TECHNO INDIA UNIVERSITY

WEST BENGAL

EM-4, EM Block, Sector V,

Bidhannagar, Kolkata, West Bengal 700091

1st Semester

LABORATORY MANUAL

of

WORKSHOP PRACTICE

TIU-ES-UME-L12192

For B. Tech ME

DEPARTMENT OF MECHANICAL ENGINEERING

INDEX

SYLLABUS

Introduction to Manufacturing Process Lab (TIU-UME-L104)

Program: B. Tech in Mechanical Engineering	Year, Semester: 1st Yr., 1st Sem.
Course Title: Introduction to Manufacturing Process Lab	Subject Code: TIU-UME-L104
Contact Hours/Week: 0–0–3 (L–T–P)	Credit: Lab-1.5

Lab Content

General safety precautions in workshop and introduction.

Fitting Shop: Safety precaution, Introduction to fitting shop tools, equipment, Operation and their uses, marking and measuring practice. **Exercise:** A simple job using fitting tools and equipment

Sheet metal work: Introduction, metals used in sheet metal work, hand tools, Sheet metal joints.

Turning and Machine Shop: Safety precautions, Demonstration and working principles of some of the general machines, like lathe, shaper, milling, drilling, grinding, slotting etc. General idea of cutting tools of the machines. **Exercise:** A simple job on lathe/ shaper

Recommended Books:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, Elements of Workshop Technology (Vol. - 1)

COURSE OUTCOMES

After completion of the course students will

CO 1 become familiar with the fitting shop tools, equipment, operation and their uses.

CO 2 understand the process of grinding

CO 3 understand the application of drilling operation.

CO 4 gain knowledge as to how to perform internal thread cutting by using taps

CO 5 know about various machining process like turning, shaping, milling, drilling and grinding.

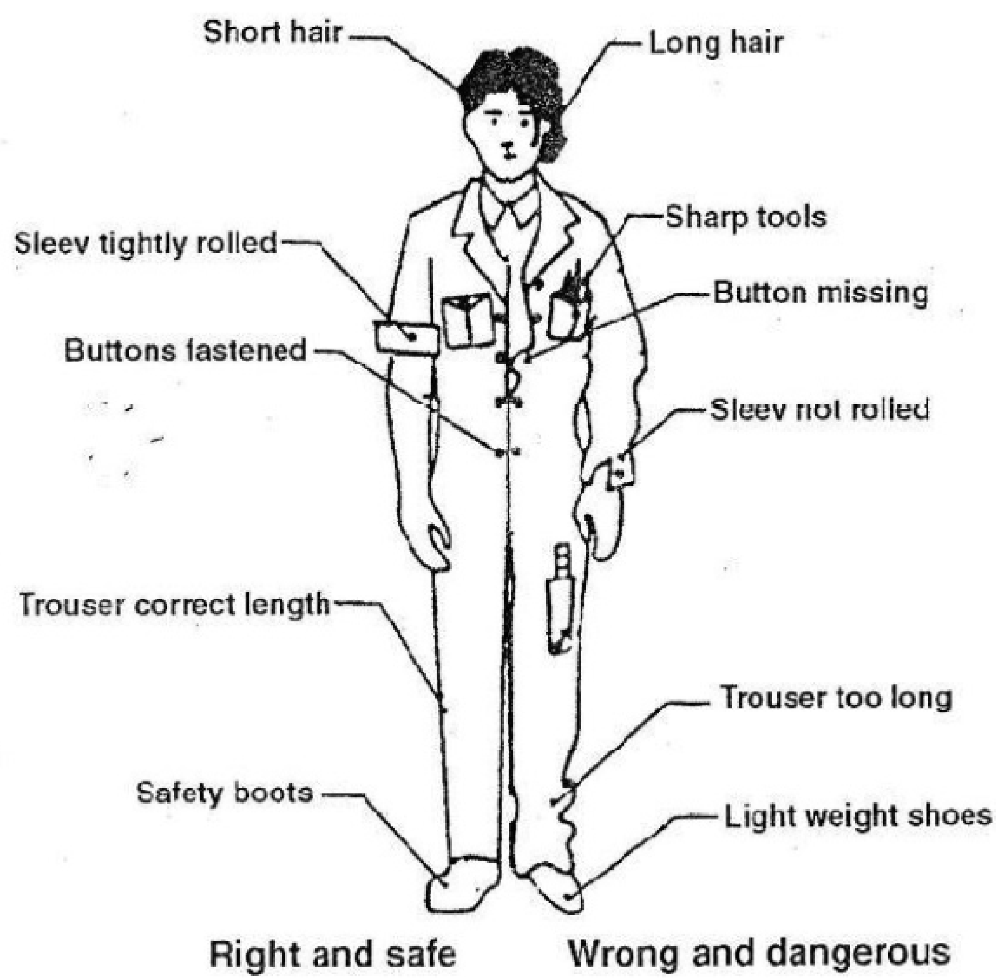
DETAILED CONTENT OF MANUAL

INTRODUCTION

Workshop practice imparts basic knowledge of various tools and their uses in different sections of manufacturing such as Fitting, Tin Smithy, House Wiring, Carpentry etc. It is true that engineers are not going to become carpenters or blacksmiths or skilled workers on the shop floor, but by exposing themselves to all working trades, they get a bird eye view of the basic practical activities associated with all sections of manufacturing. It helps them, when they occupy managerial positions, in understanding the activities and practical difficulties, so that they can take appropriate decisions.

Even when large amount of mechanical equipment is available for producing or repairing parts, there are still some elements of work which have to be performed by manual methods. However it must be borne in mind that all workshops and work areas are places of some risk. A healthy regard for rules and respect for all equipment being used reduces the risk of an accident considerably.

Finally, the engineers must also be familiar with the first aid practices. In case some minor injuries in the form of cuts, burns, fractures, fainting, electric shock etc occur in the shop floor, they should know how to give first aid to the victims.



WORKSHOP DRESS

SAFETY RULES AND UNSAFE PRACTICES
GENERAL SAFETY RULES

Do's

- Follow all machine operating instructions.
- Wear uniform, shoes & safety glasses.
- Keep hands away from all moving parts-at all times.
- Clean all machine tools after each use and handover them to the institutor properly.
- Keep work area clean and well-lit.
- Please follow instructions precisely as instructed by your supervisor.
- If any part of the equipment fails while being used, report it immediately to your supervisor.

Don'ts

- Do not touch hot work piece.
- Do not start the experiment unless your setup is verified & approved by your supervisor.
- Do not leave the experiments unattended while in progress.
- Do not crowd around the equipment & run inside the laboratory.
- Don't wear rings, watches, bracelets or other jewelry.
- Don't wear neck ties or loose turn clothing of any kind.
- Do not eat or drink inside labs.
- Do not wander around the lab and distract other students.

EXPERIMENT NO: 1

AIM: Study of fitting shop
THEORY:

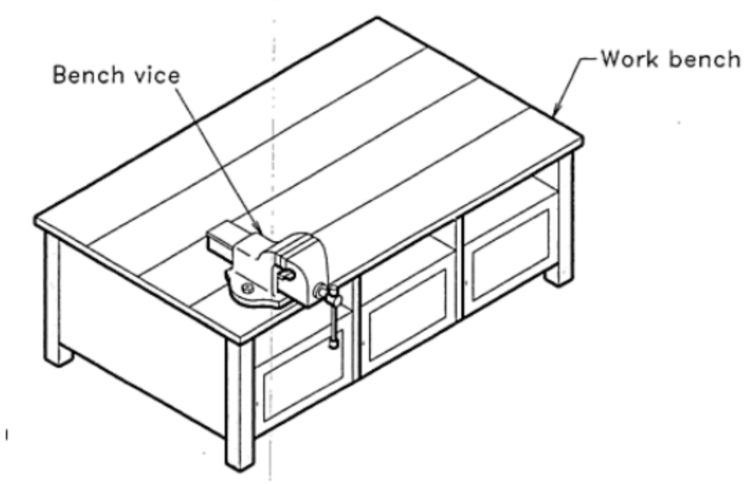
The term fitting, is related to assembly of parts, after bringing the dimension or shape to the required size or form, in order to secure the necessary fit. The operations required for the same are usually carried out on a work bench, hence the term bench work is also added with the name fitting.

The bench work and fitting plays an important role in engineering. Although in today's industries most of the work is done by automatic machines which produces the jobs with good accuracy but still it (job) requires some hand operations called fitting operations. The person working in the fitting shop is called fitter.

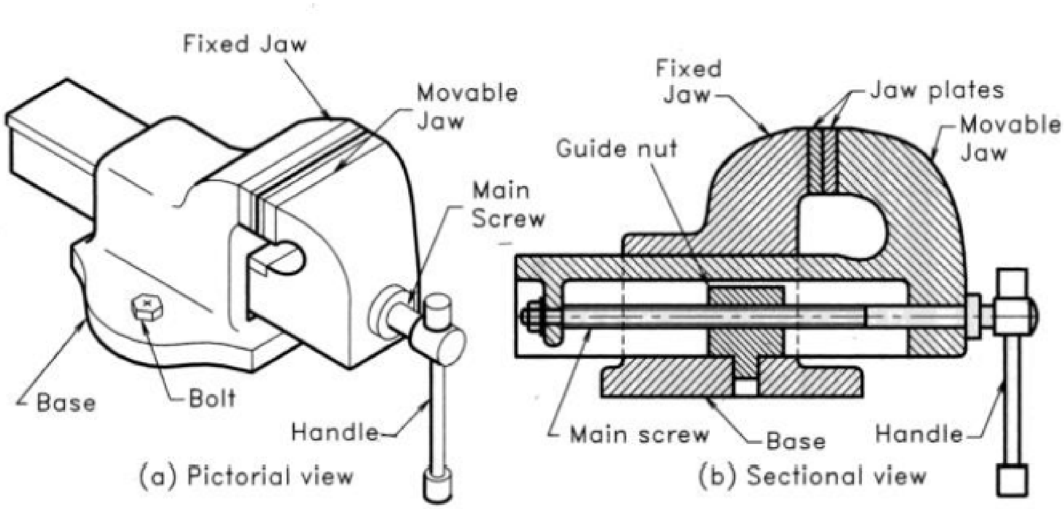
Fitting Tools:
Fitting shop tools are classified as below:

- Work Holding Devices/ Clamping Tools.
- Measuring
- Marking Tools.
- Cutting Tools.
- Striking Tools.

I. Work holding devices /clamping tools:
1. Work Bench: - A fitting process can be done at various places, but most of the important operations of fitting are generally carried out on a table called work bench. The work bench is a strong, heavy and rigid table made up of hard wood. The size of the work bench required is about 150 to 180 cm length, nearly 90 cm width and approximately 76 to 84 cm height.

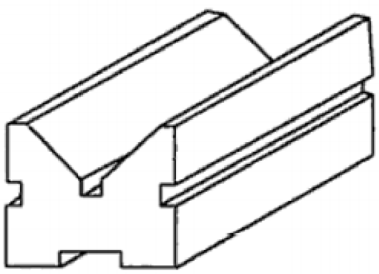


1. **Bench Vice**: - It is firmly fixed to the bench with the help of nuts and bolts. It consists of a cast Iron body and cast iron jaws. Two jaw plates are fitted on both the jaws. The holding surface of the jaw plates is knurled in order to increase the gipping. Jaw plates are made up of carbon steel and are wear resistant. One jaw is fixed to the body and the second slides on a square threaded screw with the help of a handle. The jaws are opened upto required length; job is placed in the two jaws and is fully tightened with the help of handle. Handle is used to move the movable jaw.

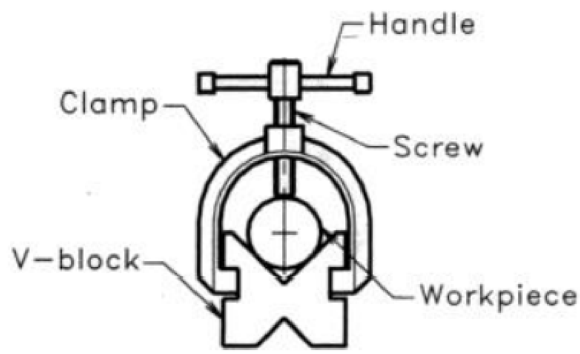


(a) Pictorial view (b) Sectional view

2. **V Block: -** In V Block, V grooves are provided to hold the round objects longitudinally. The screw of the clamp applies the holding pressure. When the handle is rotated there is movement in the screw.



(a) V Block

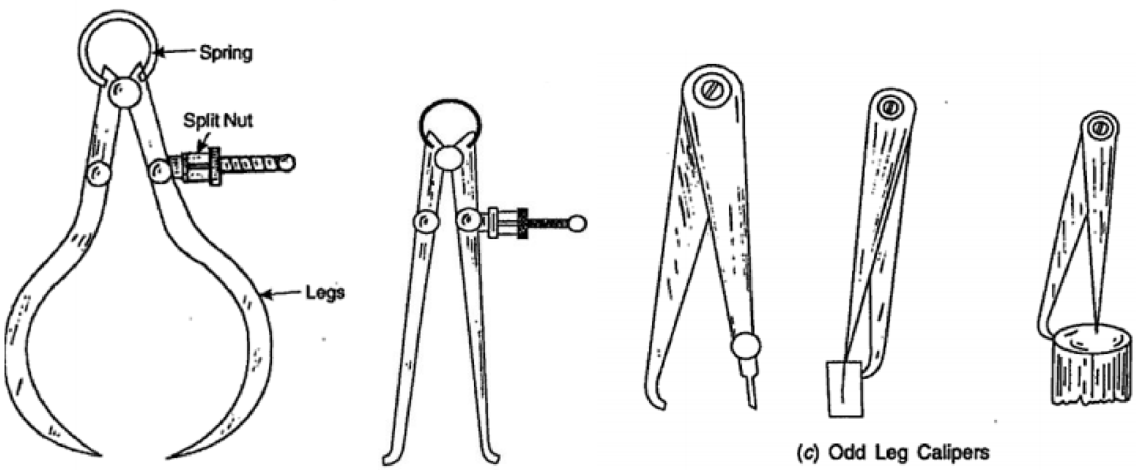


II. Measuring Tools

1. **Steel Rule: -** These are made up of stainless steel and are available in many sizes ranging from 1/2 ft. to 2 ft. These are marked in inches or millimetres. All the faces are machined true. The edges of steel rule should be protected from rough handling.

2. **Calipers: -** These are generally used to measure the inside or outside diameters. Different types are:

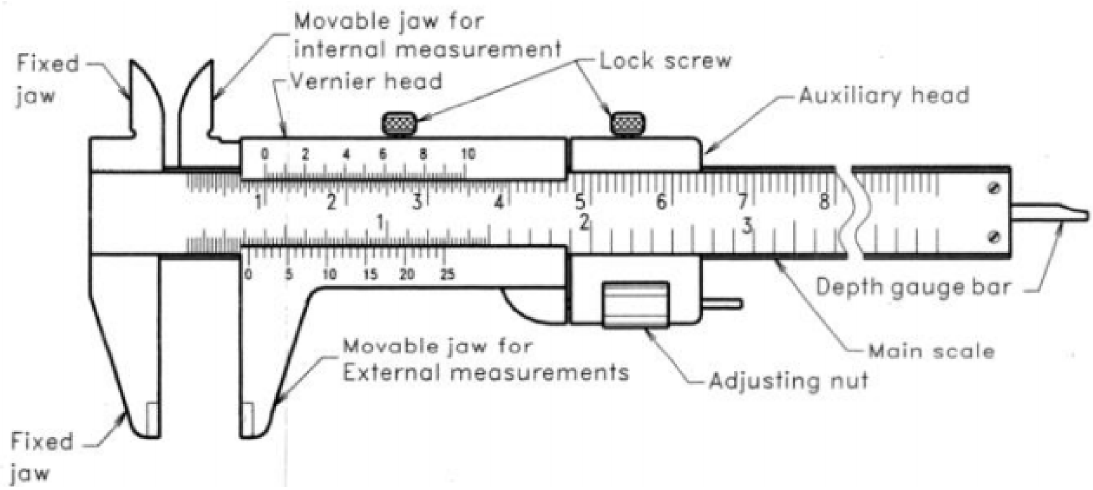
i. Outside Caliper: It is used to measure the outside dimensions.
ii. Inside Caliper: It is used to measure the inside dimensions.
iii. Spring Caliper: Spring is provided to apply the pressure and lock nut is provided to lock any desired position.
iv. Hermaphrodite, Jenny or Oddleg Caliper: One leg is bent at the tip inwardly and the other has a straight pointed end. It is used to scribe lines parallel to the straight edges.



(a) Outside Spring Caliper (b) Inside Spring Caliper (c) Odd Leg Calipers

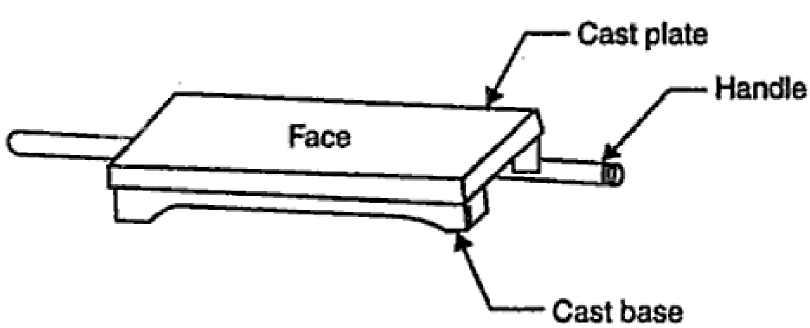
Fig. 10.20. Calipers.

3. **Vernier Caliper: -** It is used for measuring the outer dimensions of round, flat, square components and also the inner size of the holes and bore. A narrow blade is used to measure the depth of bar slots etc. The reading accuracy in metric system is 0.02 mm and British system it is 0.001”. It is made of stainless steel.

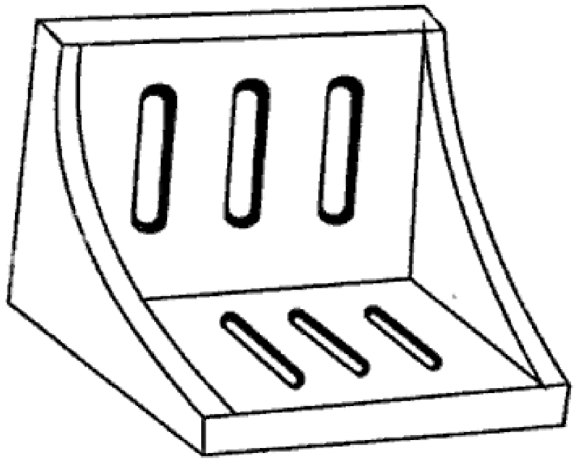


III. MARKING TOOLS:

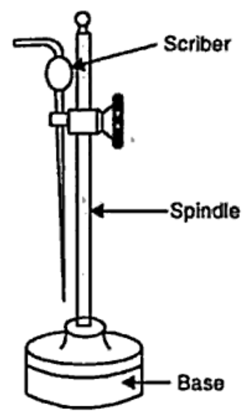
1. **Surface Plate: - It** is used for testing the flatness, trueness of the surfaces. It is made up of cast iron or graphite. Its upper face is planed to form a very smooth surface. It is also used in scribing work. While not in use, it should be covered with a wooden cover.



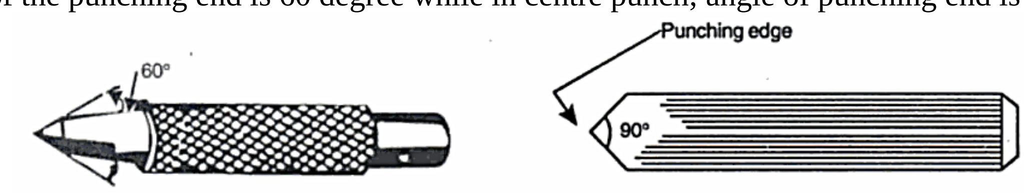
2. Angle Plate: - It is made up of cast iron in different sizes; it has two planed surfaces at right angles to each other and has various slots in each surface to hold the work by means of bolts and clamps. Never do hammering on the angle plate to fasten (lighten) the nuts and bolts**.**



3. Scriber and Surface Gauge: - It consists of a cast iron bass on the center of which a steel rod is fixed vertically. Scriber is made up of high carbon steel and is hardened from the front edge. It is used for locating the centres of round bars or for marking of the lines.

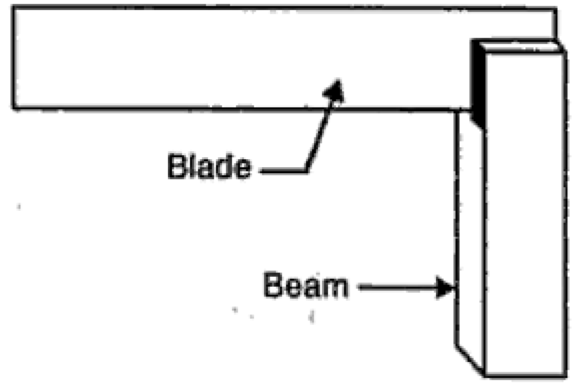


4. Punches: - Punches are used for marking purposes. Dot punches are used for marking dotted line and centre punch is used to mark the centre of hole before drilling. Punches are made up of high carbon steel or high speed steels. One end is sharpened. Hammering is done on the second end while working. For dot punch, angle of the punching end is 60 degree while in centre punch; angle of punching end is 90 degree.



(*a*) Dot Punch (*b*) Centre Punch

5. Try Square: - It is used for checking squareness of two surfaces. It consists of a blade made up of steel, which is attached to a base at 90 degree. The base is made up of cast iron or steel. It is also used to mark the right angles and measuring straightness of surfaces. Never use try square as a hammer.



6. Vernier Height gauge: - A Vernier height gauge consists of a heavy base, a graduated beam, a sliding head with Vernier sliding jaws holding the scriber and a fine adjustment clamp. It is similar to large Vernier calipers in construction, except that it consists of a heavy base which allows the gauge to stand upright instead of a fixed jaw in a Vernier. The movable jaw of Vernier height gauge consists of a projection or extension which is leveled to sharp edge for scribing lines at any required height.

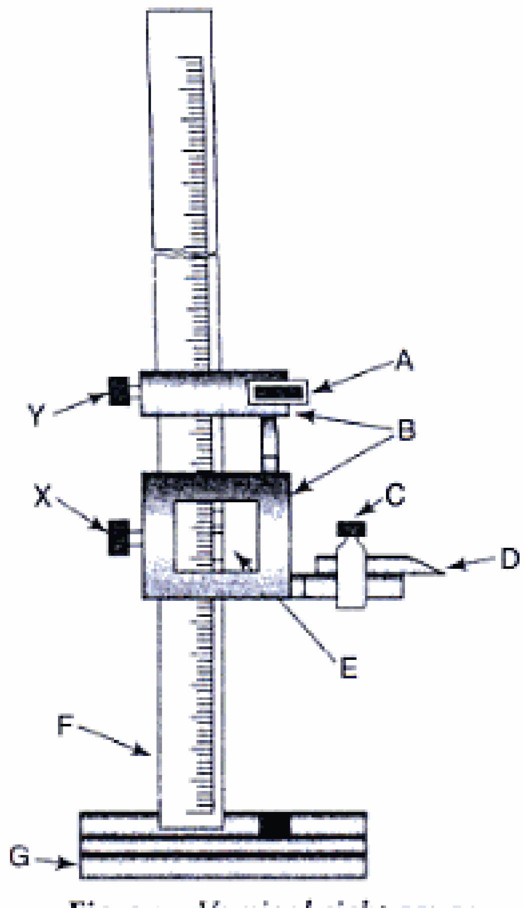


Fig. 3.17 *Vernier height gauge*
A—Fine adjustment of nut *B—Vernier slide*
C—Scriber clamp screw *D—Scriber*
E—Vernier scale *F—Main scale* *G—Base*
X, Y—Lock screws

Method of marking: - Marking means setting out dimensions with the help of a working drawing or directly transferring them from a similar part. The procedure of marking is as follows:

1. The surface to be marked is coated with the paste of chalk or red lead and allowed to dry.
2. Then the work is held in a holding device depending upon shape and size. If it is flat, use surface plate, if it is round use V block and clamp, else use angle plate etc.
3. Lines in horizontal direction are scribed by means of a surface gauge. Lines at right angles can be drawn by turning the work through 90 degree and then using the scriber. If true surface is available, try square can also be used.
4. The centre on the end of a round bar can be located by using an odd leg caliper, surface gauge etc.
5. The circles and arcs on a flat surface are marked by means of a divider.
6. After the scribing work is over, indentations on the surface are made using dot punch and hammer.

IV. CUTTING TOOLS

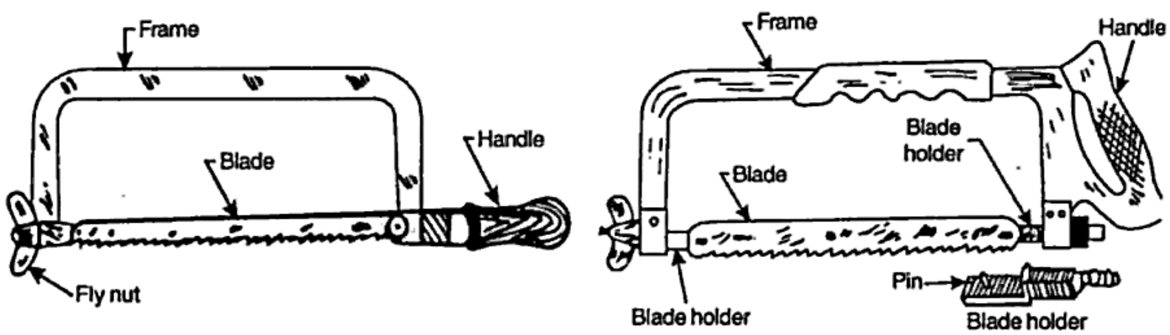
1. Hacksaw: - Hacksaw is used for cutting of rods, bars, pipes, flats etc. It consists of a frame, which is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The blade is made up of high carbon steel or high speed steel. The points of the teeth are bent in a zig-zag fashion, to cut a wide groove and prevent the body of the blade from rubbing or jamming in the saw cut. The teeth of the blades are generally forward cut so in the case, pressure is applied in the forward direction only.

Depending upon the direction of cut, blades are classified as:

- Forward cut
- Backward cut.

Depending upon the pitch of the teeth (Distance between the two consecutive teeth) blades is classified as:

- Coarse (8-14 teeth per Inch)
- Medium (16-20 teeth per inch)
- Fine (24-32 teeth per inch)



(*a*) Fixed Frame (*b*) Adjustable Frame

2. Files

Files are multi points cutting tools. It is used to remove the material by rubbing it on the metals. Files are available in a number of sizes, shapes and degree of coarseness.

Classification of files

i. On the basis of length - 4”,6”,8”,12”

ii. On the basis of grade:

- Rough (R) (20 teeth per inch)
- Bastard (B)(30 teeth per inch)
- Second cut (Sc) (40 teeth per inch)

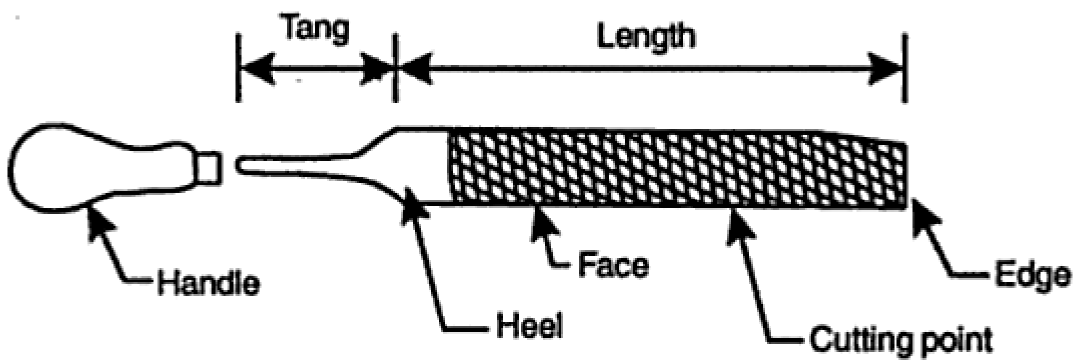
- Smooth file (S) (50 teeth per inch)
- Dead smooth (DS) (100 teeth per inch)

Rough and bastard files are the big cut files. When the material removal is more, these files are used. These files have bigger cut but the surface produced is rough.
Dead smooth and smooth files have smaller teeth and used for finishing work. Second cut file has degree of finish in between bastard and smooth file.

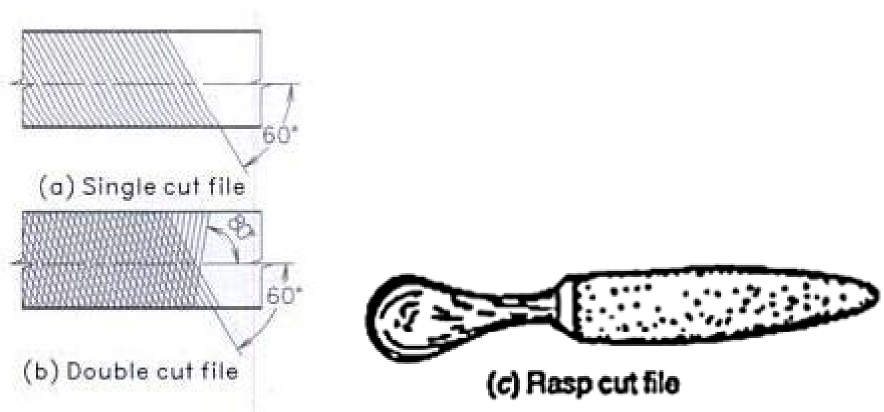
iii. On the basis of number of cuts:

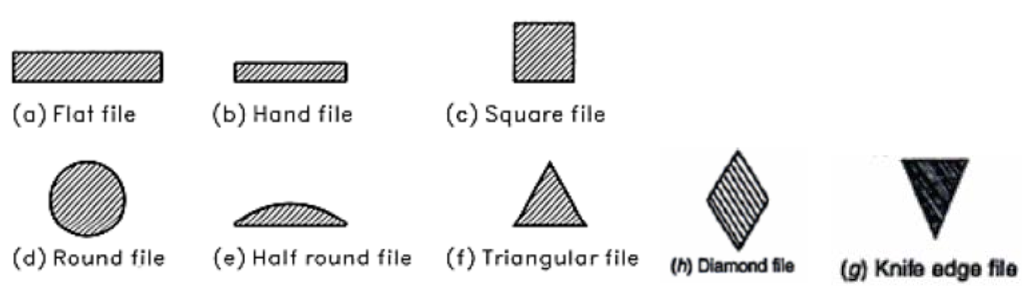
- Single cut files.
- Double cut files.
- Rasp files.

In single cut files the teeth are cut in parallel rows at an angle of 60 degree to the face. Another row of teeth is added in opposite direction in case of double cut files. Material removal is more in case of double cut files.



Nomenclature of a File





iv. On the basis of shape and size:

The length of the files varies from 4' to 14*. The various shapes of cross-section available are hand file, flat file, triangular, round; square, half round, knife-edge, pillar, needle and mill file.

a. **Flat file:** This file has parallel edges for about two-thirds of the length and then it tapers in width and thickness. The faces are double cut while the edges are single cut.

b. **Hand file:** for a hand file the width is constant throughout, but the thickness tapers as given in flat file. Both faces are double cut and one edge is single cut. The remaining edge is kept uncut in order to use for filing a right-angled corner on one side only.

c. **Square file:** It has a square cross-section. It is parallel for two-thirds of its length and then tapers towards the tip. It is double cut on all sides. It is used for filing square corners and slots.

d. **Triangular file:** It has width either parallel throughout or upto middle and then tapered towards the tip. Its section is triangular (equilateral) and the three faces are double cut and the edges single cut. It is used for filing square shoulders or comers and for sharpening wood working saws.

e. **Round file:** It has round cross-section. It carries single cut teeth all round its surface. It is normally made tapered towards the tip and is frequently known as rat-tail file. Parallel round files having same diameter throughout the length are also available. The round files are used for opening out holes, producing round comers, round-ended slots etc.

f. **Half-round file:** Its cross-section is not a true half circle but is only about one-third of a circle. The width of the file is either parallel throughout or upto middle and then tapered towards the tip. The flat side of this file is always a double cut and curved side has single cut. It is used for filing curved surfaces.

g. **Knife edge file:** It has a width tapered like a knife blade and it is also tapered towards the tip and thickness. It carries double cut teeth on the two broad faces and single cut teeth on the edge. It is used for finishing sharp corners of grooves and slots

h. **Diamond file:** Its cross-section is like a diamond. It is used for special work.

i. **Needle file:** These are thin small files having a parallel tang and a thin, narrow and pointed blade made in different shapes of its cross-section to suit the particular need of the work. These are available in sizes from 100 mm to 200 mm of various shapes and cuts. These files are used for filing very thin and delicate work.

Methods of filing

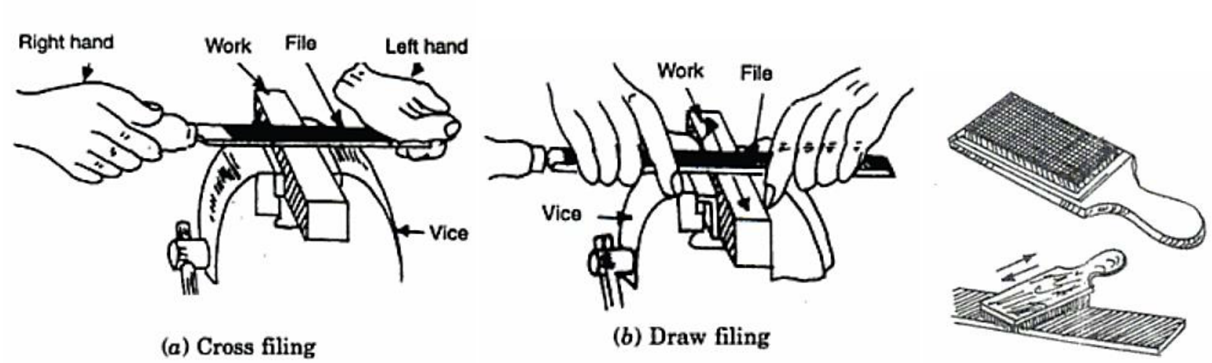
The following are the two commonly used methods of filing:

1. Cross-filing
2. Draw filing.

Cross – filing: - This method is used for efficient removal of maximum amount of metal in the shortest possible time. It may be noted that the file must remain horizontal throughout the stroke (long, slow and steady) with pressure only applied on the forward motion.

Draw filing: - This method is used to remove file marks and for finishing operations. Here, the file is gripped as close to the work as possible between two hands. In this filing method, a fine cut file with a flat face should be used.

FILE CARD: - It is a device fashioned like a wire brush used to clean dirt and chips from the teeth of a file. When particles of metal clog the teeth the file is said to the *pinned*, a condition that causes scratching of the surface of the work. Files, therefore, require cleaning by means of a file card or by dislodging the material between the teeth by means of a piece of soft iron, copper, brass, tin plate and so on, sharpened at the end. Hardened steel should never be used



V. Striking Tools used in Engineering Workshop:

These tools are used to strike or hit the work piece by the application of external force.

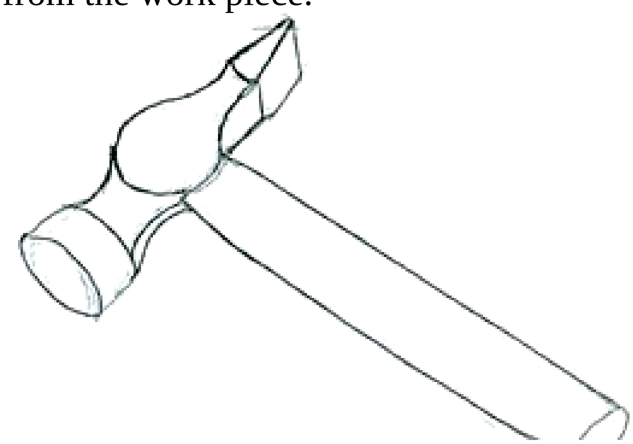
The Three Types of striking tools used in carpentry workshops are as follows.

1. Cross-peen hammer
2. Claw hammer
3. Mallet

The explanations are as follows:

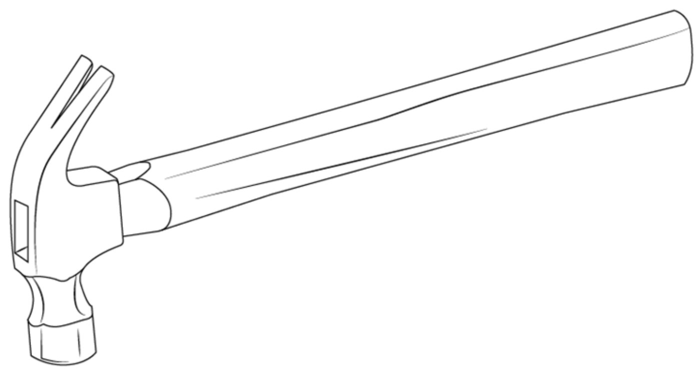
Cross-Peen Hammer:

- It has a cast Steel body and a wooden handle.
- The body has two parts. They are face and Peen.
- In a cross peen hammer, the peen is in the form of a narrow round edge used to remove the unwanted material from the work piece.



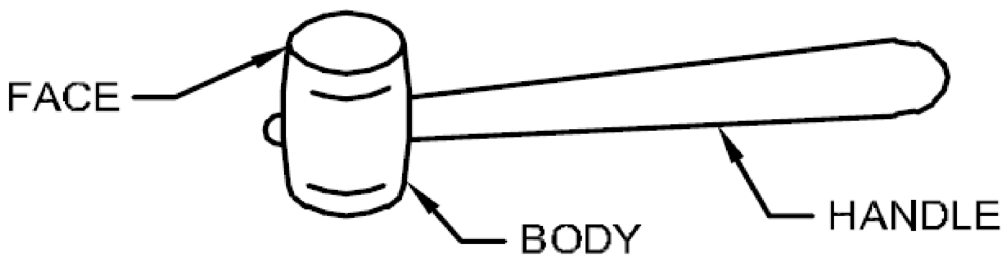
Claw Hammer:

- It is used for striking as well as for pulling the nails from the wood.
- The claw face is used for pulling out the nails and the head face is usedto drive the nails.
- It is made up of cast Steel.



Mallet:

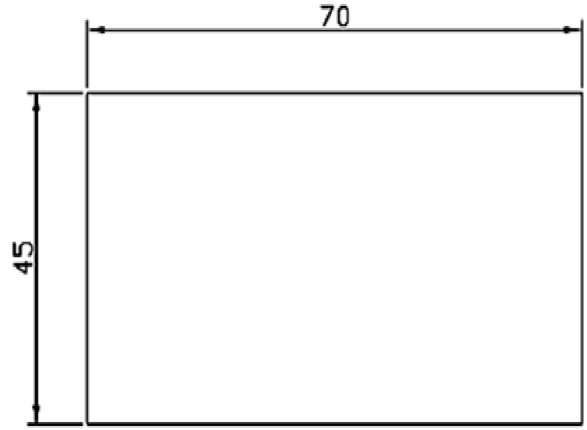
- It is used to strike the chisel on a wooden component.
- It is made up of hardwood and is round or rectangular.



EXPERIMENT NO: 02

AIM: To perform filing in a given mid steel specimen.

MATERIALS REQUIRED: Mild steel flat (45 × 70 × 3 mm).



TOOLS AND EQUIPMENT REQUIRED:

1.6”try square

2. 6”sriber

3. Steel Rule

4. 10” rough file

5. 10” smooth file

SEQUENCE OF OPERATIONS:

1. Parting

2. Marking

3. Filing

4. Finishing

PROCEDURE:

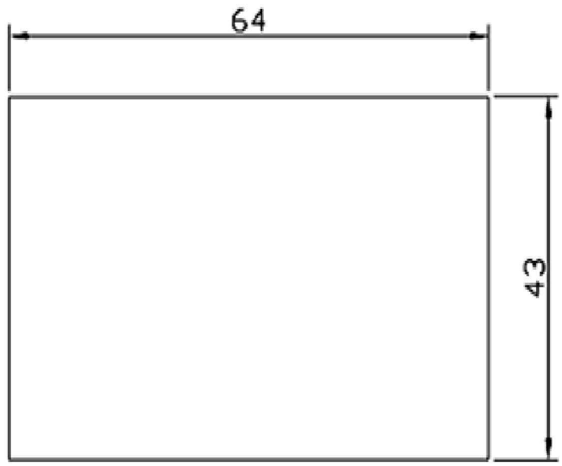
1. The mild steel flat piece is checked for given dimensions.

3. Wet chalk is applied over the flat surface.

4. A straight line is drawn on the specimen with the help of a try square and sriber, which indicates the part to be filed.

2. One edge of the given specimen is then filed with rough and smooth files and its straightness checked with a try square.

3. Adjacent edges are also filed likewise and their squareness checked with respect to the first edge with a try square.



PRECAUTIONS:

1. The perpendicularity of the edges is checked carefully by using try square.
2. Finishing is performed by using only smooth files.
3. Marking is done without parallax error.

RESULT: The filing operation is done successfully.

EXPERIMENT NO: 3
AIM: Study of Grinding Process
THEORY:

Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. In grinding, an abrasive material rubs against the metal part and removes tiny pieces of material. The abrasive material is typically on the surface of a wheel or belt and abrades material in a way similar to sanding. On a microscopic scale, the chip formation in grinding is the same as that found in other machining processes. The abrasive action of grinding generates excessive heat so that flooding of the cutting area with fluid is necessary.

The grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel's diameter and manufacturer's rating, usually by a formula) and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the workpiece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or table's position is possible using a vernier calibrated hand wheel, or using the features of numerical controls.

Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases. In very high-precision grinding machines (most cylindrical and surface grinders) the final grinding stages are usually set up so that they remove about 200 nm (less than 1/100000 in) per pass – this generates so little heat that even with no coolant, the temperature rise is negligible.

OBJECTIVES

- Set up work pieces for grinding
- Observe the safety rules to operate the grinder
- Grind flat and angular surfaces

PRINCIPLE OF GRINDING MACHINES

- Work piece is fed against the rotating abrasive wheel.
- Due to action of rubbing or friction between the abrasive particles and work piece material is removed.

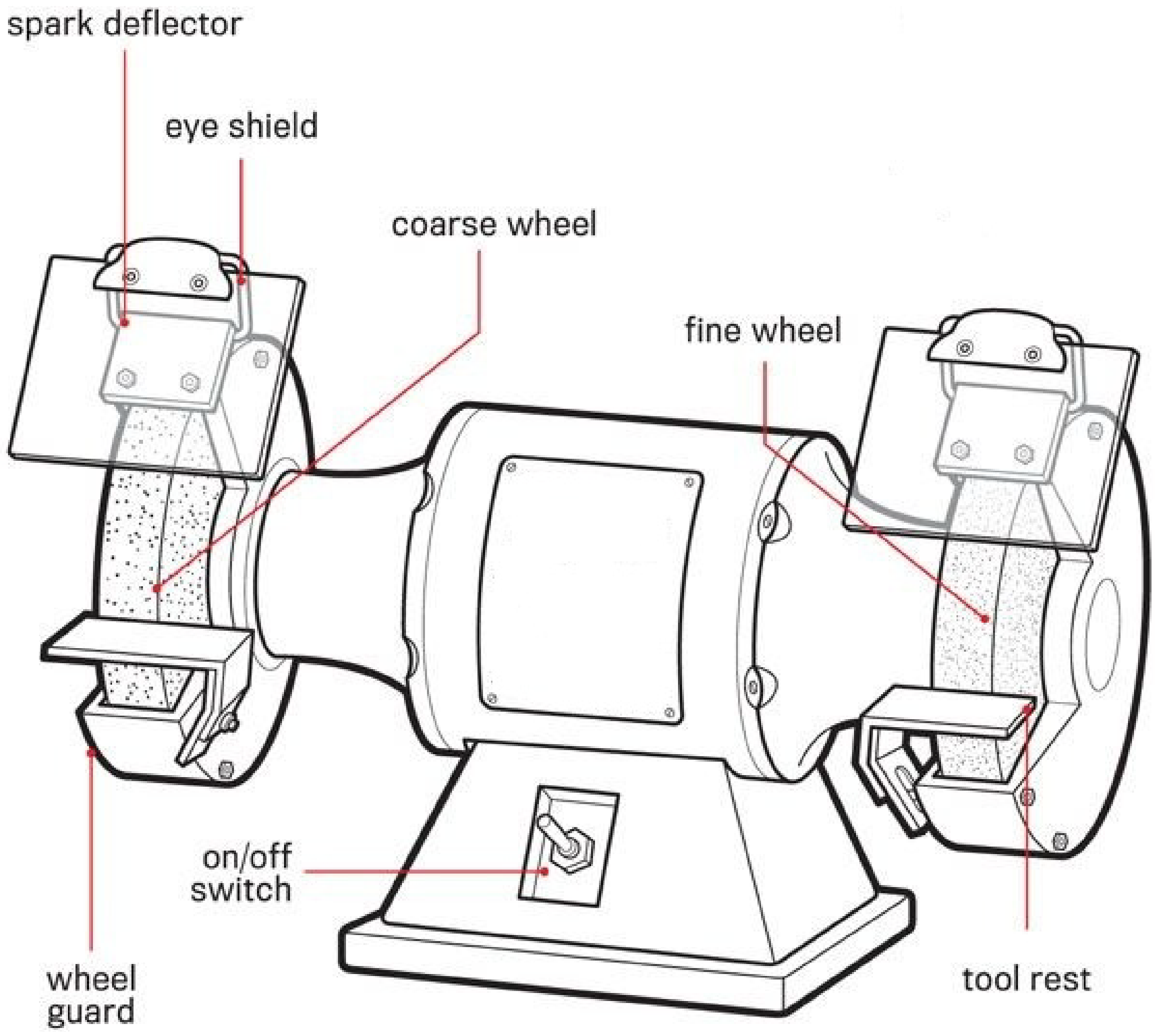
UTILITY GRINDING MACHINES

The utility grinding machine is intended for offhand grinding where the workpiece is supported in the hand and brought to bear against the rotating grinding abrasive wheel. The accuracy of this type of grinding machine depends on the operator's dexterity, skill, and knowledge of the machine's capabilities and the nature of the work. The utility grinding machine consists of a horizontally mounted motor with a grinding abrasive wheel attached to each end of the motor shaft.

The electric-motor-driven machine is simple and common. It may be bench-mounted or floor-mounted. Generally, the condition and design of the shaft bearings as well as the motor rating determine the wheel size capacity of the machine. Suitable wheel guards and tool rests are provided for safety and ease of operation.

BENCH GRINDING MACHINE (Motor RPM= 2850, Motor Power = 1 KW)

One coarse grinding wheel and one fine grinding wheel are usually mounted on the machine for convenience of operation. Each wheel is provided with an adjustable table tool rest and an eye shield for protection. On this machine, the motor is equipped with a thermal over-load switch to stop the motor if excessive wheel pressure is applied thus preventing the burning out of the motor.



WORK PIECE METAL

Cast Iron – Also referred, as iron is a ferrous metal containing more than 2% of carbon is known as cast iron. It is hard and brittle material, used in machine beds, heavy parts of machines.

Mild steel - Mild steel, also called as plain-carbon steel, is the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications, more so than iron. Low-carbon steel contains approximately 0.05–0.3% carbon, making it malleable and ductile.

CUTTING TERMINOLOGY

- **Speed:** it is the peripheral speed of the work piece per unit time. (m/min)
- **Feed:** it is the distance travelled by the tool during each revolution of the work piece. (mm/revolution).
- **Depth of cut:** it is the perpendicular distance measured from the original surface to the machined surface of the work piece. (mm)

ABRASIVE

An **abrasive** is a material, often a mineral that is used to shape or finish a work piece through rubbing which leads to part of the work piece being worn away. While finishing a material often means polishing it to gain a smooth, reflective surface it can also involve roughening as in satin, matte or beaded finishes.

Abrasive Materials

Abrasives may be classified as either natural or synthetic. When discussing sharpening stones, natural stones have long been considered superior but advances in material technology are seeing this distinction become less distinct. Many synthetic abrasives are effectively identical to a natural mineral, differing only in that the synthetic mineral has been manufactured rather than been mined. Impurities in the natural mineral may make it less effective.

Some naturally occurring abrasives are:

- Calcium carbonate
- Emery
- Diamond dust (synthetic diamonds are used extensively)
- Pumice dust
- Sand

Some abrasive minerals (such as zirconia alumina) occur naturally but are sufficiently rare or sufficiently more difficult/costly to obtain such that a synthetic stone is used industrially. These and other artificial abrasives include:

- Borazon (cubic boron nitride or CBN)
- Ceramic
- Ceramic aluminium oxide
- Ceramic iron oxide
- Alumina oxide)
- Glass powder
- Steel abrasive
- Silicon carbide (carborundum)
- Zirconia alumina

BONDS

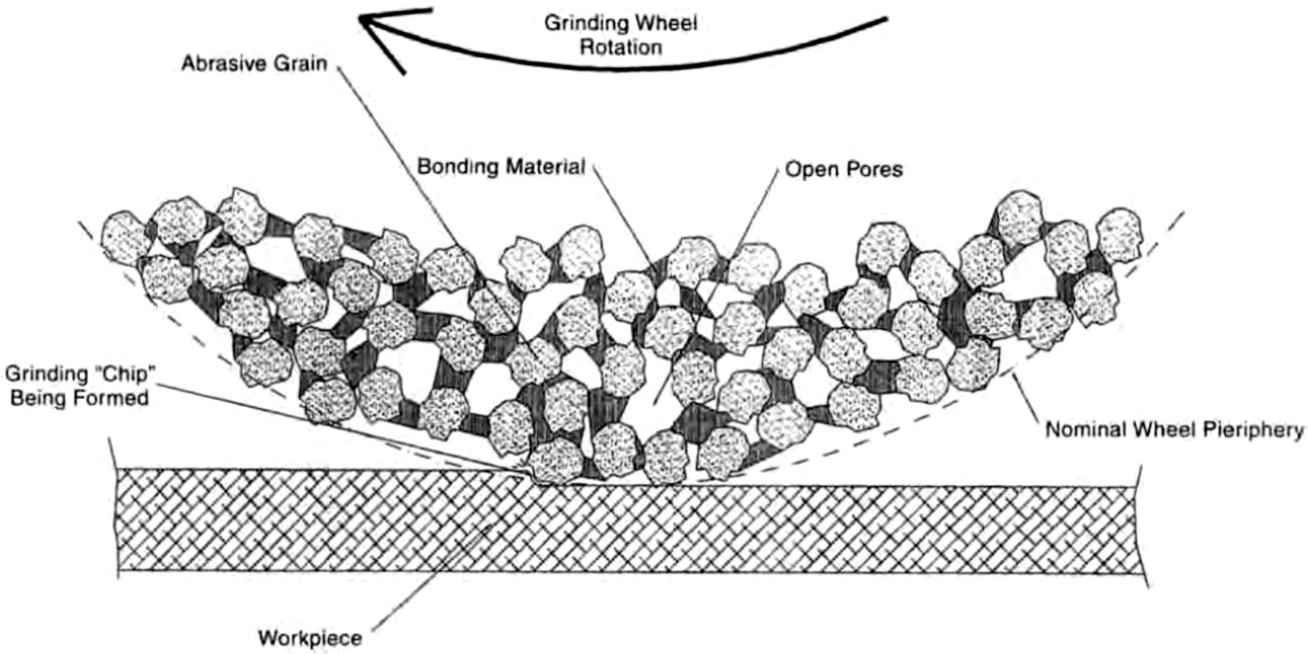
The bonding system holds the abrasives together in the wheel shape. Consisting of resins & fillers, it allows the wheel to wear away at a specific rate, to achieve the required cutting action. Wheels with tenacious bonds are called “hard”; those that break down more rapidly are considered “soft”. Resinoid bonding systems are used for dry-cutting of most materials. Rubber-Resin bonding systems are used for most wet-cutting applications.

Four types of bonds are generally used for diamond and CBN grinding tools: ***Resin bonds, Sintered metal bonds, Electroplated bonds and Ceramic bonds***

The different types of bonds are classified in bond groups which are in turn allocated to certain bonding tasks. Resin bonds are sub classified according to their bond hardness. In contrast to the hardness of a ceramic bond grinding tool, which is a measure of resistance to penetration, the hardness of a resin bond for diamond or CBN grinding tools describes the effective hardness and grinding behaviour of these tools. However, in the case of sintered metal bonds, resistance to wear is generally referred to in a somewhat modified form.

The bond decisively influences both the grinding behaviour and the service life of the grinding tool. The bond must adhere to the grains as long as possible while simultaneously wearing in such a way

that the tips of the abrasive grains can cut freely in the course of the metal cutting process. This process is called the "self-sharpening effect". It results from the combined effect of the bond, the grain size and the concentration on the one hand, and from the bond wear caused by chip formation on the other hand.
The optimal bond is the one that offers the most cost-effective balance between the stock removal rate on the work piece and the wear of the abrasive layer. In order to accomplish a wider variety of grinding tasks, a wide variety of bonds must be made available.



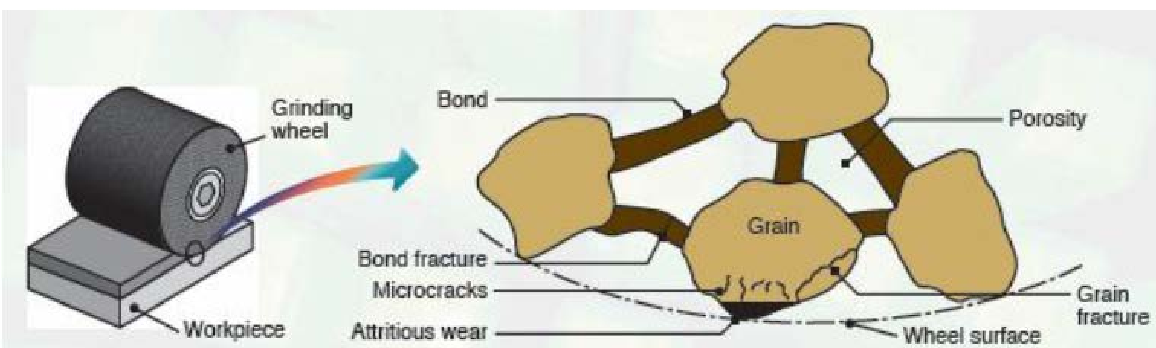


Fig: Schematic illustration of a physical model of a grinding wheel, showing its structure and grain wear and fracture patterns.

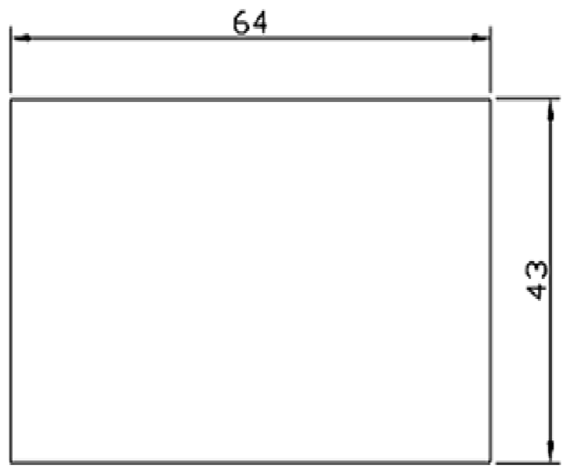
SAFETY PRECAUTIONS

- Always wear safety glasses and gloves as this machine may send shavings in all directions.
- Always wait for the wheel to reach maximum speed before using it, as there may be unseen faults in the wheel, which could cause the wheel to burst apart.
- Avoid wearing loose clothing, as they may get caught in the moving parts of the grinder.
- If you have long hair, you should keep it tied back, so that it does not get caught in the machine.
- Never strike the wheel against the material as this could cause faults in the wheel, which may result in a loss of integrity and it may fly apart.
- Always make sure the material is securely held firmly in place.

EXPERIMENT NO: 04

AIM: To perform grinding operation on a given mid steel specimen.

MATERIALS REQUIRED: Mild steel flat (43 × 64 × 3 mm).



TOOLS AND EQUIPMENT REQUIRED:

1.6” try square

2. 6” sriber

3. Steel Rule

4. Grinding wheel

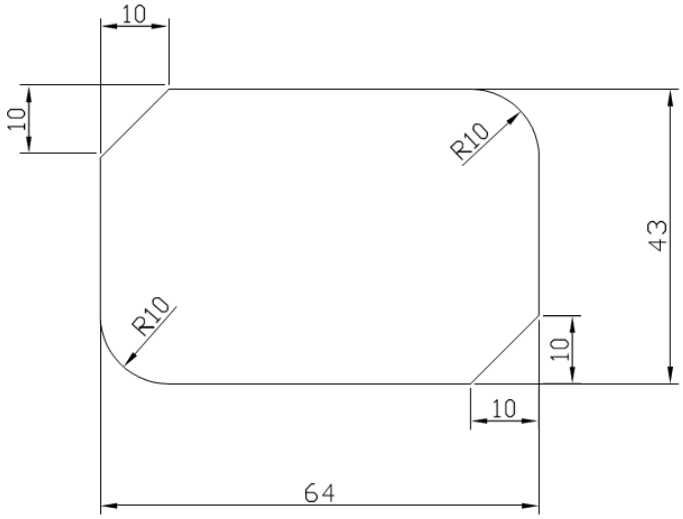
SEQUENCE OF OPERATIONS:

1. Marking
2. Grinding
3. Finishing

PROCEDURE:

1. The work piece is mounted on a table, so that the grinding wheel comes into contact with its edge.
2. Depth of cut is then given to it by down feed hand wheel.
3. The grinding wheel then produces a flat surface of the required dimensions by removing extra material from the work piece.
4. After grinding operation, filing is performed on the work piece to get the desired surface finish.

FINAL SHAPE OF THE WORK PIECE (After grinding all four edges with the dimensions given below)



PRECAUTIONS:

1. Coolant usage is compulsory as the speeds employed are very high and continuous application of coolant is necessary for ductile materials like steel.
2. Proper dressing of the grinding wheel has to be done before performing grinding.
3. Care has to be exercised so as to maintain the right feed of the material.
4. Copious amounts of coolant has to be applied at the work-wheel interface.

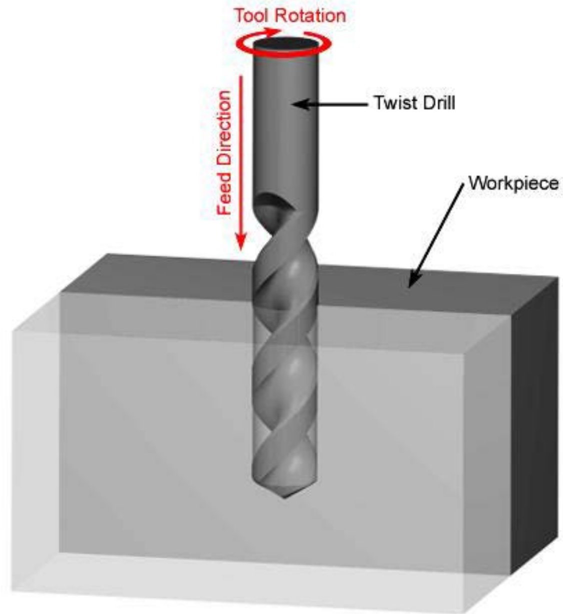
RESULT: The grinding operation is performed successfully.

EXPERIMENT NO: 5

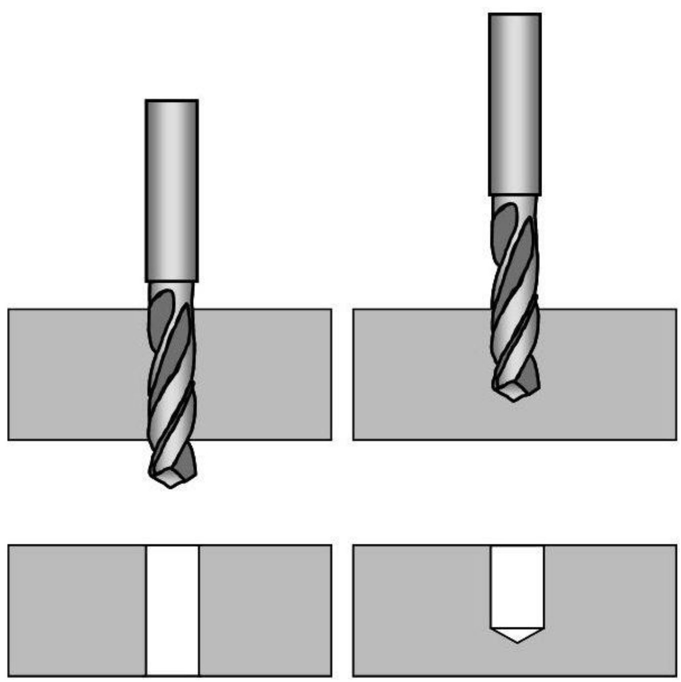
AIM: Study of Drilling Process

THEORY:

Drilling is a material-removing or cutting process in which the tool uses a drill bit to cut a hole of circular cross-section in solid materials.



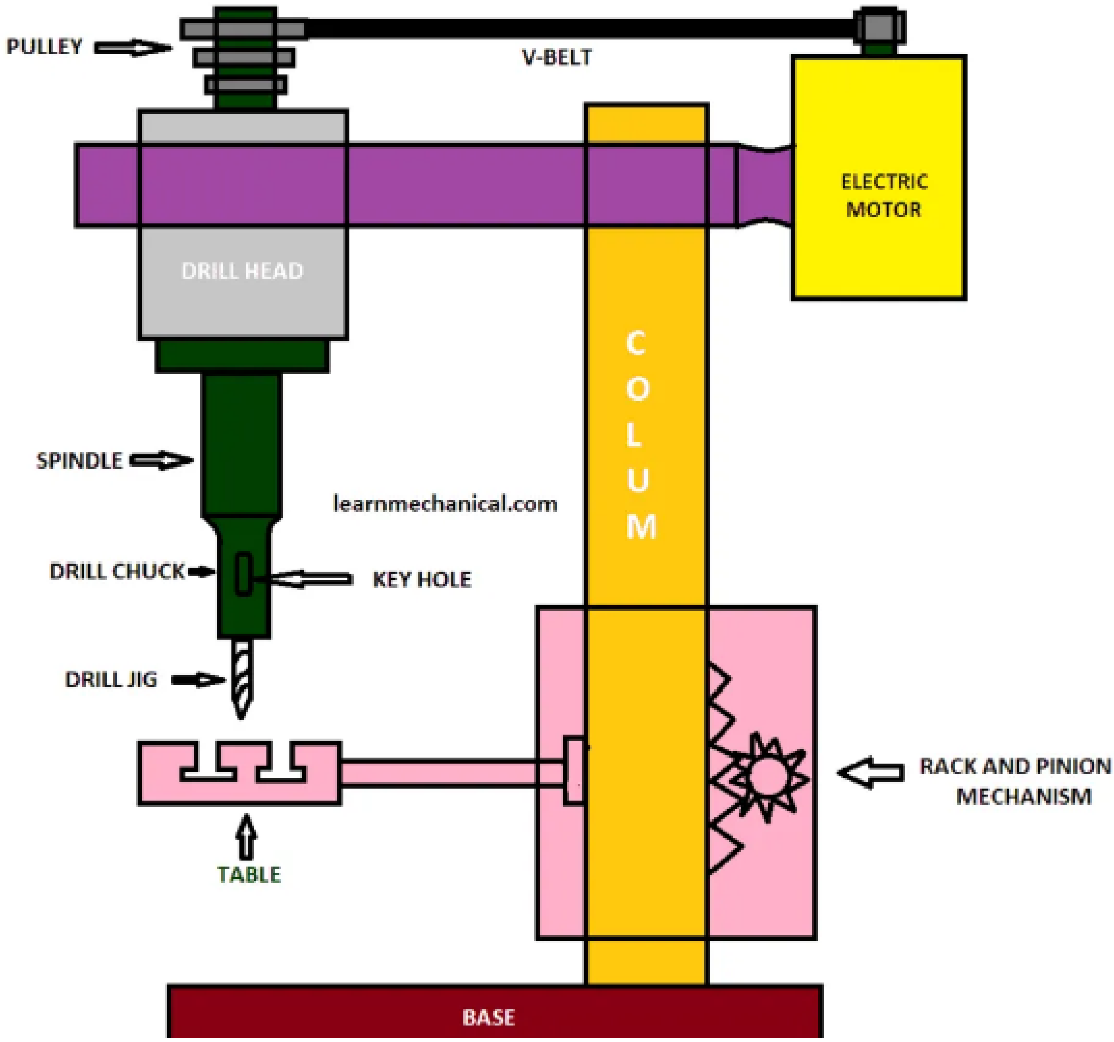
Drilled holes can be either through holes or blind holes (see Figure below). A through hole is made when a drill exits the opposite side of the work; in blind hole the drill does not exit the work piece.



(a) (b)

Figure: *Two holes types: (a) through hole and (b) blind hole*

Drilling Machine Main Parts:



Base:

It is one of the main parts of a drilling machine, it carries the entire weight of the machine, and transfer the weight to the ground. The base of a drilling machine is generally made of cast iron or steel, and it is very rigid.

Column or pillar:

The column or pillar is situated on one side of the base. In general, we use a radial column so that the movement of the arm is possible in a clockwise or anti-clockwise direction. The column is also made of cast iron or steel and is also very rigid so that it can carry the load of the arm as well as a drill head.

Worktable:

The worktable is generally made of cast iron and it is mounted on the column. T-slots are provided at the top surface of the table may be in some table there is a vice which also helps to hold the job. The table can move up and down as also right or left according to the job and tool arrangement.

Drill head:

One side of the arm a drill head is mounted, a drill head is consist of various feed and driving mechanism. A drill chuck is mounted over it. A drill head can slide up and down as per the requirement of the job.

Feed Mechanism:

In a drill machine, we use an electric motor, V-belt, and pulley to transfer the power from the motor to the spindle**.** For the up and down motion of the drill head, we use hand and as well as automatic feed by an electrical motor. Here also a rack and pinion are used to convert the rotational movement from electrical motor or by hand to the straight-line movement.

Spindle:

It is a circular taper shaft which helps to hold the drill chuck**.** It is made of high carbon chromium steel or stainless steel or steel alloys. It transfers the rotary motion from drill head to drill jigs**.**

Chuck:

The chuck is mounted on the lower end of the spindle, it holds the drill jig**.** Here also a keyhole is provided to change the drill jigs. Drill chucks are generally self-centering**.** In a drill machine, we use three-jaw chuck**.** And it is made of special alloy steel.

Electric Motor:

In a drilling machine, we use a single-phase ac motor. Which can run at an rpm of 600-5000, or maybe more for high duty drilling machine.

Pully or gears:

Pully or gears is used to transmit power and also for getting different speed. In a drilling machine, we use bevel gear to transmit power at an angle of 90 degrees.

Drilling Machine Types:

Some of the popular types of drilling machines.

- Sensitive Drilling Machine
- Vertical or Pillar
- Radial Arm
- Gang Type
- Multi-Spindle
- Numerically control
- Special Purpose Drilling Machine

Different types of drills are

1. Flat Drill
2. Straight fluted drill
3. Twist drill
4. Centre drill

Twist drills are the type generally used in shop work. They are made of High speed steel (HSS) or High carbon steel.

There are two types of twist drills namely

(i) Straight shank twist drill and

(ii) Taper shank twist drill.

The diameter of the straight shank drill ranges from 2 to 16mm. Taper shanks is provided on drills of larger diameter.

TWIST DRILL NOMENCLATURE

Axis: - It is the longitudinal centreline of the drill running through the centres of the tang and the chisel edge.

Body: - It is the part of the drill from its extreme point to the commencement of the neck, if present. Otherwise, it is the part extending up to the commencement of the shank. Helical grooves are cut on the body of the drill.

Shank: - It is the part of the drill by which it is held and driven. It is found just above the body of the drill. The shank may be straight or taper. The shank of the drill can be fitted directly into the spindle or by a tool holding device.

Tang: - The flattened end of the taper shank is known as tang. It is meant to fit into a slot in the spindle or socket. It ensures a positive drive of the drill.

Neck: - It is the part of the drill, which is diametrically undercut between the body and the shank of the drill. The size of the drill is marked on the neck.

Point: - It is the sharpened end of the drill. It is shaped to produce lips, faces, flanks and chisel edge.

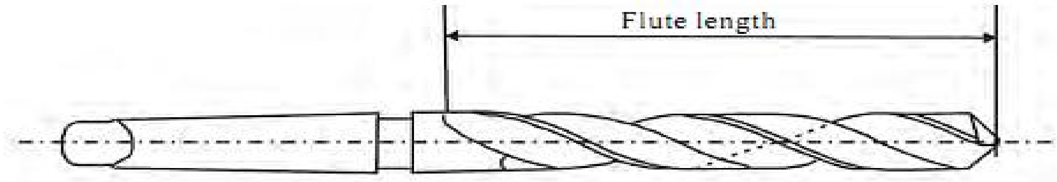
Lip: - It is the edge formed by the intersection of flank and face. There are two lips and both of them should be of equal length. Both lips should be at the same angle of inclination with the axis (59°).

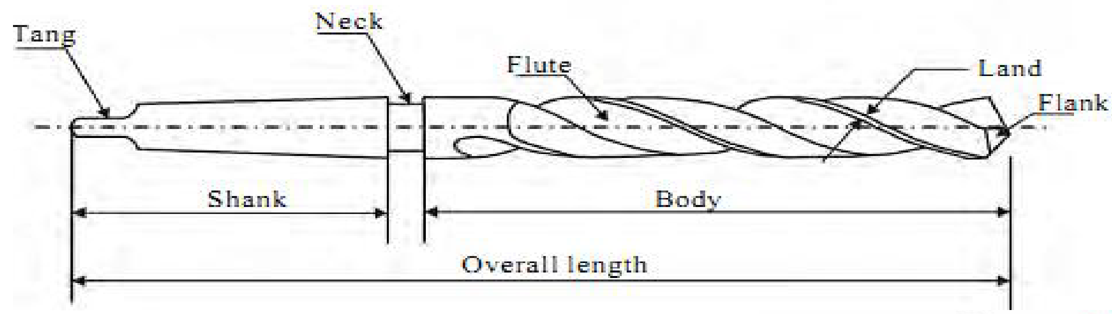
Land: - It is the cylindrically ground surface on the leading edges of the drill flutes adjacent to the body clearance surface. The alignment of the drill is maintained by the land. The hole is maintained straight and to the right size.

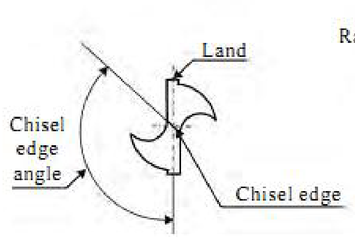
Flutes: - The grooves in the body of the drill are known as flutes. Flutes form the cutting edges on the point. It allows the chips to escape and make them curl. It permits the cutting fluid to reach the cutting edges.

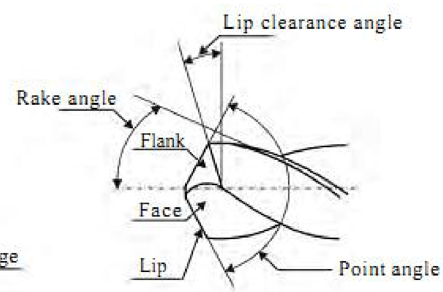
Chisel edge angle: - The obtuse angle included between the chisel edge and the lip as viewed from the end of the drill. It usually ranges from 120° to 135°.

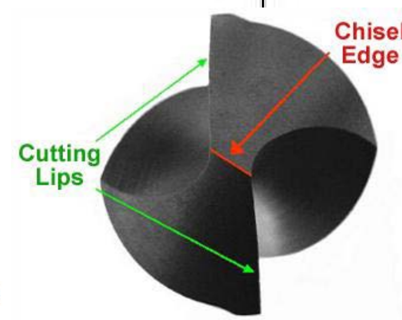
Point angle: - This is the angle included between the two lips projected upon a plane parallel to the drill axis and parallel to the two cutting lips. The usual point angle is 118°. When hard alloys are drilled the value increases.











BASIC FORMULA FOR DRILLING OPERATION

Cutting speed: - Speed in general refers to the distance a point travels in a particular period of time. The cutting speed in a drilling operation refers to the peripheral speed of a point on the cutting edge of the drill. It is usually expressed in meters per minute. The cutting speed (v) may be calculated as

Cutting speed (V) = $\boldsymbol{\pi d n / 1000}$ meter per minute

Where ‘d’ - is the diameter of the drill in mm, and

‘n’ - is the speed of the drill spindle in r.p.m.

The cutting speed of a drill depends, as in other machining processes, upon several factors like the cutting tool material, the kind of material being drilled, the quality of surface finish desired, the method of holding the work, the size, type and rigidity of the machine.

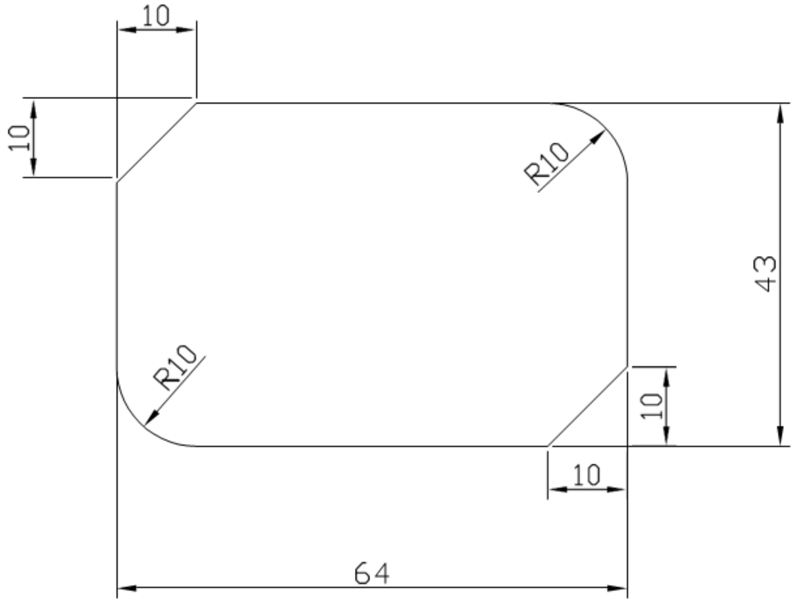
Feed: - The feed of a drill is the distance the drill moves into the work at each revolution of the spindle. It is expressed in millimeters. The feed may also be expressed as feed per minute. The feed per minute may be defined as the axial distance moved by the drill into the work per minute. Feed depends upon factors like the material to be drilled, the rigidity of the machine, power, depth of the hole and the type of finish required.

Depth of cut: - The depth of cut in drilling is equal to one half of the drill diameter. If‘d’ is the diameter of the drill, the depth of cut (t) t = d/2 mm.

EXPERIMENT NO: 6

AIM: To perform drilling operation in a given mid steel specimen.

MATERIALS REQUIRED: Mild steel flat (43 × 64 × 3 mm).



TOOLS AND EQUIPMENT REQUIRED:

1.6”try square
2. 6”sriber
3. Steel Rule
4. Punch
5. Hammer
6. Drilling tool

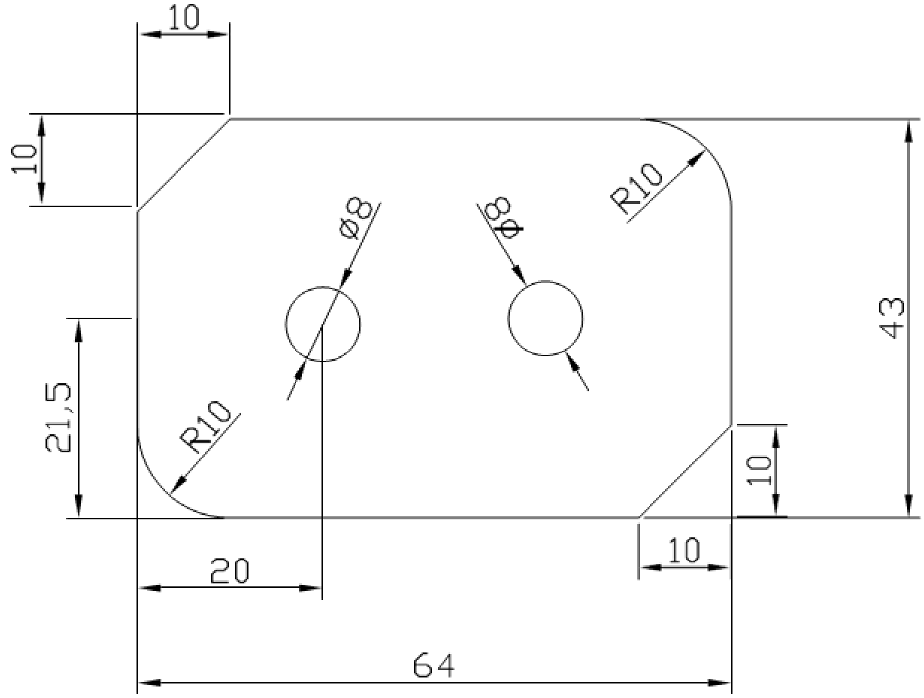
SEQUENCE OF OPERATIONS:

1. Marking
2. Punching
3. Drilling
3. Finishing

PROCEDURE:

1) First, the work piece is marked with a centre punch at the centre of the hole to be drilled.
2) It is then held firmly in a vice or other suitable clamping device and placed on the table of the drilling machine.
3) The socket containing the drill is fitted in the machine spindle.
4) The spindle is lowered by the hand lever and it is ensured that the point of the drill is in exact alignment with the previously marked centre of the hole.
5) The motor is now started and the rotating drill is gradually pressed into the work piece to produce the desired hole.

FINAL SHAPE OF THE WORK PIECE



PRECAUTIONS:

1. The work should not be held by hand in any case.
2. Proper work-holding device should be used to hold the work. If the work is not held properly, the work tends to rotate along with the drill causing injury to the operator and damage to the cutting tool.
3. Care should be taken to ensure that the belt and gears are connected properly.
4. The machine should not be left running unattended.
6. A brush should be used to clean chips off the machine.
7. In order to avoid spoiling the cutting edge of the drill, coolant such as oil or soap water should be used continuously during the drilling operation.

RESULT: The drilling operation is done successfully

EXPERIMENT NO: 7
AIM: Study of Internal Thread cutting by using Taps
THEORY:

Tapping has been defined as: A process for producing internal threads using a tool (tap) that has teeth on its periphery to cut threads in a predrilled hole. A combined rotary and axial relative motion between tap and work piece forms threads.

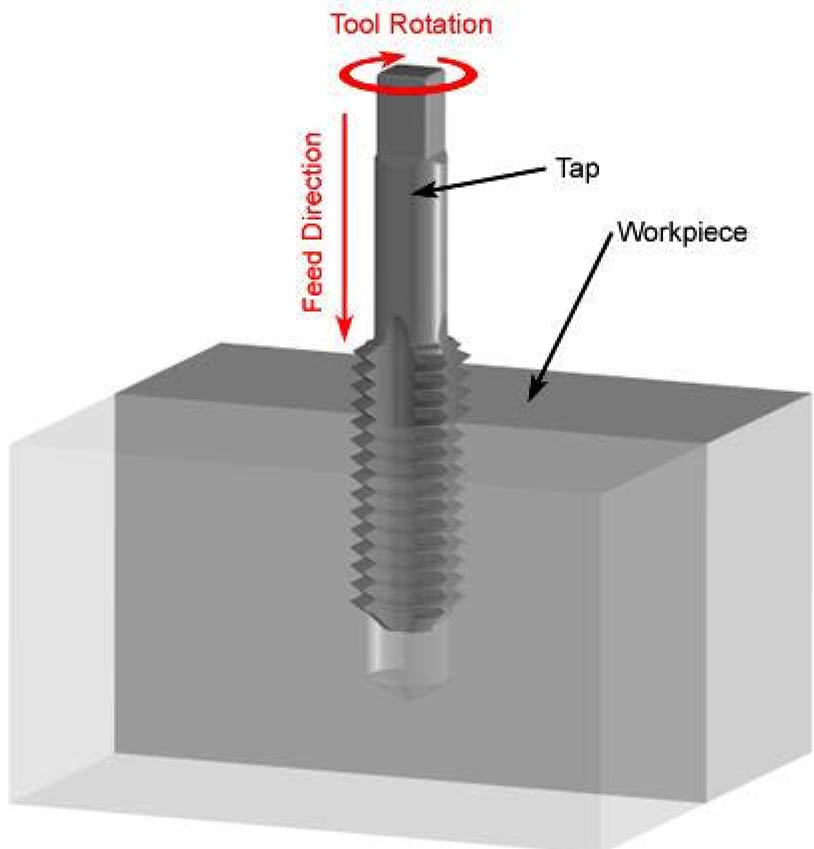


Figure: *Working Principle of tapping*

Screw threads are used for a variety of purposes and applications in the machine tool industry. They are used to hold or fasten parts together (screws, bolts and nuts), and to transmit motion (the lead screw moves the carriage on an engine lathe Screw threads are also used to control or provide accurate movement (the spindle on a micrometer), and to provide a mechanical advantage (a screw jack raises heavy loads).

When defining a screw thread, one must consider separate definitions for an external thread (screw or bolt) and an internal thread (nut).

An **external thread** is a cylindrical piece of material that has a uniform helical groove cut or formed around it.

An **internal thread** is defined as a piece of material that has a helical groove around the interior of a cylindrical hole.

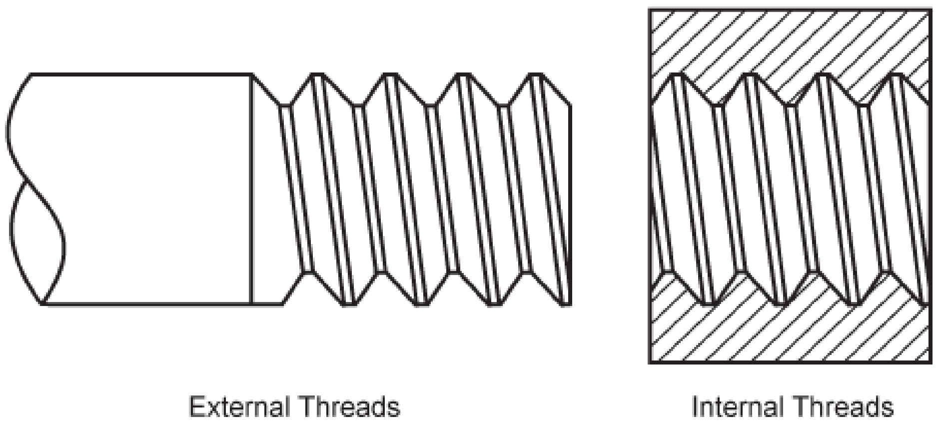
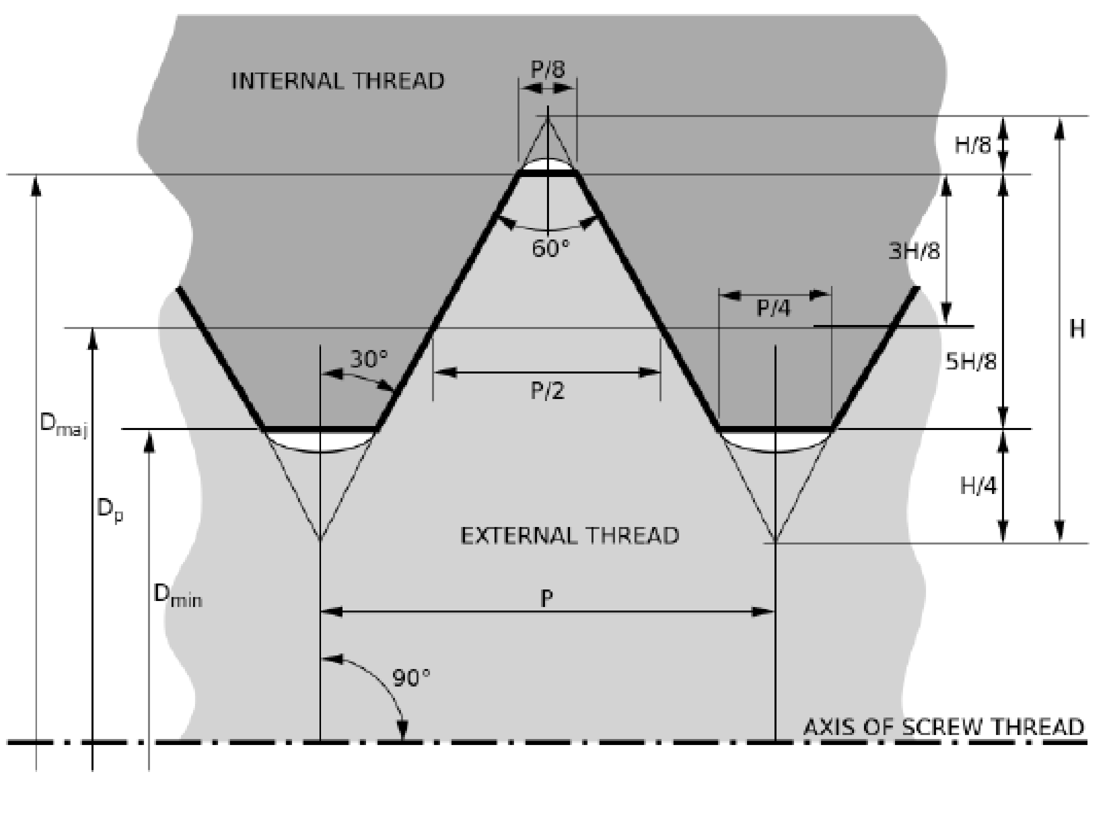


Figure: ***Shows a nut and bolt having internal and external threads respectively***

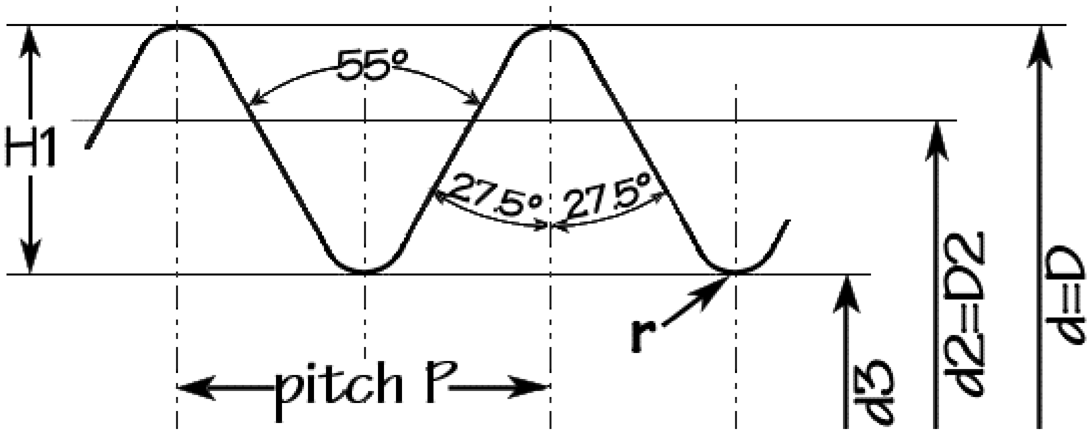
TYPES OF THREADS

Two very popular types of threads have been shown below:

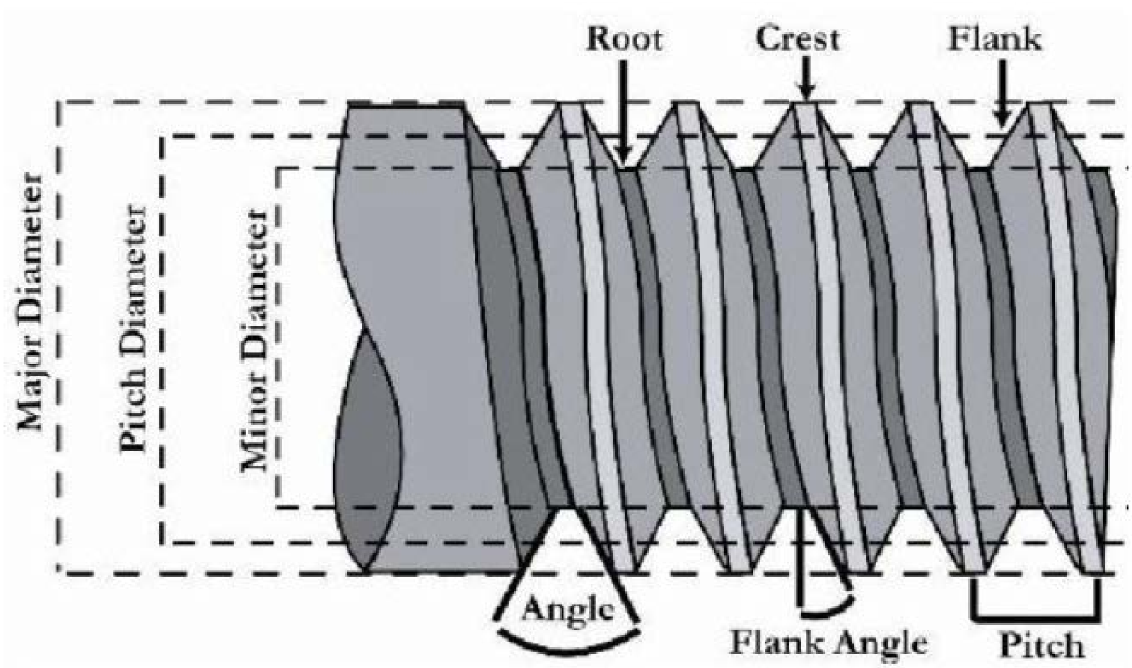
1. ISO (International Organization for Standardization) threads form



2. BSW (British Standard Whitworth) threads form



STANDARD NOMENCLATURE FOR SCREW THREAD ELEMENTS



Major diameter: Is the largest of External or Internal Thread. The screws are generally specified by this diameter. It is also known as nominal or outside diameter.

Minor diameter: It is the smallest diameter of External or Internal thread. It is also known as core or root diameter

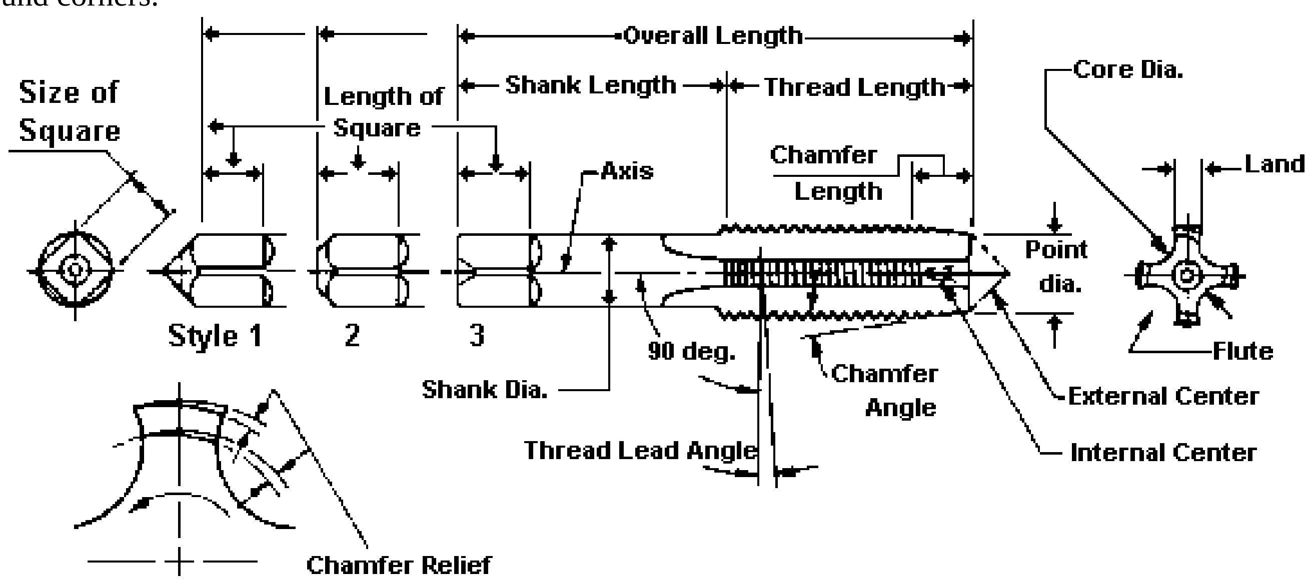
Pitch diameter: It is the mean or effective diameter which is same for External and Internal threads.

Pitch: It is distance from a point on one thread to the corresponding point on next thread.

Tap Nomenclature

Screw threads have many dimensions. It is important in modern manufacturing to have a working knowledge of screw thread terminology. A "right-hand thread" is a screw thread that requires right-hand or clockwise rotation to tighten it. "Thread fit" is the range of tightness or looseness between external and internal mating threads. "Thread series" are groups of diameter and pitch combinations that are distinguished from each other by the number of threads per inch applied to a specific diameter.

Chamfer: Chamfer is the tapering of the threads at the front end of each land of a chaser, tap, or die by cutting away and relieving the crest of the first few teeth to distribute the cutting action over several teeth.
Flank: Flank is the part of a helical thread surface which connects the crest and the root, and which is theoretically a straight line in an axial plane section.
Flute: Flute is the longitudinal channel formed in a tap to create cutting edges on the thread profile and to provide chip spaces and cutting fluid passage.
Crest: Crest is the surface of the thread which joins the flanks of the thread and is farthest from the cylinder or cone from which the thread projects.
Land: The land is one of the threaded sections between the flutes of a tap.
Lead of thread: The lead of thread is the distance a screw thread advances axially in one complete turn. On a single start tap, the lead and pitch are identical. On a multiple start tap the lead is the multiple of the pitch.
Major diameter: This is the diameter of the major cylinder or cone, at a given position on the axis that bounds the crests of an external thread or the roots of an internal thread.
Minor diameter: Minor diameter is the diameter of the minor cylinder or cone, at a given position on the axis that bounds the roots of an external thread or the crests of an internal thread.
Pitch diameter: Pitch diameter is the diameter of an imaginary cylinder or cone, at a given point on the axis of such a diameter and location of its axis, that its surface would pass through the thread in a manner such as to make the thread ridge and the thread groove equal and, as such, is located equidistant between the sharp major and minor cylinders or cones of a given thread form. On a theoretically perfect thread, these widths are equal to one half of the basic pitch (measured parallel to the axis).
Square: Square is the four driving flats parallel to the axis on a tap shank forming a square or square with round corners.

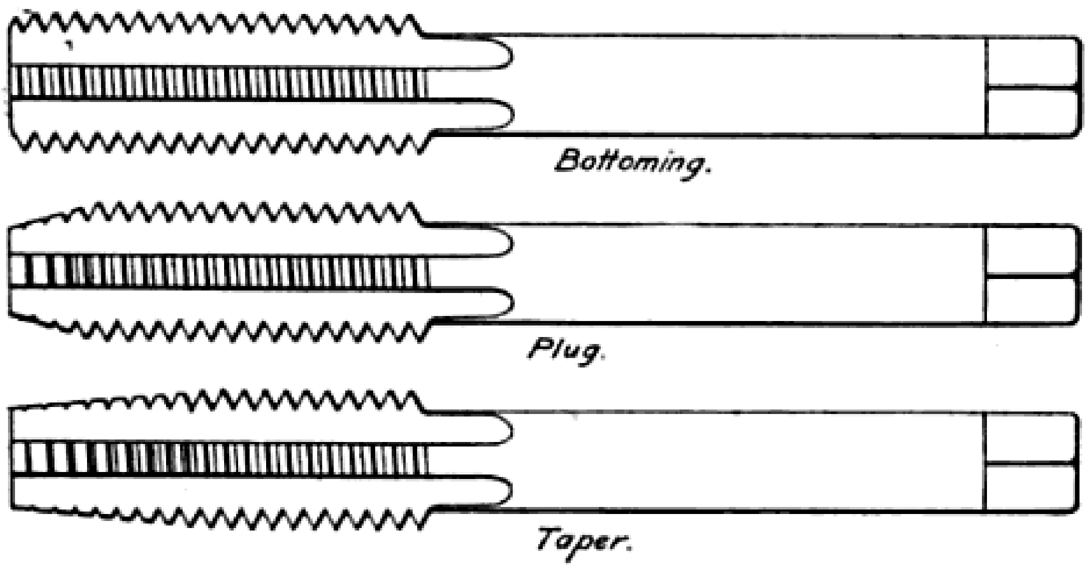


- **Taps come in three basic configurations -Taper, Plug or intermediate and Bottoming.**

TAPER TAPS: - It has the first 7 – 10 threads at the tip ground flatter than the main body of the tap to enable easy starting of the threads in the hole. Sometimes called a starter tap, taper taps can be used to start the thread in a blind hole for another tap to finish or used to cut threads all the way on a through hole.

PLUG TAPS: - Plug taps are like taper taps in that they have tapered threads at the starting end of the tap, the difference is there are fewer of them, usually the first 3-5 threads, so you get to cut a full thread sooner. Although not as easy to start as a taper tap, they can be used to start a thread. If you can only buy one type of tap, and you're a patient user, plug taps can be a good choice because they are still easy to start, but they can also form complete threads deeper into a blind hole than a taper tap.

BOTTOMING TAPS: - It has no ground threads at the starting end and is generally used after, and in conjunction with a taper or plug tap. Bottom taps can cut threads to the bottom of blind holes although they do not do well at starting threads.



EXPERIMENT NO: 8

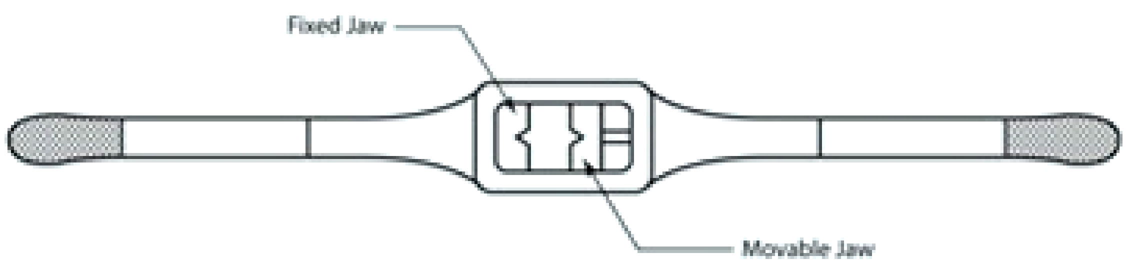
AIM: To perform the tapping operation to the given mid steel pieces.

MATERIALS REQUIRED: mild steel flat (43 × 64 × 3 mm).

TOOLS AND EQUIPMENT REQUIRED:

1. Tapping tool
2. Tap wrench
3. Oil (Mobil)
4. File

LINE DIAGRAM OF TAP WRENCH



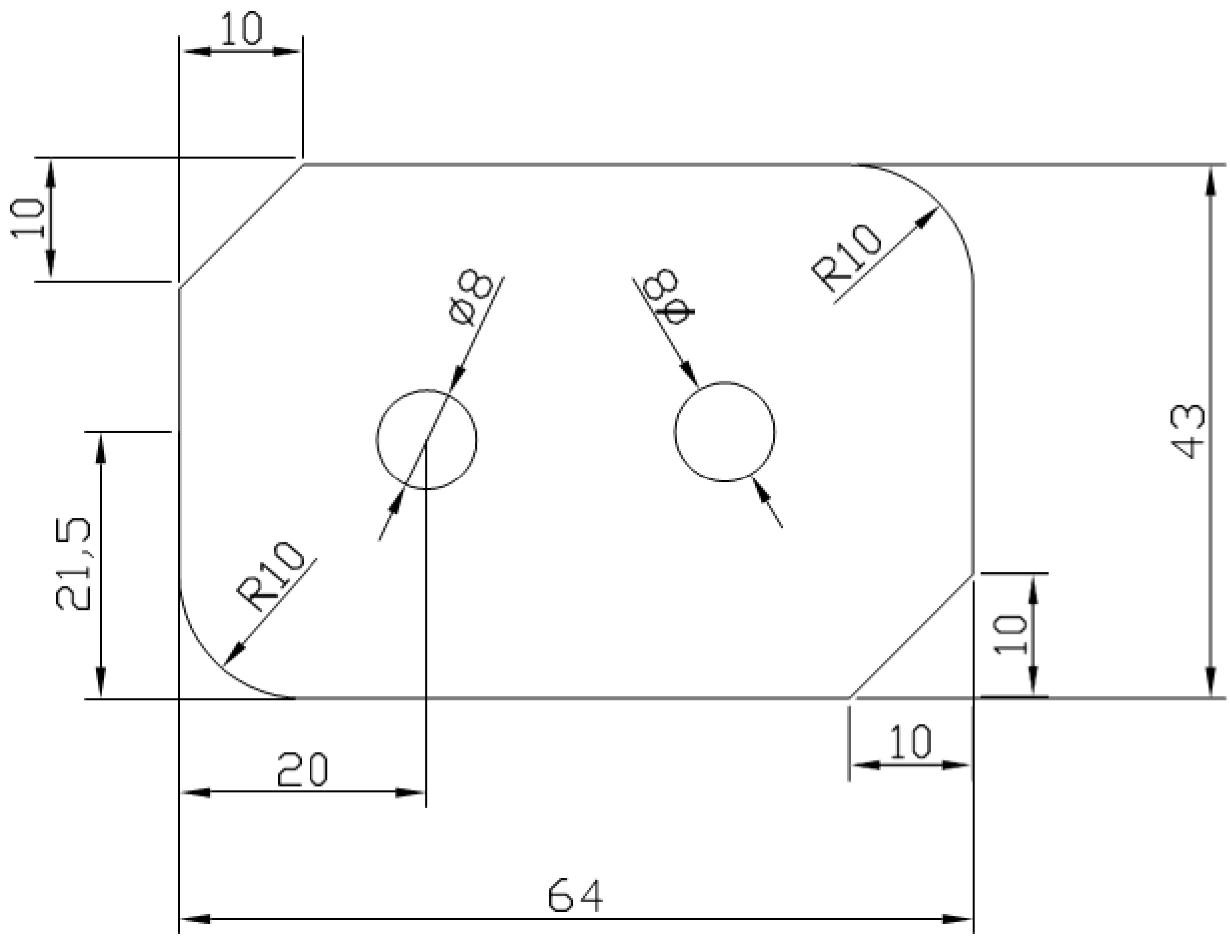
SEQUENCE OF OPERATIONS:

1. Oiling
2. Tapping
3. Finishing

PROCEDURE:

1. Hold the work piece properly on bench vice.
2. Put the oil on the drill hole.
3. Create internal thread using tap by twisting by hand.
4. Finish surface by filling process.

WORK PIECE AFTER DRILLING: -



FINAL SHAPE OF THE WORK PIECE: -

This Drawing will be made by you

PRECAUTIONS:

1. The work should not be held by hand in any case.
2. Proper work holding device should be used to hold the work.
3. Use a brush instead of your hands to clean chips.
4. Proper chose of tap.

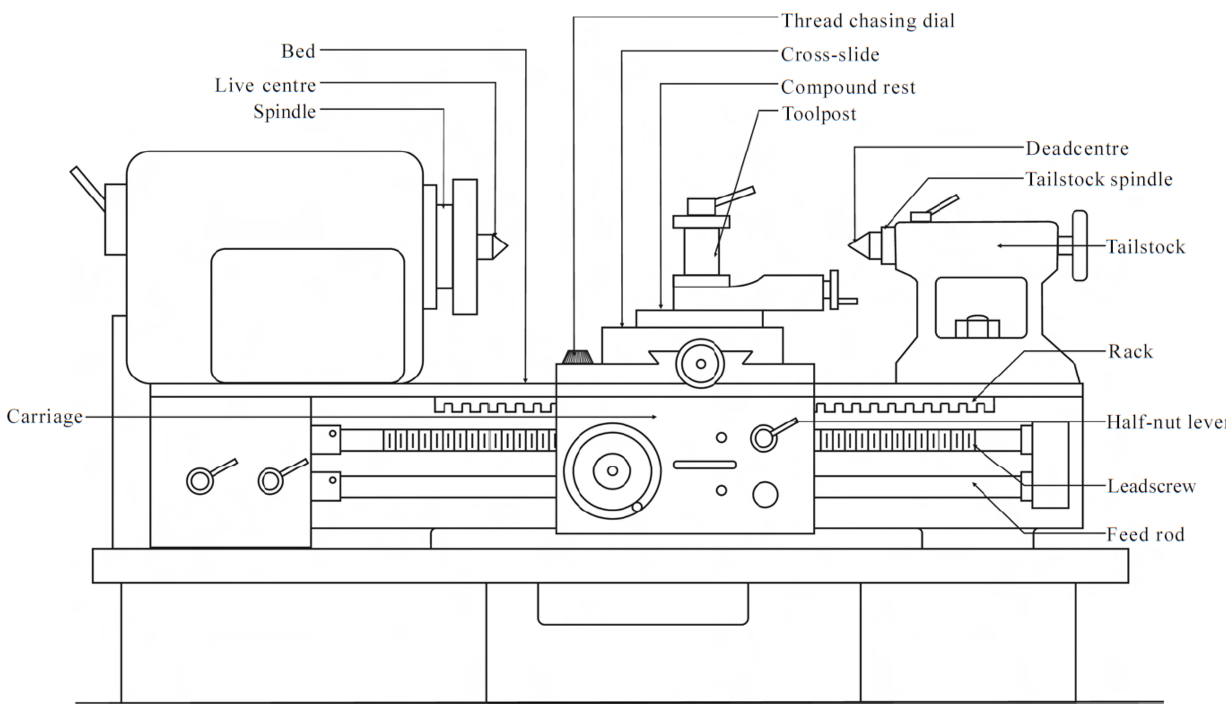
RESULT: The tapping operation is done successfully

EXPERIMENT No: - 9
AIM: Study of Lathe Machine
THEORY:
Introduction

A **lathe** is a machine tool which rotates the work piece on its axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation with tools that are applied to the work piece to create an object which has symmetry about an axis of rotation.

Lathe size is determined by two measurements: (1) the diameter of work it will swing (turn) over the ways and (2) the length of the bed. For example, a 14-inch by 6-foot lathe will swing work up to 14 inches in diameter and has a bed that is 6 feet long.

Principal Parts



The Bed: The lathe bed is a mounting and aligning surface for the other machine components. Viewed from the operating position in front of the machine, the headstock is mounted on the left end of the bed and the tailstock on the right. The bed must be bolted to a base to provide a rigid and stable platform. The bed ways are a precision surface (or surfaces) on which the carriage slides left and right during machining operations. The ways are machined straight and flat and are either bolted to the top of the bed or are an integrally machined part of the bed.

Headstock: The headstock holds the spindle and drive mechanism for turning the work piece. The spindle is a precision shaft and bearing arrangement rotated directly by a motor or through a motor-driven belt. Gears or sliding pulleys mounted at the rear of the headstock allow spindle speed adjustment. A work piece is held in the spindle for turning or drilling by a jawed chuck or a spring collets system. Large, unusual shaped, or otherwise difficult to hold pieces, can be attached to the spindle with a face plate, drive dogs and special clamps.

Tailstock: The tailstock supports long work that would otherwise sag or flex too much to allow for accurate machining. Without a tailstock, long pieces cannot be turned straight and will invariably have a taper. Some tailstocks can be intentionally misaligned to accurately cut a taper if needed. The tailstock has a centering device pressed into a shallow, specially drilled hole in the end of the work piece. The center can be either "live" or "dead." Live centers have a bearing, allowing the center to rotate along with the work piece. Dead centers do not rotate and must be lubricated to prevent overheating due to friction with the work piece. Instead of a center, a drill chuck can be mounted in the tailstock.

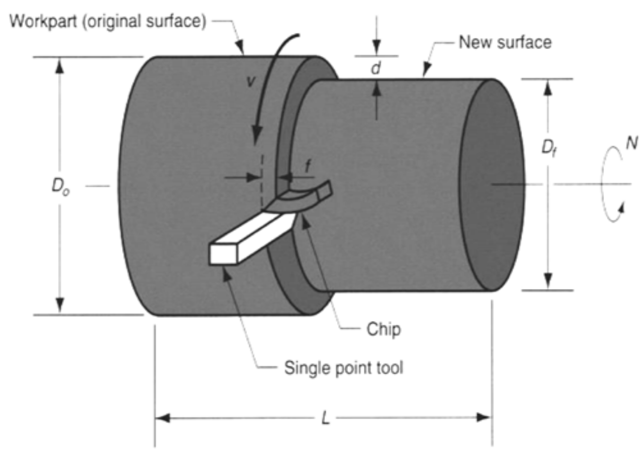
Carriage: The carriage provides mounting and motion control components for tooling. The carriage moves left and right, either through manual operation of a hand wheel, or it can be driven by a lead screw. At the base of a carriage is a saddle that mates and aligns with the bed ways. The cross-slide, compound rest and tool holder are mounted to the top of the carriage. Some carriages are equipped with a rotating turret to allow a variety of tools to be used in succession for multi-step operations.

Cross Slide: The cross-slide is mounted to the top of the carriage to provide movement perpendicular to the length of the bed for facing cuts. An additional motion assembly, the compound rest, with an adjustable angle, is often added to the top of the cross slide for angular cuts. The cutting tools that do the actual metal removal during turning are mounted in an adjustable tool holder clamped to the compound rest.

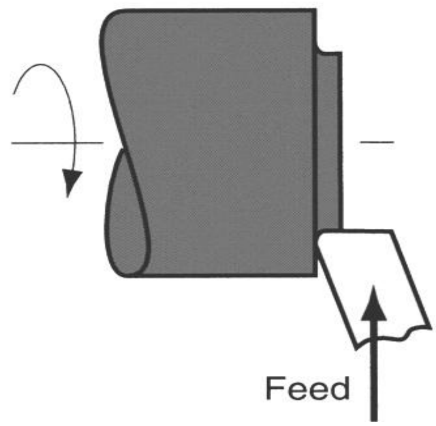
Lead Screw: The lead screw provides automatic feed and makes thread cutting possible. It is a precision-threaded shaft, driven by gears as the headstock turns. It passes through the front of the carriage apron and is supported at the tailstock end by a bearing bracket. Controls in the apron engage a lead nut to drive the carriage as the lead screw turns.

Lathe Operations

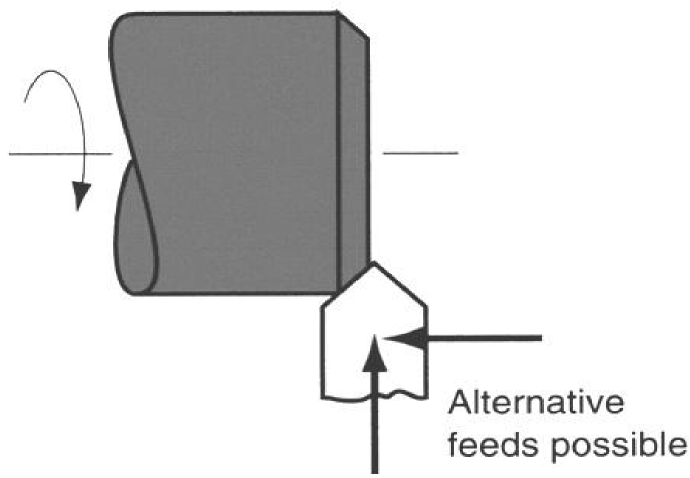
Turning: produce straight, conical, curved, or grooved work pieces



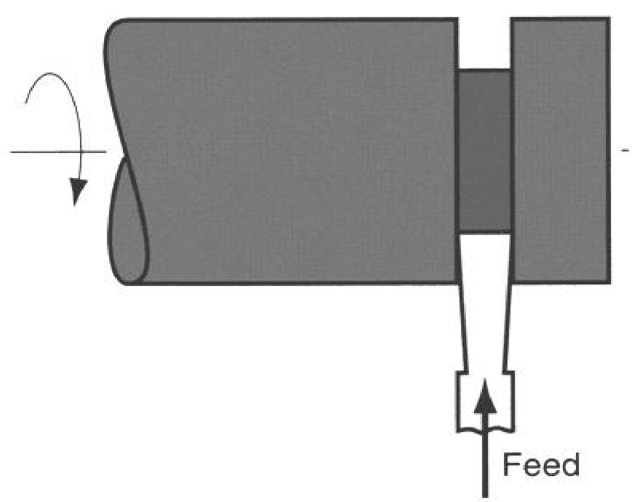
Facing: to produce a flat surface at the end of the part or for making face grooves.



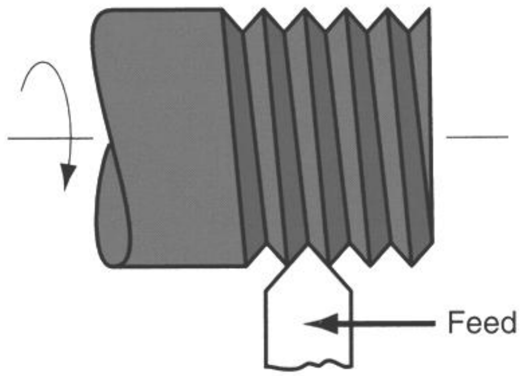
Chamfering: Cutting edge cuts an angle on the corner of the cylinder, forming a chamfer.



Parting (Cut off) / Grooving: Tool is fed radially into rotating work at some location to cut off end of part, or provide a groove.



Threading: Pointed form tool is fed linearly across surface of rotating work part parallel to axis of rotation at a large feed rate, thus creating threads.

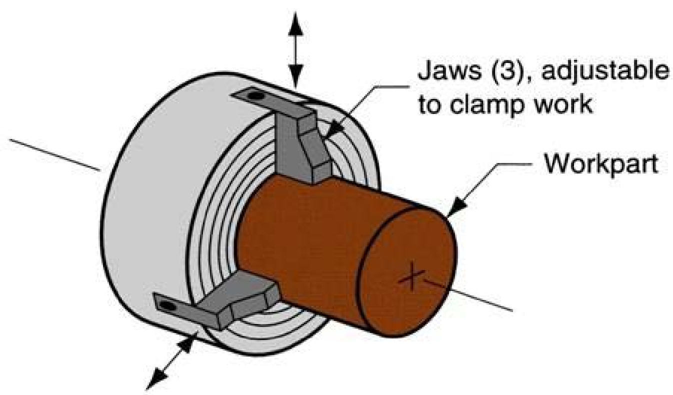


Work Holding Devices

There are many devices, which serve for clamping the work pieces. The most common ones are:

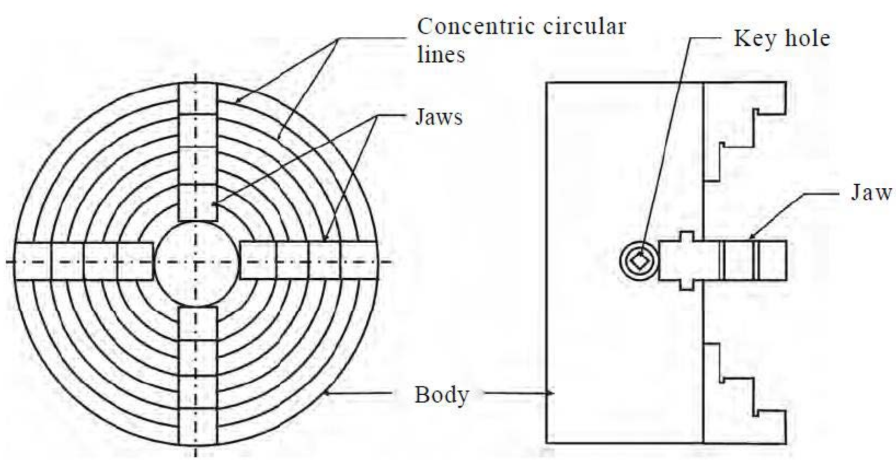
3-Jaw Chuck – Self Centering:

With self-centering chucks all jaws maintain one common center when they are moved. When the self-centering chuck is mounted on the spindle nose of the lathe, the centerline of the lathe axis and the chuck are identical. With a 3-jaw chuck round regular their sided, regular six sided work pieces are clamped centrally.



4 – Jaw Independent Chuck:

A screw moves each jaw without influencing the position of any other jaw. So work pieces can be clamped centrally or eccentrically. With the independent chuck round, square, rectangular work pieces and work pieces with irregular cross section are clamped.

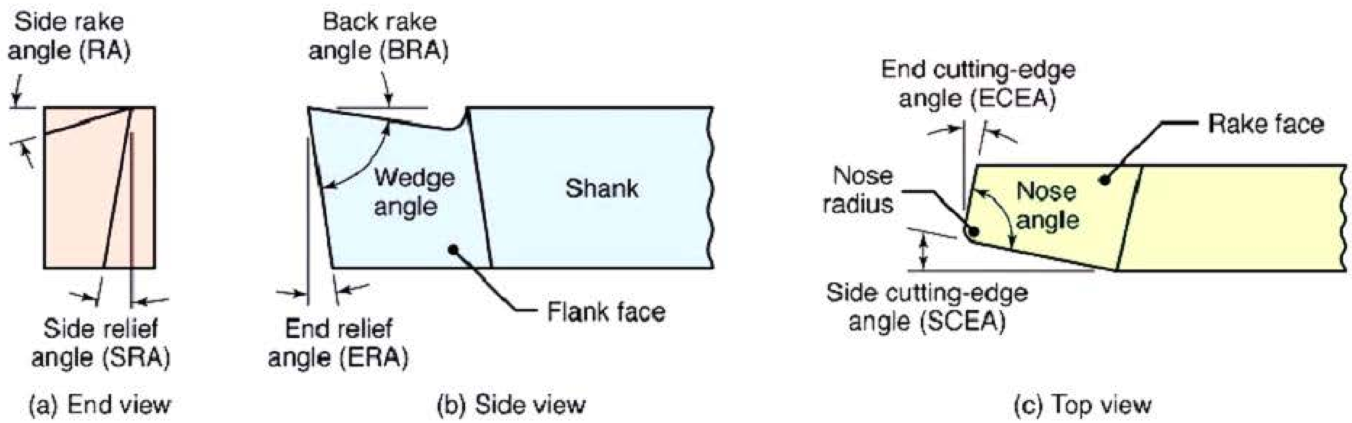


General purpose cutting tools
Single point tool bits

The *shank* is the main body of the tool bit. The *nose* is the part of the tool bit which is shaped to a carbides, ceramics, diamonds; cast alloys are able to machine workplaces at very high speeds but are brittle and expensive point and form the corner between the side cutting edge.

For normal lathe work, high-speed steel tool bits are used. The *nose radius* is the rounded end of the tool bit.

The *face* is the top surface of the tool bit upon which the chips slide as they separate from the work piece. The *side or flank* of the tool bit is the surface just below and adjacent to the cutting edge. The *cutting edge* is the part of the tool bit that actually cuts into the work piece, located behind the nose and adjacent to the side and face. The *base* is the bottom surface of the tool bit, which usually is ground flat during tool bit manufacturing. The end of the tool bit is the near-vertical surface which, with the side of the bit, forms the profile of the bit. The end is the trailing surface of the tool bit when cutting. The *heel* is the portion of the tool bit base immediately below and supporting the face.



Machining Calculations: Turning

Spindle Speed = N (rpm)

v = cutting speed

Do = outer diameter

$$N=\frac{v}{\pi Do}$$

Feed Rate - fr (mm/min -or- in/min)

Machining Time - Tm (min)

L = length of cut

$$Tm=Lfr$$

Material Removal Rate – MRR (mm^3/min -or- in^3/min)

$$MRR = v.\ f.\ d$$

EXPERIMENT No: 10

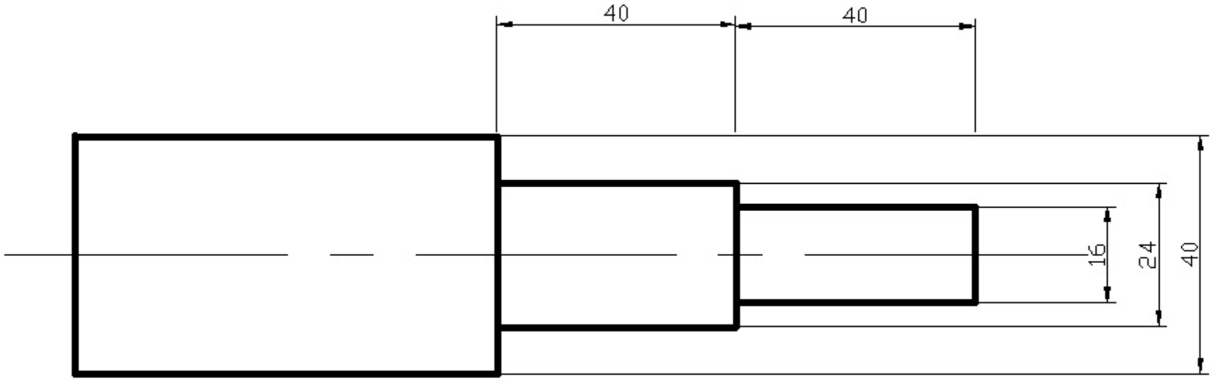
AIM: To perform step turning operations on the given Mild Steel Work piece as per the given drawing

MATERIALS REQUIRED: Mild steel rod (40 mm diameter and 150 mm length).

TOOLS AND EQUIPMENT REQUIRED:

1. Lathe Machine
2. Single Point Cutting Tool
3. Chuck key
4. Tool post key
5. outside Caliper
6. Steel Scale
7. Brush

WORK PIECE DIAGRAM:



PROCEDURE:

1) Using the Outside Calipers the diameter of the given work piece is measured.
2) The work piece is placed in the 3 jaw chuck.
3) The facing operation is carried out on both sides of the work piece
4) Cutting parameters like speed, feed, depth of cut, etc are selected before the machine is turned on.
5) Plain turning operation is carried out for required length of 150mm.
6) Markings are made to perform step turning operation.
7) Step turning operations are made to get the desired shape of the work piece by giving depth of cut on each run
8) Finishing operation is done by giving very small depth of cut (say 0.2mm) on medium feed.

PRECAUTIONS:

1. Correct dress is important, remove rings and watches.
2. Always stop the lathe before making adjustments.
3. Do not change spindle speeds until the lathe comes to a complete stop.
4. Always wear protective eye protection.
5. Never lay tools directly on the lathe ways. If a separate table is not available, use a wide board with a cleat on each side to lay on the ways.

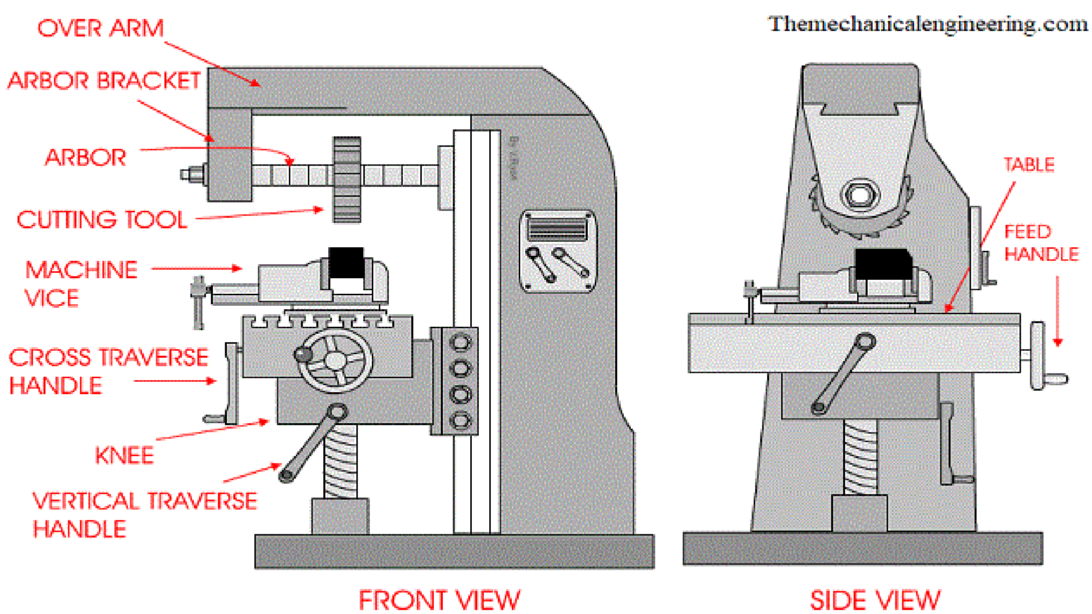
RESULT: The required turning operations are carried out on the given work piece as per the figure given with the dimensional accuracy.

EXPERIMENT No: - 11
AIM: Study of Milling Machine
THEORY:
Introduction

A milling machine is one of the most influential and versatile kinds of machines found in the manufacturing industry. Milling is the most widely used machine used in machine shops and modern manufacturing industries all over the world.

Milling Machine Parts:

- Base
- Column
- Knee
- Saddle
- Table
- Over-Arm
- Spindle or Arbor
- Arbor supports
- Ram
- Milling Head



Base: - The base is the part upon which the whole machine parts are being mounted. It is a type of foundation for the machine. The base is mostly made up of cast iron, so it has good strength and rigidity. It also helps in the absorption of shocks. Cutting fluid can also be stored in the base.

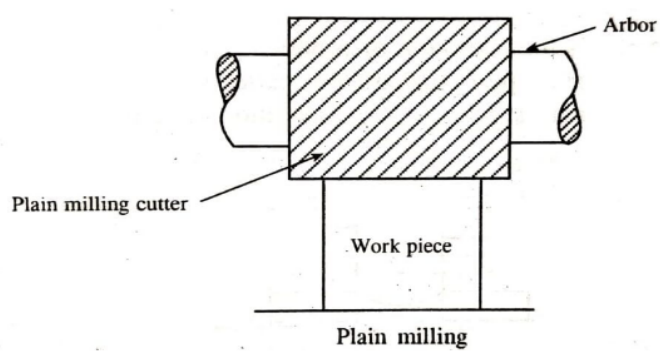
Column: - The main supporting frame which consists of all the driving mechanism and the motor is called the column. The driving mechanism usually consists of a cone pulley mechanism in which the v-belt is being used to connect it to the motor. Further by using this driving mechanism the speed of the machine can control as per our requirement.

Knee: - The knee shape is quite similar to that of the human body knee. The knee is an important part of this machine which supports the other parts like saddle and table. The knee is attached to the column and has guideways by which it can move up and down with the help of the elevating screw for adjusting its height.
Saddle: - The saddle is present on the top of the knee which further carries the table. Its basic function is to support the table. A saddle can slide on the guideways which are exactly at 90 degrees to the column face. Saddle moves crosswise (in or out) on guideways provided on the knee.
Table: - The table is present on the top of the saddle. The table consists of T-slots or sometimes fixtures are used for holding up the workpiece on the table. A table can travel longitudinally in a horizontal plane.
Over-arm: - It is also called as the over-hanging arm. Overarm is present at the top of the column. The basic function of the over-arm is to support the arbor and spindle.
Spindle or Arbor: - The top portion of the column contains the spindle. The spindle is also an important part of the machine as it the part where the multipoint cutter is attached.

Milling Machine Operations:

- Plain Milling or Slab Milling Operation
- UP and DOWN Milling Operation
- Face Milling Operation
- End Milling Operation
- Gang Milling Operation
- Straddle Milling Operation

Plain Milling or Slab Milling Operation: - Plain or slab milling is a process in which the plain, horizontal or flat surfaces are produced, which are parallel to the axis of the rotation of the cutter. A peripheral mill cuter is used for performing the slab milling operation.

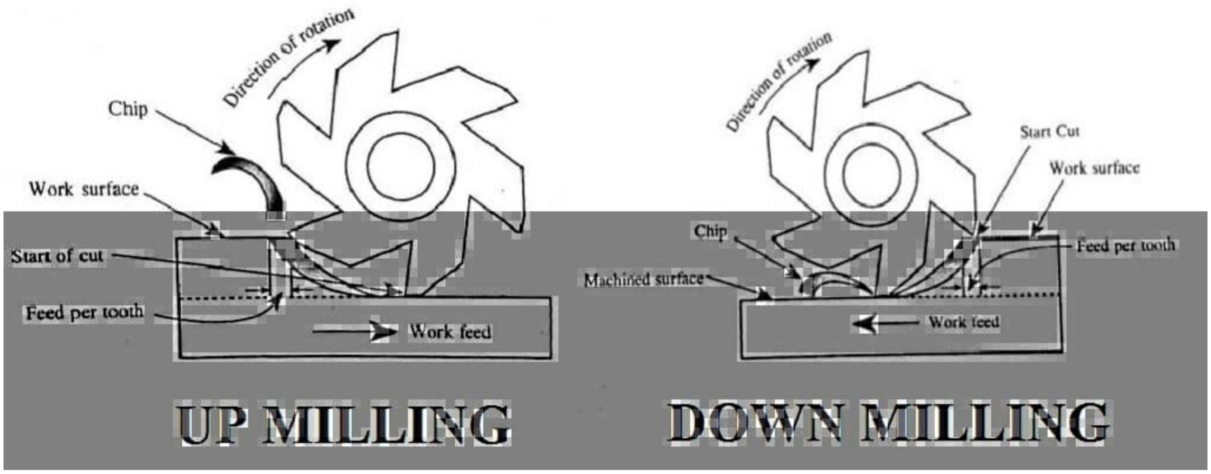


Plain Milling Operation

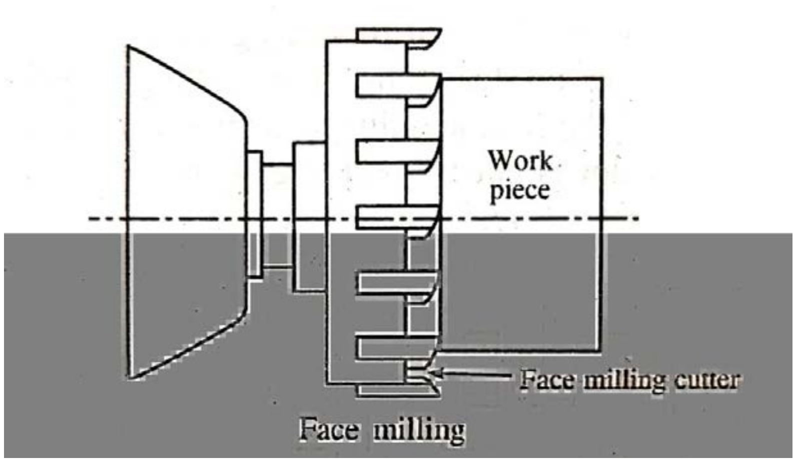
Up Milling and Down Milling:

Up milling is a method of milling operation in which the cutter and the workpiece both moves in the opposite direction.

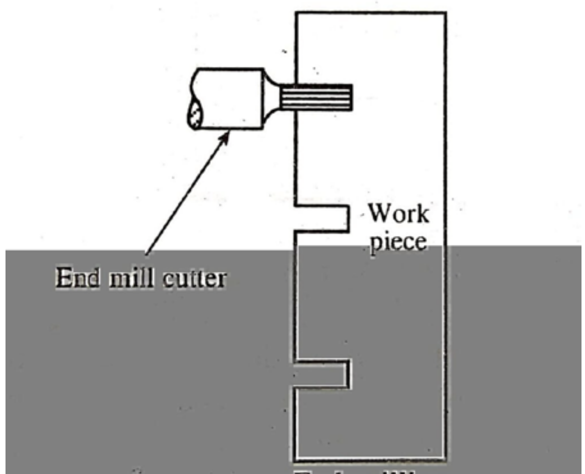
Down Milling is a method of milling operation in which the direction of the rotation of the cutter coincides with the direction of the work feed.



Face Milling Operation:- It is a type of milling operation in which the layer of material is removed from the face of the material. The end milling cutter is preferred for performing face milling operations. In Face Milling operation the teeth for cutting are present on both the periphery and the face of the cutter. The axis of rotation of the cutter is perpendicular to the work surface. In face milling most of the cutting is done by the periphery portions of the teeth, the face portion provides finishing the action.

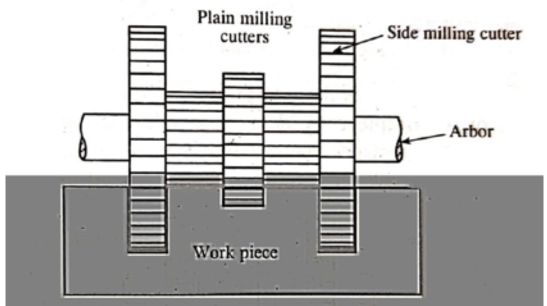


End Milling Operation: - End milling is the combination of the slab milling and face-milling operation and used for creating slots in the workpiece and mostly used for handling the complicated profile.



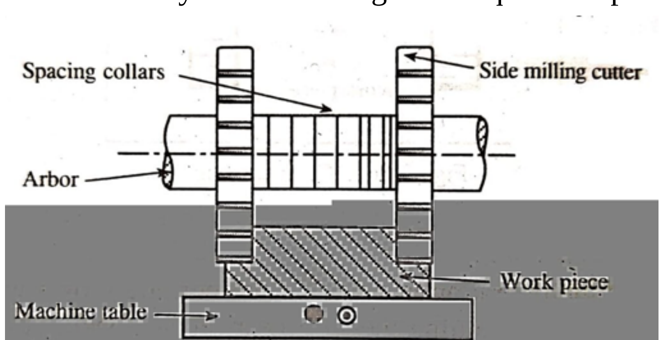
End milling

Gang Milling Operation: - Gang milling is a type of milling operation in which multiple cutters are being mounted on the same arbor to produce the desired shape on the workpiece.



Gang milling

Straddle Milling Operation: - The straddle is the type of milling process in which milling is performed on two surfaces simultaneously. T-slot milling is a unique example of straddle Milling.



Straddle milling

Advantages of Milling Machine:

- High speed
- Better surface finish
- Increase productivity
- High accuracy

EXPERIMENT No - 11

AIM: Study of Shaper Machine

THEORY:

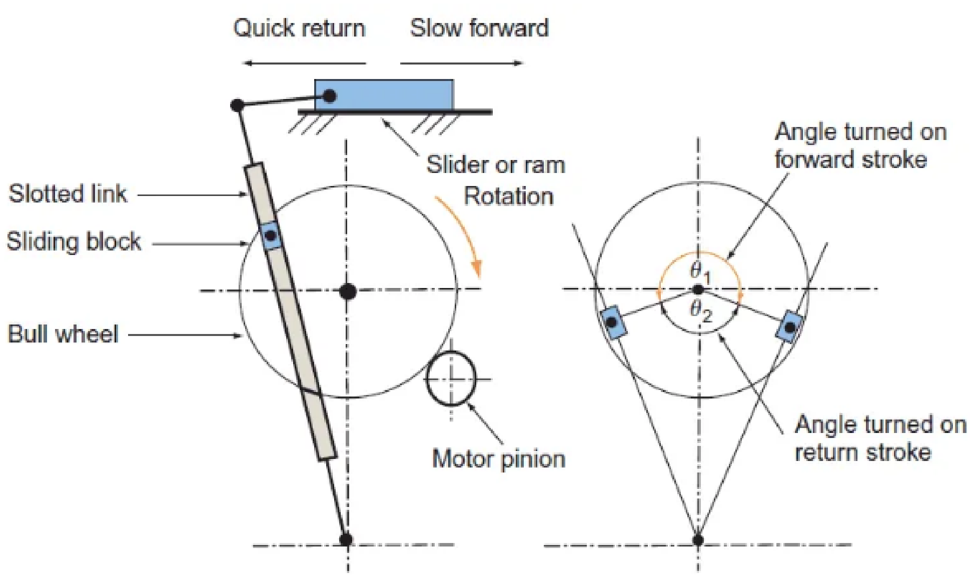
INTRODUCTION: - The Shaper Machine is a reciprocating type of machine tool basically used to produce Horizontal, Vertical or Inclined flat surfaces by means of straight-line reciprocating single-point cutting tools.

Working Principle of Shaper Machine

- A shaper machine holds the Single point cutting tool in ram and workpiece is fixed over the table.
- The ram holding the tool reciprocates over the workpiece and metal is cut during the forward stroke called a cutting stroke and
- No metal is cut during its return stroke is called an Idle stroke.
- The feed is given at the end of the cutting stroke.
- Generally, the cutting stroke is carried out at slow speed and the idle stroke is carried at high speed with the help of quick return mechanism.

Quick return motion mechanism

In the forward stroke, the Slider moves fast and removing the material from the work piece. Whereas in the return stroke, the Slider moves faster than the forward stroke that means Quick return, it takes less time to return, called a return stroke.



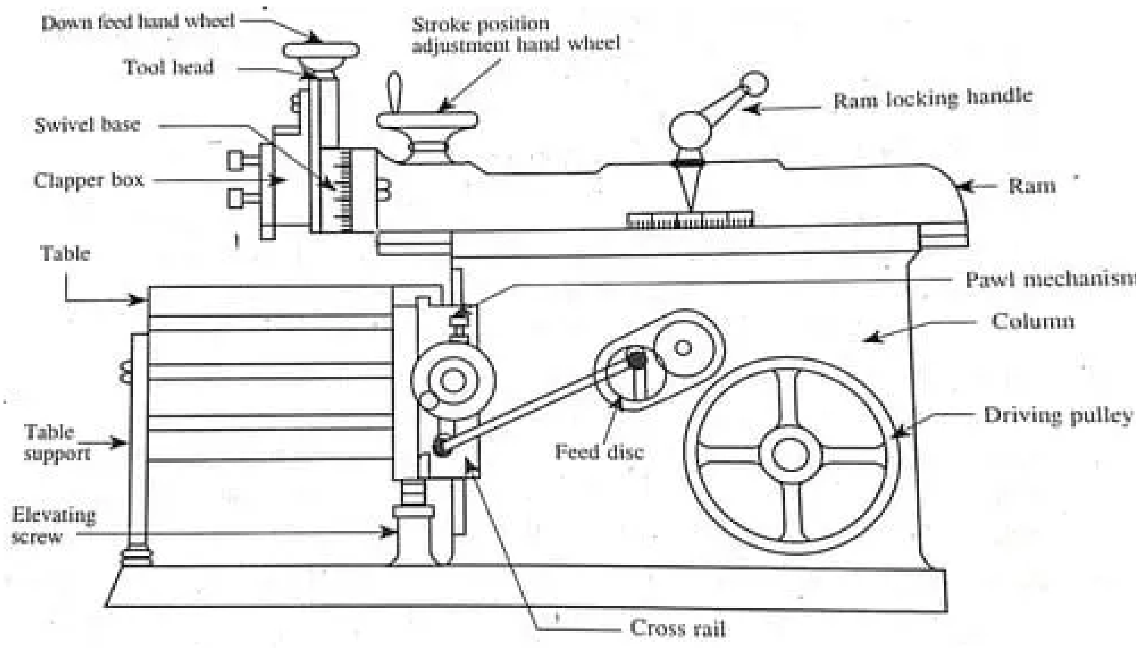
Operations Performed on Shaper Machine:

There are 4-types of operations performed in a shaper machine, and those are:

- Horizontal cutting
- Vertical cutting
- Inclined cutting

- Irregular cutting

Parts of a Shaper Machine with Function:



Shaper

Base: - The Base is designed to take the entire load of the machine tool and it is bolted to the floor of the shop. This is made of grey cast iron to resist vibration and to take the compressive load.

Column: - The column is a Box like casting made up of cast iron and mounted on a base. It is provided with accurately machined guide ways on the top on which the ram reciprocates. The guide ways are also provided on the front vertical face for the movement of cross rail. The column encloses the ram driving mechanism.

Cross rail: - The cross rail is mounted on the ground vertical guide ways of the column. It consists of two parallel guide ways on its top perpendicular to the ram axis is called as a saddle to move the table in crosswise direction by means of a feed screw. The table can be raised or lowered to accommodate different sizes of the job by rotating elevating screw which causes the cross rail to slide up and down on the vertical face of the column.

Saddle: - It is mounted on the cross rail to hold the table firmly on its top. The crosswise movement of the saddle causes the table to move crosswise direction by rotating the cross feed screw.

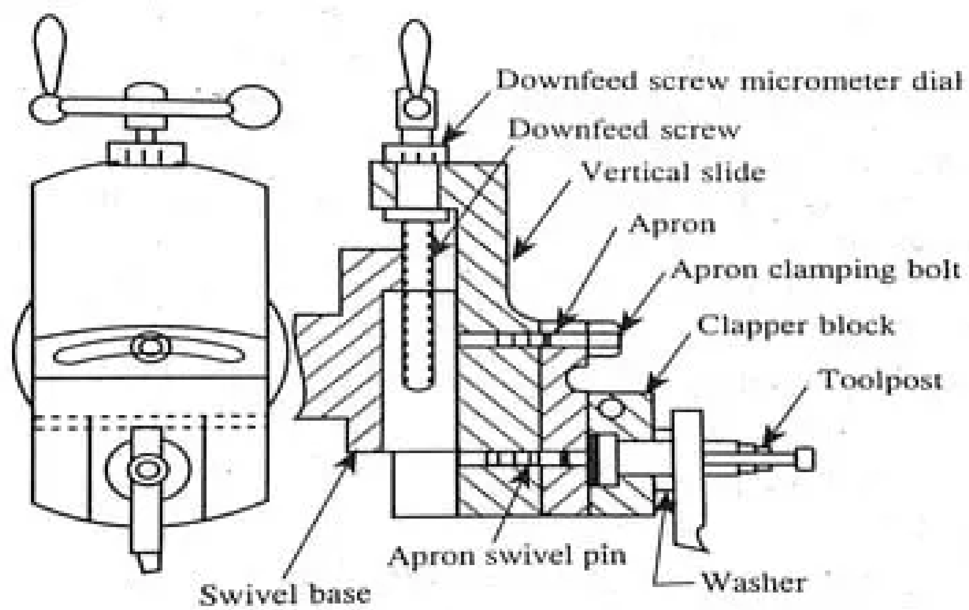
Table: - It is mounted on the saddle. It can be moved crosswise by rotating the cross feed rod and vertically by rotating the elevating screw. The table is a box-like casting with accurately machined top and side surfaces. These surfaces having t-slots for clamping the work. In Universal shaper, the table may be swivelled on a horizontal axis and its upper part may be tilted up or down. In heavy Shaper, the front face of the table is supported by adjustable table support to give more rigidity.

Ram: - It is a reciprocating member of the shaper which holds the tool and the reciprocates on the guide ways on the top of the column by means of quick return motion mechanism. It houses the screwed shaft for altering the position of the RAM with respect to the work. The RAM is in semi-cylindrical form and heavily ribbed inside to make it more rigid.

Tool Head: - The tool head holds the cutting tool firmly and provides both vertical and angular movement to the tool with the help of a down feed screw handle. The head allows the tool to have an automatic relief during the return stroke. The vertical slide of a tool head consists of a swivel base which is graduated in degrees. So, the vertical slide can set at any angle with the work surface. The amount of feed or depth of cut may be adjusted by a micrometer dial on top of the down feed screw.

A tool head again consists of:

- Apron
- Clapper box and clapper block



Toolhead of a shaper

Specification of Shaper Machine:

The specification of shaper machine depends upon the following:

- The maximum length of stroke rams.
- Types of the drive (Crank, Gear and Hydraulic type)
- Power input of the machine
- Floor space required to establish the machine
- Weight of the machine in tonne.
- Feed
- Cutting to return stroke ratio.

- Angular movement of the table.

Advantages of Shaper Machine:

- The single point tool used is inexpensive or we can say low tooling cost.
- The cutting stroke having a definite stopping point.
- The work can be held easily in the shaper machine.
- The setup is very quick and easy and also can be readily changed from one job to another job.

Disadvantages of Shaper Machine:

- By nature, it is a slow machine because of its straight-line forward and returns strokes the single point cutting tool requires Several strokes to complete a work.
- The cutting speed is not usually very high speeds of reciprocating motion due to high inertia force developed in the motion of the units and components of the machine.

Applications of Shaper Machine:

- To generate straight and flat surfaces.
- Smooth rough surfaces.
- Make gear teeth.
- Make key ways in pullies or gears.
- Machining of die, punches, straight and curved slots.

EXPERIMENT No - 12

AIM: Study of Sheet Metal

THEORY:

INTRODUCTION: -A piece of metal that can be formed into a thin sheet is called sheet metal. Sheet metal is one of the basic metalworking that can be trimmed and bent in various shapes. There so many different types of metals that can be formed into a sheet. Some examples are Aluminium, steel, copper, tin, brass etc widely used in industries. Some precious metals such as gold, silver, platinum are also used as sheet metals for special purposes. In our daily life, there are uncountable products we use which are made of sheet metals. Sheet metal is used in Automobiles, Aerospace, Construction and various industries. There are various types of sheet metal operations for making products various. Some basic operations list is below.

1. Blanking
2. Punching
3. Piercing
4. Cut-off
5. Parting off
6. Notching
7. Bending

Let we will discuss the types of sheet metal operations in detail.

Basic Properties of Sheet Metal

Before we read the sheet metal operations in detail, we must have to get familiar with the sheet metal properties. Every metal has unique properties that give it's a unique identity. Like gold has a higher density, that's why it is heavy metal than others. And it is softer than other metals as well. Some metals having the ability to drawn into the wire that metals are known as ductile metals. And this characteristic is known as **Ductility**.

Ductility is a property of material it makes able to drawn into the wire with the application of tensile force. A ductile material must be both strong and plastic. Examples of ductile materials are - Steel, copper, aluminium, tin and lead etc.

Like ductile metals, the ductile materials are rolled or hammered into a thin sheet in some special cases. This property of the material is known as **Malleability**. So, malleability is the property of the material that gives an identity of sheet metal. the sheet metal or malleable material should be plastic but not compulsory to be so strong. And this is the main characteristic of sheet metal.

All sheet metals having basic mechanical properties like Tensile strength, shear and bending strength, compressive, yield strength and hardness.

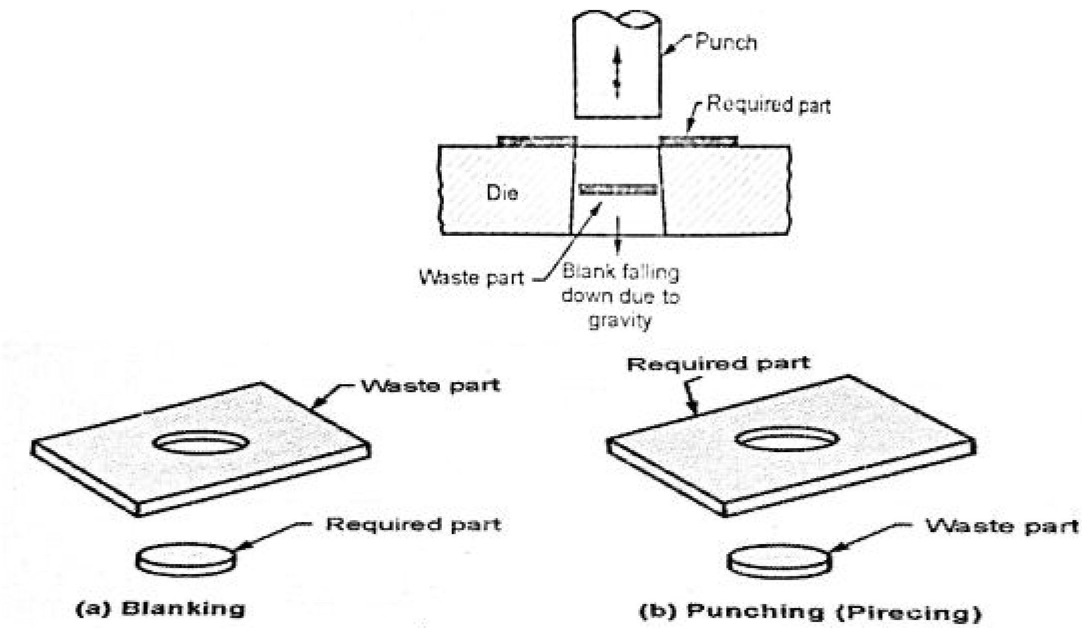
Sheet Metal Operations

1. Blanking:

Blanking is the process of producing flat pieces from a large sheet. Only a small amount of sheet metal will be processed as a finished product or part over the larger sheet area in the blanking process. In this process, enough residue will remain. This process is done with the help of punch and die. The blanking process is used to manufacture various parts in automobiles, such as doors, hoods, lids, BIW components and etc. And in other industries like utensils, jewellery, electrical components etc., the blanking process is used.

2. Punching:

The punching operation is vice versa to blanking. In this operation, extra (scrape) material removes from the raw sheet. This operation also performed with the help of die and punch. But here the punch removes scrap. This process is used to create holes and cutouts in the sheet.



3. Cut-off:

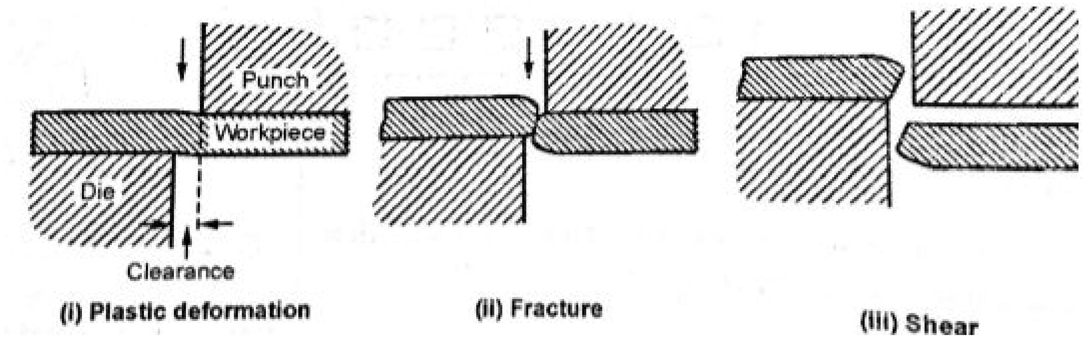
This operation separates the work material along a curve (which may be a straight line or irregular single curve). That's why in the Cut-off operation no scrape will be created. For example, cutting a paper into two pieces using a seizer.

4. Notching:

Notching operation is to cut out a portion of the sheet from its sides. And in semi notching operation metal cutting out from inside of the sheet. Sometimes, notches applied for stress relieving during the bending. So, notches created before the bending operations.

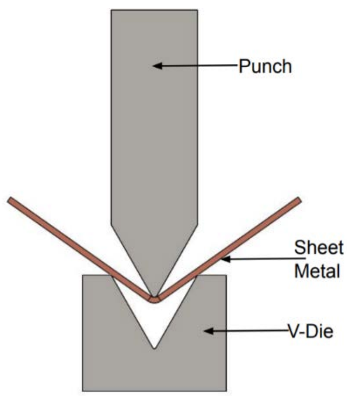
5. Shearing:

Shearing, also known as die cutting, is a process that cuts stock without the formation of chips or the use of burning or melting. Strictly speaking, if the cutting blades are straight the process is called shearing; if the cutting blades are curved then they are shearing-type operations.

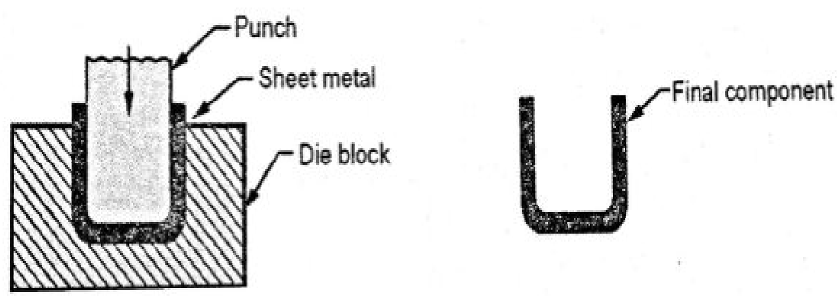


6. Bending:

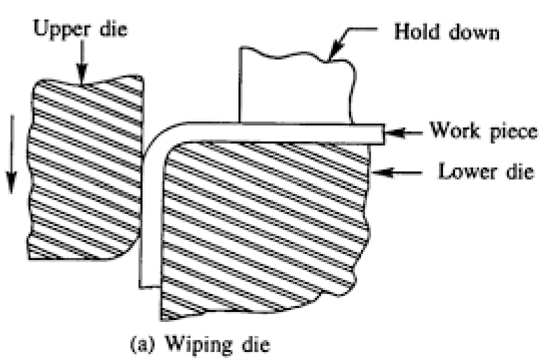
It is a metal forming operation in which the straight metal sheet is transformed into a curved form. In bending operations, the sheet metal is subjected to both tensile and compressive stresses. During the operation, plastic deformation of the material takes place beyond its elastic limit but below its ultimate strength



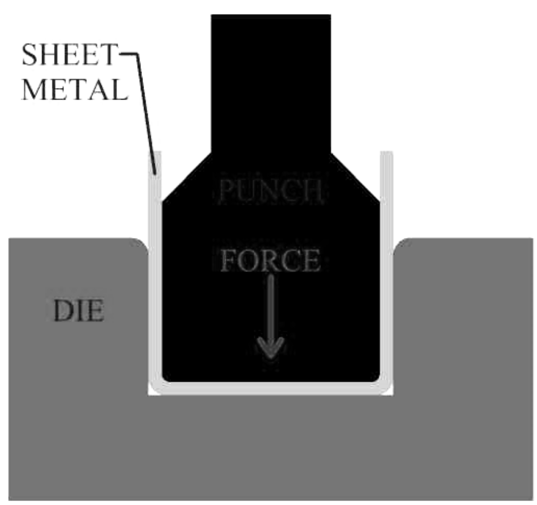
V-Bending



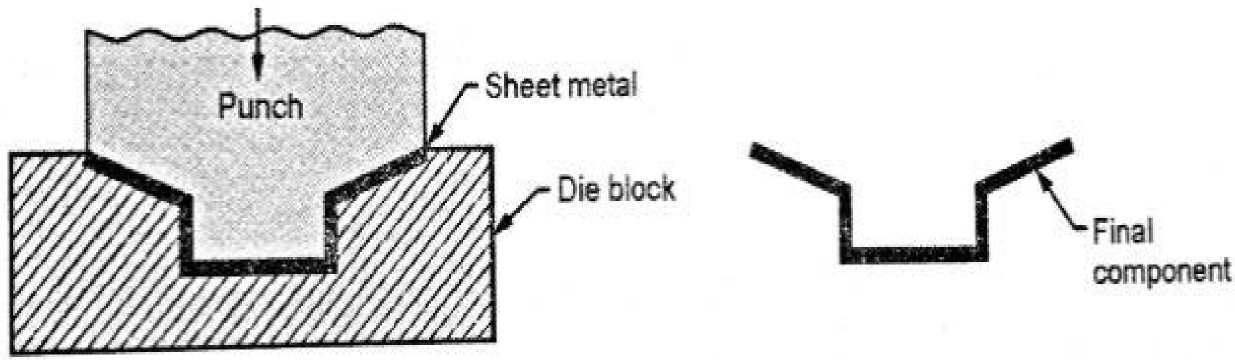
U-Bending



Edge Bending



Channel Bending



Forming