixtures on it. A lead screw under the table engages a nut on the saddle to move the table horizontally by hand or power.

OVERHANGING ARM:

The overhanging arm that is mounted on the top of the column extends beyond the column face and serves as a bearing support for the other end of the arbor. The arm is adjustable so that the bearing support may be provided nearest to the cutter.

FRONT BRACE:

The front brace is an extra support that is fitted between the knee and the over arm to ensure further rigidly to the arbor and the knee. The front brace is slotted to allow for the adjustment of the height of the knee relative to the over arm.

SPINDLE:

The spindle of the machine is located in the upper part of the column and receives power from the motor through belt, gear, clutches and transmit it to the arbor. The front end of the spindle just projects from the column face and is provided with a tapered hole into which various cutting tools and arbors maybe inserted.

ARBOR:

An arbor may be considered as an extension of the machine spindle on which milling cutters are securely mounted and rotated. The arbors are made with taper shanks for proper alignment with the machine spindle having taper holes at their nose.

MECHANISM:

The milling machine mechanism is composed of spindle drive mechanism and table feed mechanism. In spindle drive mechanism is incorporated in the column. All modern machines are driven by individual motors housed with in the column, and spindle receives power from a combination of gears and clutch assembly. Multiple speed of the spindle may be obtained by altering gear ratio. The power in feed mechanism contained within the knee of the machine to enable the table to have three different feed movements like longitudinal, cross and vertical. The power is transmitted from the feed gear box consisting of change gears to shaft in the knee. Gear is fastened to shaft and meshes with gear which is fastened with bevel gear.

CONCLUSION:

From this above experiment we knew different components and working principle of milling machine.

EXPERIMENT-6

AIM OF THE EXPERIMENT:

Preparation of different types of joint using arc welding on the given work piece.

MATERIAL SUPPLIED:

Mild steel plate of size 6 mm thickness.

MACHINE &TOOLREQUIRED:

Welding machine, electrodes, tongs, chipping hammer, wire brush, shields, gloves.

SEQUENCE OF OPERATION:

1) Edge Preparation
2) Tacking
3) Welding
4) Cooling
5) Chipping
6) Cleaning.

THEORY:

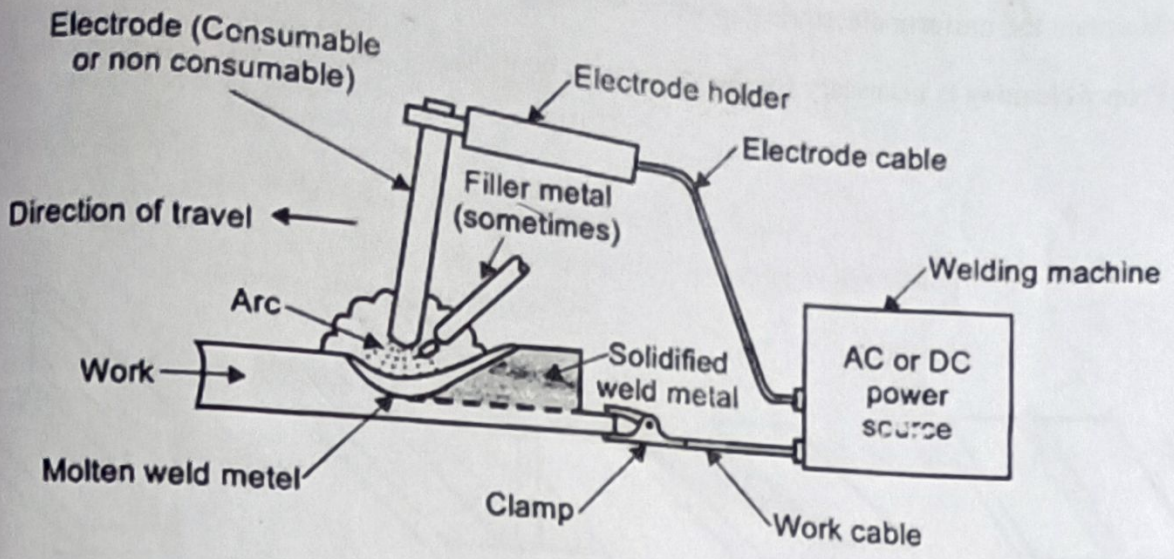
WELDING PROCESSES:

Welding is a process in which two materials, usually metals, and is permanently joined together by coalescence, resulting from temperature, pressure, and metallurgical conditions. The particular combination of temperature and pressure can range from high temperature with no pressure to high pressure with any increase in temperature. Thus, welding can be achieved under a wide variety of conditions and numerous welding processes have been developed and are routinely used in manufacturing.

ARC WELDING:

In this process a joint is established by fusing the material near the region of joint by means of an electric arc struck between the material to be joined and an electrode. A high current low voltage electric power supply generates an arc of intense heat reaching a temperature of approximately3800oC. The electrode held externally may act as a filler rod or it is fed independently of the electrode. Due to higher levels of heat input, joints in thicker materials can be obtained by the arc Welding process. It is extensively used in a variety of structural applications.

There are so many types of the basic arc welding process such as shielded metal arc welding (SMAW),gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), submerged arc welding.



SCHEMATIC LAYOUT OF ARC WELDING

PROCEDURE:

1) First of all the work piece must be cleaned to remove rust, scale and other foreign materials.

2) Prepare the edges according to the type of lap joint.

3) Now the work pieces are placed in the table in such a way that one work piece is placed on the other in suitable position for welding decomposition.

4) Connect the power supply to the work and electrode according to the requirements.

5) Adjust the power supply setting to the correct requirements.

6) Track the both ends in order to avoid the distortion during welding.

7) Now weld the pieces with minimum defects.

8) As soon as welding is completed switch off the power supply.

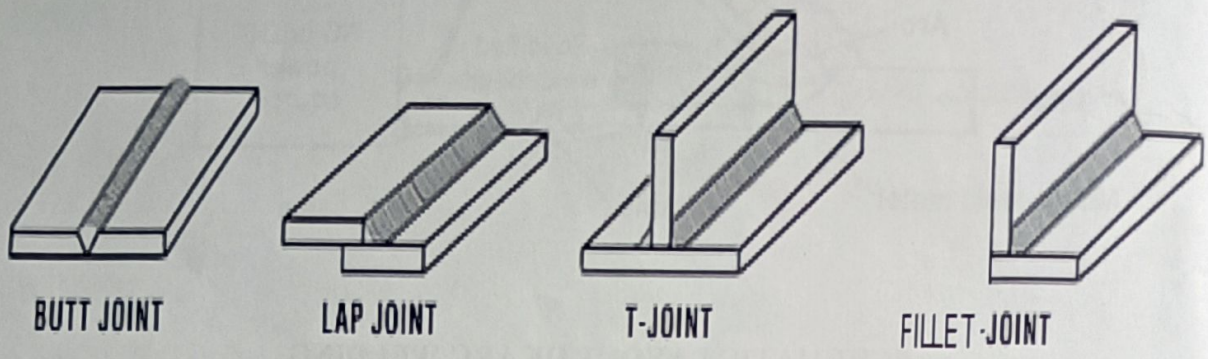
9) Keep the pieces in cooling medium for cooling.

10) Remove the slag by using chipping hammer and clean the surface using wire brush.

PRECAUTIONS:

1) Maintain the uniform electrode gap while welding.

2) Proper cleaning is necessary for the surfaces to be weld.



(ARC WELDING WITH DIFFERENT TYPES OF JOINT)

CONCLUSION:

Hence we have done this experiment successfully and known the mechanism of Manual Metal Arc Welding.

EXPERIMENT-7

AIM OF THE EXPERIMENT:

To study the process of Oxy-acetylene gas welding operation.

OBJECTIVES:

- To familiar with different types of oxy-acetylene flame.
- To familiar with different equipments and components of gas welding.
- To familiar with gas welding operation.

TOOLS AND EQUIPMENT:

Oxygen and acetylene tanks with regulators, welding torch and tip, spark lighter, brazing goggles, welder's apron, and gloves.

MATERIALS:

1/16" x ½" x 6" sheet metal pieces, 2.5 mm filler rods.

SAFETY PRECAUTIONS:

- Make sure there is proper ventilation in the area that you are brazing in.
- NEVER set the acetylene pressure above 15 psi.
- Always wear brazing goggles before lighting torch.
- Point the torch in a safe direction before lighting it.

THEORY:

Welding is a process for joining similar /dissimilar metals. Welding joins metals by melting and fusing the base metals being joined and the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Welding covers a temperature range of (800°C - 3600°C). Weld joints are usually stronger than or as strong as the base metals being joined.

Gas welding involves using a gas-fed torch to heat the metal parts to be welded. The primary gas combination for gas welding is an oxygen-acetylene mixture, but other gases are used. The welder can change the performance of the welding torch by adjusting the ratio of the gases, which in turn changes the properties of the flame. Different types of flames are used depending on the particular welding application.

CREATING A FLAME:

When the welder is ready to start, he opens the valves on the gas tanks and ignites the gas exiting the torch. The welder then adjusts the ratio of oxygen and fuel gas by opening or closing valves on the torch. These valves allow the welder to change the properties of the flame depending on the task at hand.

NEUTRAL FLAME:

The neutral flame is the primary flame used by gas welders. A neutral flame has two zones: a hotter, lighter inner zone and a cooler, darker outer zone. In a neutral flame, all of the fuel gas is being burned in the process, resulting in a clean flame. The welder uses the tip of the inner flame zone to heat the parts to be welded, as this is the hottest part of the flame.

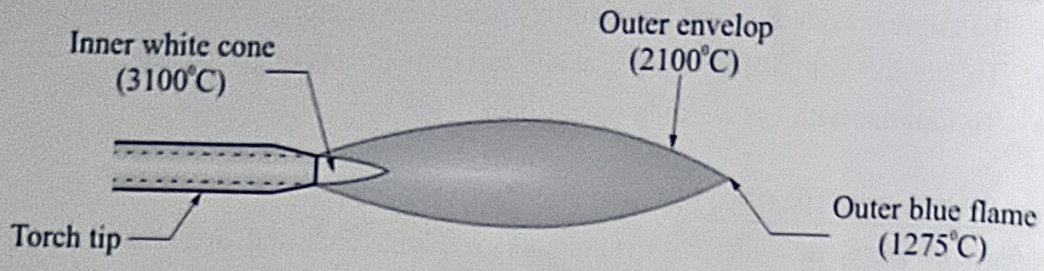


Fig. Neutral flame

CARBONIZING FLAME:

If the oxygen is reduced, a carbonizing flame is created from a neutral flame. In this case, not all of the fuel gas is being burned by the flame. A carbonizing flame has three zones, and is cooler than a neutral flame because the excess carbon acts as an insulator. Carbonizing flames deposit soot on the work piece that has to be cleaned when the part is cooled, but the addition of carbon to the metal is desirable in some iron and steel welding applications.

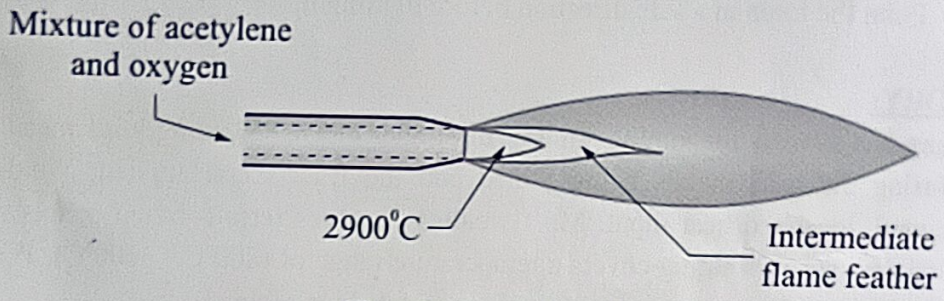


Fig. Carburizing flame

OXIDIZING FLAME:

An oxidizing flame is caused by increasing the oxygen from a neutral flame. Because of the excess oxygen, this flame is hotter than the neutral or carbonizing flames. Welders generally do not use an oxidizing flame, because it can increase the oxides in the base material. However, an oxidizing flame is used for bronze and brass work.

Fig. Oxidizing flame

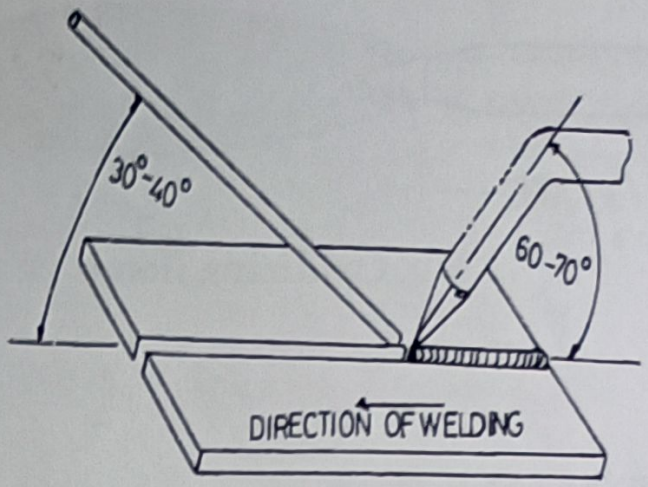
WELDING TECHNIQUES :

There are two usual methods depending upon the ways in which welding rod and welding torch are used.

1. Leftward technique or forehand welding method.
2. Rightward technique or Backhand welding technique.

1) LEFTWARD TECHNIQUE:

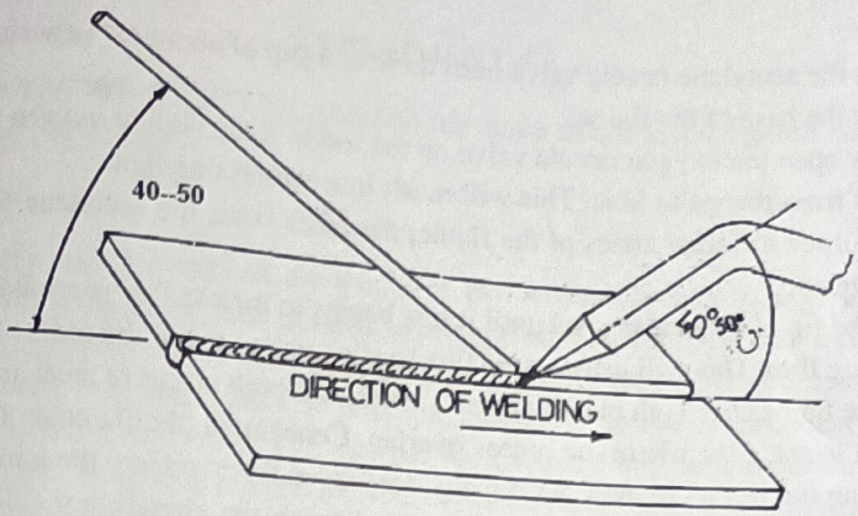
- The welder holds welding torch in the right hand and filler rod in the left hand.
- The welding flame is directed away from the finished weld i.e. towards the un-welded part of the joint. Filler rod when used is directed towards the welded part of the joint.
- The weld is commenced on the right hand side of the seam, working towards the left-hand side. The blowpipe or welding torch is given small side way movement, while the filler rod is moved steady across the seam. The filler rod is added using the backward and forward movement of the rod allowing the flame to melt the bottom edge of the plate just ahead of the weld pool.
- Since the flame is pointed in the direction of the welding, it preheats the edges of the joint.
- Good control and a neat appearance are characteristics of the leftward method.
- Leftward technique is usually used on relatively thin metals, i.e having thickness less than 5mm.
- When work piece thickness is over 3mm bevel the plate edges to produce a V-joint so that good root fusion may be achieved. The included angle of V-joint is 80-90 degree.
- When welding materials over 6.5mm thick, it is difficult to attain even penetration at the bottom of the V and therefore the quality of the weld decreases as plate thickness increases.
- The leftward technique requires careful manipulation to guard against excessive melting of the base metal and filler metal. The influence of the base metal on the properties of the weld metal can be very deep.



(Leftward technique)

2) RIGHTWARD TECHNIQUE:

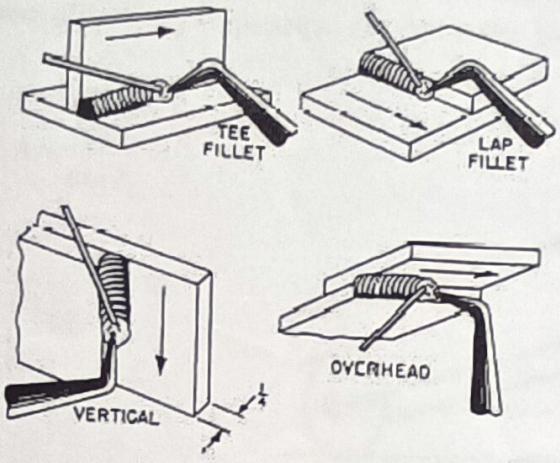
- The welder holds the welding torch in the right hand and the filler rod in the left.
- Welding begins at the left hand end of the joint and precedes towards the right, hence the name rightward technique.
- The direction of welding is opposite to that when employing the leftward technique.
- The torch flame in rightward technique is directed towards the completed weld and the filler rod remains between the flame and the completed weld section.
- Since the flame is constantly directed towards the V ahead of the weld puddle no side-wise motion of the welding torch is necessary. As a result a narrower V groove can be utilized than in leftward welding. This provides a greater control and reduced welding cost.
- During welding the filler rod can be moved in circles (within the puddle) or semi-circles (back and forth around the puddle).
- In rightward welding the weld puddle is less fluid and this result in a slightly different appearance of the weld surface. The ripples are heavier and spaced further apart.
- The rightward technique is used on heavier or thicker (above 5mm) base metal. Weld with penetration of approximately12mm can be achieved in a single pass.



(Rightward technique)

TYPES OF JOINT IN GAS WELDING:

A welding joint is a point or edge where two or more pieces of metal or plastics are joined together. They are formed by welding two or more work pieces (metal or plastic) according to a particular geometry. Five types of joints referred to by the American Welding Society: butt, corner, edge, lap, and tee. These configurations may have various configurations at the joint where actual welding can occur.



(Types of joint)

PROCEDURE:

1. Make sure that everyone is wearing a leather apron, leather gloves, and brazing goggles.
2. Open main valves of acetylene and oxygen tanks. Adjust regulators to provide proper working pressure for the gases (acetylene = 5 PSI, oxygen = 20 PSI).
3. Place two pieces of steel on a firebrick so that they overlap each other.
4. Open the acetylene needle valve on the torch (red hose = acetylene) approximately ¾ of a turn, and light the torch with a spark lighter.

5. Adjust the acetylene needle valve until there is a gap of about ¼" between the tip of the torch and the base of the flame.
6. Slowly open the oxygen needle valve on the torch. Keep adding oxygen until the flame just turns from orange to blue. This will result in a carburizing flame.
Note the three different zones of the flame; the inner cone, the acetylene feather, and the outer envelope.
7. Heat the tip of the brazing rod until it just begins to melt (a few seconds) and dip it into the brazing flux. This will cause some flux to stick to the end of the rod.
8. Fan the flame over both pieces of steel. Make sure both pieces of steel are heated.
9. Touch to the edge where the pieces overlap. Concentrate the flame on this point, until the brazing rod begins to melt. As it melts, feed more filler rod into the joint.
10. More flux can be added at any time by dipping the already hot filler rod into the container of flux. Be sure to add brazing rod to the other edge where the pieces touch.
11. In order to draw the brass into a joint, heat the steel, which lies in the direction in which you want the brass to flow.
12. When extinguishing the flame, turn off the oxygen needle valve first; then the acetylene needle valve.

CONCLUSION:

Hence we have done this experiment successfully and known the operation of oxy-acetylene gas welding.

EXPERIMENT-8

AIM OF THE EXPERIMENT: To calculate the angle of the given tapered component by using sine bar and slip gauges.

THEORY:

The sine principle uses the ratio of the length of two sides of a right triangle in deriving a given angle. It may be noted that devices operating on sine principal are capable of self generation. The measurement is usually limited to 45 degree from loss of accuracy point of view. The accuracy with which the sine principle can be put to use is dependent in practice, on some from linear measurement. The sine bar itself is not complete measuring instrument. Another datum such as surface plate is needed, as well as other auxiliary instrument, notably slip gauge, and indicating device to make measurements.

- **Measuring known angles or locating any work to a given angle.**

For this purpose the surface plate is assumed to be having a perfectly flat surface, so that its surface could be treated as horizontal. One of the cylinders or rollers of sine bar is placed on the surface plate and other roller is placed on the slip gauges of height h. Let the sine bar be set at an angle θ. Then sin θ = h/l, where l is the distance between the center of the rollers. Thus knowing θ & l, h can be found out and any work could be set at this angle as the top face of sine bar is inclined at angle θ to the surface plate. The use of angle plates and clamps could also be made in case of heavy components. Second roller is placed on slip gauges of height(h) such that.

$$\sin\theta = \sin\angle O_2O_1A = \frac{O_2A}{O_1O_2} = \frac{h}{l}$$

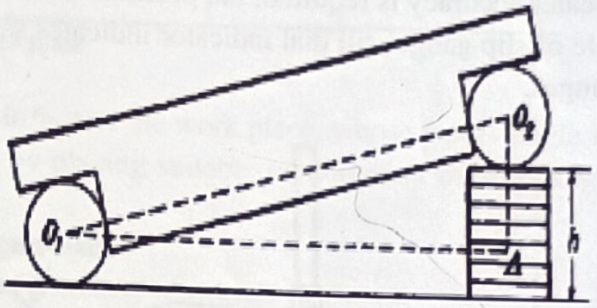


Fig.: Use of sine bar

- **Checking of unknown angles.**

Many times angle of a component to be checked is unknown. In such a case, it is necessary to first find the angle approximately with the help of a bevel protractor. Let the angle be 8. Then the sine bar is set at an angle 6 and clamped to an angle plate. Next, the work is placed on sine bar and clamped to angle plate as shown in Fig. and a dial indicator is set at one end of the work and moved to the other, and deviation is noted. Again slip gauges are so adjusted (according to this deviation) that dial indicator reads zero across work surface.

If deviation noted down by the dial indicator is h_w over a length l_w of work, then height of slip gauges by which it should be adjusted in equal to

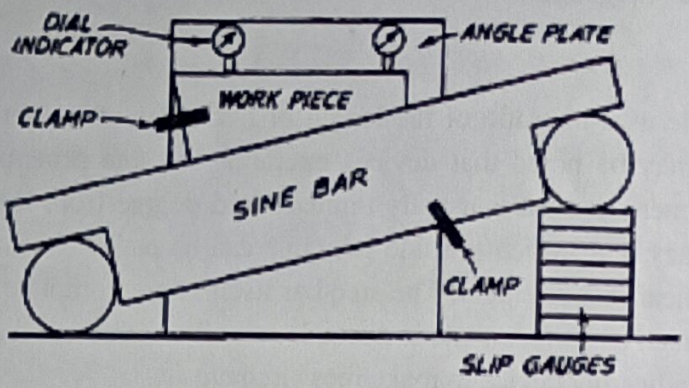


Fig. : Checking unknown angle using sine bar.

Checking of unknown angles of heavy component.

In such cases where components are heavy and can't be mounted on the sine bar, then sine bar is mounted on the component as shown in Fig. The height over the rollers can then be measured by a vernier height gauge ; using a dial test gauge mounted on the anvil of height gauge as the test indicator to ensure constant measuring pressure. The anvil on height gauge is adjusted with probe of dial test gauge showing same reading for the topmost position of rollers of sine bar. Fig. shows the use of height gauge for obtaining two readings for either of the roller of sine bar. The difference of the two readings of height gauge divided by the centre distance of sine bar gives the sine of the angle of the component to be measured. Where greater accuracy is required, the position of dial test gauge probe can be sensed by adjusting a pile of slip gauges till dial indicator indicates same reading over roller of sine bar and the slip gauges.

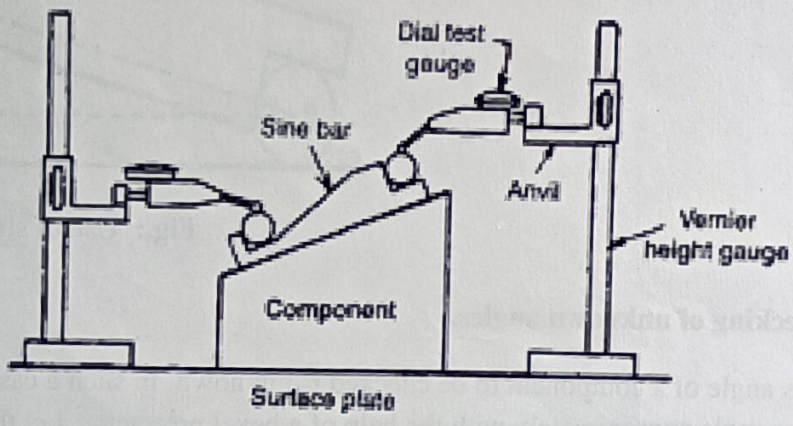


Fig. : Checking unknown angle of heavy component using sine bar.

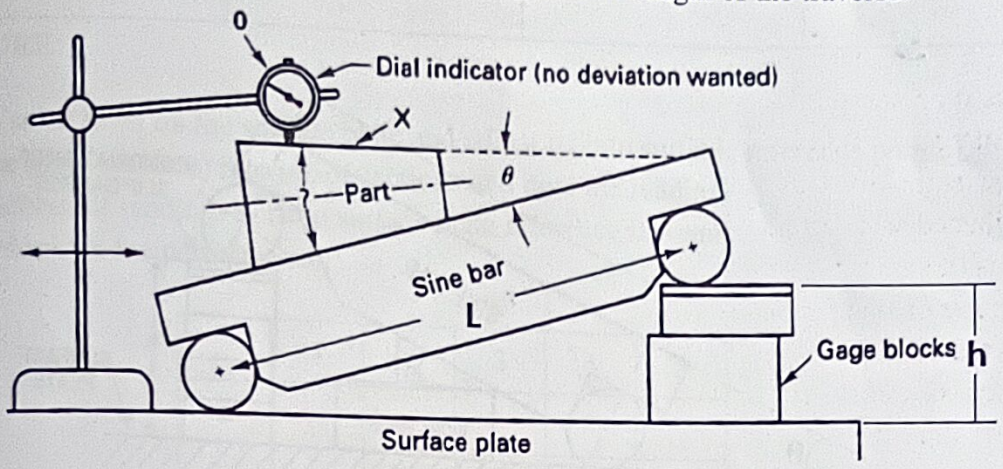
APPARATUS & SPECIMEN REQUIRED:

a) Sine Bar
b) Slip Gauges
c) Dial indicator with stand
d) Surface plate
e) Angle plate
f) Suitable tapered work Piece for angle measurement

PROCEDURE:

Measurements of unknown taper angle:

a. The given work piece is cleaned before taking measurement.
b. Set the work piece to measure the taper angle using sine bar and dial gauge.
c. Transverse the dial gauge plunger over the ramp of work piece.
d. Note down the initial reading, final reading and the length of the traverse.



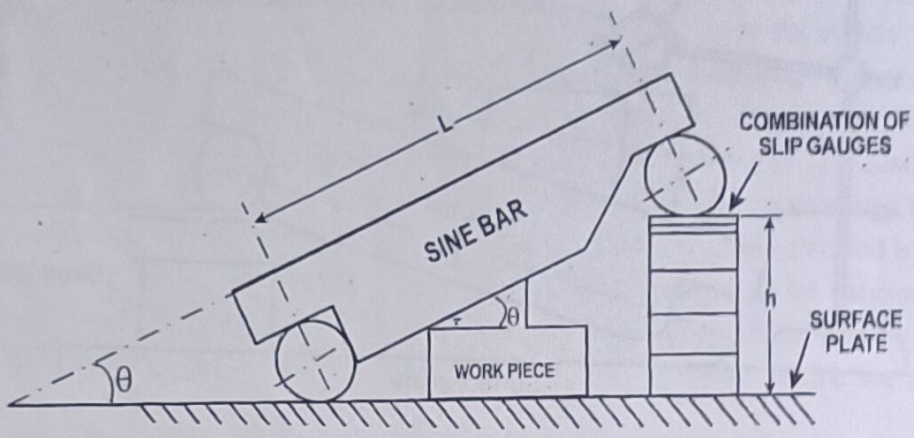
e. Alternately, try to king the inclined surface of the work piece, whose taper angle is to be measure, to the horizontal plane by placing suitable combination of slip gauge under the lower end of the work piece.
f. Note down the length of the slip gauge.
g. Calculate the taper angle through the formula given.

Sl. No.	Length of the Sine Bar between roller canters (l) (mm)	Height of Slip Gauge stack under second roller(h) (mm)	Taper angle $\theta = \sin^{-1}\left(\frac{h}{l}\right)$

Setting the given sine bar to the given angle:

h. Take note of the given angle for which the top surface of the sine bar is to be set.
i. Theoretically calculate the height of the slip gauge required to lift one end of sine bar such that top surface of the sine bar make the required slope.
j. Insert the selected combination of slip gauge under one end of the sine bar.
k. Use dial gauge with stand and traverse the plunger of the dial gauge over a know length and check the slope of the sine bar.

Length of the Sine Bar between roller centers (l) (mm)	Given angle at which sine bar is to be set (θ) (mm)	Total height of the slip gauge stack (h) (mm)	Combination of slip gauges selected



PRECAUTIONS:

a. Clean the measuring faces with paper or cloth. Keep the instrument in the box properly.
b. Gripped the instrument to the measuring face exactly
c. Use sine bar when angle is less than 45 degree & more than 15 degree to get high accuracy
d. Use angle plate to avoid any kind of error due to leaning of the system.

CONCLUSSION:

From the above experiment, the angle for the given component is found to be _____ .

EXPERIMENT-9

AIM OF THE EXPERIMENT: To find the flatness of a given surface plate.

APPARATUS: Surface plate and precision spirit level.

THEORY AND DESCRIPTION:

The simplest form of flatness testing is possible by comparing the surface with an accurate surface. Spirit level is used in special cases and called Clinometers, precision micro-optic clinometers utilizes bubble unit with a prismatic coincidence reader which presents both ends of the bubble an adjacent images in a spirit field. Leveling helps in the coincidence of the 2 images, making it very easy to sec when the bubble is exactly centered without reference to any graduations. The special features to precision micro-optic clinometers arc direct reading over range 0-360°, optically reading system, main
Coarse setting, slow motion screw to fine setting. The least count of precision spirit level is 0.01 mm.

PROCEDURE:

1. Place the spirit level on the surface plate and adjust its into suitable reference point.
2. Divide the plate (surface) into no. of sections and note the reading.
3. Thus a number of readings w.r.t to surface plate reference is found.
4. A plot is done on the performance.

	1	2	3	4	5
a					
b					
c					
d					
e					

Fig. Dividing the surface plate into sections.

RESULT: The Flatness of a surface plate is determined.

EXPERIMENT- 10

AIM OF THE EXPERIMENT: To determine the surface roughness test of various components.

APPARATUS REQUIRED:

1. Surface roughness tester
2. Various components on which surface roughness is to be measured.

THEORY:

A surface roughness tester is used to quickly and accurately determine the surface roughness of a given material. The tester is small in size ,light in weight and easy to carry. Although it is complex and advanced, it is more convenient to use and operate .Its ruggedness will allow many years of use if proper operating techniques are followed.

SPECIFICATIONS:

Display: 4 digits, 10 mm LCD, with blue backlight

Parameters: R_a, R_z , R_q, R_t

Display range: R_a , R_q : 0.025-16.00 µm /1.000-629.9 µ inch

R_z , R_t : 0.020-160.0 µm/0.780-6299 µ inch

Accuracy: Not more than ±10 %

Fluctuation of display value: Not more than 6 %

Sensor: Test principle – Induction type

Radius of probe pin: 2 µm

Material of probe pin: Diamond

Probe angle: 90^0

Vertical radius of guiding head: 48 mm

Maximum driving stroke: 17.5mm /0.7 inch.

Cut-off length (l): 0.25 mm/0.8 mm/2.5 mm

Evaluation length: (1-5) cut-off optional

Power: Li-ion battery (rechargeable)

Weight: 420 g

Size: (140×2.2×1.9 inch

MEASURING PROCEDURE:

1. Preparation for measurement:

(a) We shall switch ON the test if the battery voltage is normal.

(b)The instrument will automatically restores conditions of the last measurement before it is turned OFF; since these conditions are automatically stored. Meanwhile, the second line of 2 digits on display shows groups stored in the memory.

(c) Check whether the cut-off length selected is right; if not, press **ON/OFF** to select.

(d) Check whether the evaluation length selected is right; if not, press the key **RANGE**. Then **SAVE** to select.

(e) Check whether the profile filter selected is right; if not, press and don't release it until it shows **FILT** on display.

(f) Check whether the measurement unit selected is right; if not, press the key **DEL/MENU** don't release it until it shows **UNIT** on display.

(g) This step is very important to check whether the parameter selected is right; if not, press the key $\mathbf{R_a}$ $\mathbf{R_z}$ to select.

(h) The instrument shall be placed on the surface correctly and it should be stable .

(i) The sliding trail of the sensor must be vertical to the direction of process line of the measured surface.

(j) Adjust leg and sheath of sensor when the measured surface of the part is smaller than the bottom surface of the instrument. The sheath of sensor and adjustable leg can be used for auxiliary support to complete the measurement.

2. Measuring:

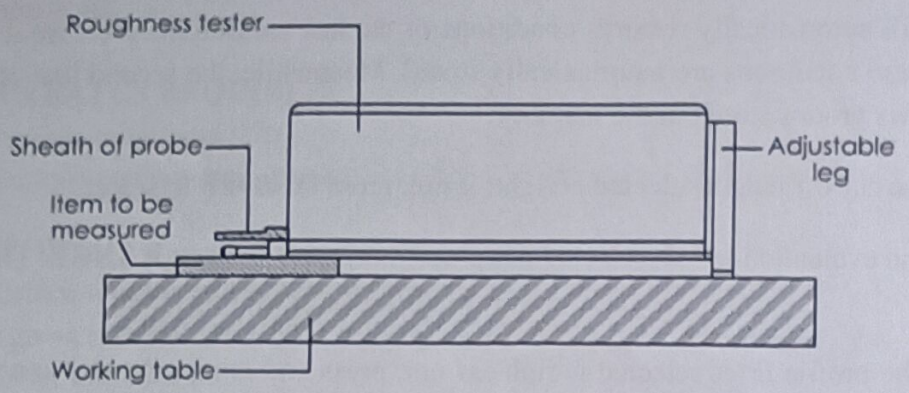
(a) After the preparation, just press the **START** key to measure if measuring conditions are not to be changed.

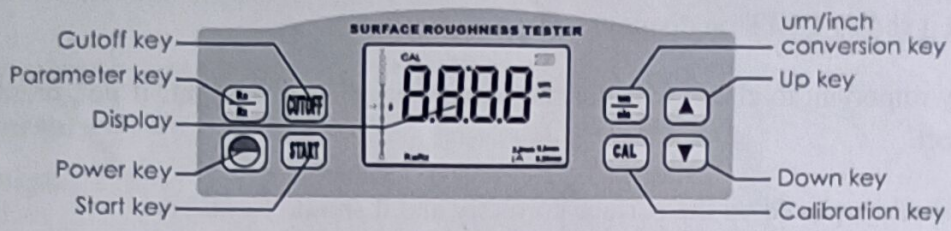
(b) Save the measurement results to the tester for later use. After measuring , you will see the original 'M' becomes the ' $\bar{M}$ ' . In such a state , you can save this group of results including R_a, R_z, R_q, R_t and measurement conditions to the memory of the tester by pressing the key **SAVE**.

(c) **How to browse the different parameters in ' $\bar{M}$ ' state.**

You can browse different parameters and its values showing on the display once pressing the key.

(d) Delete the measurement results in $\bar{M}$ state. You can delete this group of results by pressing the key **DEL/MENU.** Then the symbol '$\bar{M}$' changes to 'M' automatically. On the other hand. the new measurement results will replace the old ones if pressing the **START** key in ' $\bar{M}$ ' state.





TABULATION:

SL. NO.	Name of the surface	Surface Readings			
		R_a (μm)	R_q(μm)	R_z(μm)	R_t(μm)
1	Experiment table surface				
2	Stool				
3	Student Table				
4	Paper				
5	Plate				

CONCLUSION:

Hence from the above experiment, we have done surface roughness test of the various components.

EXPERIMENT-11

AIM OF THE EXPERIMENT:

1. To study the characteristics of a linear variable differential transducer (LVDT)
2. Calibration of LVDT by using micrometer.
3. Measurement of a small linear displacement.

APPARATUS USED:

- LVDT
- Micrometer
- Digital panel-meter
- Connecting cable
- Power source

Theory:

Linear variable differential transducer is one type of electrical transformer used for measurement in linear displacement.

- it is a displacement transducer comprising three coils , one is primary and other two are secondary
- The transfer current between the primary and secondary of the LVDT is controlled by the magnetic core called as armature.
- The two secondary coils are connected in opposite to each other.
- An AC is driven through the primary which causes a voltage to be induced in each secondary proportional to its mutual inductance with the primary. The frequency range is usually in the range of 1-10 KHz.
- At the centre of the position measurement stroke the two secondary voltage of the displacement transducer are equal but because they are connected in opposition the output result of the sensor is zero.
- As the LVDT armature moves away from the centre the value increases in one of the secondary coil and decreases in another. This results in an output measurement of sensor.
- The phase of the output (relative to the excitation phase) lets the system to know, in which half of the coil the armature resides.
- The advantage/strength of the LVDT sensor is that, there is no electrical contact across the transducer position sensing elements. So it gives right data infinite resolution and very long life.
- The magnitude of output voltage is proportional to the distance moved by the core (up to its limit of travel). So the device is called linear phase of voltage which indicates the direction of displacement.

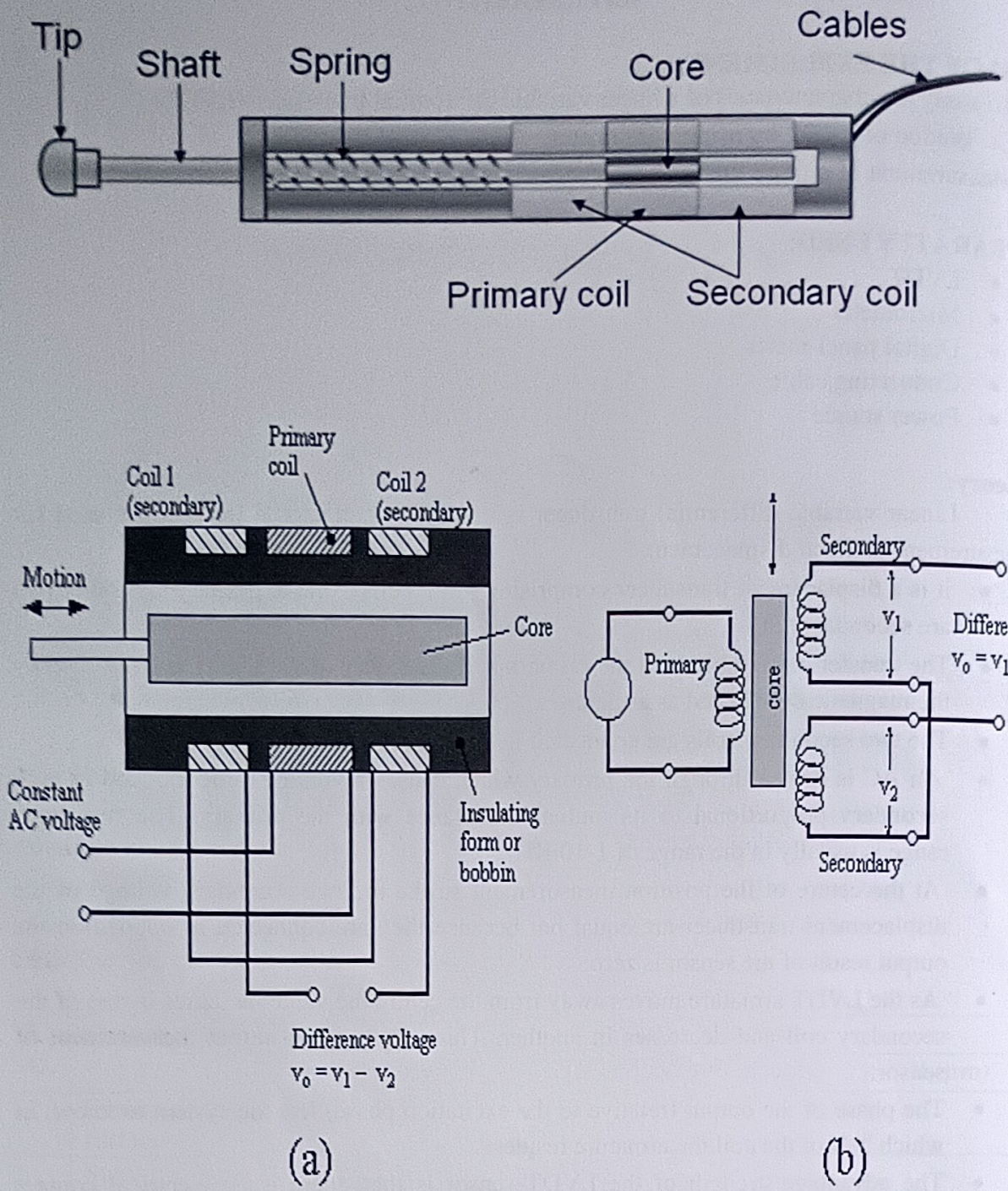


Fig: LVDT Principle

EXPERMENTAL SETUP:

Effective secondary voltage (V_{sc})=(V_{s1}- V_{s2})

Where V_{s1}=voltage at secondary 1

V_{s2}=voltage at secondary 2

$V_{s1\alpha}$ = core length available in secondary 1

$V_{s2\alpha}$ = core length available in secondary 2

(Assumption primary excitation kept fixed)

Here output of the each secondary is connected to an OPAMP , based circuit and small signal rectifier so as to get effective DC output with polarity. This is proportional to the actual movement of core and its direction. And finally output of this stage is given as input to DPM type Digital read output. The OPAMP based circuitry and small signal rectifier is also proportional with span and zero controls from users point of view.

OPERATING INSTRUCTIONS :

Following steps are required to be followed and ensured before connecting supply mains to experimental module

- Ensure that LVDT primary and secondary winding are connected properly to electronic / instrumentation setup.
- Ensure moving core is positioned at centre position i.e. mechanical zero position.
- Ensure zero point is at centre position.
- Ensure that SPAN POT is at centre position.
- Connect 230 volt AC 50 HZ mains supply to the module .This means supply must be free of fluctuation and with good earthing.
- Just once again ensure all the steps given above are followed.
- As core is at centre position one can adjust zero pot to get the zero reading on the digital zero readout.
- Slowly start to move the core so as to get displacement and set core position to maximum allowed mechanical displacement indication. (10 mm)
- Now, one can adjust SPAN to get the desired proportional reading with the polarity on the digital read out.
- Repeat steps 5 to 7 to remove any span and zero setting error.
- Now one can observe that the moment start moving core digital read out will start showing proportional reading in mm.
- However please ensure that displacement you are applying is not crossing maximum limit with respect to provided LVDT (Here it is ± 10mm max)
- After completion of reading set please get the mechanism to initial is zero displacement condition.
- Note down the reading as per given observation setup.
- After completion of experiment isolate and turn OFF the mains ON/OFF switch.
- Please keep entire setup in dears and dry place.

OBSERVATION:

- Zero reading properly adjusted.
- Maximum reading properly adjusted.
- Note down the respective reading.

OBSERVATION TABLE:

1. When one moved towards left.

SL No	Micrometre reading, (in mm)	O/P on indicator (in mm)	Error

2. When one moved towards right.

Sl No	Micrometre reading, (in mm)	O/P on indicator (in mm)	Error

Conclusion: Hence we performed the experiment on calibration of LVDT using micrometre successfully.

EXPERIMENT-12

AIM OF THE EXPERIMENT: 1. Calibration of load cell using proving ring.
2. To measure load (tensile/compressive) using load cell on a tutor.

APPARATUS USED: Load cell on a tutor
Digital panel meter
Electric supply

THEORY:

Measurement of load Is very common and essential phenomenon. Because force or load is one of the basic physical parameter to learn about its importance is never going to get declined and for such measurement load cell is a very common type of used transducer. But normally actual process of calibration and hence keeping this aspect in view, this load calibration setup has been designed. Here beam type load cell is used as transducer to sense the applied force or load nicely about the beam type of load cell it is normally used for uni-directional type of load with certain changes in fitment using S type load cell is basically designed to measure Bi-directional loads but here the students usage point of view only uni-directional load is allowed.

A simple mechanical setup is provided to apply the unidirectional load using simple mechanical screw type lever loading arrangement for load cell one end of the proving ring is fixed to the load cell and other end is having loading lever. Basically a low voltage DC excitation is providing to connect load cell which is nothing but a wheat stone bridge where strain gauge are used as basic sensing element obviously as a result output of the load cell is differential rather the single ended. Hence a standard as well as well known instruments amplifier based design is implemented. Because it is the most suitable way to process the output from wheat stone bridge type transducer. Gain for this instrument amplifier is settable so that output shown on digital readout directly shows the reading in basic zero adjustment is provided to initial load. If any output of this instrument amplifier stage is given as a input to DPM type digital read out remains with the fact that is directly avoids parallel error which are possible in case of dial or analog type indication.

SPECIFICATIONS:

- Load cell with strain gauge beam type capacity.
- Proving ring dial gauge compression type capacity.
- Digital load indicator with cable.
- Main frame and platform with loading lever.

OPERATING PROCEDURE:

Follow the steps given below before connecting supply mains to indicator:

- Beam type load cell is properly fitted on the mechanical setup (normally in unloaded condition).
- Zero point is at centre position.
- Beam type load cell is properly connected to the digital indicator.
- Give stabilized 230 volt AC 5O HZ mains supply with good earthing to the module.
- Before starting the experiment see that all the bolts are property tightened.
- Keep the load lever just touching the top end of the proving ring . Now load cell is free or unloaded condition. Adjust zero point is to get the zero reading on the digital readout.
- Gradually start rotating the lever so as to apply toad on the proving ring and toad cell. This apply load will generate unidirectional loaded in down ward direction.
- Now adjust gain point get minimum 1 kg reading and maximum 100 kg on the indicator by applying load.
- The moment you start loading the digital readout will start showing proportional reading in kgf.
- However please ensure that toad you are applying is not crossing maximum limit for provided beam type load cell (here it is 100 kg).
- Note down the reading for various toad on load cell and proving ring as per the given observation table.
- After completion of experiment unload the load cell, turn OFF the mains ON/OFF switch.
- Please keep entire setup in safe and dry place.

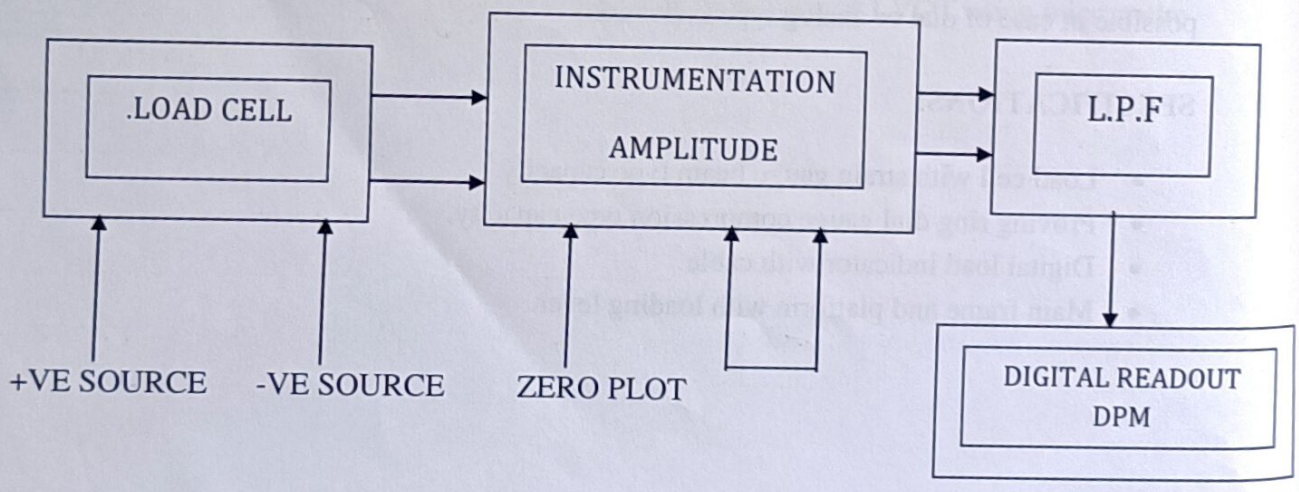


Fig: Block diagram of Load Cell

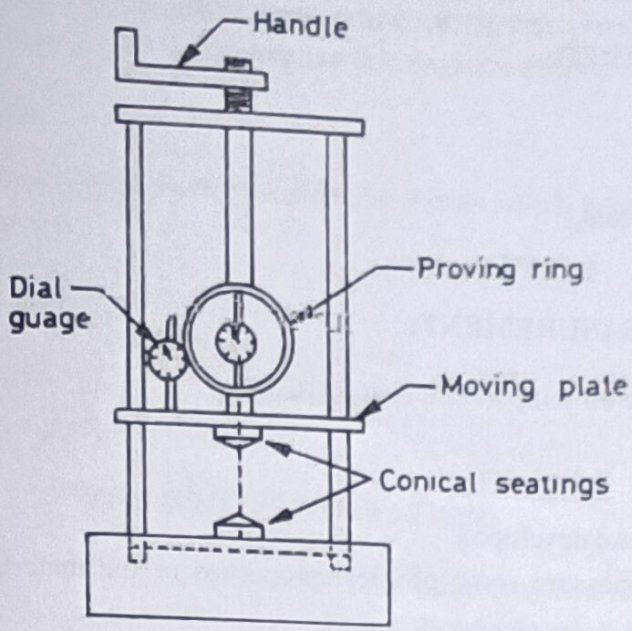


Fig. Load cell using Proving Ring

OBSERVATION:

- Zero reading properly adjusted.
- Maximum reading property adjusted
- Note down the respective reading,

CALIBRATION FOR CALCULATION:

100 division of big indicator=1 unit in small indicator
100 N = 10.2 kg = _____ divisions
1 division = 10.2/ (_____) kg =_____ kg

TABULATION:

SL. NO.	DIAL GAUGE READING (in kg)	LOAD CELL READING

CONCLUSION: Hence we performed the experiment on the force measurement application by load cell and proving ring successfully.

EXPERIMENT-13

AIM OF THE EXPERIMENT: Calibration of thermocouple by using thermometer.

APPARATUS REQUIRED:

- Thermocouple
- Thermometer
- Digital panel meter
- Electric kettle

TEMPERATURE MEASUREMENT:

World's average surface air temperature is at 15 ^{0}C.

TECHNOLOGY:

- Many methods are developed.
- Most of them measure some physical properties of the material which varies with temperature.

GLASS THERMOMETER:

- Glass field with mercury or some other liquid acting as working fluid.
- Increase in temperature expands the fluid, so temperature is measured by measuring volume of liquid.

TRANSDUCER:

It is a device which is usually electrical, electronic, electrochemical, electromagnetic which converts one type of physical to another type. Generally there are three types of transducer:

1. **SENSOR:**
   It detects the parameter in one form and report it in another form of energy. Ex- Tachometer.

2. **ACTUATOR:**
   It converts electrical to non electrical energy. Ex- Loud speaker.

3. **BOTH:**
   It has both the function. Ex- Ultrasonic transducer.

TRANSDUCER TO MEASURE TEMPERATURE:

- PTC (Positive temperature coefficient)
- NTC (Negative temperature coefficient)
- Thermocouple(J, K, T type)

PTC: Some materials have positive temperature coefficient properties that are their base resistance changes with respect to temperature in a positive manner. Ex- PT100

NTC: Some materials have negative temperature coefficient properties that are their base resistance changes with respect to temperature in a negative manner.

THERMOCOUPLE:

Thermocouple is a junction between two different metals which produces a voltage related to a temperature difference.

- It is used as a temperature sensor.
- It is used to convert heat into electric power.
- It can measure wide range of temperature.
- The main limitation is accuracy.

THERMOCOUPLE:- PRINCIPLE OF OPERATION:

In 1821 German Physicist Thomas Johan Seeback discovered that any conductor if subjected to temperature will generate voltage. It is known as thermoelectric Seeback effect.

- This voltage can be measured by connecting another conductor to the end.
- This conductor will also experience the heat and develop a voltage of its own.
- This magnitude of voltage depends on metal used.
- This voltage increases with temperature.
- Through two metals are coupled, it is called thermocouple.
- Important thing is that thermocouple measures this temperature difference between two points not the absolute temperature.
- Any circuit made of dissimilar metals would produce a temperature related potential difference.
- Different alloys are used for different temperature ranges.
- When the measurement point is far from the measuring instrument the intermediate connection can be made by extension wire.
- The power generated is a conversion of heat energy which must be continuously supplied to the hot side of the thermocouple to maintain the electrical potential. If thermocouples are connected in series produce thermocouple resulting in increasing in sensitivity higher voltage.

Ex- Radioactive decay of transuranic elements provide heat sources to power space craft on mission going to far from the sun,

USES:

- Temperature measurement of Kilns.
- Measurement of exhaust temperature of gas turbine or diesel engine.

TYPES OF THERMOCOUPLE:

A variety of thermocouple are available for different measuring application. Selection is based on temperature and sensitivity.

- **J-TYPE THERMOCOUPLE:**
  a. Based on metal ingredient are iron (positive) and constantus (negative).
  b. The curie point of iron (110^0C) causes abrupt changes in the characteristics which provide the upper temperature limit.
  c. Sensitivity is about 55 div/^{0}C.

- **K-TYPE THERMOCOUPLE:**
  a. Base metal are Chromium (positive) and Aluminum (negative).
  b. Used for high temperature (-200^0C to 1350^0C).
  c. For K-type it occurs at 150^0C.
  d. Sensitivity is about 41 div/^{0}C.

- **T-TYPE THERMOCOUPLE:**
  a. Base metals are copper (positive) and Constantan (negative).
  b. Used for negative and low temperature. (-200^0C to 350^0C).
  c. No curie point because both are non magnetic.
  d. Sensitivity about 43 div/^{0}C

OPERATING INSTRUCTION:

1. Follow the steps before connecting supply main to module.
   a. Ensure that thermocouple sensor is properly connected to the setup.
   b. Note that only one sensor to be connected at a time.
   c. Water bath is done at ambient temperature. All required sensor with thermometers are properly dipped into water pot.
2. Connect 230AC 50Hz main supply to the module connection must be free from fluctuation and having good earthing.
3. Ensure once again that all the above steps are followed.
4. Put ice in the ice bath to get it nearly zero temperature.
5. Set 6000 by using zero display.
6. Now slowly heat the water bath to get the dual rise in the temperature.
7. Note down the reading on the thermometer and display after completion of the experiment.
   a. Keep all set up in safe and dry place.
   b. Now slowly heat the water both to get the gradually rise in temperature.

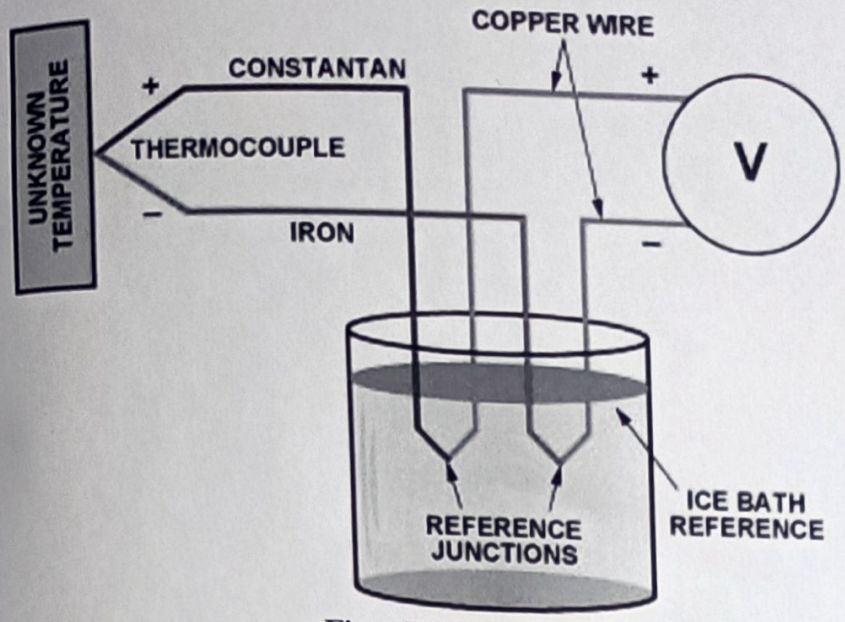


Fig. : Principle of thermocouple

TABULATION:

SL NO.	OBSERVED READING(^{0}C)	ACTUAL READING(^{0}C)	ACTUAL READING (mv)

CONCLUSION:

Hence we have successfully completed the experiment and calibration of thermocouple using thermometer.