MANUFACTURING PRACTICES LAB

Introduction :

The basic manufacturing practice help students to understand the basic skills required for fitting, welding and machining. Since all engineers must not only know to design products but also have a basic knowledge of how to make them. First year students of all engineering branches are made to undergo manufacturing practices. Students use various tools and instruments to perform fitting, welding and machining exercise. The lab also has drilling, grinding and machines among with sheet metal tools to help the students better understand manufacturing practices.

List of Experiments :

- **i) Experiment 1**
- **ii) Experiment 2**
- **iii) Experiment 3**
- **iv) Experiment 4**
- **v) Experiment 5**
- **vi) Experiment 6**
- **vii) Experiment 7**

Experiment - 1

Theory :

Machine tools are capable of producing work at a faster rate, but there are occasions when components are processed at the bench. Sometimes, it becomes necessary to replace or repair component which must be fitting accurately with another component on reassembly. This involves a certain amount of hand fitting. The assembly of machine tools, jigs, gauges, etc. involves certain amount of bench work. The accuracy of work done depends upon the experience and skill of the fitter.

The term ‘bench work’ refers to the production of components by hand on the bench, whereas fitting deals which the assembly of mating parts, through removal of metal, to obtain the required fit. Both the bench work and fitting requires the use of number of simple hand tools and considerable manual efforts. The operations in the above works consist of filing, chipping, scraping, sawing drilling, and tapping.

<u>Classification of tools</u>

Tools are classified according to the nature of work.

<u>Measuring tools</u>

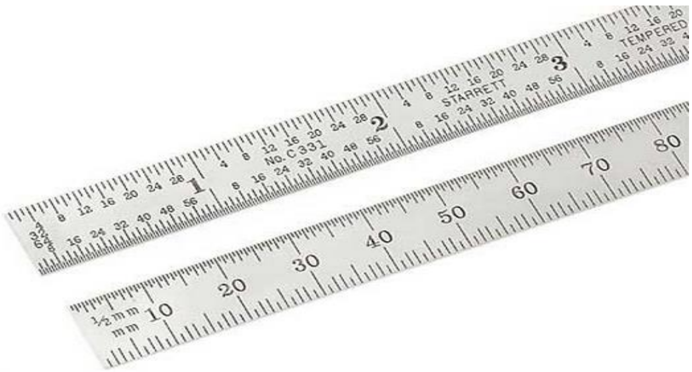
Measuring tools are divided into two categories

- Direct measuring tools
- Indirect measuring tools

<u>DIRECT MEASURING TOOLS</u>

Steel rule

A steel rule is a direct measuring tool which is used to measure the dimensions of length, breadth & thickness. Graduations marked on this instrument are both in Metric system and in British (inch) system. In the Metric system its least count is

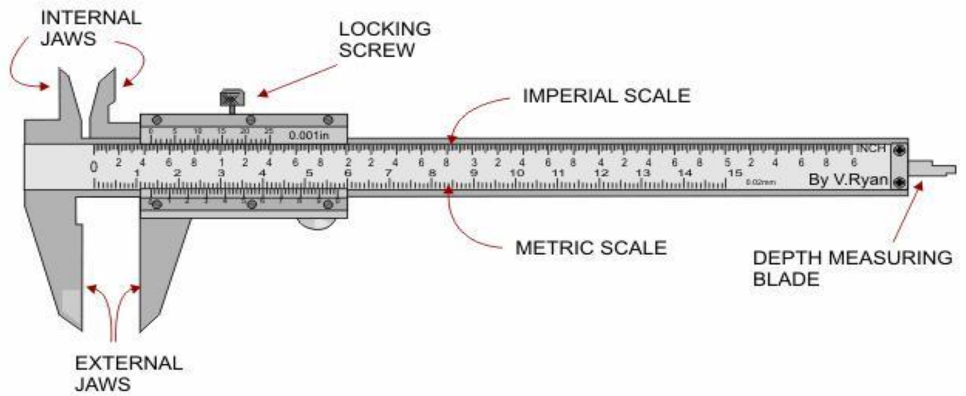


0.5mm and in the British system its least count is 1/64”.It is available in length of 150 mm,300mm and 600mm. In British system it is available in length of 6inches,12inches & 24inches. It is specified by its length. It is made of stainless steel.

Vernier Caliper

It is a precision and direct measuring tool. It is used for measuring outside and inside dimensions accurately. It is also used for depth measurement. It has two jaws. One jaw is formed at one end of its main scale and the other jaw is made part of a Vernier Scale. The least count is defined as the minimum dimension which can be measured by the instrument. For measuring the size of an object, it is held between its jaws and noting the main scale and Vernier Scale readings .The Vernier Calliper is generally made of Nickel-Chromium steel. Its size is specified by the maximum length that can be measured by it. The least count of Vernier Calliper in the metric system is 0.02mm and in the British system 0.001”.

Calculation of least count in Metric system



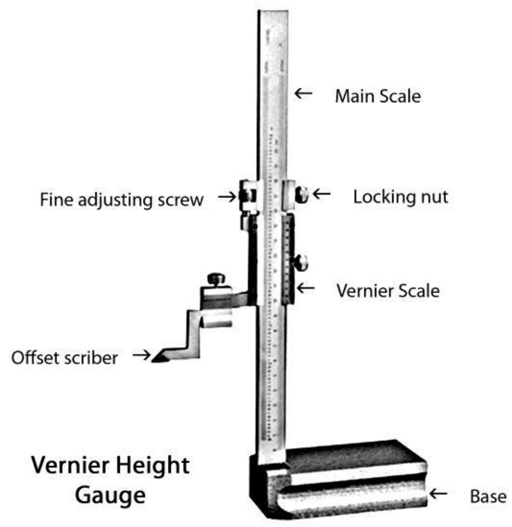
In the Metric system on mains cale,1cm is divided in 10 equal divisions. So1 main scale division (msd) =1mm. The total Vernier scale is divided in 50 equal divisions.

When close the measuring faces (both jaws), 50 divisions of Vernier scale = 49 division of main scale. So1 vernier scale division (vsd) = 49/50mm.

Least count = 1 main scale division (msd) – 1 vernier scale division (vsd)

= (1 – 49/50)mm.= 0.02mm.

Vernier Height Gauge



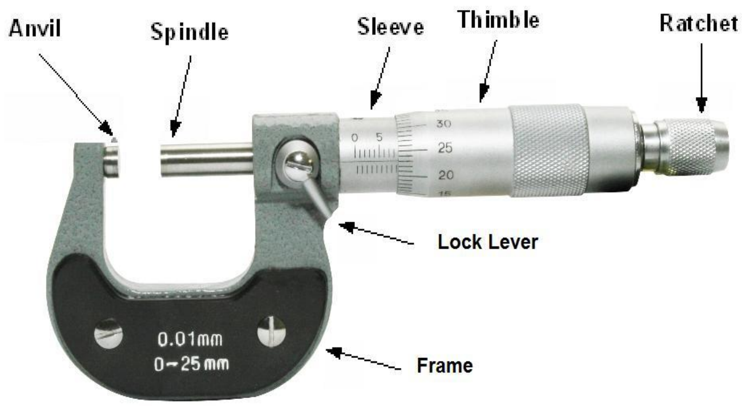
The Vernier height gauge is a direct and precision measuring tool .It is also used as a marking tool. The Vernier height gauge is clamped with an off-set scriber. An off-set scriber is used when it is required to take measurements from the surface, on which the gauge is standing. The accuracy and working principle of this gauge are the same as those of the Vernier calliper. Its size is specified by the maximum height that can be measured by it. It is made of Nickel–Chromium steel. The least count of the Vernier height gauge in the

Metric system is 0.02mm and in the British system it is 0.001”.

Outside Micrometer

This is used for measuring external dimensions accurately. Its least count is 0.01mm.These are available in different ranges with interchangeable anvils .

These are available in 0-25mm, 25-50mm, 50-75mm, etc. It works on the principle of screw thread’s pitch and lead. It consists of one jaw or anvil, fixed to one end of the frame and another movable jaw, in the form of a round bar, called the Spindle. This Spindle is mounted on the other end of the frame and housed in the thimble.



OUTSIDE MICROMETER

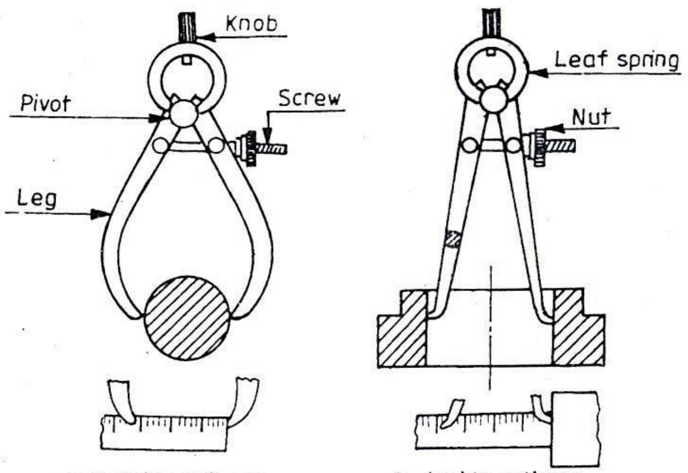
INDIRECT MEASURING TOOL

Outside Calipers

It is an indirect measuring tool. It is used to measure the external dimensions. It consists of two legs bent towards the inside. It is used to check the out side measurements with the help of a Steel rule. It is specified by the length of the leg.

Inside Callipers

It is an indirect measuring tool. It is used to measure the internal dimensions. It consists of two legs bent towards the outside. It is used to check the outside measurements with the help of a Steel rule. It is specified by the length of the leg.

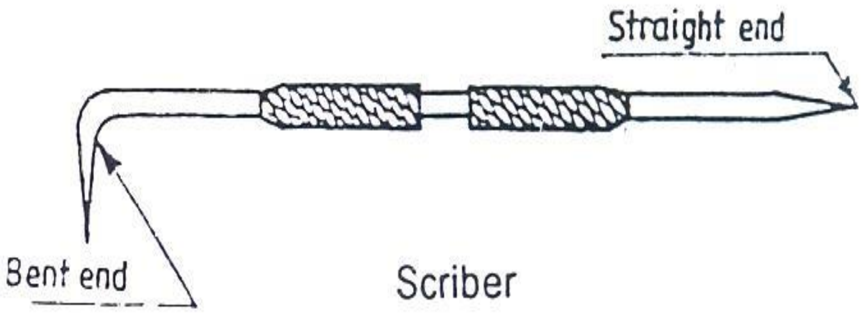


a-Outside calipers b-Inside calipers

MARKING TOOLS

Scriber

A scriber is a slender steel tool ,used to scribe or mark lines on metal work pieces. It is made of hardened and tempered

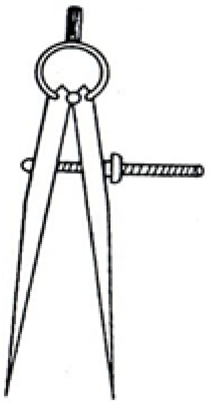


high carbon steel. The tip of the scriber is generally ground at 12 to15 degrees. It is generally available in lengths, ranging from 125mm to 250mm. It has two pointed ends. The bent end is used for marking lines where the straight end can not rich.

Odd leg callipers

This is also called ‘Jenny Calliper’ or Hermaphrodite. This is used for marking parallel lines from a finished edge and also for locating the center of round bars. It has one leg pointed like a divider and the other leg bent like a calliper. It is specified by the length of the leg up to the hinge point.

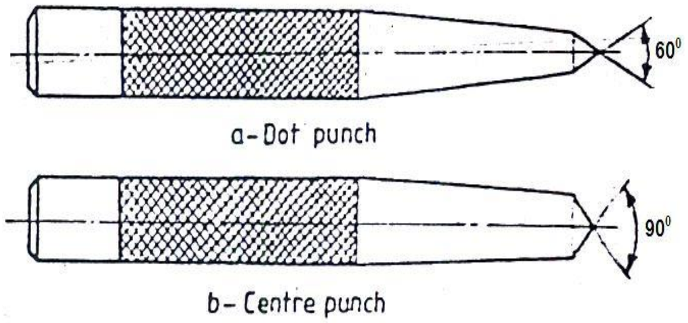
Dividers



It is basically similar to the callipers except that its legs are kept straight and pointed at the measuring edge. It is used for marking circles, arcs, laying out perpendicular lines, bisecting lines, etc. It is made of case hardened mild steel or hardened and tempered low carbon steel. Its size is specified by the length of the legs.

Punch

These are used for making in dentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. A punch is specified by its length and diameter. It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered point of the punch is hardened over a length of 20 to 30mm.



Punches

Dot Punch

It is used to lightly indent along the lay out lines and to provide a small centre mark for divider point etc. For this purpose the punch is ground to a conical point having 60^0 included angle.

Centre Punch

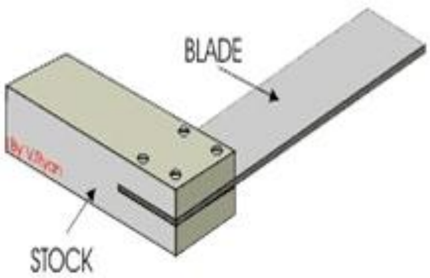
It is similar to the dot punch except that it is ground to a conical point having 90^0 included angle. It is used to mark the location of the holes to be drilled.

Number Punch and Letter Punch

These are used for punching the numbers and letters on the job.

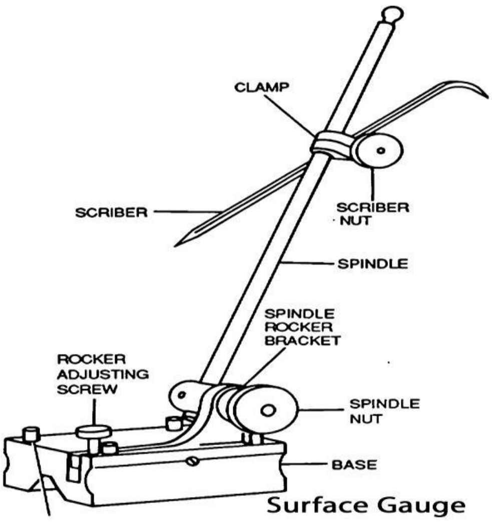
Try-square

It is a measuring and marking tool for 90^0 angle. In practice, it is used for checking the square-ness of many types of small works, when extreme accuracy is not required. The blade of the try-square is made of hardened steel and the beam, of cast iron. The size of the try- square is specified by the length of the blade.



Surface Gauge/ Universal Scribing Block

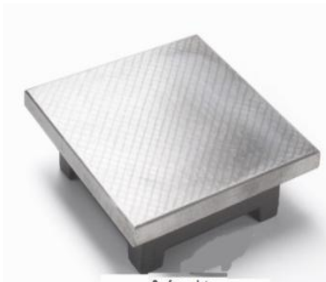
It is used for scribing lines for layout work and checking parallel surfaces. Its spindle can be adjusted to any angle by an adjusting screw. In some designs, the base of the block will have a “V” shaped groove, to enable the block to rest on round bars if required, to set–off the dimensions from the bar to the surface of the components



Surface Gauge

Surface plate

It is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small works and is more precise than the marking table. The degree of


Surface plate

Fineness of the finish depends upon whether it is designed for bench work in a fitting shop or for using in an inspection room. It is made of cast iron, hardened steel or granite stone. It is specified by length, width, height and grade. Handles are provided on two opposite sides to carry it while shifting from one place to another.

Angle plate

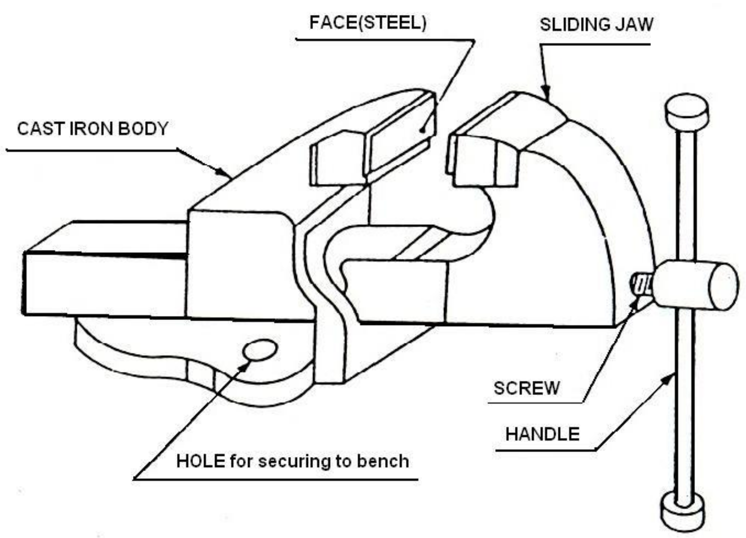
It is made of cast iron. It has two surfaces, machined at right angle to each other. Plates and components, which are to be marked out ,may be held against the upright face of the angle plate to facilitate the marking. Slots are provided on the angle plate to clamp the work in position.


Angle plate

HOLDINGTOOLS

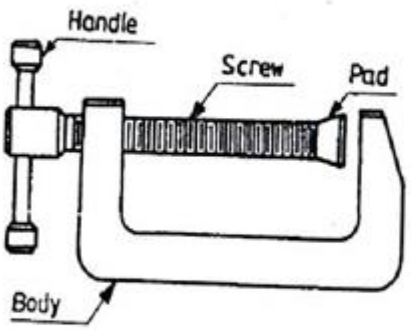
Bench vice

The bench vice is a work holding device. It is the most commonly used vice in a fitting shop. It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and movable jaw. When the vice handle is turned in a clockwise direction, the sliding jaw forces the work against the fixed jaw. Jaw plates are made of hardened steel. Serrations on the jaws ensure a good grip. Jaw caps made of soft material are used to protect finished surfaces, gripped in the vice. The size of the vice is specified by the length of the jaws. The vice body is made of Cast Iron which is strong in compression, weak in tension and so fractures under shocks and therefore should never be hammered.



C-Clamp

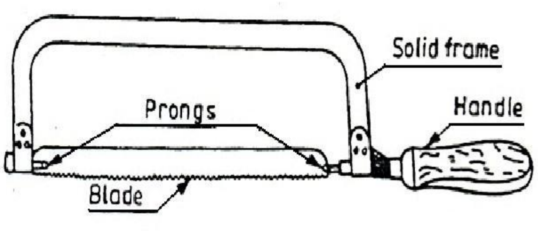
It is used to hold work against an angle plate or V-block or any other surface, when gripping is required. Its fixed jaw is shaped like English alphabet, “C” and the movable jaw is round in shape and directly fitted to the threaded screw at the end. The working principle of this clamp is the same as that of the bench vice.

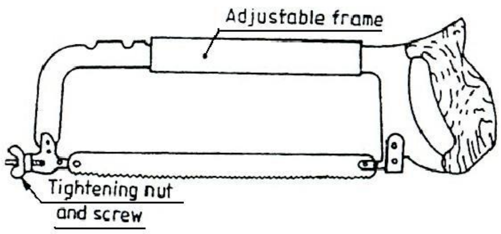


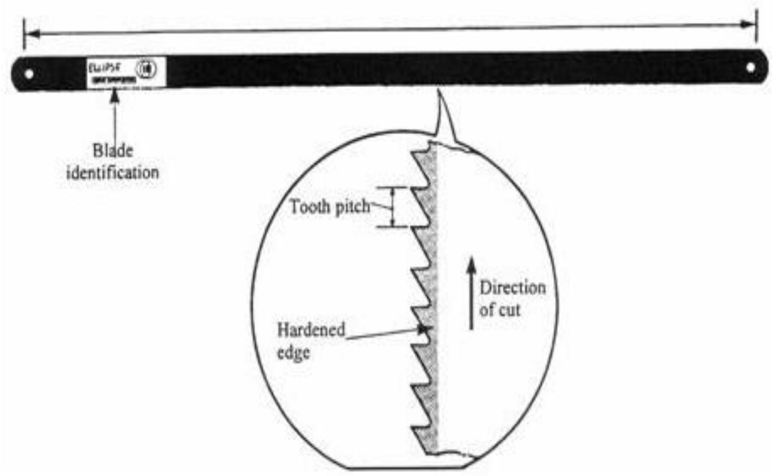
CUTTING TOOLS

Hack Saw

The Hack Saw is used for cutting metal by hand. It consists of a frame, which holds a thin blade, firmly in position. Hacksaw blade is specified by the number of teeth per inch. Blades having lesser number of teeth per inch are used for cutting soft materials like aluminum, brass and bronze. Blades having larger number of teeth per inch are used for cutting hard materials like Steel and Cast Iron.



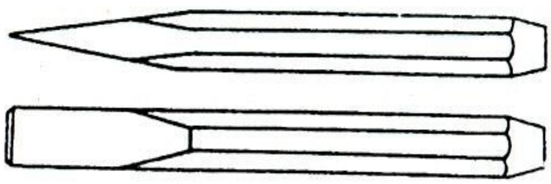




Hacksaw blades are classified as (i) All hard and (ii) flexible type. The all hard blades are made of H.S.S, hardened and tempered throughout to retain their cutting edges longer. These are used to cut hard metals. These blades are hard and brittle and can break easily by twisting and forcing them into the work while sawing. Flexible blades are made of H.S.S or low alloy steel but only the teeth are hardened and the rest of the blade is soft and flexible. These are suitable for use by un-skilled or semi-skilled persons.The teeth of the hacksaw blade are staggered, as shown in figure and known as a ‘set of teeth’. These make slots wider than the blade thickness, preventing the blade from jamming.

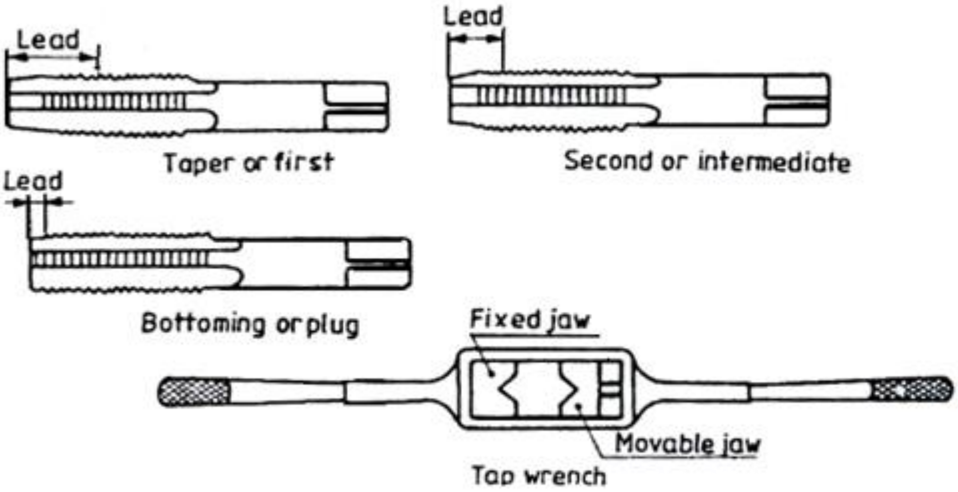
Chisel

Chisels are used for removing surplus metal or for cutting thin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisels are annealed, hardened and tempered to produce a tough shank and hard cutting edge. Annealing relieves the internal stresses in a metal. The cutting angle of the chisel for general purpose is about 60°



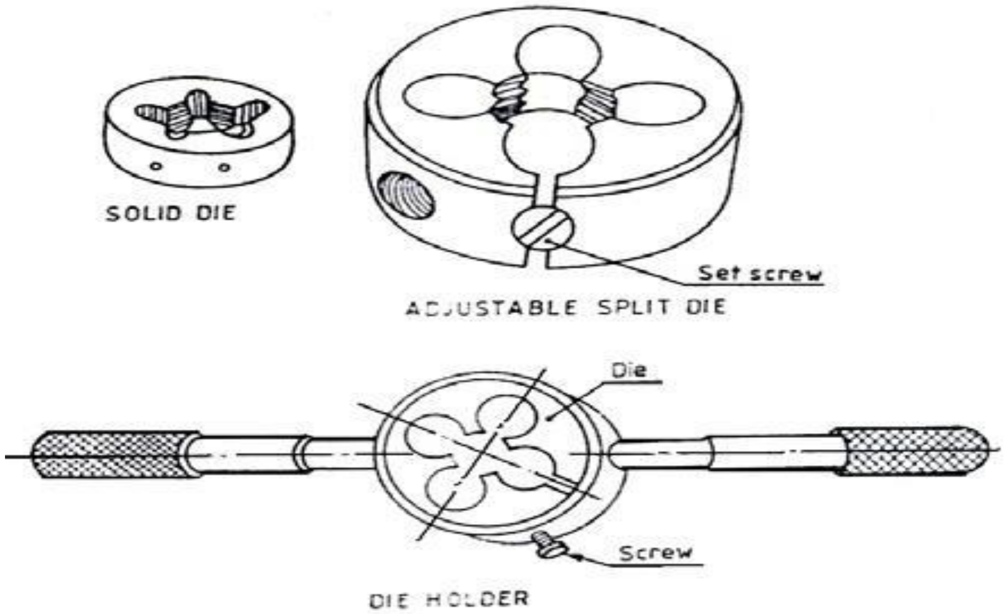
Taps and Tap wrenches

A tap is a hardened and steel tool, used for cutting internal thread in a drill hole. Hand Taps are usually supplied in sets of three in each diameter and thread size. Each set consists of a tapper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.



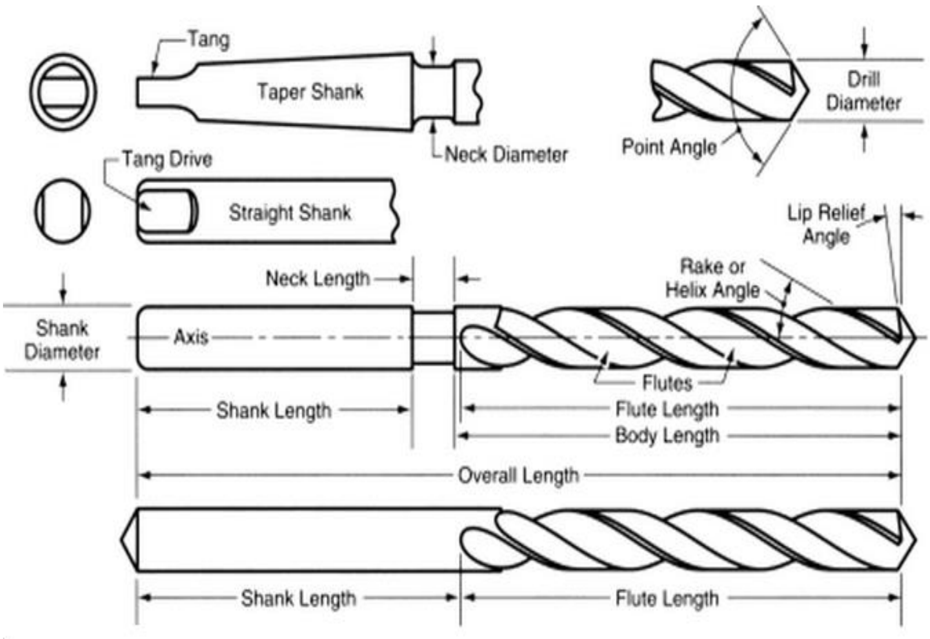
Dies and die-holders

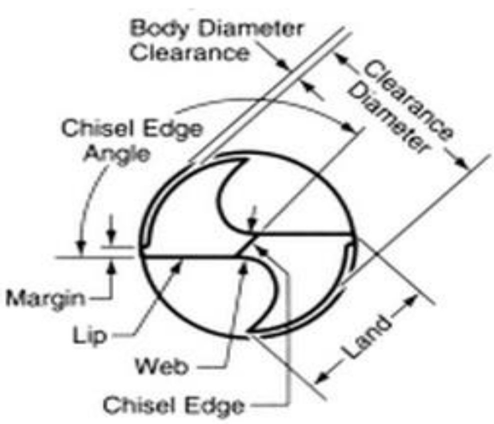
Dies are the cutting tools used for making external thread. Dies are made either solid or split type. They are fixed in a die stock for holding and adjusting the die gap. They are made of Steel or High Carbon Steel.



Twist Drill

Twist drills are used for making holes. These are made of High speed steel. Both straight and taper shank twist drills are used. The parallel shank twist drill can be held in an ordinary self centering drill chuck. The tapper shank twist drill fits into a corresponding tapered bore provided in the drilling machine spindle.





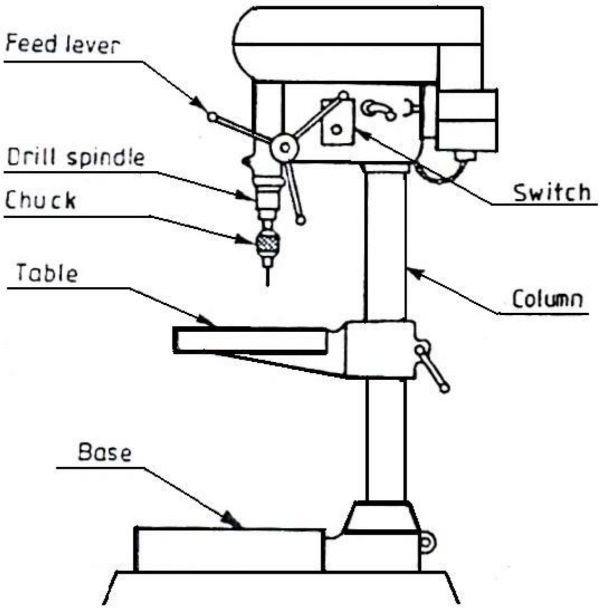
Bench Drilling Machine

Holes are drilled for fastening parts with rivets, bolts or for producing internal thread. Bench drilling machine is the most versatile machine used in a fitting shop for the purpose. Twist drills, made of tool steel or high speed steel are used with the drilling machine for drilling holes.

Following are the stages in drilling work

- Select the correct size drills, put it into the check and lock it firmly

- Adjust the speed of the machine to suit the work by changing the belt on the pulleys. Use high speed for small drills and soft materials and low speed for large diameter drills and hard materials.
- Layout of the location of the pole and mark it with a centre punch.
- Hold the work firmly in the vice on the machine table and clamp it directly on to the machine table. Put on the power, locate the punch mark and apply slight pressure with the Feed Handle.



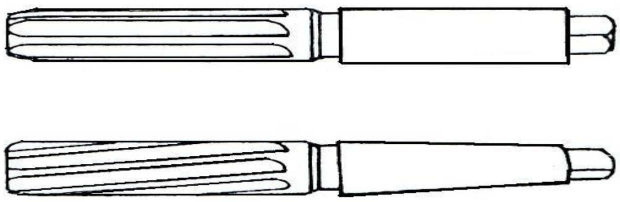
- Once Drilling is commenced at the correct location, apply enough pressure and continue drilling. When drilling steel apply cutting oil at the drilling point.
- Release the pressure slightly, when the drill point pierces the lower surface of the metal. This prevents the drill catching and damaging the work or drill.
- On completion of drilling retrace the drill out of the work and put-off the power supply.

FINISHING TOOLS

Reamers

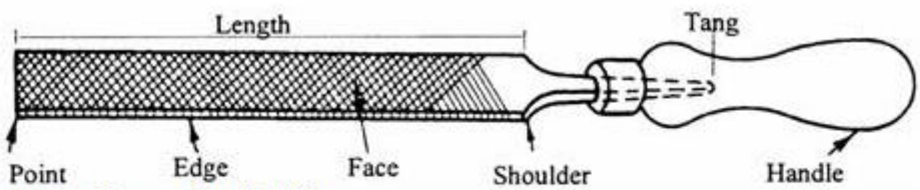
Reaming is an operation of sizing and finishing a drilled hole, with the help of a cutting tool called reamer having a number of cutting edges. For this, a hole is first drilled, the size of which is slightly smaller than the finished size and then a hand reamer or machine reamer is used for finishing the hole to the correct size.

Hand Reamer is made of High Carbon Steel and has left-hand spiral flutes so that, it is prevented from screwing into the whole during operation. The Shank end of the reamer is made straight so that it can be held in a tap wrench. It is operated by hand, with a tap wrench fitted on the square end of the reamer and with the work piece held in the vice. The body of the reamer is given a slight tapper at its working end, for its easy entry into the whole during operation, it is rotated only in clock wise direction and also while removing it from the whole.



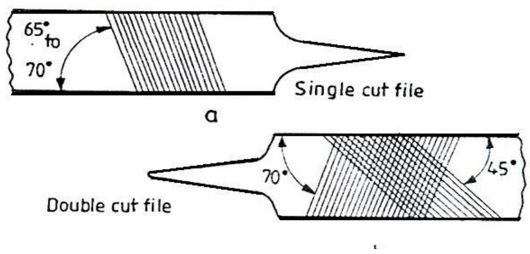
Files

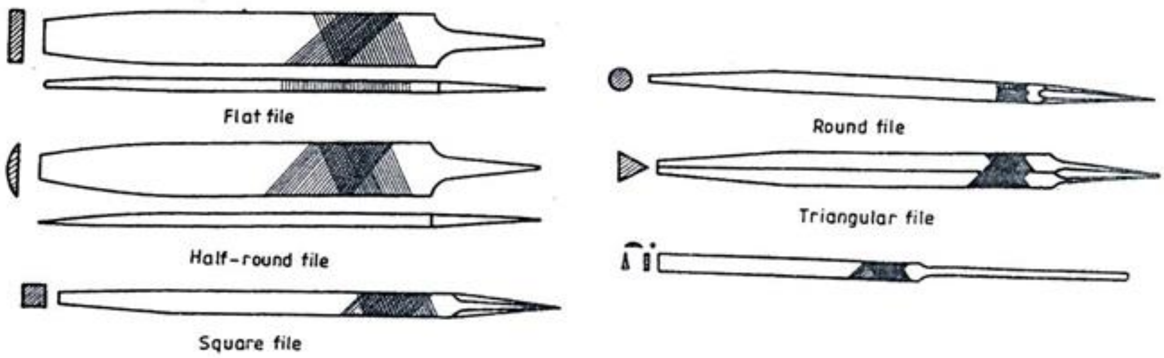
Filing is one of the methods of removing small amounts of material from the surface of a metal part. A file is hardened steel too, having small parallel rows of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. The figure shows various parts of a hand file. The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth. On the faces, single cut on one edge and no teeth on the other edge, which is known as a safe edge.



Outline views of a flat file

Files are classified or specified according to their shape, cutting teeth and pitch or grade of the teeth. The figure shows the various types of files based on their shape.





Length of file

Length of file is measured from the tip of the file to heel of the file.

Types of Files

The various types of files based on their shape.

Hand File

Rectangular in section, tapered in thickness but parallel in width. The face shave double cut teeth and one of the edges, single cut. The other edge does not have any teeth and hence is called as safe edge file. It is used for filing a surface, at right angle to an already finished surface.

Flat File

Rectangular in cross section and tapered for $1/3^{rd}$ length in width and thickness. The faces have double cut teeth and edges single cut. Used as a general purpose file.

Square File

Square in cross section and tapered for $1/3^{rd}$ length on all faces. All the faces have double cut teeth. Used for filing corners and slots and also to cut keyways.

Triangular File

Equilateral triangular in cross sections and tapered for $1/3^{rd}$ length on all faces. All the faces have double cut teeth. Used for filing internal corners.

Half round File

It has one flat face, connected by a curved face and tapered for$1/3^{rd}$ length. The curved face is not exactly semi-circular but only apart of circle. The flat face has double cut teeth and the curved face, single cut. Used for filing concave surfaces and internal corners.

Round File

Circular cross-section and tapered for 1/3rd of its length. It has double cut teeth. Used for filing concave surfaces and circular openings.

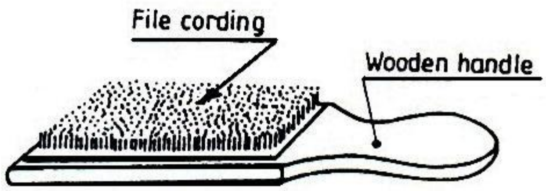
Grade of Files

Grade of files are determined on the basis of number of teeth per cm. Files most often used are the rough, double cut and smooth. Other grades are used for special jobs only.

MISCELLANEOUS TOOLS

File card

It is a metal brush, used for cleaning the files, to free them from filings, clogged in-between the teeth.

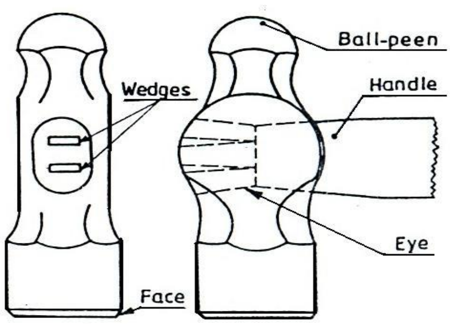


Spirit level

It is used to check the levelling of machines.

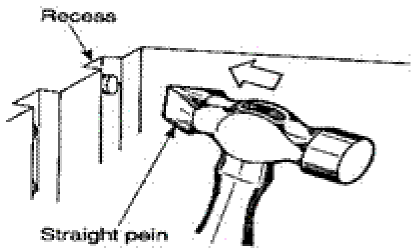
Ball- Peen Hammer

Ball- Peen Hammers are named, depending upon their shape and material and specified by their weight. A ball peen hammer has a flat face which is used for general work and a ball end, particularly used for riveting.



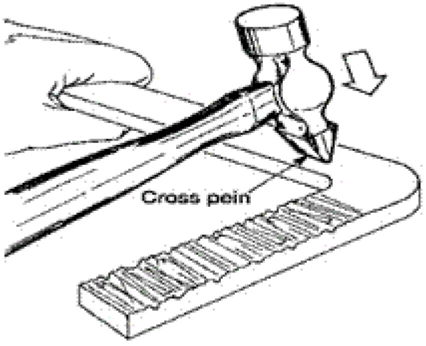
Straight-Peen Hammer

This is similar to cross peen hammer, but its peen is in-line with the hammer handle. It is used for swaging, riveting in restricted places and stretching metals.



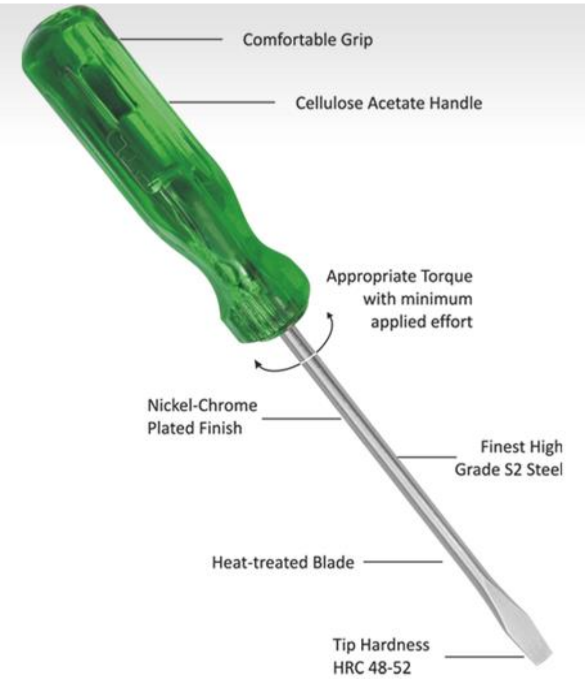
Cross-Peen Hammer

It is similar to ball peen hammer, except the shape of the peen. This is used for chipping, riveting, bending and stretching metals and hammering inside the curves and shoulders.



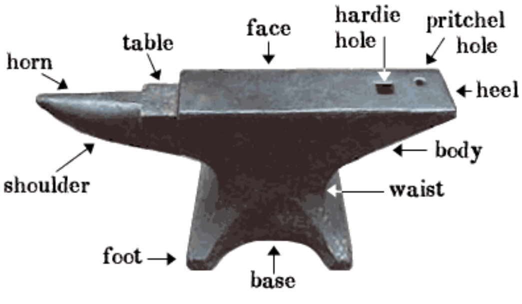
Screw driver

A screw driver is designed to turn screws. The blade is made of steel and is available in different lengths and diameters. The grinding of the tip to the correct shape is very important. A star screw driver is specially designed to fit the head of star screws. The end of the blade is fluted instead of flattened. The screw driver is specified by the length of the metal part from handle to the tip.



Anvil

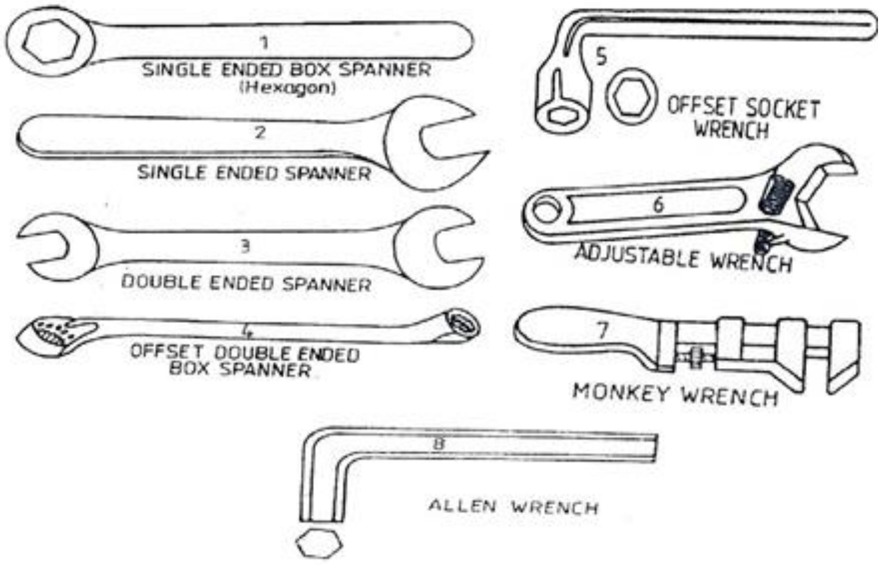
It provides the necessary support during forging by resisting the heavy blows rendered to the job. It is also useful for operations such as bending, swaging etc. Its body is generally made of cast steel, wrought iron or mild steel, with a hardened to player of about 20 to 25mm thick.



Anvil

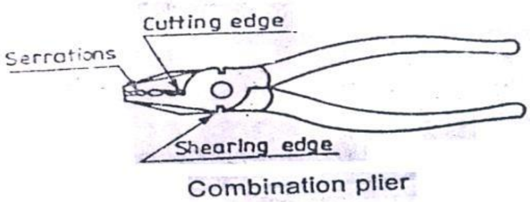
Spanners

A spanner or wrench is a tool for turning nuts and bolts. It is usually made of forged steel. There are many kinds of spanners. They are named according to the application. The size of the spanner denotes the size of the bolt on which it can work.

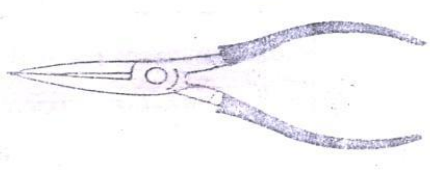


Plier

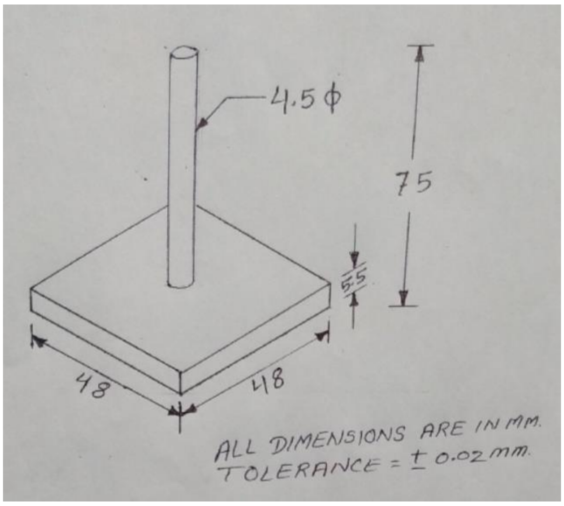
It is made of high carbon steel by proper hardening and tempering and is used for cutting as well as for gripping the work. Its handles are well insulated which makes it suitable for electrical working. Different types of pliers are: (i) Flat Plier and (ii) Nose Plier



Combination plier


Nose plier

AIM :- To make a square paper weight on M.S.



Raw material used :- M.S. flat

M.S. rod

Size used :- (50 x 50 x 6)mm. 1pc.

(76 x 6)mm 1pc.

Tools & Equipments used :-

Steel rule, Vernier calliper, Vernier height gauge, Scriber, Punch (dot & centre), Odd leg calliper,

Try square, Number punch, Surface plate & Angle plate, Bench vice, Hacksaw, File flat rough & File flat smooth, Drill bit (4.5mm), Anvil, Hammer ball peen, Bench drilling machine.

PROCEDURE :

Measuring : :- After receive the work piece, first measure the raw material size (length, width & thickness) by steel rule whether it is correct or not as per basic size. i.e (50 x 50 x 6)mm for flat & (76 x 6)mm for rod.

Marking : After measurement, marking a line of length 50mm on MS. Flat using steel rule, try square & scriber. Similarly another line of length 76mm. on MS rod.

Cutting : After marking, set the MS flat and rod in bench vice at proper height and cut the metal as per marking line using hacksaw.

Filling : After marking, first filing one side of the job using rough file and check the flatness with blade of the try square. Then filing the adjacent side of the base surface for making right angle and check the right angle with try square. Then set the odd leg calliper in 48mm. with the help of steel rule. Then mark the lines in 48mm. on the opposite side of the right angle surface with odd leg calliper. Then set the job in bench vice and remove the extra metal from the marking area to provide accurate shape and size using rough file. Similarly prepare the MS rod Of size (75 x 5.5)mm.

Drilling : After prepare the female part, draw the diagonals using scriber and steel rule and make a centre mark on the intersecting point of the diagonals using centre punch and ball peen hammer. Then set the job in machine vice in drilling machine and make a hole of diameter 4.5mm. using drill bit.

Fitting : After prepare the both male and female parts, fitting the male part (MS rod) into the fe male part (MS flat) using push fit.

Finishing : After fitting the both male and female parts, finishing the both parts using smooth file.

Checking : Finally after finishing, check the dimensions of both parts using vernier calliper, whether it is correct or not as per fig.

Submitting : At last punching the roll number on the job using number punch and ball peen hammer and submit it for evaluation.

Experiment - 2

Theory :

In a machine shop, metals are cut to shape on different machine tools. A lathe is used to cut and shape the metal by revolving the work against a cutting tool. The work is clamped either in a chuck, fitted on to the lathe spindle or in-between the centres. The cutting tool is fixed in a tool post, mounted on a movable carriage that is positioned on the lathe bed. The cutting tool can be fed on to the work, either lengthwise or cross-wise. While turning, the chuck rotates in counter-clockwise direction, when viewed from the tail stock end.

Specification of Lathe machine

Lathe machine is specified by the maximum size of work piece that can be held by the lathe. Size of work piece means diameter and length of the work piece. Length of work is the maximum distance between lathe centres (live centre and dead centre) or sometimes the length is specified as the length of the lathe bed.

Types of Lathe machine

There are different types of lathes used in different places according to their utility. Types of lathes are classified according to the design, type of drive ,arrangement of gears and purpose. Different types of lathes are:

Speed Lathe:-This lathe is the simplest of all types of lathes. It is drive by power. There is no gearbox, carriage and lead screw. In this lathe tool rests on a support and the tool is fed into the work by hand and depth of cuts are small. It has a bed on which head stock and tail stock are mounted. This type of lathe is mainly used for wood working, polishing etc.

Automatic Lathe:-In this lathe tools are automatically fed into the work and with drawn after all operations are complete. These lathes are used for mass production.

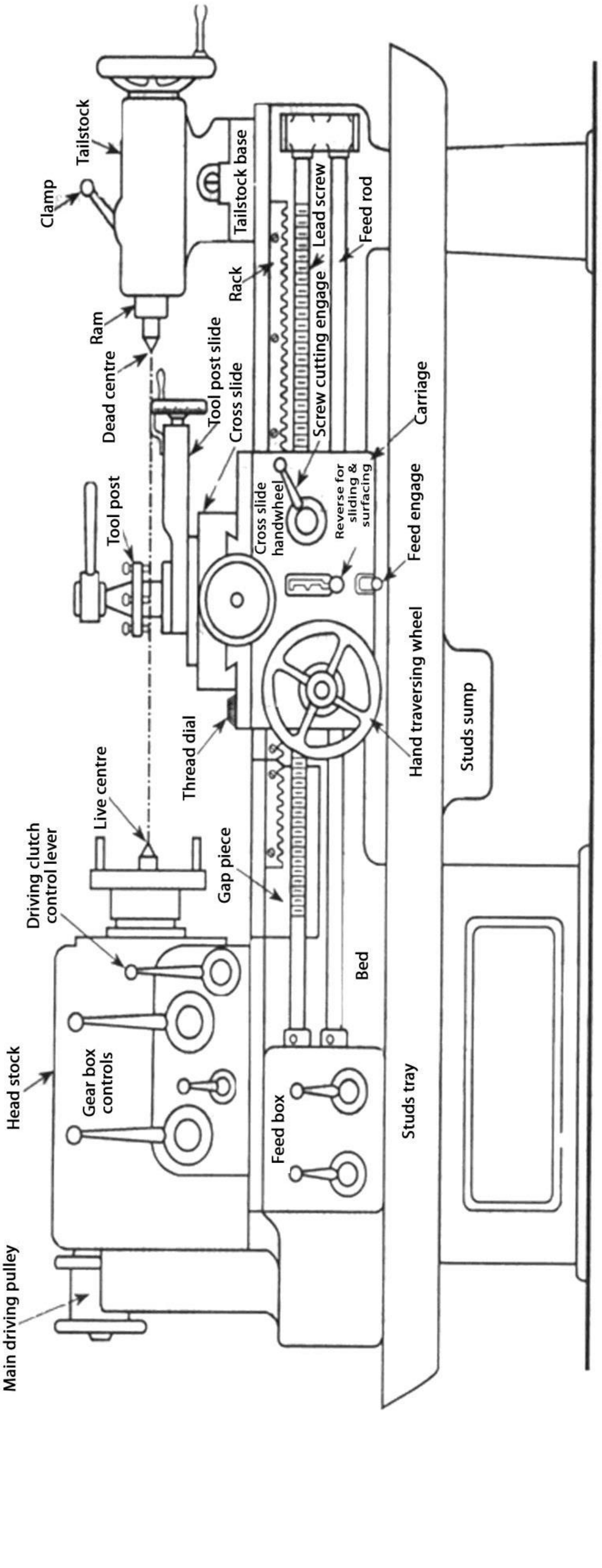
Bench Lathe:-This type of lathe is very small. It is small enough so that it can be mounted on a bench. It is used for small work like production of gauge, punch etc.

Capstan and Turret Lathe:-These lathes are the modification of engine lathe and particularly used for mass production in tool room or production center.

Engine Lathe:-It is the most widely used lathe. When electric motors were not invented, these machines were operated by steam engine. That’s why it was named as engine lathe.

Function of an Engine lathe

An engine lathe is used to produce a cylindrical work piece from any shape of work piece. The shape of work piece may be square, rectangular, hexagonal or octagonal. Besides this the lathe can use for other operations. Such as: drilling, reaming, boring, taper turning, knurling, thread cutting (external and internal), grooving etc.



Lathe parts

PRINCIPAL PARTS OF A LATHE

The name is due to the fact that work pieces are held by the centers. Different parts of lathe machine are :

Bed

It is an essential part of a lathe, which must be strong and rigid. It carries all parts of the machine and resists the cutting forces. The carriage and the tail stock move along the guide ways provided on the bed. It is usually made of cast iron.

Head stock

It contains either a cone pulley or gearings to provide the necessary range of speeds and feeds. It contains the main spindle, to which the work is held and rotated.

Tail stock

It is used to support the right hand end of a long work piece. It may be clamped in any position along the lathe bed. The tail stock spindle has an internal Morse taper to receive the dead center that supports the work. Drills, reamers, taps may also be fitted into the spindle, for performing operations such as drilling, reaming and tapping.

Carriage or Saddle

It is used to control the movement of the cutting tool. The carriage assembly consists of the longitudinal slide, cross slide and the compound slide and apron. The cross slide moves across the length of the bed and perpendicular to the axis of the spindle. This movement is used for facing and to provide the necessary depth of cut while turning. The apron, which is bolted to the saddle, is on the front of the lathe and contains the longitudinal and cross slide controls.

Cross-slide

It is mounted on the carriage. The tool is fed perpendicular to the axis of the work piece by moving its hand traversing wheel which helps to give the depth of cut to the tool.

Compound-slide

It is mounted on the cross-slide. It has a swivel base on which degree graduation are marked which helps to set the compound slide at desired angle for taper turning operation. It has no power feed. The feed is given by moving its hand traversing wheel by hand (manually).

Tool Post

The tool post, holds the tool holder or the tool, which may be adjusted to any working position.

Lead Screw

It is a long threaded shaft, located in front of the carriage, running from the head stock to the tail stock. It is geared to the spindle and controls the movement of the tool, either for automatic feeding or for cutting threads.

Centers

There are two centers known as dead center and live center. The dead center is positioned in the tail stock spindle and the live center, in the head stock spindle. While turning between centers, the dead center does not revolve with the work while the live center revolves with the work.

FEED MECHANISM

Feed:- Feed is defined as the distance which the tool advances for each revolution of work piece. It is expressed in mm. Feeds are of three types:

Longitudinal feed

When the tool travels along the work piece parallel to the bed or axis of the work piece that is called longitudinal feed. This feed can be hand (manually) or power operated.

Cross feed

When the tool travels perpendicular to the axis of work piece by the help of cross slide is called Cross feed. This feed can be hand (manually) or power operated.

Angular feed

When the tool travels by the compound-slide in some angle to the axis of the work piece that is called Angular feed. This feed is only hand (manually) operated. The feed mechanism is used in lathe for impacting various feeds to the cutting tool.

Feed mechanism consists of Tumbler reversing mechanism, feed gearbox, Feed changing lever, Lead screw, Feed rod.

Tumbler reversing mechanism or Gear train

Gears in gear train transmit power from lathe spindle to the lead screw or feed rod through the feed gear box. In gear train there is a stud gear, an idler gear (pinion) and a screw gear. The motion from the stud gear is trans mitted to the screw gear through the idler gear. The idler gear is mounted on a slotted link.

Feed gear box

On the front part of this gear box there are two levers. One is the speed changing lever, another is the feed and lead lever. These two levers help to move the lead screw, feed rod, carriage and cross- slide in different speeds.

Feed changing lever

This lever is mounted on the apron. It is used to give the automatic feed to the tool i.e. longitudinal feed or cross feed. When lever position in center, the longitudinal feed and cross feed is given manually. When the lever position is right side then the carriage move longitudinally parallel to the axis automatically and automatic cross feed is given when the lever position is left side.

Lead screw

It is a long threaded shaft. Square threads are cut on it. It is used to give auto feed to the carriage during thread cutting operation.

Feed rod

It is a plain lengthy shaft which is attached to the feed box below the leads crew. It is used to give auto feed to the tool i.e. longitudinal feed or cross feed during facing, turning, boring and knurling operation.

WORK HOLDING DEVICES LATHEACCESSORIES

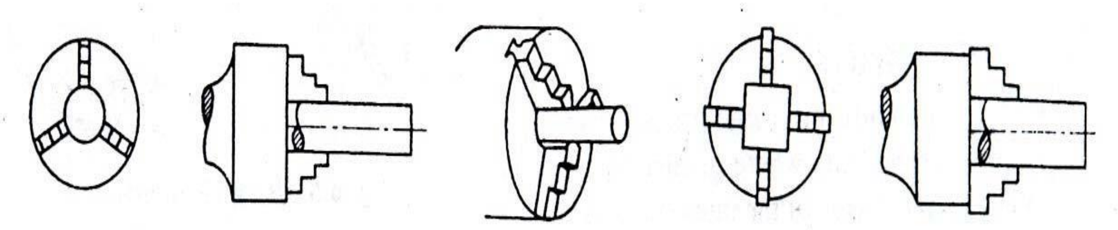
Lathe accessories are used for holding and supporting the work piece or cutting tool for different type of operations. Different types of lathe accessories are:

Lathe center : Lathe centers are of two types, that is live center and dead center. These are made of tool steel or high speed steel or alloy steel. These are made solid tapered or conical in shape. Live center is fitted into head stock's spindle. Live center is driven by power of the machine. That's why this center is called live center. Dead center is fitted into the tail stock's spindle. This is not revolved, so this center is called dead center. These centers are used to provide support to a lengthy job for turning & threading.

Chuck : It is a device which helps to hold the work piece for different types of operations. Internal threads are cut inside the chuck and external threads are cut on the spindle. By these threads chuck easily fit on the head stock spindle. Short, cylindrical, hollow and irregular shape of work piece which can not be mounted between the centers, are easily held in a chuck. Chucks are of different types according to their utility. Different types of chucks are: Two jaw chuck, three jaw chuck, four jaw chuck ,magnetic chuck, Colet chuck, and Combination chuck. But three jaw chuck and four jaw chucks are commonly used.

Three jaw chuck : It is known as universal chuck as movement of the three jaws takes place simultaneously. Also called self- centering chuck as centering is not required in this case because all the jaws automatically come to the center by tightening any one of them. Basically it is used for cylindrical and hexagonal job.

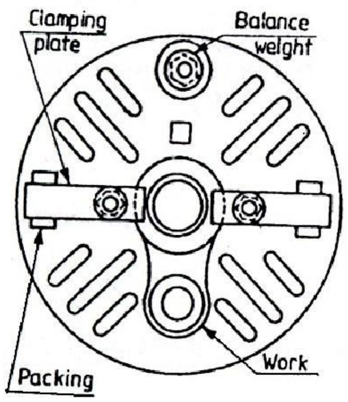
Four jaw chuck : Motion of the jaws is independent of each other so it is known as independent chuck. It takes more time for setting the job than the three jaw chuck. Here gripping is better than three jaw chuck. Can be used for both regular and irregular jobs.



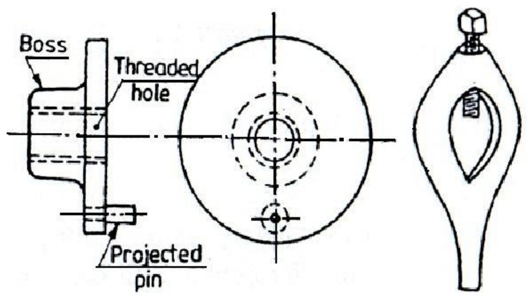
Three jaw chuck Four jaw chuck

Face plate

It is a plate of large diameter, used for turning operations. Certain types of work that cannot be held in chucks are held on the face plate with the help of various accessories.



Face plate



Lathe dog and driving plate

Lathe dogs and driving plate

These are used to drive a work piece that is held between centers. These are provided with an opening to receive and clamp the work piece and dog tail, the tail of the dog is carried by the pin provided in the driving plate for driving the work piece.

CUTTING PARAMETERS

Cutting speed

It is defined as the speed at which the material is removed and is specified in meters per minute. It depends upon the work piece material, feed, depth of cut, type of operation and so many other cutting conditions. It is calculated from the relation,

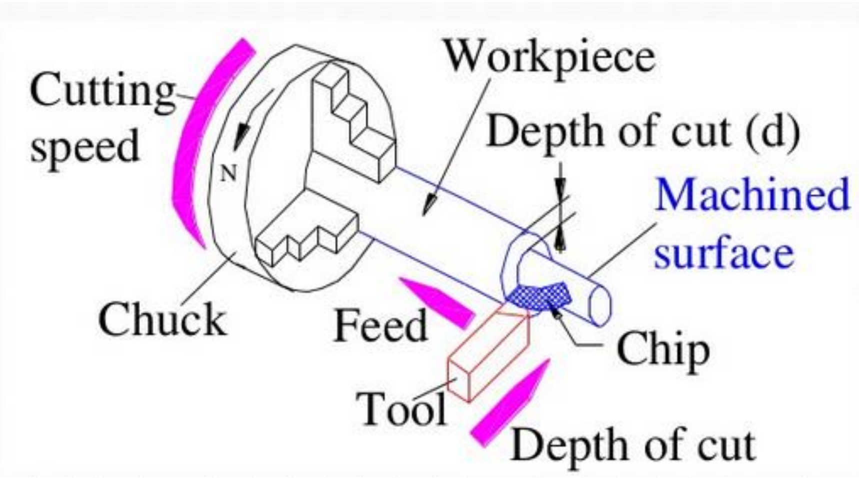
Spindle speed (RPM) = cutting speed x 1000 / (πD) Where D is the work piece diameter in mm.

Feed

It is the distance traversed by the tool along the bed, during one revolution of the work. Its value depends upon the depth of cut and surface finish of the work desired.

Depth of Cut

It is the movement of the tip of the cutting tool, from the surface of the work piece and perpendicular to the lathe axis. Its value depends upon the nature of operation like rough turning or finish turning.

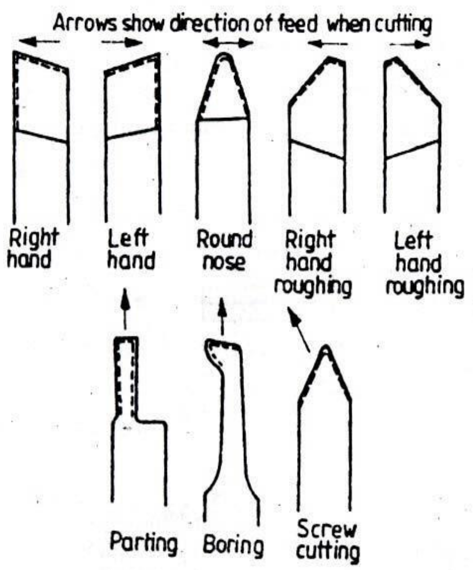


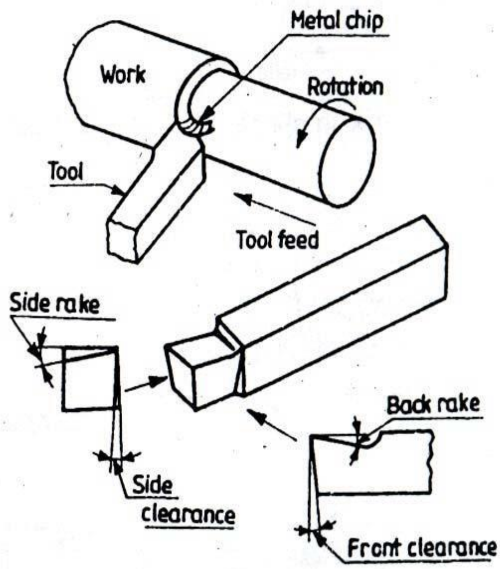
TOOL MATERIALS

General purpose hand cutting tools are usually made from carbon steel or tool steel. The single point lathe cutting tools are made of high speed steel (HSS).the main alloying elements in 18:4:1 HSS tools are 18 percent tungsten, 4 percent chromium and 1 percent vanadium.5 to 10 percent cobalt is also added to improve the heat resisting properties of the tool. Carbide tipped tools fixed in tool holders, are mostly used in production shops.

TOOL GEOMETRY

A single point cutting tool used on lathe may be considered as a simple wedge. Figure A shows the common turning tools used for different operations. Figure B shows the basic angles of a simple turning tool.





(A) Common turning tools **B)** Tool geometry

LATHE OPERATIONS

Turning

Cylindrical shapes, both external and internal, are produced by turning operation. Turning is the process in which the material is removed by a traversing cutting tool, from the surface of a rotating work piece. The operation used for machining internal surfaces is often called the boring operation in which a hole previously drilled is enlarged. For turning long work, first it should be faced and center drilled at one end and then supported by means of the tail stock centre. It is used for reducing the diameter of the work piece.

Boring

Boring is enlarging a hole and is used when correct size drill is not available. However, it should be noted that boring cannot make a hole.

Facing

Facing is a machining operation, performed to make the end surface of the work piece, flat and perpendicular to the axis of rotation. For this, the work piece may be held in a chuck and rotated about the lathe axis. A facing tool is fed perpendicular to the axis of the lathe. The tool is slightly inclined towards the end of the work piece. It is used for reducing the length of the work piece.

Straight Turning:-This is an operation of removing excess amount of metal from the entire surface of cylindrical work piece by the help of turning tool. In this operation longitudinal feed is given by carriage by manually (hand) or by power. In this operation the job is held in chuck or in between centre.

Step Turning:- It is an operation to make smaller diameter on a plain round shaft than the diameter of shaft by the help of turning tool. This operation is done after the facing and straight turning operation.

Taper Turning

A taper is defined as the uniform change in the diameter of a work piece, measured along its length. It is expressed as a ratio of the difference in diameters to the length. It is also expressed in degrees of half the included (taper) angle. Taper turning refers to the production of a conical surface, on the work piece on a lathe. Short steep tapers may be cut on a lathe by swivelling the *compound rest* to the required angle. Here, the cutting tool is fed by means of the compound slide feed handle. The work piece is rotated in a chuck or face plate or between centers.

Drilling

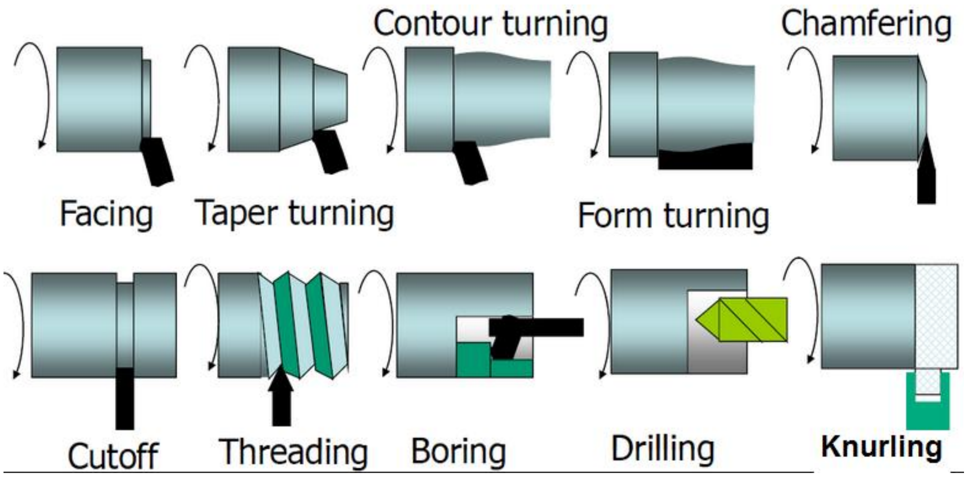
Holes that are axially located in cylindrical parts are produced by drilling operation, using a twist drill. For this, the work piece is rotated in a chuck or face plate. The tail stock spindle has a standard taper. The drill bit is fitted into the tail stock spindle directly or through drill chuck. The tail stock is then moved over the bed and clamped on it near the work. When the job rotates, the drill bit is fed into the work by turning the tail stock hand wheel.

Knurling

It is the process of embossing a diamond shaped regular pattern on the surface of a work piece using a special knurling tool. This tool 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 work piece to squeeze the metal against the multiple cutting edges. The purpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slipping when operated by hand.

Chamfering

It is the operation of bevelling the extreme end of a work piece. Chamfer is provided for better look, to enable nut to pass freely on threaded work piece, to remove burrs and protect the end of the work piece from being damaged.

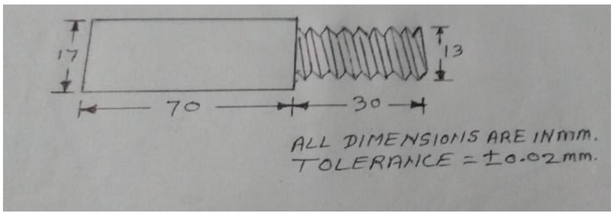


Operations of Lathe

Threading

Threading is nothing but cutting helical groove on a work piece. Threads may be cut either on the internal or external cylindrical surfaces. A specially shaped cutting tool, known as thread cutting tool, is used for this purpose. Thread cutting in a lathe is performed by traversing the cutting tool at a definite rate, in proportion to the rate at which the work revolves.

AIM:- To Make a Cylindrical Step turning and threading.



Material Used :- M S Rod

Size Used :- (103 x 20)mm

Tools & Equipments Used :-

Lathe Machine, Steel Rule, Vernier calliper, Scriber, Surface Gauge, Centre Gauge, Screw Pitch Gauge, Facing Tool, Right hand Turning Tool, V – Thread cutting Tool, Flat Smooth File, Triangular Smooth File.

PROCEDURE :-

Measuring & Marking_:- After receive the work piece, first measure the size of the work piece (length & diameter) by vernier calliper whether it is correct or not as per basic size.

Setting the Job & Tool :- After measurement, set the job i n three jaw chuck and tight it properly by chuck key. Then check the centre of the job by surface gauge. Then set the cutting tool in tool holder & set the tool holder in tool post at proper height & check the centre of the tool by dead centre.

Operation :- After setting the job & tool, first make plain one end of the work piece by facing operation. Then remove the job from chuck & mark a line with 100mm. by scriber & depth bar of the vernier calliper at the opposite end of the facing surface. Then reduce the diameter out of 20mm to 17.1mm by turning operation with the help of right hand turning tool. Then again mark a line in 30mm & reduce the diameter (30mm length) out of 17.1mm to 13.1mm. Then surface finishing is done by flat smooth file & also reduce the diameter of all steps i.e 17mm & 13mm as per fig. After that cutting the thread on the last step by V – thread cutting tool & time to time check the pitch of the thread by screw pitch gauge. Then finishing of the thread is done by triangular file.

Checking :- After complete all operation, check the length & dia. Of each step by vernier calliper, whether it is correct or not as per fig.

Submitting :- After checking, punching the roll no & branch on the job by number punch & letter punch & submit it for evaluation.

Experiment - 3

Theory :

Milling machine is a machine tool which is used to remove metal form the work piece as the work piece is fed against a rotating multipoint cutter. In this machine, the cutter rotates at high speed and it removes metal at a very fast rate due to multipoint cutting edges. This is superior to other machines in accuracy and better surface finish.

Specification of Milling Machine:-

Milling machine is specified according to the (i) Size of the work table i.e. length & breadth, (ii) Maximum length of longitudinal, cross and vertical travel of the work table.

Types of Milling Machine

Different types of milling machines are used in different place according to their utility. The different types of milling machines are:

- ➢ Column and knee type milling machine
- ➢ Fixed bed type milling machine
- ➢ Special type of milling machine

Column and knee type milling machine:-

This type of milling machine is most commonly used in general workshop. In this machine the work table is mounted on the knee which slides on vertical part of the column by the guide ways. This type of milling machine is classified according to the various method of supplying power to the table, different movements of the table and different axis of rotation of the spindle. Vertical milling machine, Horizontal milling machine and Universal milling machines are under column and knee type milling machine.

Vertical Milling machine:

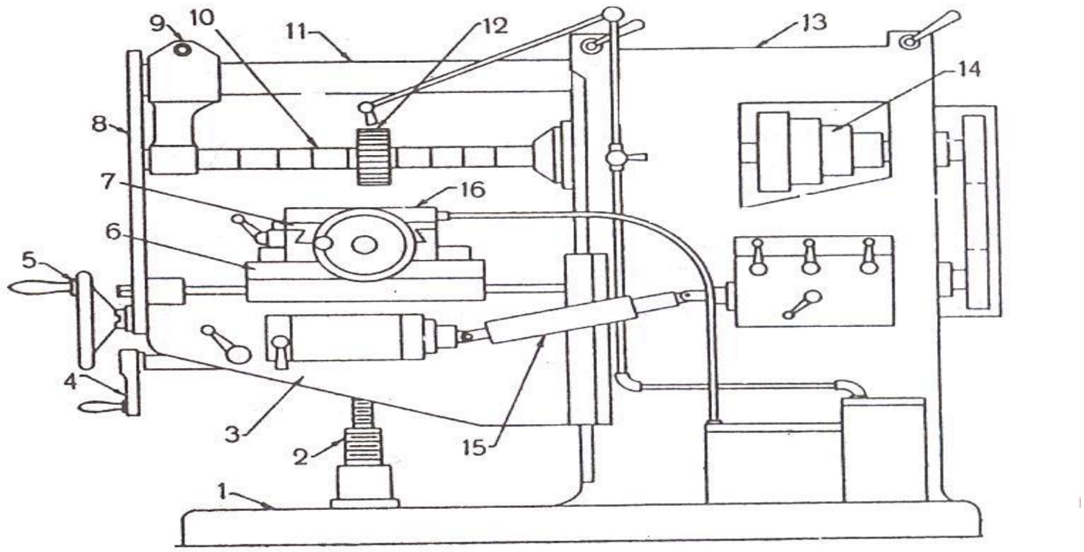
In the vertical milling machine the spindle is vertical or perpendicular to the work table. The vertical head is clamped to the vertical column swivelled at an angle for machining an angular surface. End milling cutter, Face milling cutter, T-slot milling cutters are mounted on the spindle of vertical milling machine. This machine is used for machining grooves, slots, key ways and flat surface.

Horizontal Milling machine:

In this milling machine table or work piece is fed against a rotating cutter which is mounted on a horizontal arbor. In this machine the table may be fed in a longitudinal, cross or vertical direction. When the table is moved at right angle to the spindle, that feed is longitudinal feed. When the table is moved parallel to the spindle that feed is cross feed and when the table moves vertical up ward and downward it is vertical feed.

Universal Milling Machine:

This machine is used in tool room for very accurate work. In appearance it is similar to the horizontal milling machine. But the difference is, horizontal milling machine has three table movements (longitudinal, cross and vertical) where as universal milling machine has four table movements. In this machine table is mounted on a swivel base on which graduation are marked in degrees, which helps to swivel the table at any angle up to 45 degree horizontally for making helical grooves. This machine is used for manufacturing different types of gears, threads, drill bits, reamers and also used for cutting slots, grooves, keyways, steps and producing flat surface (horizontal, vertical or inclined).



Column and knee type milling machine

1. Base, 2. Elevating screw, 3. Knee, 4. Knee elevating handle, 5. Crossfeed handle, 6. Saddle, Table, 8. Front brace, 9. Arbor support, 10. Conepulley, 15. Telescopic feed shaft.

PARTS OF A MILLING MACHINE

Base: -Base gives the support to all parts of machine and carries the column which is mounted at its back end. An elevating screw is mounted on the base which gives the support to the knee and the knee moves up ward and down ward by the help of the elevating screw.

Column:-It is a rectangular box shaped part mounted on the base. A gear mechanism is arranged in side the column for transmitting power from the motor to the spindle. Dovetail guide ways are made on the front part of the column and the knee slides up and down vertically by dovetail guide ways. The top of the column supports the over arm.

Knee:-It moves vertically up and down on the column by the guide ways provided on the column. A spindle is mounted on the top face of the knee.

Saddle: -It slides crosswise i.e .parallel to the axis of the arbour by the guide ways which is provided on the top face of the knee. Saddle gives the support to the work table.

Table:-It slides longitudinally i.e. perpendicular to the axis of the arbour over the saddle by the guide ways provided on the top of the saddle. T-slots are cut on the surface of the table for clamping the work piece on it. A lead screw is provided under the table which engages with a nut on the saddle to move the table horizontally manually or by power. It can move up and down by raising or lowering the knee and also cross wise by rotating the cross feed handle. In Universal milling machine, table can swivelled horizontally in an angle up to 45 degrees for making helical grooves.

Over arm:-It is mounted on the top of the column. It can be adjusted horizontally. The over arm supports the arbor.

Spindle:-It is a hollow shaft which is located on the top part of the column. The spindle receives power from the motor through the belt, gears, clutches (provided inside the column).The front end of the spindle projected from the column face has a tapered hole into which arbour are fitted.

Arbor:-Itisashaft.Oneendofthearboristaperedwhichfitsintothemachinespindle.Milling cutters are held on the different position of the arbor.

Spacing collar:- These are hollow cylindrical parts are fitted on the arbor.These are used to give the support to the milling cutters and also helps to setting the cutter on different position on the arbour for different types of operations.

MECHANISM OF MILLING MACHINE

The milling machine mechanism are Spindle drive mechanism and Table feed mechanism.

Spindle drive mechanism: - In light duty machine, spindle speeds are changed by shifting the V-belt to the pulley combination. In belt drive machine, spindle has four direct speeds and four back gear speeds. In all gear drive machine has 16 spindle speeds.

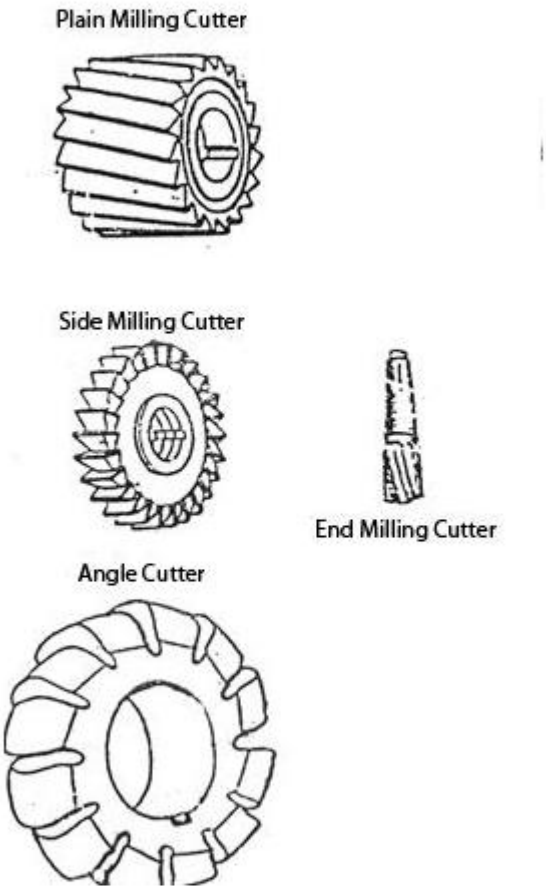
Table feed mechanism: - In a milling machine a telescopic feed shaft is connected with the gear box and the other end connected with the table, which helps to give the automatic feed to the table.

Work Holding Devices of milling machine :

Different types of holding devices used in milling machine for the clamping the work piece on the table securely for different types of operation. Holding devices are: T-bolts and clamp, angle plate, machine vice (plain or swivel base) and fixtures.

Milling Cutters and Its Function

Material :- Milling cutters or the cutter teeth are made up high speed steel for general purpose of work, cemented carbide steel for cutting hard metal in production center and cast alloy steel for cutting HSS metal.



For different types of operation different milling cutters are used in milling machine. Different milling cutters are:

Plain milling cutter: - Used for producing flat surfaces which are parallel to the spindle axis.

Side milling cutter: - Used for producing flat surfaces, cutting slots and making steps.

Angle milling cutter: - Used for dovetail notches or ratchet wheel, also for machining V-grooves.

End milling cutter: - Used for producing flat surface, machining slots, keyways, grooves and also used for making steps.

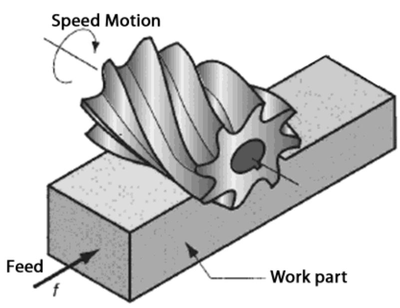
T-slot cutter: - Used for making T-slots on the work table of the machines.

Gear cutter: - Used for producing gear wheel.

Thread cutter: - Used for cutting different types of threads.

MILLING METHODS

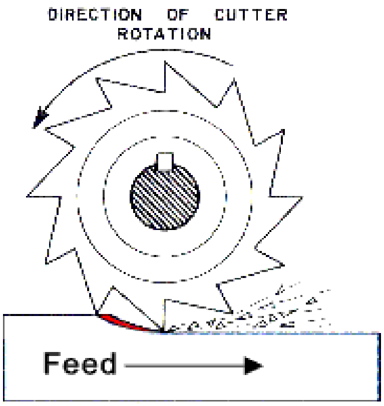
Different milling methods performed by the different cutters.



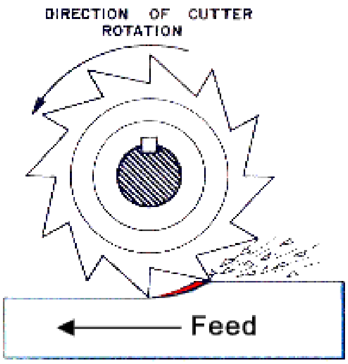
Peripheral Milling: - It is the operation performed by a milling cutter to produce a machined surface parallel to the axis of rotation of the cutter. In this method the cutting force is not uniform. Up milling method and down milling method is under this method.

Up milling method: - This is the method in which the cutter rotates against the direction of work is feeding. This method is suited for all operation in all machines. In this method the load on each cutter tooth is gradually increased. It increases the life of the cutting tool. It gives better finish. If the depth of cut is more or the work piece is not properly clamped in vice, the cutter tends to lift the work piece from the work table. If the depth of cut is more, some scallops mark show on the finished surface.

Down milling method:-It is the method in which the cutter rotates in the same direction in which the work is feeding. This method is not suited for all machines or all types of work. For down milling machines are specially designed. It is a newly invented method. In this method the cutter tends to press the work down on the work table.

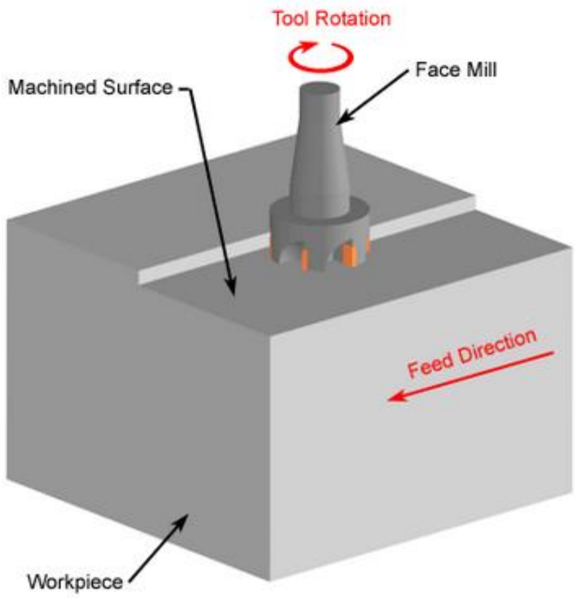


Down Milling



Conventional Up Milling

Face milling: - The face milling is the operation performed by a milling cutter to produce a flat surface perpendicular to the axis of rotation of the cutter. In this method both up and down milling to be performed simultaneously on the work surface.

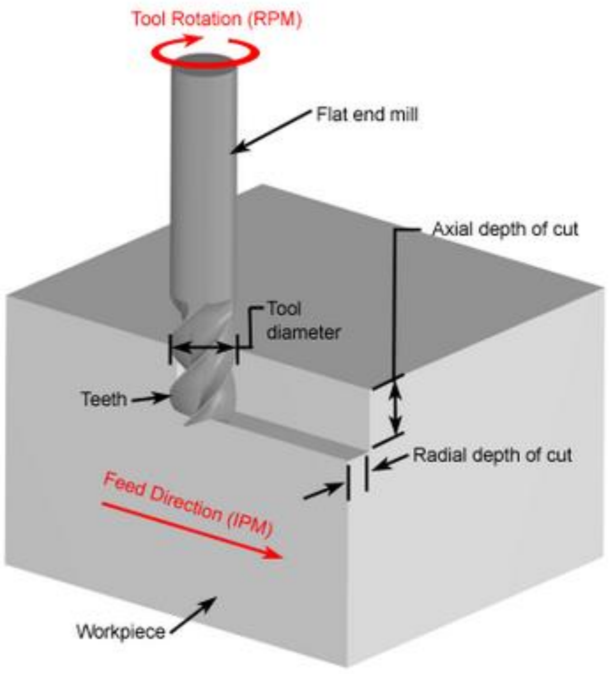


Cutting Speed, Feed & Depth of Cut of Milling Machine

Cutting speed:- The speed at which the metal is removed from the work piece in one revolution of the cutter. It is expressed in meter per minute.

Feed:- It is defined as the distance which the work piece advances for each revolution of the cutter. It is expressed in mm/ revolution.

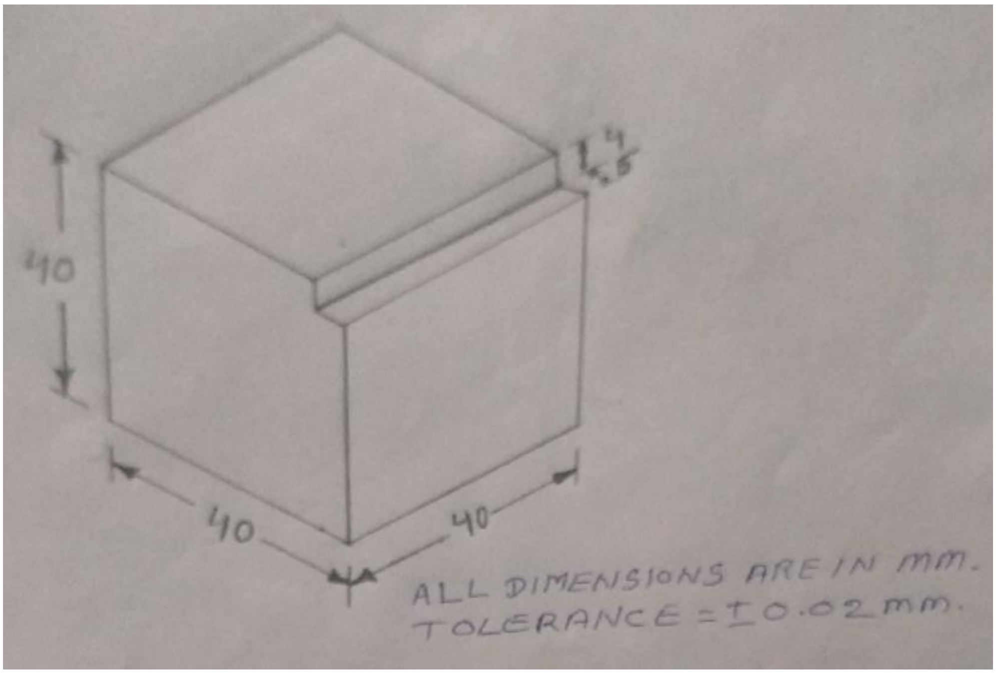
Depth of cut:- It is defined as the thickness of metal is to be removed from the work piece by the cutter. It is expressed in mm.



CUTTING FLUID

During cutting due to friction between the job and the cutting tool, heat is generated. This causes tools to wear out and their cutting capacity is reduced. Finishing and faster cutting cannot be done with the cutting tools. Cutting fluid is used to avoid damage of the cutting tools. For different jobs different kinds of cutting fluids are used i.e. soluble oil, mineral lard oil, sulphureted oil, kerosene oil and low viscosity neutral oil. Soluble oil is used for mild steel.

AIM:- To Make Single Step on a Square Block.



Material Used :- M S Square Block

Size Used :- (40 x 40 x 40)mm.

Tools & Equipments Used :-

Milling Machine, Steel Rule, Vernier calliper, Odd leg calliper, Dot Punch, Ball peen Hammer (200gm), Soft Hammer, Flat Smooth File, Side Milling Cutter,

PROCEDURE :

Measuring & Marking_:- After receive the work piece, first measure the size of the work piece (length, width & height) by vernier calliper whether it is correct or not as per basic size. Then coating the surface by chalk & also mark the lines of the step on the chalking surface by odd leg calliper & steel rule as per fig. Then punch the marking lines by dot punch & hammer.

Setting the Job & Tool :- After measurement, set the job i n machine vice at proper height & set the milling cutter on the arbor.

Operation :- Then set the cutting edge of the cutter on 5mm marking line of the job by cross feed handle. Then remove the extra metal from the marking area by increasing the depth of cut time to time with the help of knee elevating handle till to get the proper depth of the step as per fig.

Checking :- After complete all operation, check the depth and width of the step by vernier calliper, whether it is correct or not as per fig.

Submitting :- After checking, punching the roll no & branch on the job by number punch & letter punch & submit it for evaluation.

Experiment - 4

Theory :

Shaping machine or shaper is a reciprocating type of machine tool in which a single point cutting tool moves in a reciprocating manner over a stationary work piece. This machine is used to produce a flat surface and the flat surface may be horizontal, vertical or inclined. Besides producing a flat surface it is also used for making square grooves, rectangular grooves, v-grooves, kee-ways, slots and also for making steps.

SPECIFICATIONS OF THE SHAPING MACHINE

- Shaping machine is specified according to the Maximum length of stroke.
- Size of the table i.e. length, width & depth of the table.
- Distance between table surface and ram.
- Maximum movement of the table i.e. vertical and horizontal

TYPES OF SHAPING MACHINES

Different types of shaping machines are used in different places according to their utility. Types of shaping machines are classified on the basis of,

- Design of the work table
- Driving mechanism
- Direction of movement of ram Nature of cutting stroke

Design of the Work Table

According to the design of the work table shapers are two types. Standard shaper & Universal shaper.

Standard Shaper :-

In standard shaper, the work table has only two movements i.e. horizontal and vertical. But it cannot be swivelled or tilted.

Universal Shaper :-

In universal shaper, the work table moves vertically, horizontally and also swivelled or tilted. This type of shaper is mostly used in the tool room.

Driving Mechanism

According to the driving mechanism shapers are of three types. Crank shaper, Gear shaper & Hydraulic shaper.

Crank Shaper:- A crank shaper is the most common type of shaper which has a crank and slotted lever quick return mechanism. In this machine the bull gear receives power from the motor and a crank is arranged inside the body of the bull gear. The crank changes the circular motion of the power from motor to the reciprocating motion of the ram.

Gear Shaper:- In gear shaper, a rack is fixed below the ram which is driven by a spur gear.

Hydraulic Shaper:-This type of shaper is more efficient than crank and gear shaper. In this type of shaper, there is no crank and gear to move the ram. The reciprocating movement of ram is obtained by the oil pressure on the piston in a cylinder. The end of the piston is connected to the ram.

Direction of Movement of the Ram

According to the direction of movement of ram, shapers are of two types i.e Horizontal shaper & Vertical shaper.

Horizontal Shaper:-In this type of shaper, the ram moves in a horizontal direction. This type of shaper is mainly used to produce flat surface and also used for making steps, slots & grooves.

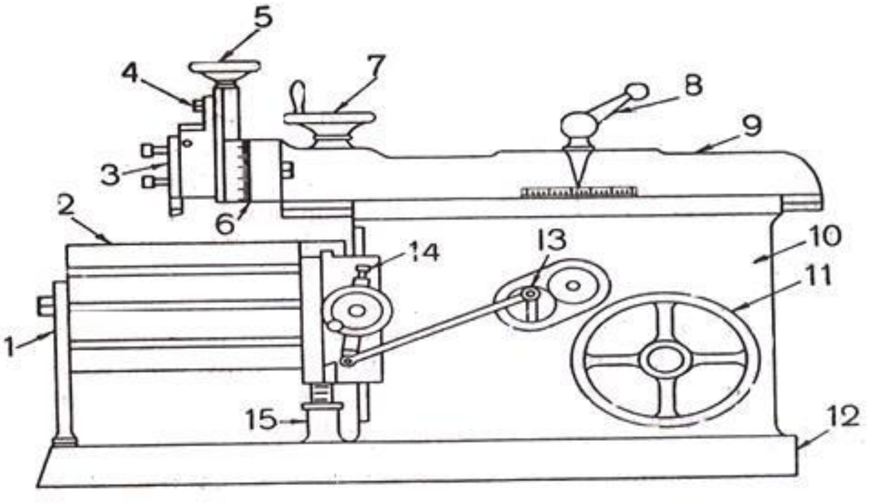
Vertical Shaper:-In this type of shaper, the ram moves vertically up ward and down ward direction. This type of shaper is used for machining internal surfaces, keyways, slots or grooves.

Nature of Cutting Stroke

According to the nature of cutting stroke, shapers are of two types: Push cut shaper & Draw cut shaper.

Push Cut Shaper:-In this shaper, ram pushes the cutting tool across the work piece. The metal is removed from the work piece in forward stroke, but in return stroke it does not cut the metal.

Draw Cut Shaper:-In this type of shaper, the metal is removed in back ward stroke. So in this shaper, the back ward stroke is the cutting stroke and the forward stroke is the idle stroke



Parts of a standard shaper

1. Table support, 2. Table, 3. Clapper box, 4. Apron clamping bolts, 5. Downfeed hand wheel, 6. Swivel base degree graduations, 7. Position of stroke adjustment handwheel, 8. Ram block locking handle, 9. Ram, 10. Column, 11. Driving pulley, 12. Base, 13. Feed disc, 14. Pawl mechanism, 15. Elevating screw.

PARTS OF SHAPERS

The different parts of shapers are:

Base:-The base of the shaper is made of cast iron. The base of the shaper gives support to the column and other parts.

Column:- Column is a box like part mounted on the base. It is made of cast iron. On the top of the column two dovetail guide ways are made. The ram reciprocates over the column by this dovetail guide ways. The crank and slotted link mechanism are arranged inside the column which helps to reciprocate the ram.

Cross-rail:- The cross rail is mounted on the front vertical guide ways of the column. A lead screw & an elevating shaft are arranged inside the crossrail. By rotating the elevating shaft the crossrail moves vertically upward and downward by the guide ways provided on the front side of the column.

By rotating the lead screw (by hand or by power) the work table moves longitudinally, perpendicular to the axis of the ram over the crossrail.

Work Table:-The work table is a box shaped casting. T-slots are cut both on the top and sides for clamping the work piece and also a machine vice is clamped by T-slots for holding the work piece for different type of operation. The work table is bolted to the saddle which is mounted on the crossrail. The table can be moved vertically and cross wise with the help of saddle and crossrail.

Ram:-The ram is locate on the top of the column. The ram reciprocates over the column by the dovetail guide ways provided on the top of the column. A stroke adjustment lever is mounted on the column which helps to adjust different strokes of the ram. The forward stroke of the ram is called the cutting stroke or working stroke and the backward stroke is called the return stroke or idle stroke. One cycle of shaper is the complete of one forward stroke and backward stroke.

Tool Head:-Tool head is attached to the front portion of the ram with the help of nuts and bolts. It has a swivel base and degree graduation is marked on it which helps to swivel the tool head in angle from 0^0 to 90^0. A hand traversing wheel is attached on the top of the tool head which helps to give the down feed or give the depth of cut. The tool head holds the cutting tool by the help of single screw tool post. The tool post is mounted on a clapper box which is attached on the front part of the tool head. The clapper box helps to lift the cutting tool on the return stroke to save the cutting edge of the tool from being damaged.

SHAPER DRIVE MECHANISM (Quick Return Mechanism)

A shaper drive mechanism converts the rotary motion of the motor into the reciprocating motion of the ram. In standard shaper, metal is removed in the forward stroke, but no metal is removed in return stroke. To reduce the machining time it is necessary to reduce the time taken by the return stroke. So that the ram moves in slow speed during cutting stroke whereas during the return stroke the ram moves at a faster rate to reduce the return time. This mechanism is called quick return mechanism.

FEED MECHANISM

In shaper two types of feeds are used .i.e. down feed and cross feed .Down feed is given by rotating the down feed hand wheel of the tool head by hand. Cross feed is given by rotating the cross feed lead screw which is provided inside the cross rail by hand or by power (pawl mechanism). To give the automatic feed to the table, a slotted driving disc is driven by a gear connected to the bull gear shaft. The rotation speed of the driving disc is same as the bull gear speed. The driving disc is linked to the rocker arm by a connecting rod. The rocker arm carries a spring loaded reversible pawl which straight on one side and bevel on the other side. The rocker arm is fulcrum at the center of the ratchet wheel which is keyed to the cross feed lead screw. As the driving disc rotates it causes pawl to oscillate. By offsetting the driving pin on the slotted disc, the rocker arm is made to oscillate to move the pawl over the teeth of ratchet wheel which helps move the cross feed lead screw and work table. To reverse the direction of table, the pawl is lifted by the knob and turned round so that it moves the ratchet wheel in the opposite direction. When no feed is required, the pawl is lifted & turned by 90 degrees, so that the pin is out of groove and the pawl is free from ratchet wheel.

WORK HOLDING DEVICES

For holding or clamping the work piece on the work table different types of holding devices are used. Shaper holding devices are: machine vice, parallel strips, clamps, angle plate, v-block.

Machine vice:- It is a holding device which is used in a shaper to hold the work piece for different types of operations. Machine vices are of two types i.e. plain machine vice and swivel base machine vice.

Parallel strips:- Parallel strips are used to give support to the job and raise the surface to be shaped to the proper height above the vice jaw

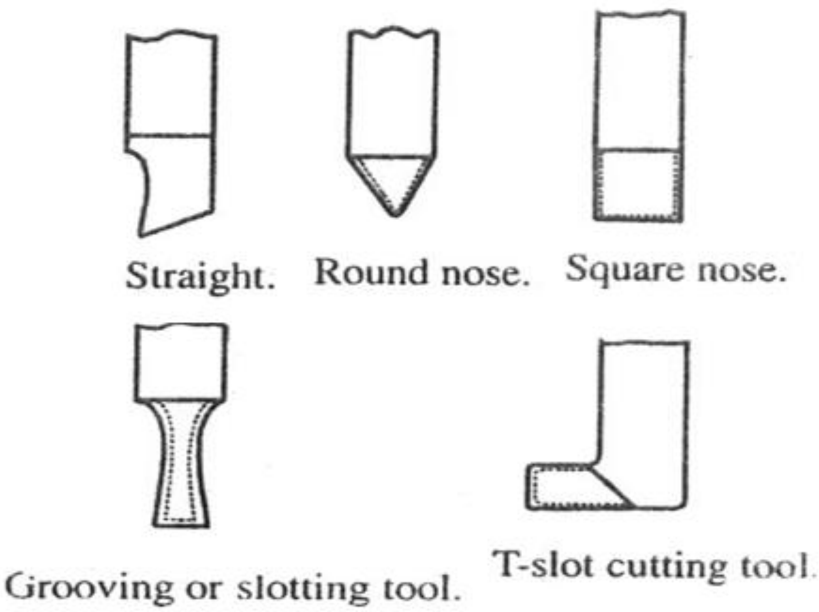
SHAPER OPERATIONS

Different types of operations are carried out in shaper are

- Horizontal shaping (facing top of the job)
- Vertical shaping (facing sides)
- Cutting slots, grooves, keyways & steps
- Angular shaping (Dovetail cutting)
- Cutting gear teeth

SHAPER CUTTING TOOLS

The cutting tools used in shaper are single point cutting tools similar to the lathe cutting tools and the tool holders are also same as lathe tool holder.



Shaper tools are madeup of high speed steel, cast alloy or cemented carbide steel. HSS cutting tool is the most common tool used for general work in a shaper. But cemented carbide cutting tool is used for hard material to be machined. Some of the most common cutting tools are,

Left hand & right hand cutting tool for planning.

Left hand & right hand side facing tool for vertical shaping and for shaping sharp corners.

Round nose cutting tool for making round grooves and can cut down on both left & right sides.

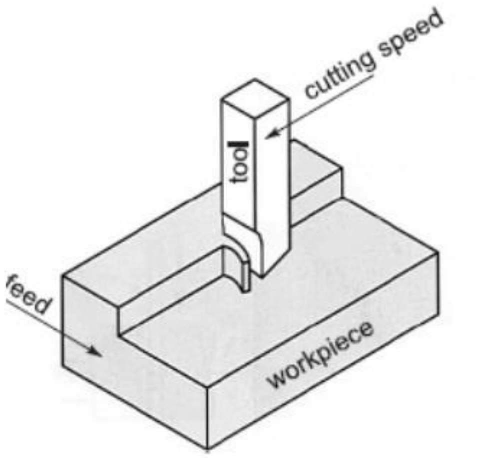
V-nose cutting tools for making v-grooves.

Straight nose & flat or square nose tools for making slots, keyways and cutting steps.

CUTTINGSPEED, FEED & DEPTH OF CUT

Cutting Speed:-

The speed at which the metal is removed by the cutting tool from the work piece is called cutting speed. It is expressed in meter per minute.



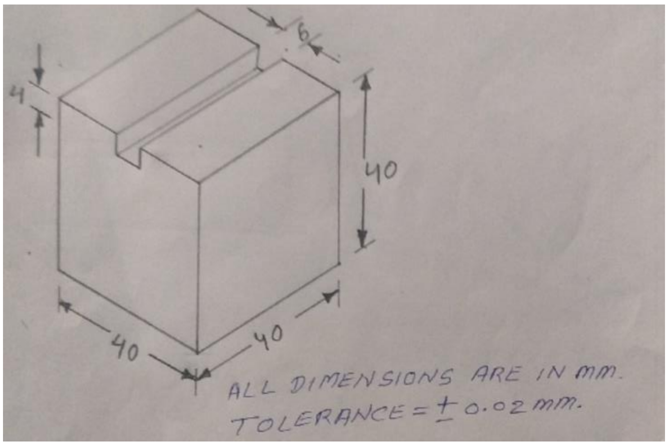
Feed:-

It is defined as the distance which the work piece advances perpendicular to the axis of reciprocation of the ram per double stroke. It expressed in mm. The feed is always given at the end of return stroke when the tool is not cutting the metal.

Depth of Cut:-

Depth of cut is defined as the thickness of metal removed in one cut. In a shaper, depth of cut is the distance through which the tool digs into the metal during cutting stroke. It is expressed in mm.

AIM : To Make a Key way on a Square Block.



Material Used :- M S Square Block

Size Used :- (40 x 40 x 40)mm.

Tools & Equipments Used :-

Shaping Machine, Steel Rule, Vernier calliper, Odd leg calliper, Dot Punch, Ball peen Hammer (200gm), Soft Hammer, Flat Smooth File, Square nose Cutting Tool.

PROCEDURE :

Measuring & Marking_:- After receive the work piece, first measure the size of the work piece (length, width & height) by vernier calliper whether it is correct or not as per basic size. Then mark the surface by chalk & also mark the lines of the key way on the chalking surface by odd leg calliper & steel rule as per fig. Then punch the marking lines by dot punch & hammer.

Setting the Job & Tool :- After measurement, set the job i n machine vice at proper height & set the tool in tool post. Then set the nose of the tool in between two marking lines of the key way on the job.

Operation :- After setting the job and tool, set the depth of cut by touching the cutting edge of the tool on the job. Then remove the extra metal from the marking area by increasing the depth of cut time to time with the help of down feed handle till to get the proper depth of the key way as per fig.

Checking :- After complete all operation, check the depth and width of the key way by vernier calliper, whether it is correct or not as per fig.

Submitting :- After checking, punching the roll no & branch on the job by number punch & letter punch & submit it for evaluation.

Experiment - 5

Theory :

Welding is the process of joining similar metals by the application of heat, with or without application of pressure or filler metal, in such a way that the joint is equivalent in composition and characteristics of the metals joined. In the beginning, welding was mainly used for repairing all kinds of worn or damaged parts. Now, it is extensively used in manufacturing industry, construction industry (construction of ships, tanks, locomotives and automobiles) and maintenance work, replacing riveting and bolting, to a greater extent.

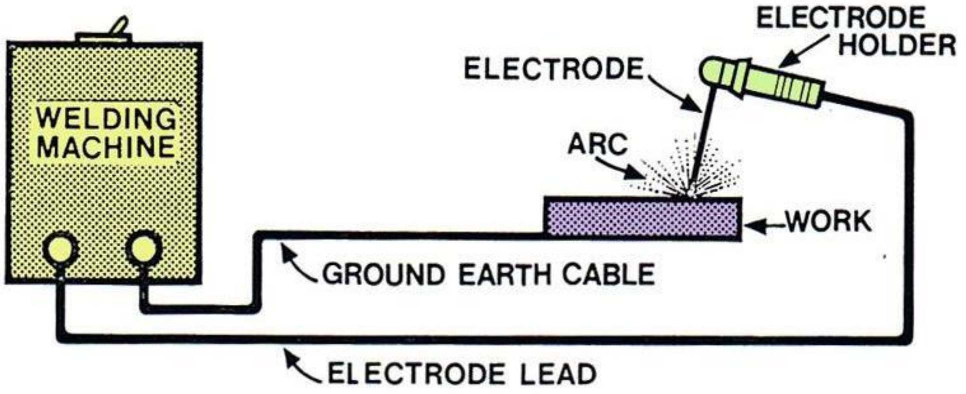
The various welding processes are:

1. Electric arc welding,
2. Gas welding
3. Thermal welding
4. Electrical Resistance welding and
5. Friction welding

However, only electric arc welding process is discussed in the subject point of view.

ELECTRIC ARC WELDING

Arc welding is the welding process, in which heat is generated by an electric arc struck between an electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes through ionized gas.



Arc welding set up.

Any arc welding method is based on an electric circuit consisting of the following parts:

a. Power supply (AC or DC)
b. Welding electrode
c. Work piece
d. Welding leads (electric cables) connecting the electrode and work piece to the power

supply.

Electric arc between the electrode and work piece closes the electric circuit. The arc temperature may reach 10000°F (5500°C), which is sufficient for fusion the work piece edges and joining them. When a long joint is required the arc is moved along the joint line. The front edge of the weld pool melts the welded surfaces when the rear edge of the weld pool solidifies forming the joint.

Transformers, motor generators and rectifiers' sets are used as arc welding machines. These machines supply high electric currents at low voltage and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and the arc melts the surface so that, the metals to be joined are actually fixed together.

Sizes of welding machines are rated according to their approximate amperage capacity at 60% duty cycle, such as 150,200,250,300,400,500 and 600 amperes. This amperage is the rated current output at the working terminal.

Transformers

The transformers type of welding machine produces A.C current and is considered to be the least expensive. It takes power directly from power supply line and transforms it to the voltage required for welding. Transformers are available in single phase and three phases in the market.

Motor generators

These are D.C generators sets, in which electric motor and alternator are mounted on the same shaft to produce D.C power as pert the requirement for welding. These are designed to produce D.C current in either straight or reversed polarity. The polarity selected for welding depends upon the kind of electrode used and the material to be welded.

Rectifiers

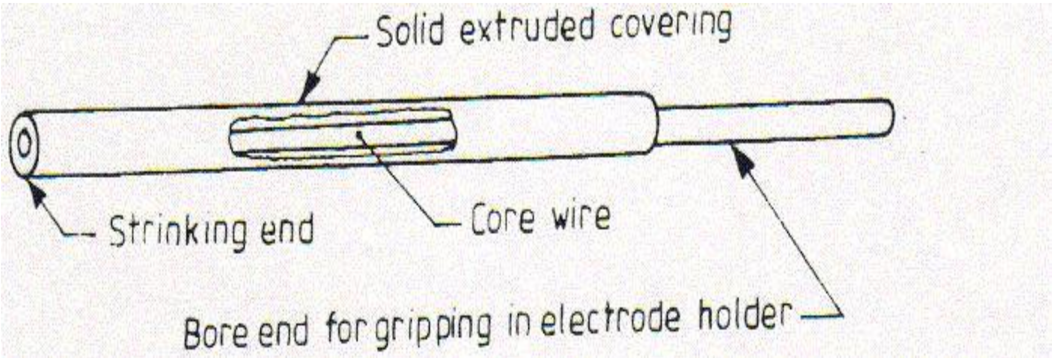
These are essentially transformers, containing an electrical device which changes A.C into D.C by virtue of which the operator can use both types of power (A.C or D.C, but only one at a time).In addition to the welding machine; certain accessories are needed for carrying out the welding work.

Welding cables

Two welding cables are required, one from machine to the electrode holder and the other, from the machine to the ground clamp. Flexible cables are usually preferred because of the case of using and coiling the cables. Cables are specified by their current carrying capacity, say 300 A, 400 A, etc.

Electrodes

Filler rods are used in arc welding are called electrodes. These are made of metallic wire called core wire, having approximately the same composition as the metal to be welded. These are coated uniformly with a protective coating called flux. While fluxing an electrode; about 20mm of length is left at one end for holding it with the electrode holder. It helps in transmitting full current from electrode holder to the front end of the electrode coating. Flux acts as an insulator of electricity. Figure.4 shows the various parts of an electrode.



Parts of an electrode

In general, electrodes are classified into five main groups; mild steel, carbon steel, special alloy steel, cast iron and non-ferrous. The greatest range of arc welding is done with electrodes in the mild steel group. Various constituents like titanium oxide, potassium oxide, cellulose, iron or manganese, Ferro- silicates, carbonates, gums, clays, asbestos, etc., are used as coatings on electrodes. While welding, the coating or flux vaporizes and provides a gaseous shield to prevent atmospheric attack.

The size of electrode is measured and designated by the diameter of the core wire in SWG and length, apart from the brand and code names; indicating the purpose for which there are most suitable.

Electrodes may be classified on the basis of thickness of the coated flux. As

1. Dust coated or light coated
2. Semi or medium coated and
3. Heavily coated or shielded

Electrodes are also classified on the basis of materials, as

1. Metallic and
2. Non-metallic or carbon

Metallic arc electrodes are further sub-divided into

1. Ferrous metal arc electrode (mild steel, low/medium/high carbon steel, cast iron, stainless steel, etc)
2. Non-ferrous metal arc electrodes (copper, brass, bronze, aluminium, etc).

In case of non-metallic arc electrodes, mainly carbon and graphite are used to make the electrodes.

WELDING TOOLS

Electrode holder

The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light, strong and easy to handle and should not become hot while in operation. Figure shows one type of electrode holder. The jaws of the holder are insulated, offering protection from electric shock.

Electrode holder

Ground clamp

Ground clamp

It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit. It should be strong and durable and give a low resistance connection.

Wire brush and chipping hammer

A wire brush is used for cleaning and preparing the work for welding. A chipping hammer is used for removing slag formation on welds. One end of the head is sharpened like a cold chisel and the other, to a blunt, round point. It is generally made of tool steel. Molten metal dispersed around the welding heads, in the form of small drops, is known as spatter. When a flux coated electrode is used in welding process, then a layer of flux material is formed over the welding bead which contains the impurities of weld material. This layer is known as slag.

Removing the spatter and slag formed on and around the welding beads on the metal surface is known as chipping.

Wire brush

Chipping hammer

Welding table and cabin

It is made of steel plate and pipes. It is used for positioning the parts to be welded properly. Welding cabin is made-up by any suitable thermal resistance material, which can isolate the surrounding by the heat and light emitted during the welding process. A suitable draught should also be provided for exhausting the gas produced during welding.

Face shield

A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available either in hand or helmet type. The hand type is convenient to use wherever the work can be done with one hand. The helmet type though not comfortable to wear, leaves both hands free for the work. Shields are made of light weight non-reflecting fiber and fitted with dark glasses to filter out the harmful rays of the arc. In some designs, a cover glass is fitted in front of the dark lens to protect it from spatter.

Hand gloves

These are used to protect the hands from electric shocks and hot spatters

Hand-held type

Hand gloves

Helmet type

Face shield

TECHNIQUES OF WELDING

Preparation of work

Before welding, the work pieces must be thoroughly cleaned of rust, scale and other foreign material. The piece for metal generally welded without bevelling the edges, however, thick work piece should be bevelled or veed out to ensure adequate penetration and fusion of all parts of the weld. But, in either case, the parts to be welded must be separated slightly to allow better penetration of the weld.

Before commencing the welding process, the following must be considered

a) Ensure that the welding cables are connected to proper power source.

b) Set the electrode, as per the thickness of the plate to be welded.

c) Set the welding current, as per the size of the electrode to be used.

Table for Electrode current Vs electrode size Vs plate thickness.

Plate thickness (mm)	Electrode size (mm)	Electrode current range (amp)
1.6	1.6	40-60
2.5	2.5	50-80
4.0	3.2	90-130
6.0	4.0	120-170
8.0	5.0	180-270
25.0	6.0	300-400

NOTE: While making butt welds in thin metal, it is a better practice to tack-weld the pieces intervals to hold them properly while welding.

Striking an arc

The following are the stages and methods of striking an arc and running a bead

a) Select an electrode of suitable kind and size for the work and set the welding current at a proper value.

b) Fasten the ground clamp to either the work or welding table.

c) Start or strike the arc by either of the following methods

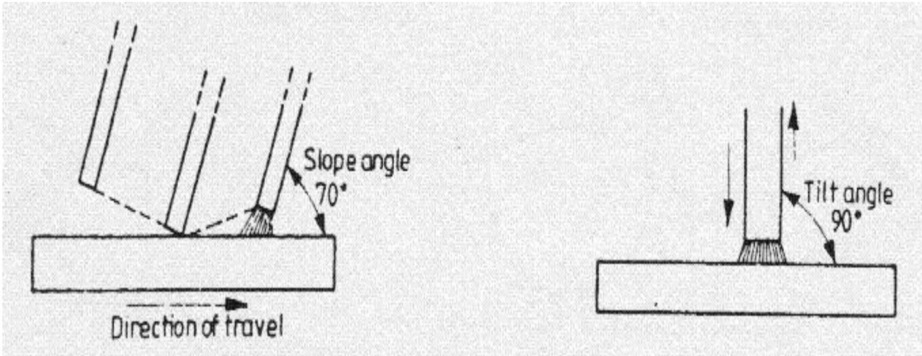
Strike and withdraw

In this method the arc is started by moving the end of the electrode onto the work with a slow sweeping motion, similar to striking a match.

Touch and withdraw

In this method, the arc is started by keeping the electrode perpendicular to the work and touching or bouncing it lightly on the work. This method is preferred as it facilitates restarting the momentarily broken arc quickly. If the electrode sticks to the work, quickly bend it back and forth, pulling at the same time. Make sure to keep the shield in front of the face, when the electrode is freed from sticking.

As soon as the arc is struck, move the electrode along, slowly from left to right, keeping at 15º to 25º from vertical and in the direction of welding.



Strike and withdraw Touch and withdraw

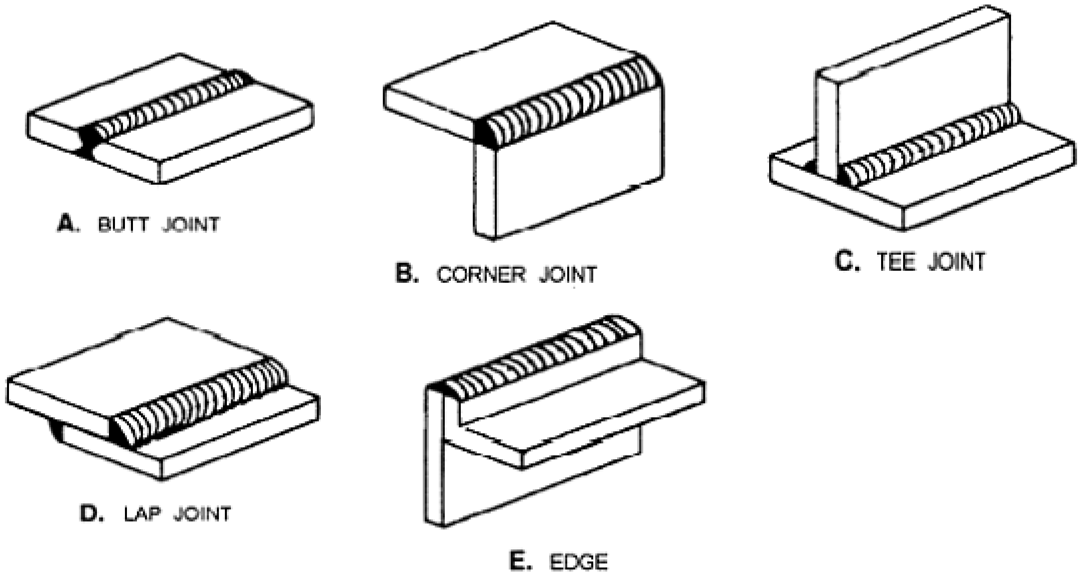
Weaving

A steady, uniform motion of the electrode produces a satisfactory bead. However, a slight weaving or oscillating motion is preferred, as this keeps the metal molten a little longer and allows the gas to escape, bringing the slag to the surface. Weaving also produces a wider bead with better penetration.

TYPES OF JOINTS

Welds are made at the junction of the various pieces that make up the weldment. The junctions of parts, or joints, are defined as the location where two or more numbers are to be joined. Parts being joined to produce the weldment may be in the form of rolled plate, sheet, pipes, castings, forgings, or billets. The five basic types of joints are listed below.

A butt joint is used to join two members aligned in the same plane (fig. 3.10, view A). This joint is frequently used in plate, sheet metal, and pipe work. A joint of this type may be either square or grooved.



Types of welding joints.

Corner and tee joints are used to join two members located at right angles to each other (fig. B & C). In cross section, the corner joint forms an L-shape, and the tee joint has the shape of the letter T. Various joint designs of both types have uses in many types of metal structures.

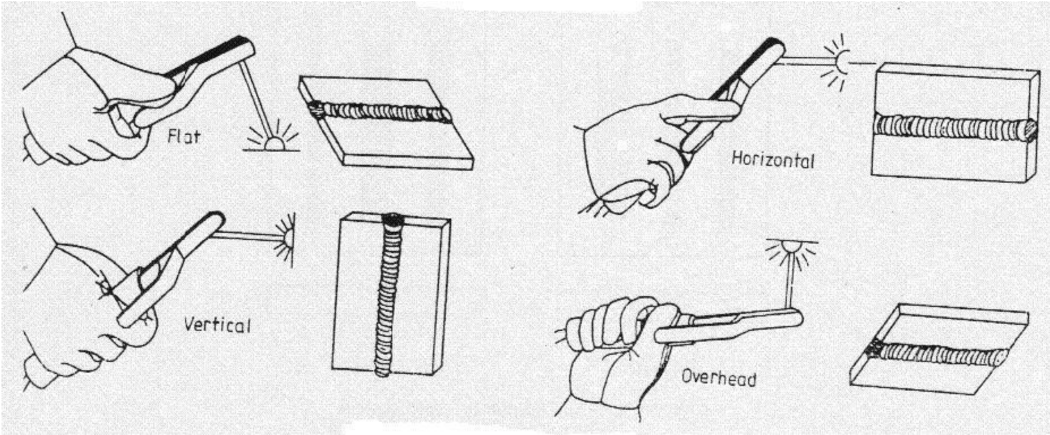
A lap joint, as the name implies, is made by lapping one piece of metal over another (fig. D). This is one of the strongest types of joints available; however, for maximum joint efficiency, you should overlap the metals a minimum of three times the thickness of the thinnest member you are joining. Lap joints are commonly used with torch brazing and spot welding applications.

An edge joint is used to join the edges of two or more members lying in the same plane. In most cases, one of the members is flanged, as shown in figure (E). While this type of joint has some applications in plate work, it is more frequently used in sheet metal work. An edge joint should only be used for joining metals 1/4 inch or less in thickness that are not subjected to heavy loads.

WELDING POSITIONS

All welding is done in one of four positions, depending upon the location of the welding joints, appropriate position of the electrode and hand movement.

1. Flat
2. Horizontal
3. Vertical
4. Overhead



Welding positions

Flat position welding

In this position, the welding is performed from the upper side of the joint, and the face of the weld is approximately horizontal. Flat welding is the preferred term; however, the same position is sometimes called down hand.

Horizontal position welding

In this position, welding is performed on the upper side of an approximately horizontal surface and against an approximately vertical surface.

Vertical position welding

In this position, the axis of the weld is approximately vertical as shown in figure.

Overhead position welding

In this welding position, the welding is performed from the underside of a joint.

ADVANTAGES & DISADVANTAGES OF ARC WELDING

Advantages

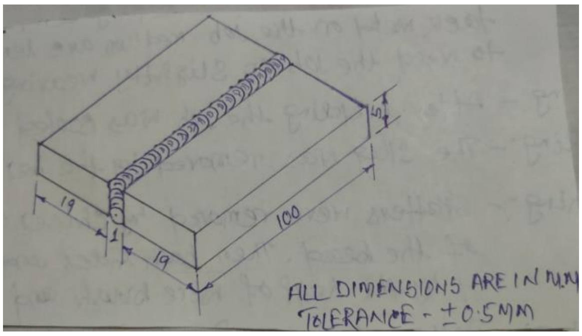
1. Welding process is simple.
2. Equipment is portable and the cost is fairly low.
3. All the engineering metals can be welded because of the availability of a wide variety of electrodes.

Disadvantages

1. Mechanized welding is not possible because of limited length of the electrode.
2. Number of electrodes may have to be used while welding long joints.

A defect (slag inclusion or insufficient penetration) may occur at the place where welding is restarted with a fresh electrode.

AIM : To make a butt joint by arc welding.



MATERIAL USED : M.S Flat and M.S Electrode

SIZE USED : (101 x 19 x 5) 2pcs and 3.15mm(dia.) 1pc

TOOLS AND EQUIPMENTS USED :

Steel rule, Scriber, Try square, Bench vice, Hcksaw, Odd leg calliper, Rough file, Leather apron, Hand glove, Hand shield, Tong, Chipping hammer, chisel, Ball peen hammer, Wire brush, Number punch, Transformer with all accessories.

PROCEDURE :

Measuring : A mild steel flat of (19x5)mm was taken and by using steel rule it was measured about 101mm.

Marking : Chalk was coated on m.s flat then by using scriber and try square the line was marked about 101mm.

Cutting : The m.s flat was hold with the help of bench vice and marking line was cut by using hacksaw.

Edge preparation : The edges of m.s flat were prepared by using odd leg calliper, try square and rough file to obtain required dimension(100x19x5)mm for two pieces.

Job setting : The two pieces of m.s flat were placed in the arc welding booth on flat position with 1mm root gap for butt joint.

Current setting : Current was set up (90-120)Amp by using transformer according to the 3.15mm diameter of the electrode.

Welding : First arc was produced by scratching method then tack weld on the job. Medium arc length was maintained to weld the job in slightly weaving motion.

Cooling : After welding the job was cooled by natural air.

Chipping : The slag was removed by the help of chipping hammer.

Cleaning : Spatters were removed by chisel and hammer both side of the bead.Then both sides and beads were cleaned by the help of wire brush and rough file.

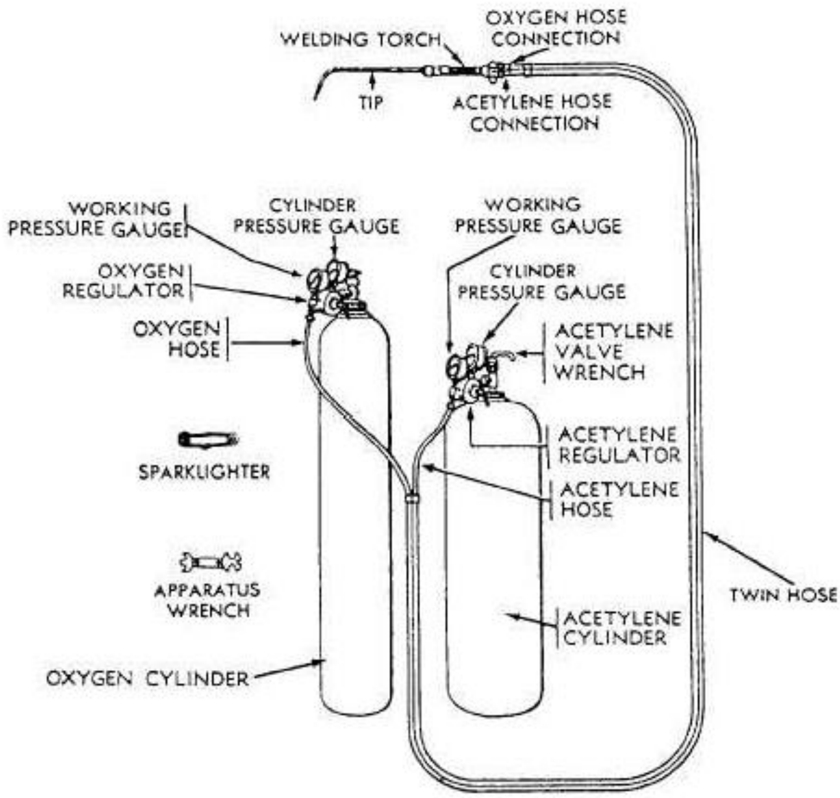
Punching : Roll number was punched by number punch after checking the dimensions.

Submitting : The job was submitted for assessment

Experiment - 6

Theory :

Oxy-acetylene is commonly used for gas welding. It consists of the supply of oxygen and acetylene under pressure cylinders, pressure regulators, a torch, hoses and accessories like goggles and a lighter. The oxygen and acetylene cylinders are connected to the torch through pressure regulators and hoses. The regulator consists of two pressure gauges, one for indicating the pressure within the cylinder and the other shows the pressure of the gas fed into the torch, which may be regulated. The torch mixes the two gases the two gases and the flame may be controlled by adjusting the oxygen and acetylene supply.



Note :

- In oxy-acetylene welding the flame must be supplied by a correct balance of oxygen and acetylene so that it is neither oxidizing nor carburizing, since either of these flames would weaken the weld.
- Oxygen regulators have “Right hand” threads with plain nuts and acetylene regulators have “Left hand” threads with notched hexagon nuts so that they cannot be confused. The regulator is closed by unscrewing the regulating screw.

- Apart from oxygen and acetylene gases, there are other combinations of gases used to obtain hot flame. They are oxygen and hydrogen, air and acetylene and oxygen and propane. However, the combination of oxygen and acetylene is the most commonly used, as the heat produced is maximum in this case.

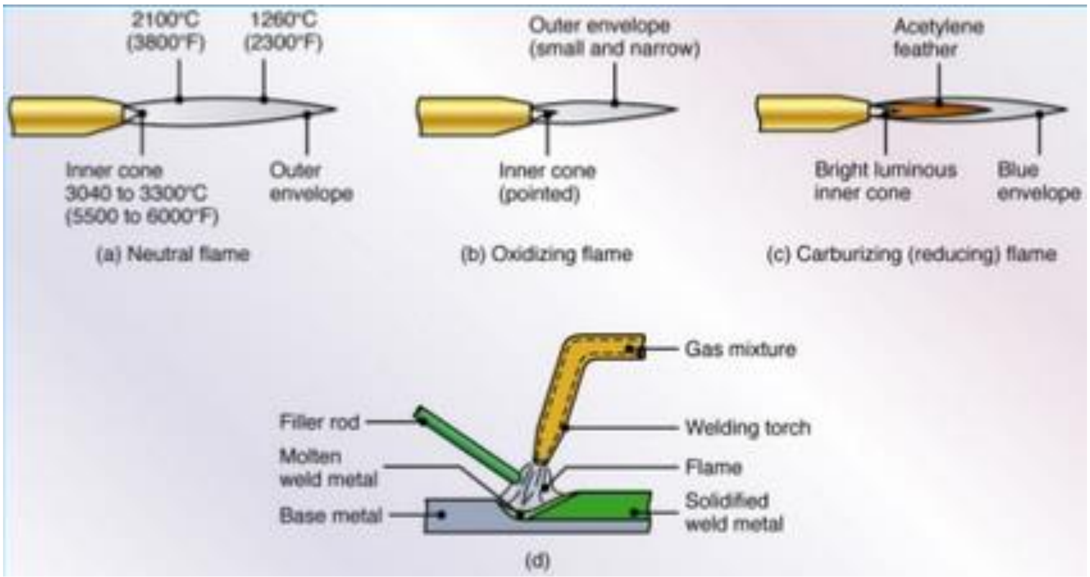
Goggles

Goggles with colour glasses are used to protect the eyes from glare and flying bits of hot metal. A welding table with a top of fire bricks is recommended for oxy-acetylene welding.

Types of Flames

The correct adjustment of the flame is important for efficient welding.

When oxygen and acetylene are supplied to the torch in nearly equal volumes, **a neutral flame** is produced having maximum temperature of 3200^0 C. The neutral flame is widely used for welding steel, stainless steel, cast iron, copper, aluminium, etc. Carburizing flame produced with an excess of acetylene, is need for welding lead. Oxidizing flame with excess of oxygen is used for welding brass.



Depending upon the thickness of the job, a different torch nozzle size is used. The pressure of the gases and the flame size vary depending upon the size of the nozzle tip.

Filler Rods

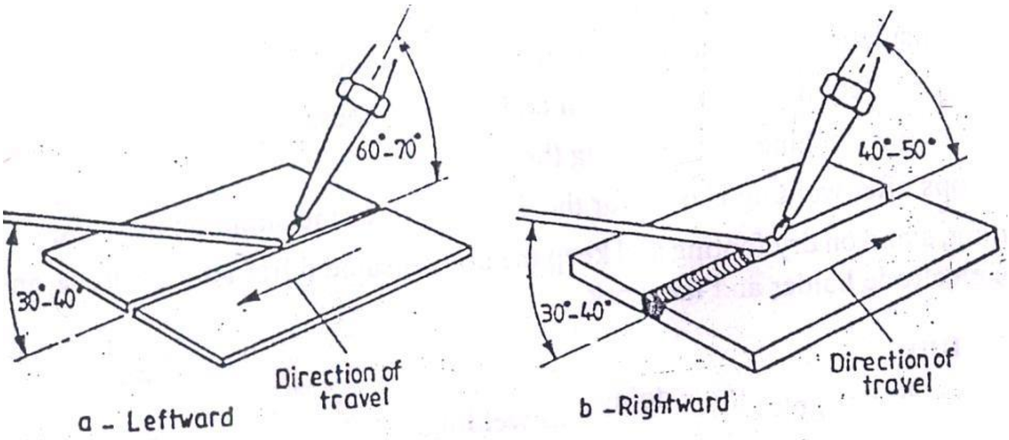
For oxy-acetylene gas welding, filler rods are not coated with flux; however they are applied separately. Mild steel welding rods are usually copper coated to prevent rusting. Cast iron rods are square shaped. Brazing rods are made of brass or bronze. They are usually one meter long. Filler rod size increases as the metal thickness to be joined increases.1.5mm diameter filler rod is recommended for18 SWG sheet and 2 to 3mm diameter for3mm thick sheet and soon.

Note :

Except for mild steel, every metal requires a good quality of flux for better welding quality. Sometimes, borax powder may be used as a flux for gas welding of mild steel. In general, the flux should be of such a quality that it can dissolve impurities in molten metal and light in weight so that they can float above the welding metal in molten condition.

Technique of Welding

Adjusting the equipment and lighting the torch, the recommended stages for adjusting the gas welding equipment and lighting the torch are as follows:



- Select the proper size tip for the   job and insert it carefully into the torch.
- Check the valves on the torch to ascertain that they are turned-off (clockwise)
- Open the acetylene cylinder valve slightly, say¼ to½ turn.
- Open the oxygen cylinder valve slowly, till it is fully open.
- Open the acetylene valve on the torch and turn the acetylene regulator screw clockwise, until the gauge reads 0.5 to 1kg/cm2 of pressure. Then close the valve on the torch.
- Open the oxygen valve on the torch to check the flow and close it.
- Put-on the welding goggles, gloves and apron.
- Open the acetylene valve on the torch by¼ turn. Light the torch with a lighter, keeping its tip away from the cylinders and your body.
- Adjust the acetylene valve on the torch until the flame extends slightly form the end of the tip.
- Open and adjust the oxygen valve on the torch until the desired flame is obtained.

WELDING PROCESS

The following are the steps involved in a gas welding work.

- Prepare the work pieces to be welded and place them in proper position on the welding table.
- Wear goggles, gloves and an apron.
- Select the proper size tip for the job and fixit to the torch.
- Select the filler rod of recommended size.
- Adjust the welding equipment and light the torch.
- Adjust the torch for neutral flame.
- Hold the torch; with the inner cone about 3mm away from the metal and tack-weld the pieces at either end.
- Starting from one end, weld along the edge with a zigzag torch movement. Add the filler metal to the joint as welding progresses.

The two techniques of gas welding are used.

In leftward welding most of the heat is absorbed by filler material and hence it is preferred in welding thin sheets up to 6mm thick. In rightward welding most of the heat is absorbed by the base metal and so it is preferred in welding thick sheets of 6 to 25mm thick.

Note :

Do not touch the torch tip with the rod or molten metal. Always keep the rod in the melt, if the torch tip is too close to the melt, it will form small blow holes in the weld and the torch may back fire. Practice the rhythm of torch and rod movement for achieving good results.

Shutting off the equipment : After completing gas welding operation, the following procedure must be followed for shutting–off the equipment;

- First close the torch acetylene valve and then the torch oxygen valve.
- Close the acetylene cylinder valve first and then the oxygen cylinder valve.
- Drain the gas from the regulator and hose by opening the torch acetylene valve.
- Drain the oxygen from the regulator and hose by opening the torch oxygen valve.
- Open the regulator screws on each regulator and remove the pressure from the diaphragms of the regulators.
- Hang-up the hose and torch.

Tools and equipment used in gas welding :

Steel rule, scriber, try square, odd leg calliper, shearing machine, chisel, file, hammer, bench vice, tong, spanner, cylinder key, spark lighter, wire brush, hand glove, safety boot, apron, goggles.

Advantages of Gas Welding

- It can be used for a wide variety of manufacturing processes and repairs
- As the source of heat and filler metal are different, the welder can have control over filler metal deposition rates.

Disadvantages of Gas Welding

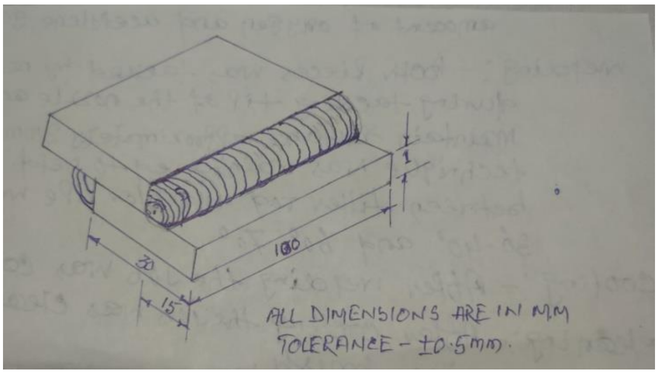
- It is not economical to join heavy sections.
- Flame temperature is less than the temperature of the arc welding.
- Fluxes used, produce fumes that are irritating in nature.

WELD DEFFECTS

A **welding defect** is any flaw that compromises the usefulness of a weldment. There is a great variety of **welding defects**. Different weld defects produced during arc and gas welding are Spatter, Crater, Lack of fusion, Blowholes, Less penetration.

1. Spatter: During arc welding molten metal's spread and deposited on the bead is known as spatter. It is formed due to excess current and improper arc length.
2. Crater: Depression or cavity occurs on the end of the bead is known as crater. It is formed due to excess current, temperature and improper technique.
3. Lack of fusion: Edges are not melted properly during arc and gas welding is known as lack of fusion. It is formed due to less current and temperature.
4. Blow holes: After arc and gas welding small holes formed on the bead is known as blow holes. It is formed due to excess current, improper arc length and technique.
5. Less penetration: Depth of less fusion is known as less penetration. It is formed due to low current, less temperature and improper root gap.

AIM : To make a lap joint by gas welding.



MATERIAL USED: M.S sheet and M.S C.C filler rod

SIZE USED: (101 x 31 x 1)mm-2pcs and 1.6mm(dia)-1pc

TOOLS AND EQUIPMENTS :

Steel rule, Scriber, Try square, Odd leg calliper, Bench vice, Shearing machine, Rough file, Ball peen hammer, Tong, Cylinder key, Spark lighter, Wire brush, Hand glove, Leather apron, Goggles, Oxy-acetylene cylinder with all accessories.

PROCEDURE :

Measuring : A mild steel sheet1mm was taken and by using steel rule it was measured about (101 x 31)mm.

Marking : Chalk was used on m.s. sheet then using scriber and try square the lines were marked for length 101mm and width 31mm for two pieces.

Cutting : The m.s sheet marking lines were cut by using shearing machine.

Edge preparation : The edges of m.s sheet were prepared by using odd leg calliper, try square and rough file to obtain required dimensions length 100mm and breadth 30mm.

Job setting : Two pieces of m.s sheet were placed one over another on gas welding table on flat position for lap joint.

Flame setting : The flame was set up neutral (3200 degree centigrade) equal amount of oxygen and acetylene gases.

Welding : Both piece was tacked by neutral flame during tacking tip of the nozzle and filler rod maintain distance approximately 3mm.Then left ward technique was maintained to weld pieces which angle between filler rod and blow pipe was taken to be (30-40) degree and (60-70) degree.

Cooling : After welding the job was cooled by natural air.

Cleaning : After cooling the job was cleaned by rough file and wire brush.

Punching : The job was punched by the number punch after checking the dimensions.

Submitting : The job was submitted for assessment.

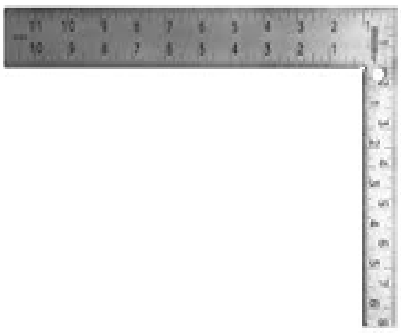
Experiment 7

Theory :

Sheet metal is simply formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut, bent and stretched into a variety of different shapes and joining. Sheets are specified by standard gauge number. Greater the gauge number, thinner the sheet of metal. It has its own significance as a useful trade in engineering works also for our day to day requirements. Common Example of sheet metal works are, hoopers, guards, covers, pipes, hoods, funnels, boxes, dust pan etc. In sheet metal work, the sheet metals used are : mild steel, galvanised iron, stainless steel, copper , brass, aluminium, tin. Basic tools used in sheet metal works are : steel rule, vernier calliper, micrometer, measuring tape, wire gauge, folding rule, straight edge, steel square, scriber, divider, punches, chisel, snip, shearing machine, plier, hammers, mallet, stakes, rivet set, rivet gun, anvil.

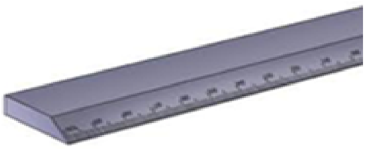
Folding rule : This is very useful in measuring and laying out larger work, the accuracy being 0.5 mm.

Steel square : It is a L-shaped piece of hardened steel with marks graduated on the edges for measuring. The narrow arm of the square is called tongue and the wide part is known as the body. It is used for marking in the perpendicular direction to any base line.



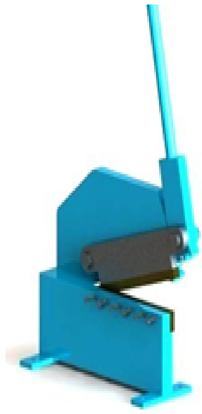
Wire gauge : This is a notched plate having a series of gauged slots. These are numbered according to the sizes of wire and sheet metal. It is used for measuring the diameter of wire. The number of slots in which wire oe sheet fits properly, is its gauge.

Straight edge : This is a flat graduated bar of steel with one longitudinal edge bevelled. These are available in length ranging from 1 to 3 meter. It is useful for scribing long straight lines.



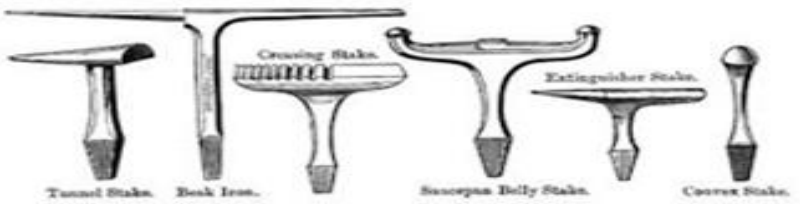
Snip : It is used for cutting thin metal sheets, before or after marking according to the job. It looks like scissors. Its edges are grinded at 80 degree angle and hardened and tempered. These are of two types. Straight snips are used for cutting the sheet in a straight line. Bent snips are used for cutting circular cuts curved cuts.

Hand shearing machine : It is fixed on the work bench with nut and bolts. Lower part is base and on the upper side a handle is fixed. Two blades are fitted between them. The lower blade is stationary and the upper blade moves up and down by the handle. It is used for cutting the thin sheets. It is specified according to the length of the blade.



Mallet : These are made of wood. These are used in carpentry work and for making netal sheets plain or to turn or bend them.

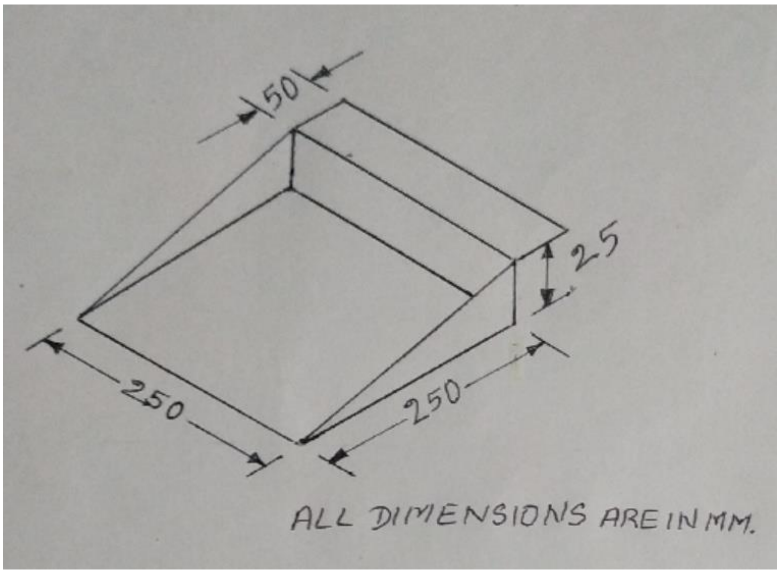
Stake : In different kind of jobs along with hand tools some special anvils are also used for sheet bending, grooving, riveting and hollowing etc. These anvils are called stakes. Different types of stakes are used for different types of work.



Rivet set : This is a hardened steel tool with a hollow in one end. It is used to shape the end of a rivet into a round, smooth head. (In order to join the jobs made of sheets or plates, rivets are used. It is used for making trunks and buckets etc. Rivets are made of mild steel, aluminium, copper, and brass.)

Rivet gun : It is also used for riveting purpose. Different types of rivet guns are used for different types of work.

AIM : To make a Dust Pan.



MATERIAL USED : G.I. Sheet.

MATERIAL SIZE USED : (325 X 300 X 1) mm.

TOOLS AND EQUIPMENTS USED :

Measuring tape, steel rule, straight edge, steel square, scriber, shearing machine, snip, hand drilling machine, hammer, mallet, stake, pop rivet gun and pop rivet.

PROCEDURE :

Measuring : At first G I sheet was measured (325 x 300 x 1) mm. using steel rule for checking whether it is correct or not as per supplied size.

Marking : After measurement, lines were marked as per fig. Using scriber and steel square.

Cutting : Then marking lines were cut as per fig. using snip.

Bending : According to the fig. the sheet was bend using stakes and mallet.

Riveting : After bending both joining parts were drilled using drilling machine and riveting was done to joint the both bending parts using pop rivet and pop rivet gun.

Submitting : After complete the job, it was submitted for evaluation.