

**MANUAL**

**ON**

**WORKSHOP PRACTICE**

**OF  
FIRST/SECOND  
SEMESTER**

**COMMON TO ALL BRANCHES**



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*Signature of the H.O.D./Lect.  
of the Department*



# SAFETY PRACTICE

## INTRODUCTION :

It's generally recognized that there is no machine or industrial or consumer product that cannot somehow be involved in an "accident" or "injury". "Safety" is a judgement of the acceptability of danger, where danger is the combination of hazard and risk. Thus, the safety of a machine or workshop depends on the hazard and risk involved with machine operation. Hazard is the likelihood that an injury will occur.

*The causes of injury are varied, but they involve the following factors such as :*

- a. Having part of the body caught in or between machine components.
- b. Being struck by an object.
- c. Falling from equipment, structures, or ladders.
- d. Slipping or tipping on floor surfaces.
- e. Explosions and fire.
- f. Exposure to high voltage electrical wiring and switch box.
- g. Burns with or exposure to temperature extremes.
- h. Exposure to or injection of toxic chemicals.
- i. Excessive physical strain.
- j. Protection of eyes from metal chips.

In United States, various safety and health standards have been promulgated by the American National Standards Institute. Safety literature is available from the National Safety Council.

*Safety professionals and organization have created the following hierarchy for treating hazards in the workplaces such as :*

- a. Reduce the danger to a reasonable level through design.
- b. Apply safeguarding technology.
- c. Use warning signs and label.
- d. Train and instruct the workers.
- e. Prescribe personal protective safety equipment (goggles, apron, shoes etc.)

All workshops and work-areas are places of some risks, but a healthy regard for the Rules and respect for the equipment being used reduces the risk of an accident considerably.

*The following are the golden rules of safe work-practices such as :*

- a. If you open it, close it.
- b. If you turn it 'ON', turn it 'OFF'.
- c. If you unlock it, lock it.
- d. If you break it, repair it.
- e. If you can't fix it, call in some one who can.
- f. If you make a mess, clean it up.
- g. If you move it, put it back.
- h. If it doesn't concern you, leave it alone.



## **SAFE GUARDING METHODS :**

### *Barrier Guards :*

- i. Provision of proper fencing around dangerous/ hazardous activity centre.

### *Safety Devices :*

- i. Pull-back mechanism for the operator's hands.
- ii. Dead-man Controls – A system in which the power is automatically shut off in the event of operator becoming senseless or collapsed.
- iii. Presence of sensing devices.

### *Safety During Maintenance of Machinery :*

Normally, safety devices are temporarily removed during maintenance. It's the Employer/ Manager's responsibility to ensure. The maintenance personnel are competent to interact with the types of hazards expected and supposed to perform the maintenance in a safe manner. The maintenance staff should be familiar with safety practices related to their activities.

### *Warnings :*

Sign Post, signals and instruction charts warn the worker about sudden hazards, danger control methods, or non-obvious consequences. The format, size, colour of warnings have been prescribed by Industry Standards and ISI codes.

### *Personal Protective Equipment :*

Goggles, face-shields, earplugs, helmets, respirators, gloves and aprons are types of personal protective equipment that reduce worker's exposure to hazards.

## **SAFETY IN WORKSHOP :**

The first duty of the Manager or Instructor in a workshop is to brief a student or worker about various safety features and make them aware of various safety precautions to be observed while working on a particular machine/ machine tool. They should be sufficiently briefed about causes/ sources of injury or accidents and how to guard against them.

### *Some of the Common Sources of Accident in Workshop are as Following :*

- a. Revolving parts like shafts, spindles, tools etc.
- b. Projecting sharp edges of belt/ chain/ pulley joints/ fasteners etc.
- c. Revolving parts like gears, rollers, friction wheels, drum, crushers etc.
- d. Continuously rotating parts like fans, open-arm pulleys, gear trains etc.
- e. Conveyors and mixers.
- f. Grinding wheels and stones.
- g. Reciprocating parts/ tools.
- h. Intermittent feed mechanism.
- i. Moving cranes/ trolleys/ welding machines.
- j. Bare cables, joints, switches, switchboard etc.

## **COMMON METHODS OF PROTECTION IN A WORKSHOP :**

*Some Common Methods of Protection in a Workshop are Discussed Given Below :*

### *By Design :*

When a new machine is designed, suitable housing should be designed as safety guards.

*For Example :* i. Belt Drive/motor in a lathe or milling machine are enclosed in a housing.

ii. All control panels/handles should be carefully located to ensure adequate safety.



### **By Position :**

A machine should be designed in such a way that the dangerous parts are located beyond the reach of the operator. They should be well-guarded also. The guards should form an integral part of the machine or they should be tightly secured and should not be easily removable. They should be robust and rigid. Guards can also be automatic/ distant/ trip guards.

### **Interlock Guards :**

It ensures guards not be removed or the machine cannot start without the guards in position.

### **SAFETY FOR JOB :**

Production or repair of a machine or any part of a machine costs a lot of money. If we do a job carelessly it would further increase its cost. Therefore, it is also essential that one should do the job with due care and precautions for safety. The following safety measures are necessary to ensure safety for job as follows :

- i. *Before taking any job in the workshop, it is necessary to plan the operation of work and job should be performed accordingly otherwise it may result in loss of time and money and the job would not be done satisfactorily.*
- ii. *If a machine is required to be used for doing a job, it should be ensured that job is carried out properly on the machine.*
- iii. *While cutting a particular object one should not make a deep cut.*
- iv. *Proper tools, with sharp edges, should be used for cutting jobs otherwise it would spoil the job.*
- v. *Proper arrangements should be made to fasten heavy jobs on machines.*
- vi. *Use of right types of tools and machines for various jobs is very important for proper results.*

### **IMPORTANT POINTS REGARDING FIRST AID :**

- i. *We should not get nervous at the sight of patient's injury or pain.*
- ii. *Instead of going into the questions of how the accident occurred, when it happened and why it happened, we should immediately arrange to provide First Aid to the patient.*
- iii. *We should check up properly how much pain the accident - victim is feeling and where.*
- iv. *If the patient is unconscious and blood is coming out, immediate steps should be taken to stop it.*
- v. *It should be ensured that crowd does not gather around a patient.*
- vi. *An accident patient can be given hot milk or tea but not water or intoxicating things.*
- vii. *If an accident victim has got burn injuries, he/she should not be allowed to remain in open air but a blanket should be wrapped round his/her body.*
- viii. *We should arrange to call a doctor immediately or try to carry the accident victim to a doctor, if the situation so demands.*





# FITTING SHOP

## INTRODUCTION :

Components may be produced by working on metal either on a machine tool or on the bench. Sometimes it becomes necessary to replace or repair a component which must fit accurately with another component on re-assembly. This involves a certain amount of hand fitting. The assembly of machine tools, jigs, gauges, etc. involves a certain amount of bench work. The accuracy of work done depends upon the experience and skill of the fitter. Metal removal at the bench requires the use of a number of simple hand tools and considerable manual effort. Working on components with hand tools and instruments, mostly on work benches is generally referred to as, 'Fitting Work'. The hand operations in bench work consist of filing, chipping, scraping, sawing, drilling, tapping, grinding etc.

## TOOLS AND EQUIPMENT REQUIRED IN THE FITTING SHOP :

Both the bench work and fitting require the use of a number of simple hand tools.

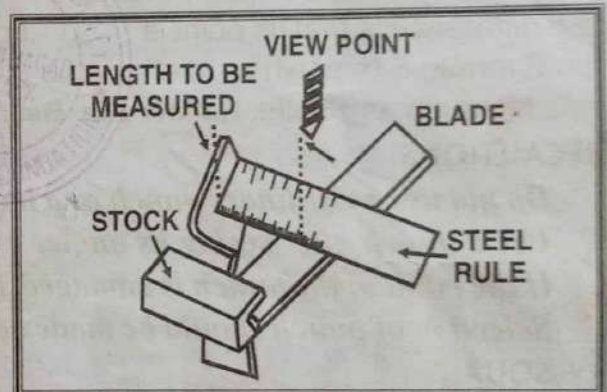
### Marking and Measuring Tools :

#### STEEL RULE :

When dimensions are given in drawing without any indication about the tolerance, it has to be assumed that measurement are to be made with a **Steel Rule**, which is used for measurement of length. It is usually graduated in millimeter and inches. Its least count is 0.5 mm or 1/64 of an inch. Steel Rules are made of spring steel or stainless steel. The surface of the steel rule is stain - chrome finished to reduced glare and to prevent rusting.

#### Measuring with a Steel Rule :

The given figure indicates the method of using a try square and a steel rule for accurate measurements. It is necessary to read vertically and avoid errors arising out of parallax for accurate readings. The steel rule graduations are accurately engraved, with line thickness ranging from 0.12 to 0.18 mm.



#### PRECAUTIONS :

- For maintaining the accuracy of a steel rule, it is important that to see it that its edges and surfaces are protected from damage and rust.
- Do not place a steel rule with any cutting tools.
- Apply a thin layer of oil when not in use.

#### SCRIBER :



A **scriber** is a slender steel tool used to scribe or mark lines. It is made of steel or high carbon steel wire of 3 mm to 5 mm, whose one end is straight and the other is bent at about 90° Angle. Its length varies from 150 mm to 300 mm. Both its ends are pointed. There are Five types of Scribers are available as follows : Ordinary, Improved, Adjustable Sleeve, Pocket and Knob Scriber.

#### PRECAUTIONS :

- Scriber points are very sharp, and they are to be handled very carefully.
- Do not put the scriber in your pocket.
- Place a cork on the point when not in use to prevent accidents.

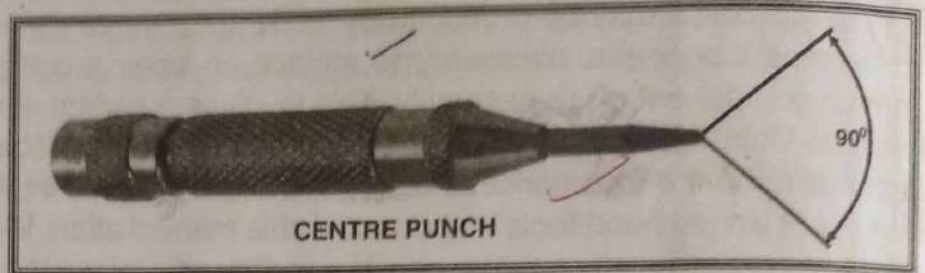


## PUNCH :

Punch is a marking tool used in order to make certain dimensional features of the layout permanent. Basically, there are two types of punches such as : **Dot** and **Centre Punch**.

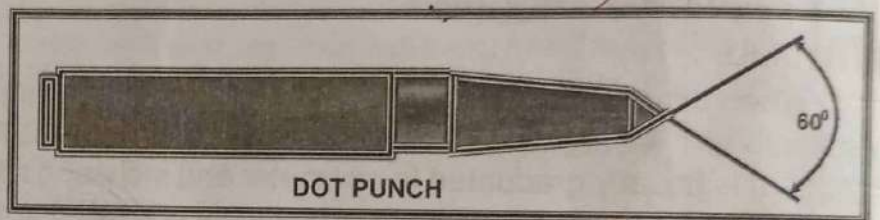
### Centre Punch :

**Centre Punch** is made of high carbon steel. The angle of the point is  $90^\circ$  in a centre punch and the punch mark made by this is wide and not very deep, which is particularly used for locating holes. Its length is from 35 mm to 125 mm. and its width is from 4 to 12 mm. If this centre is not made by the centre punch, then there are chances of slipping of the point and drilling at a wrong point, which is shown as the given figure.



### Dot Punch :

**Dot punch** is used in order to lightly indent along the layout lines to locate centre of holes and to provide a small centre mark for divider point etc. The main difference is that its point is at  $60^\circ$  angle. Its length is from 80 mm to 100 mm. and its thickness from 3 mm to 5 mm/ which is shown as given figure. There are also different types of punches are available such as : **Solid, Hollow, Pin, Bell, Prick and Automatic Punch**.

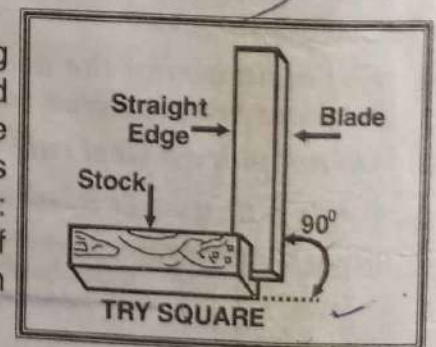


## PRECAUTIONS :

- Do not use an ordinary punch on a hard metal.
- Use a punch after seeing its angle.
- If the point of the punch is damaged, then it should be repaired and the punch should be used.
- Selection of punch should be made according to the make-up of the job or metal.

## TRY SQUARE :

**Try Square** is used for measuring right angle of a job and for checking squareness of many types of small works. The blade is made of hard steel and the beam of steel. It is actually used to check whether the angle made by the two sides of square is a right angle ( $90^\circ$ ) or not. Try Squares are used in engineering field can be divided into Three parts such as : **Solid, Adjustable and Diemakers try square**. The accuracy of measurement by try square is about 0.002 mm per 10 mm length, which is accurate enough for most workshop purposes.



## PRECAUTIONS :

- We should not use try square as a hammer i.e. we should not use it to hit any job otherwise its accuracy is spoiled.
- Try square should be kept away from cutting tools.
- It should be cleaned properly before use.
- After making its use, it should be kept after applying grease.

## SURFACE PLATE :

**Surface Plate** is used for marking purpose. The job is placed over the surface plate and marked with the help of bevel protractor. It is made of cast iron. It is usually rectangular in shape.



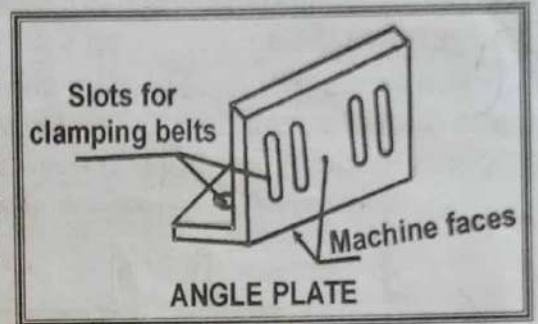


### PRECAUTIONS :

- Before marking or measuring a job, its surface should be properly cleaned with a soft paper.
- While using it, it should not be hit as there are chances of damage to its surface.
- In order to make the marking of the job permanent it should not be used as a table.
- Cutting tool should never be used on it.

### ANGLE PLATE :

Angle Plate is placed over the surface plate for supporting jobs at the time of marking. It is made of cast iron. The angle plate is built at  $90^\circ$  Angle, which has rectangular grooves. Both its outer surfaces are accurately plained by the scraper. In case of heavy jobs, nut bolts are fitted in its grooves and marking is done. Angle plate is of two types such as : Fixed angle and Adjustable angle plate.

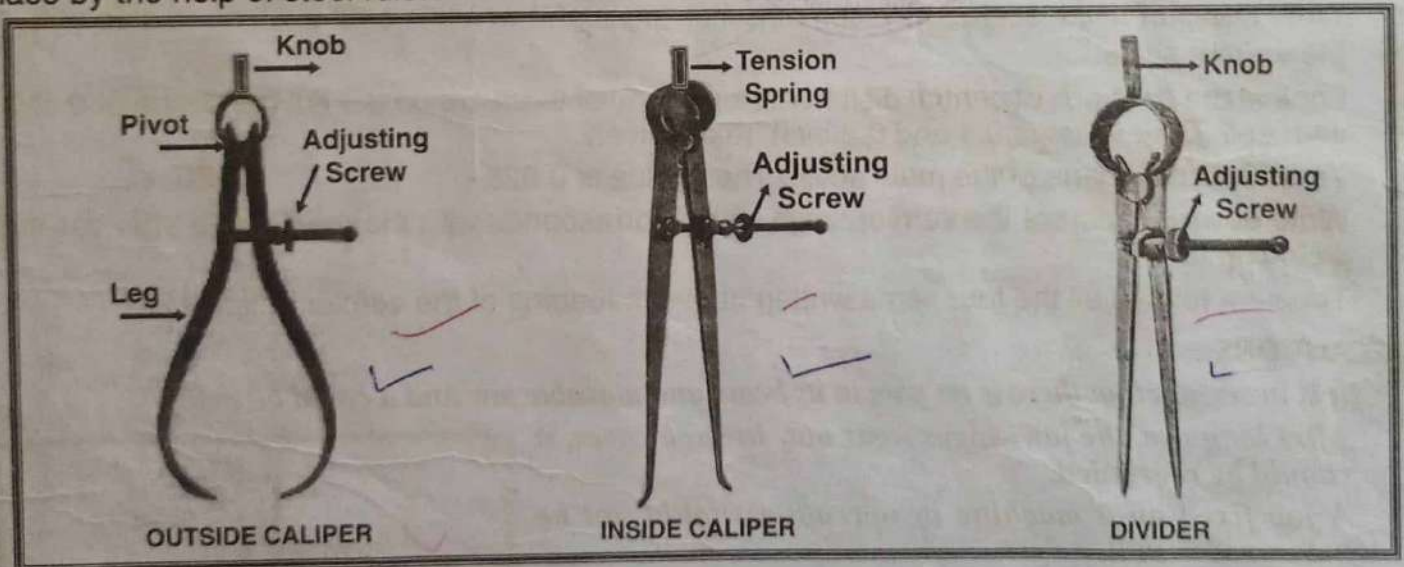


### PRECAUTIONS :

- Angle plate should be carefully handled and maintained.
- Any nicks or scratches can spoil the accuracy of the angle plates.
- In order to make the marking of the job permanent it should not be used as a table.

### OUTSIDE CALIPER :

The caliper whose leg bent toward the centre is called Outside Caliper. It is used to measure the outside diameter of a cylinder, bar etc. It is also used for transfer dimension one place to another place by the help of steel rule.



### Inside Caliper :

The Caliper whose leg forward to the centre is called inside caliper. It is used to measure inside diameter of a hole, bore, slot etc. It is also used for transfer dimension one place to another place by the help of steel rule.

### Steel Tape :

Steel Tape is measuring instrument, which is used to measure length, breadth and thickness of a job.

**Spirit Level :** Spirit Level is used for testing the levels of flat surface.

### Straight Edge :

This tool is used for testing the straightness and flatness of plane surfaces.

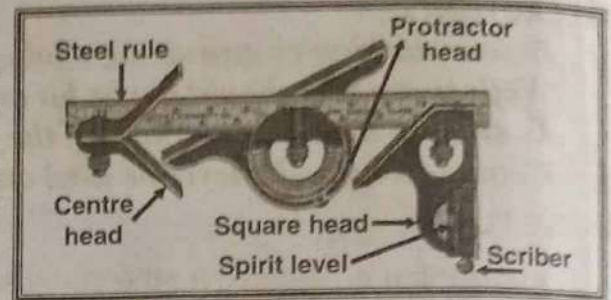
### Dividers :

Dividers is used for marking circles, arcs, laying out perpendicular lines, bisecting lines etc.



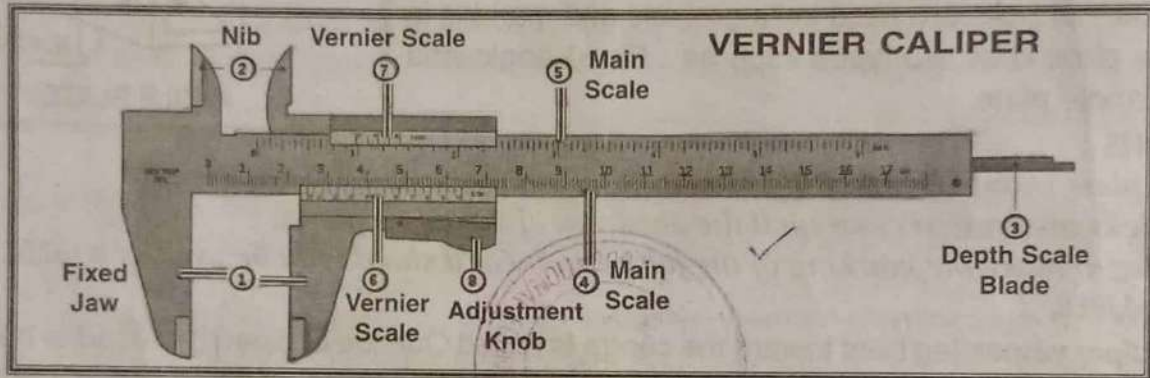
## COMBINATION SET :

**Combination Set** is a very useful instrument having a combination of five different instruments in one. A combination set consists of a rule, square head, centre head and a protractor. This may be used as a rule, a square, a depth gauge for marking degrees ( $45^\circ$ ) and for locating the measuring and marking angles.



## VERNIER CALIPER :

**Vernier Caliper** is a precision measuring instrument used for measurement of outside diameter, inside diameter and depth. The least count of vernier caliper is 0.001 inch and 0.02 mm. Vernier caliper is made by assembling several different parts as shown in the given figure.



## METHOD OF TAKING READING :

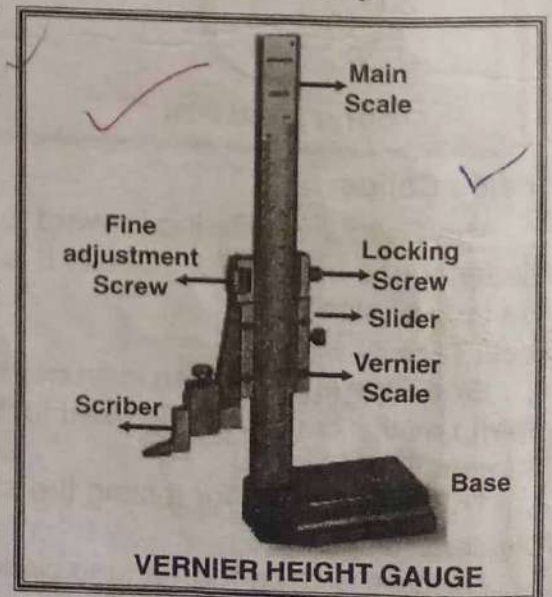
- Write that part of the scale which contains inch signs and which is on the left hand side of 0, on the vernier scale.
- Look at the divisions of central distance. How many of them are on the left hand side of 0 of the vernier? Their value is 0.1 and 0.2 inch. respectively.
- Write the small parts of the main scale. Their value is 0.025.
- Write down the part of the vernier scale which corresponds with the main scale after carefully watching it.
- The sum total of all the four items written above is reading of the vernier caliper.

## PRECAUTIONS :

- It is necessary that there is no play in its beam and movable jaw and it could be easily.*
- After long use, the jaw-edges wear out. In such cases, it should be regrinded.*
- A job fixed on a machine in operation should not be measured with it.*
- It should always be kept away from the cutting tools.*
- It is difficult to see the part of scale. Therefore, it is advisable to use a magnifying glass.*
- After using it, we should clean it with thinner and keep it in the case.*

## VERNIER HEIGHT GAUGE :

**Vernier Height Gauge** is similar to vernier calipers and used for marking purpose by the help of surface plate and angle plate. It consists of scribe by which lines are scribed on the job. In vernier height gauge, slide base remains joint with the beam permanently as shown in the figure.



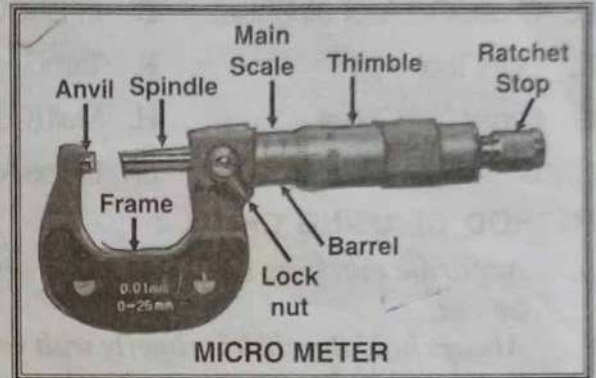


**PRECAUTIONS :**

- It should always be used on the plain surface of the job.*
- While marking, excessive pressure should not be exerted on its scriber.*
- It should be used on a surface plate only.*
- It should be used only for precision marking or measurement.*
- Its reading should be noted down.*

**MICROMETER :**

Micrometer is a measuring instrument used for measuring external, internal and depth dimensions accurately. They are available in different ranges. It is made on the basis of nut and screw bolt. The different parts of the micrometer are given in the figure. There are Three types of micrometer such as : Outside, Inside and Depth Micrometer.



**PRECAUTIONS :**

- Before using it, it should be properly cleaned with a soft cloth.*
- Before use, it should be ensured that it is faultless.*
- It should not be used on machines in operation or on rough surface.*
- Before measuring, job should be properly cleaned.*
- For setting it Ratchet Stop should be used.*
- After measuring, it should be locked and then reading should be taken.*
- While keeping it, anvil and spindle should be separated.*
- It should be saved from water.*

**DIFFERENCE BETWEEN CALIPER AND MICROMETER**

VERNIER CALIPER	MICROMETER
a. Its range varies from 0 to 48 inch or 0 to 1200 mm.	a. Its range is limited from 0 to 1 inch or 0 to 25 mm. For measurement beyond this we require other micrometers.
b. With this we can measure both the external and internal jobs.	b. Different micrometers are needed for taking measurements.
c. We can take measurement in inches and mm simultaneously.	c. Different micrometers are required for measurement in inch and mm.
d. It is easy to make and also costs less.	d. It is difficult to make and it costs more.
e. Measurement taken by Vernier caliper is not considered very exact because its touch is not always equal.	e. Its measurement is considered exact because appropriateness of touch is controlled by ratchet stop.
f. Experience is required to take measurement with this caliper.	f. It is easy to measure with the micrometer.
g. Its least count is 0.02 mm.	g. Its least count is 0.01 mm.

**CUTTING AND FINISHING TOOLS :**

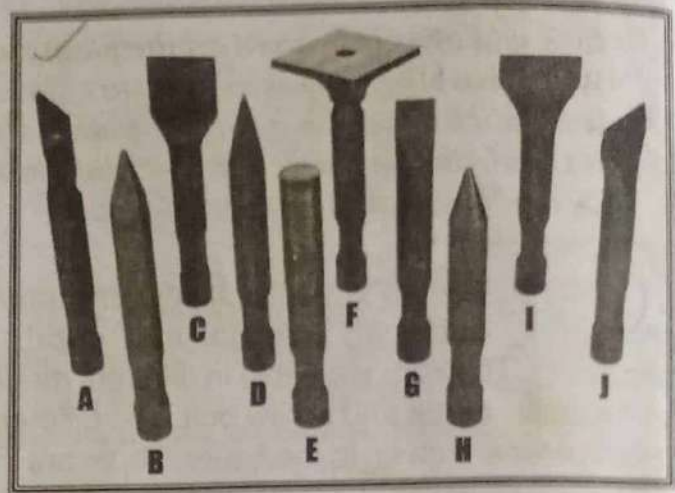
**CHISEL :**

Chisel is a single point cutting tool. It is used for removing surplus metal or for cutting sheets. The tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisel is used to cut flat round or angle iron and 1/8 inch fitness of metal sheet, it also used to removed for unwanted metal from the surface of a job by cutting it in bits and small pieces, this act is known as chipping, cutting



done by chisel is rough, therefore chisels are used to both hot and cold metal. The different types of chisels are available as shown in the figure as follows :

- |                             |                           |
|-----------------------------|---------------------------|
| A. In-Line Asphalt Cutter   | B. Nail Point             |
| C. Cross-Cut Asphalt Chisel | D. In-Line Chisel         |
| E. Blunt Tool               | F. Tamping Pad            |
| G. Cross Cut Chisel         | H. Moil (Conical) Point   |
| I. Cross-Cut Wide Chisel    | J. In-line Asphalt Chisel |



#### METHOD OF USING CHISEL :

- Accurate marking should be done on the metal to be cut.
- Always hold the chisel properly with your left hand and the hammer in your right hand.
- Set the chisel properly on the marked line then strike the hammer on its head. Before striking the second blow on the chisel, it should be set again.
- While cutting with a chisel we should concentrate on its cutting edge.
- Strike the hammer blow at the centre of the head of chisel.

#### METHOD OF CHIPPING :

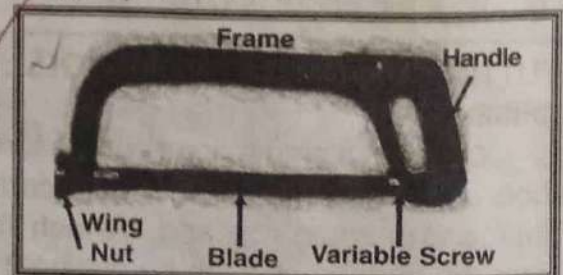
- Select the chisel with appropriate cutting angle according to the metal.
- If job is small in size and it has to be held in a vice, we should use a wooden block under the job.
- While chipping we should stand to the left of vice and near the bench.
- We should hold handle of the hammer from its end, raise it up to the height of our neck and then strike a blow.
- Chisel should be inclined towards the user at an angle of  $40^\circ$ , while chipping.
- At a time we should not chip any metal more than 2 or 3 mm. Otherwise the edge of chisel may be damaged.
- If the surface to be chipped is broad, before using a cross cut chisel, we should make a groove on the job by making a cut.
- Only a flat chisel should be used for chipping.
- While chipping after hitting the chisel with a hammer three four times, we should withdraw for a while and then chipping.
- While chipping a job held in vice we should strike the hammer blow in the direction of its stationary jaw.

#### PRECAUTIONS :

- At the time of chipping we must always use safety goggles.
- Keep your face towards the wall, while chipping.
- If someone is working in your front, you should fix chipping guard at the rear of vice so that chips do not hit him.
- While chipping we should keep on applying grease on the edge of the chisel.

#### HACKSAW :

Hacksaw is a multi-point cutting tool. It is used for cutting metal by hand with a frame which holds a thin blade, finally in position. The blade has a number of cutting teeth. The number of teeth per inch is selected on the bit of types of job. Hacksaw is a hand cutting tool, in order to cut metal rods, pipes, plates or sheet of varied thickness. It can be operated by hand or by power.





Mainly, it consists of two parts such as : Frame and Blade. It is available at 300 mm of length of blade. There is two types of Hacksaw such as : Fixed and Adjustable Hacksaw.

#### METHOD OF USING HACKSAW :

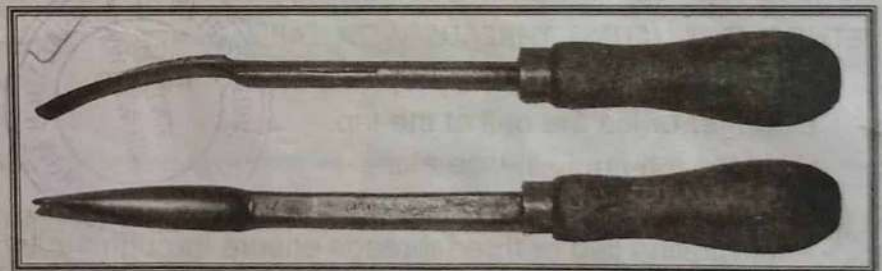
- a. Selection of hacksaw blade should be done according to the metal for which it is to be used.
- b. While fixing the blade on the frame it should be ensured that its teeth should cut the metal when they are driven forward.
- c. Job should be held in the vice in such a way that its cutting lines are clearly visible.
- d. Before starting a cut with hacksaw blade, blade should be kept on the marking line, the left hand thumb should be placed with its support.
- e. You should stand on the left hand of the vice and keep your right foot backward and the left foot a little ahead of the right.
- f. The speed of operating hacksaw should be 40 to 50 strokes per minute.
- g. Pressure should be exerted on forward stroke and it should be withdrawn on backward stroke.

#### PRECAUTIONS :

- a. *Hacksaw blade should be fitted on the frame very carefully.*
- b. *It should be neither be very tight nor very loose.*
- c. *The job which is to be cut should not be held in a vice much high otherwise there would be vibrations in it.*
- d. *Hacksaw blade should not be allowed to become slanting while using a hacksaw. If it becomes slanting, there are chances that it may break.*
- e. *If a blade get broken while working, then we should replace it with a new blade.*
- f. *If necessary, water should be used as a coolant.*
- g. *After using a hacksaw either its blade should be taken out or it must be made loose.*

#### SCRAPER :

Scraper is a cutting hand tool, which is used to remove the high spots left after machining has been done on a job. Scrapers may be flat, triangular and half-round. The material is a good quality forged steel and cutting edge is usually left very hard. Scrapers are made in a variety of lengths from 100 mm onwards and in many shapes. Scrapers are used whose length is 100 mm to 250 mm and there thickness varies from 1 mm to 3.5 mm.



Scrapers are used whose length is 100 mm to 250 mm and there thickness varies from 1 mm to 3.5 mm.

#### METHOD OF USING HACKSAW :

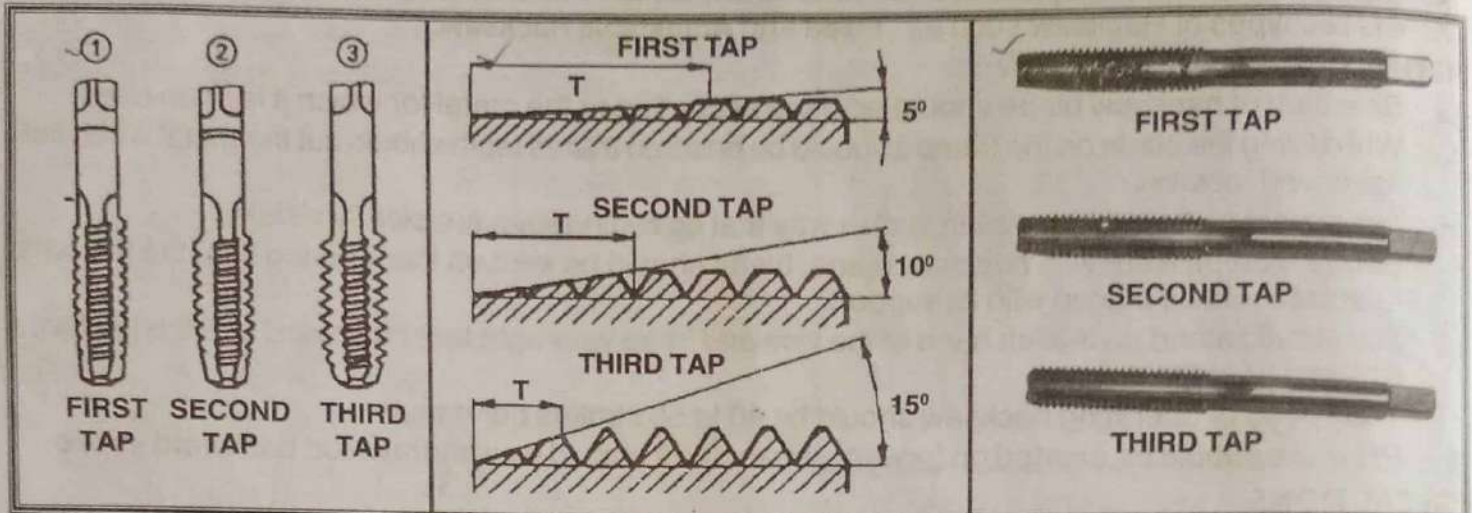
- a. We should have our right hand on its handle and left hand on its body.
- b. While using a scraper it should be bent at about  $30^\circ$  angle.
- c. We should not keep a stroke of the scraper tool long.
- d. After scraping once, scraper should be driven at right angle.
- e. Scraping should be considered accurate only when the colour of paste start appearing on the entire surface.

#### PRECAUTIONS :

- a. *Select the scraper according to the requirement of the job.*
- b. *Scraper should have proper edge.*
- c. *Our hands should be free from any sticky substance while scraping.*
- d. *Scraper should not be used without handle.*
- e. *Scraper should be kept separate from other tools.*
- f. *After scraping surface should be properly cleaned.*



## TAPS AND TAP WRENCHES :



A tap is a thread cutting tool, which is used for cutting internal threads in a drilled hole. Hand taps are usually supplied in sets of three for each diameter and thread size. Each set consists of a taper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel (HCS), high speed steel (HSS) and Alloy steel. The upper portion is square and four flutes are made on the entire part in which threads are formed. Taps is of three types such as : First, Second and Third taps.

### TAP WRENCH :

Tap wrench is a tap holding device, which is used to hold the tap strongly and tightly. There are Three types of tap wrenche such as : T-type, Fixed and Adjustable tap wrench.

### METHOD OF CUTTING THREADS WITH TAP :

- Bore a tap drill hole of appropriate size for the tap.
- Chamfer or file the drill at the tap.
- Hold the job firmly in vice etc.
- First of all, use the taper tap for cutting threads.
- After moving two or three threads ensure through the try square that tap is movig straight.
- Tapping should be done by moving the tap forward and backward.
- Adequate lubricant should be used while tapping.
- After moving the taper tap, intermediate and finishing tap should be moved.
- While cutting threads in blind hole in between tap should be taken out to clean the metal particles.

### PRECAUTIONS :

- Tap drill hole of appropriate size is essential before tapping.
- Use tap handle according to the tap.
- Tap should be moved forward and backwards and we should prevent any jobs.
- Tap should be cleaned properly and kept safely.

### DIES AND DIE-HOLDERS :

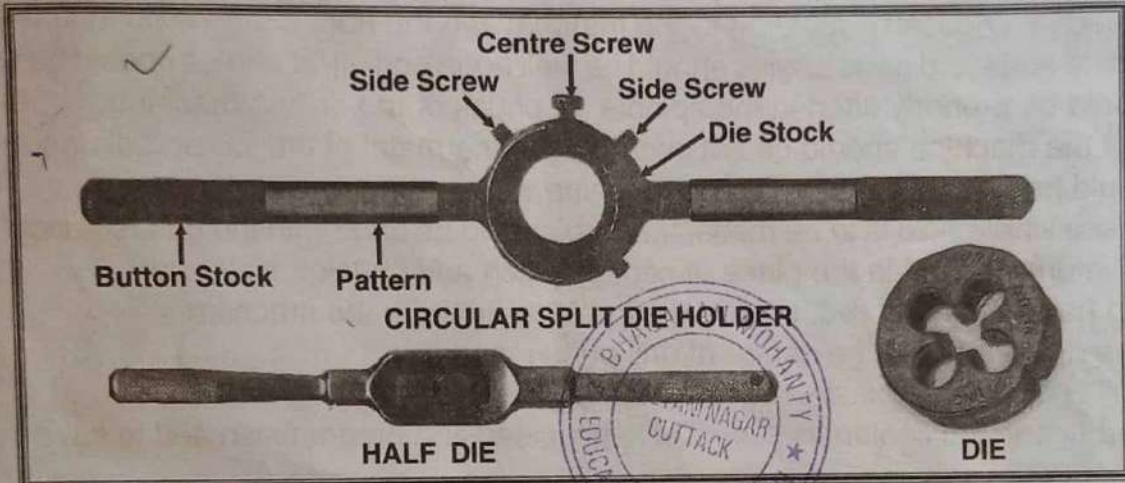
Dies are the cutting tools used for making external threads. Dies are made either solid or split type. They are fixed in a die-holder for holding and adjusting the die-gap. They are made of tool steel or high carbon steel. There are three types of dies such as : Circular Split, Half and Adjustable Screw plate Die.

### METHOD OF USING DIE :

- Before cutting outer threads, the end of pipe or rod should be chamfered with a grinder or a file.
- For cutting threads on a pipe, rod or any other job, it should be firmly held in a vice.

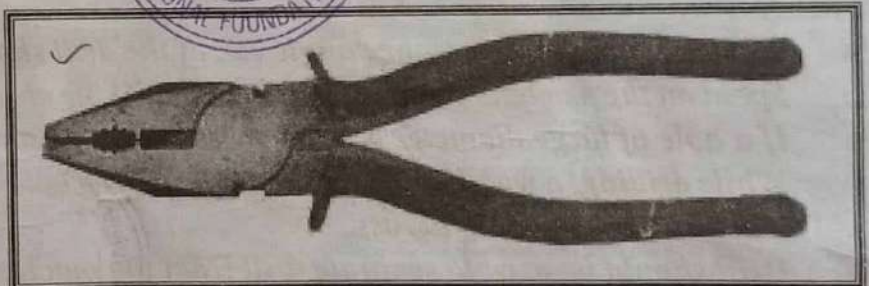


- c. While fitting die in a job only the side of tapered threads should be fitted.
- d. After fitting the die on the job you should adjust it according to your requirement.
- e. Keep on moving the die forward and backwards.
- f. Equal pressure should be exerted on the die handle.
- g. Jobs of large diameter, threads should be cut after adjusting two–three cuts.
- h. Proper lubrication should be used while cutting threads.
- i. After cutting the threads, it should be checked with a nut or ring gauge.
- j. After using the drill. It should be properly cleaned and replaced at its proper place.



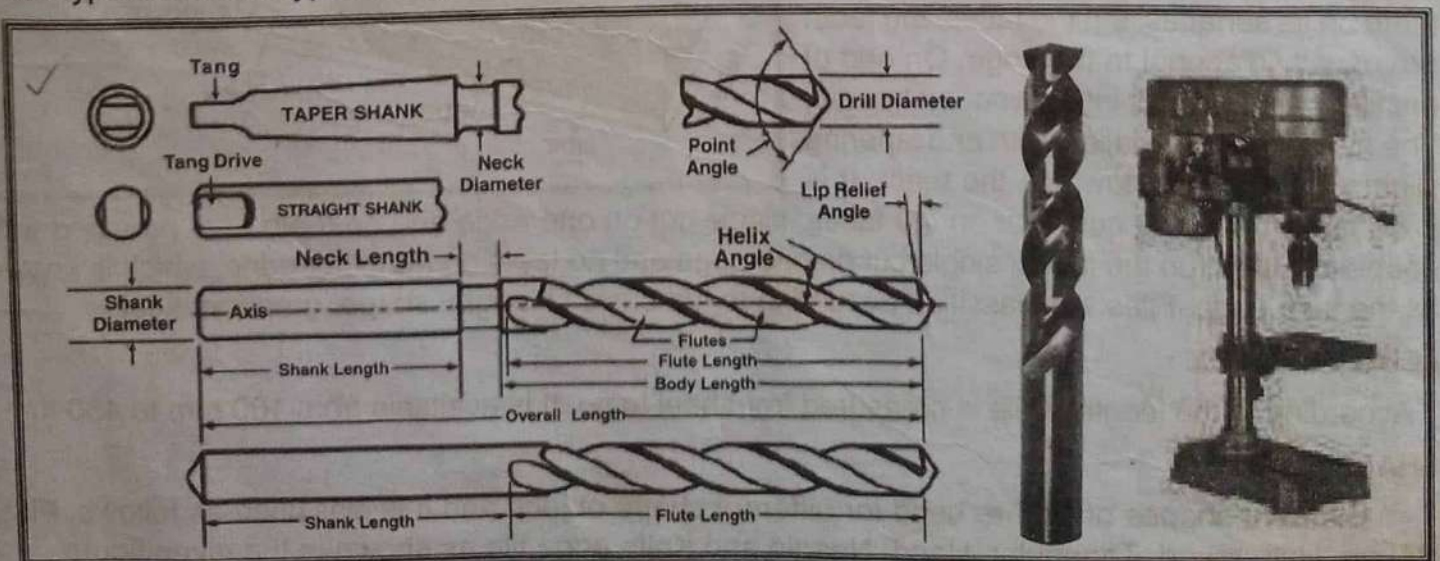
**COMBINATION PLIER :**

**Combination Plier** is a mechanical multipurpose tool, which is used to bend, cut and scrap the insulation of cables having length of 15 or 20 cm, and a P.V.C. or rubber sleeve is covered on its arms as shown in the figure.



**TWIST DRILL AND DRILLING MACHINE :**

**Drilling** is a process of making holes on a workpiece. The tool used for boring hole is called drill bit, the machine with which the drill is moved is called **drilling machine**. The process of boring holes with drill and drilling machine is called **drilling**. Various types of drilling machines are available such as : Sensitive, Pillar type and radial type drilling machine. The following are the sizes and designations of twist drills.





Millimeters	From 0.4 mm onwards
Inches	From 1/16" onward
Letter Drills	A to Z
Number drills	60 to 20.
Taper shank drills	3 to 100 mm

#### METHOD OF DRILLING :

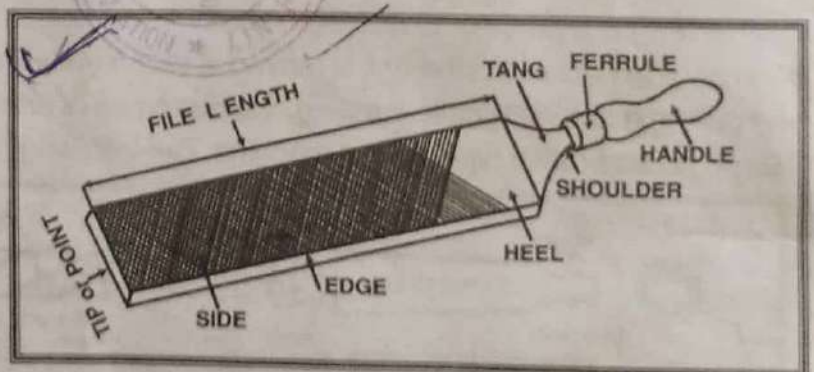
- Drill should be chosen according to the material and the hole to be bored in it. It should have appropriate edge and all its angles should be well edge and all its angles should be well grinded.
- Drill should be properly fitted in the spindle or chuck of the drilling machine.
- Speed of the machine should be set according to the metal of the job and diameter of the drill.
- Job should be properly gripped in the machine vice or other medium.
- At the place where hole is to be made, marking should be done with the centre punch.
- Place the drill straight in the place of centre punch and check.
- If a blind hole is to be bored, set the depth of the drill with the machine.
- Place the drill exactly in the centre of drill punch mark.
- If the drill is operating exactly in the centre, speed can be given.
- Use of lubricant and coolant is essential to get clean and proper finish and to save the drill from getting hot.

#### PRECAUTIONS :

- Cutting angle and clearance angle etc. of the drill should be grined according to the material .*
- Speed on the machine should be set according to the metal and the diameter of the drill.*
- If a hole of large diameter is to be bored, first the hole should be bored with a small drill.*
- While drilling, a wooden socket should be placed below the job so that drill may not damage the machine bed by going across.*
- Drift should be used to separate drill from the machine.*

#### FILE :

Filing is one of the methods of removing small amount of material from the surface of a metal part. A file is a hardened steel tool, having slant parallel role of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. On end of the file is shaped to fit into a wooden handle. The hand file is of parallel width and tapering slightly in thickness, towards the teeth. It is



provided with double cut teeth on the faces, single cut on one edge and no teeth. 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 the safe edge. Files are classified according to the basic of length, shape, grade and cut.

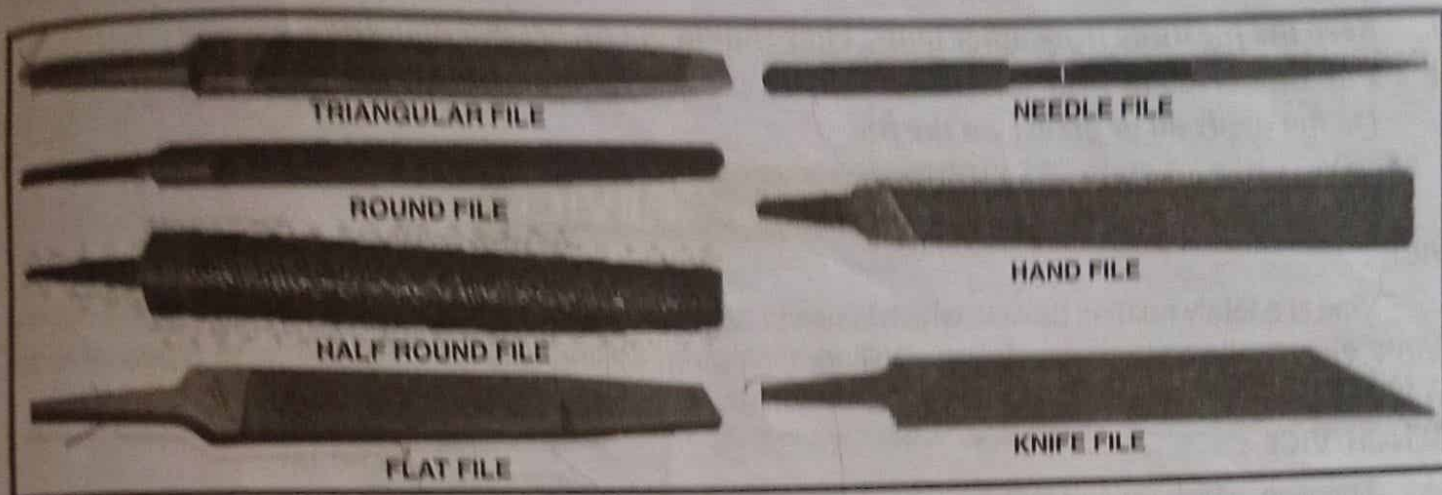
#### LENGTH OF FILE :

According to the length, a file is measured from heel to tip. It is available from 100 mm to 450 mm.

#### SHAPE OF FILE :

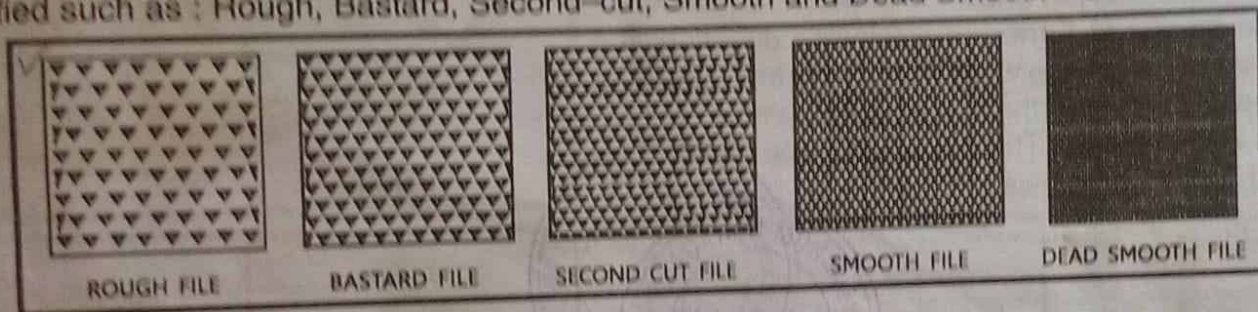
Different shapes of file are used for different shape of jobs and it is classified as follows, Flat, Round, Half-round, Triangular, Hand, Needle and Knife edge file as shown in the given figure.





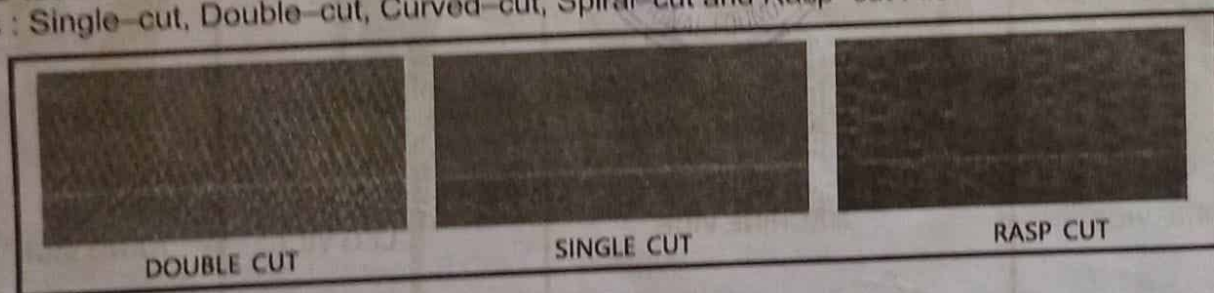
**GRADE OF FILE :**

Grade of a file is determined on the basis of distance between the teeth of the file (TPI). On the basis of these teeth their grades are made. On the basis of the number of teeth on a file, it is classified such as : Rough, Bastard, Second-cut, Smooth and Dead Smooth file.



**CUT OF FILE :**

The teeth cut on the files are of different shapes and types. According to the cut, they are classified such as : Single-cut, Double-cut, Curved-cut, Spiral-cut and Rasp-cut File.



**METHOD OF FILE :**

- Choose the right type of file, according to the job.
- There should be handle fitted on the tang of the file. In small files, a small handle should be fitted and a larger handle in larger file. Otherwise the balance of the file would not be proper and power would be unnecessary wasted.
- Hold the handle of the file with the right hand and keep the file end balanced with the left hand.
- At the time of filing, left leg should be kept ahead and the right leg a little behind.
- Pressure on the file should be exerted while moving it ahead, not while driving back.
- Only your hands should move with the file and not your whole body. As far as possible, keep rest of your body still.
- Speed of moving the file should be at the rate of 30 to 35 strokes per minute. }

**PRECAUTIONS :**

- Select the file according to the job.
- Do not use a file without handle. According to the size, complete handle should be fixed on the file.
- While filing a sheet, we should cut it in length.



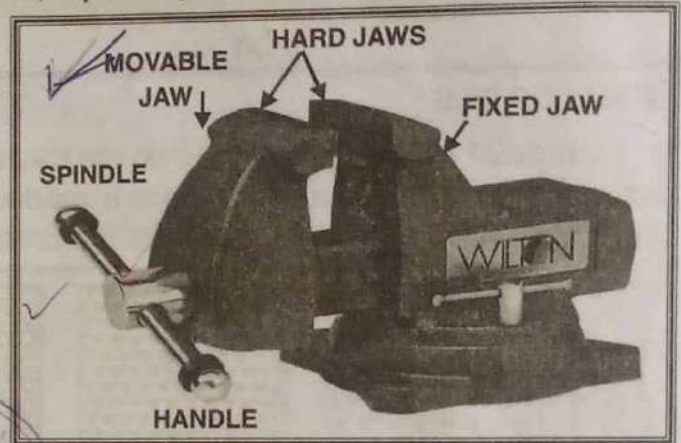
- d. *Keep the file away from other tools. They should not be heaped together.*
- e. *File should not be heated.*
- f. *Do not apply oil or grease on the file.*

## HOLDING DEVICE

**VICE :**  
**Vice** is a totally holding device, which is use to hold the job strongly and tightly to perform the various types of operations such as : Filing, Drilling, Chipping, Milling and etc. For different types of work, different types of vice are used such as : Bench, Machine, Pipe, Leg and Hand vice.

**BENCH VICE :**

The vice, which is used for bench work is known as the **bench vice**. Bench Vice is made of cast iron or cast steel, which is used to hold work for filing, sawing, threading and other hand operation. It consists of two jaws, i.e., one fixed jaw and another movable jaw. When the vice handle is turned in clockwise direction, the movable jaw forces the work against the fixed jaw. The job is held in between the two jaws at the time of filing, sawing and chipping. The size of the vice is specified by width of the hard jaws.



**PIPE VICE :**

**Pipe Vice** is used for holding cylindrical jobs (pipes and tubes). In this case, the movable jaw moves in vertical axis. It is used for holding pipes at the time of cutting and thread cutting.

**MACHINE VICE .**

**Machine vice** is used to hold a job strongly for carrying out drilling, milling, sloting and shaping. For fastening it on the table 'T' bolts are used, which fasten the vice firmly and easily in the 'T' slot made in the table. Machine vice are classified based on holding the job such as : Plane, Flanged, Swivel, Universal and Vertical machine vice.

**LFG VICE :**

**Leg vice** is a holding device, which is used in black-smithy shop. Hot job is fastened in it and black-smith operations like forging, bending and etc. done by the leg vice. It is fitted in the work bench in a hanging manner. It contains one leg which is straight way placed on wood. Movable jaw and fixed jaw are joined with each other through a hinge. Its entire body is made of rough iron.



## HAND VICE :

Hand vice is very similar to leg vice with a long leg and opens like leg vice. The hand vice is used for gripping screws, rivets, keys and small drills and other similar objects which are too small to be held by bench vice. Only small jobs can be held in the vice. It can not be fitted on a work bench. Instead of handle a wing nut is used which is attached on the spindle fixed between the two jaws.

## PRECAUTIONS :

- Job should be fastened nearly at the centre and it should not be very high from the surface of the vice.
- While chipping care should be taken to ensure that the blow of hammer should not hit the vice.
- Job should be tightened in the jaw only by moving the handle manually. A hammer should not be used for this purpose.
- This job should be held in the jaw with a wood packing otherwise at the time of filing etc. chattering takes place.
- After using the vice it should be cleaned. While cleaning it should be ensured that the tiny particles of metal do not go into the spindle.

## V-BLOCK :

V-Block is a rectangular block, which has a 'V' shaped groove on its upper surface which is shown in the given figure. The angle of the 'V' is during layout of measurements or for measuring operations. Heavy round jobs are kept over it for marking. There is no provision to clamp the job since because of heavy weight of the job, it remains fixed.

## CLAMP :

Clamp is a holding device, which is used for holding small jobs or two-three machine parts other tools like vice. Basically, the clamps are two types such as : Tool-makers and 'C' Clamp.

## TOOL MAKERS CLAMP :

Tool makers clamps are similar to the hand vice and also is known as parallel jaw clamp. Its jaws are plain and two threaded holes are made in which threaded screw and bolts are fitted. In both the jaws these are fitted opposite direction. These jaws are brought closer or their distance is increased by tightening these bolts.

## 'C' CLAMP :

The shape of the 'C' Clamp is like the english letter 'C'. Its all parts are made of mild steel. On one of the frame is made flat and other end threads are cut. It is made round in shape. Job is held between flat side of the clamp and the swivel tip. According to the height of the clamp job can be held.



V-BLOCK



TOOL MAKER CLAMP



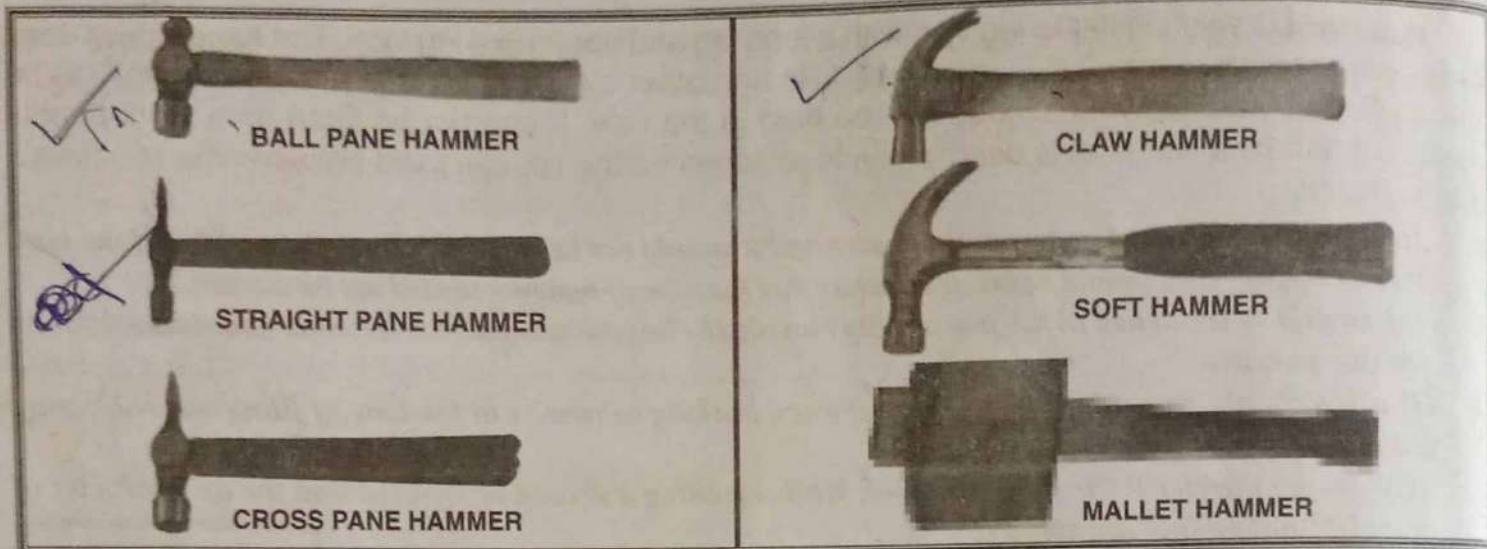
C-CLAMP

## MISCELLANEOUS TOOLS

## HAMMER :

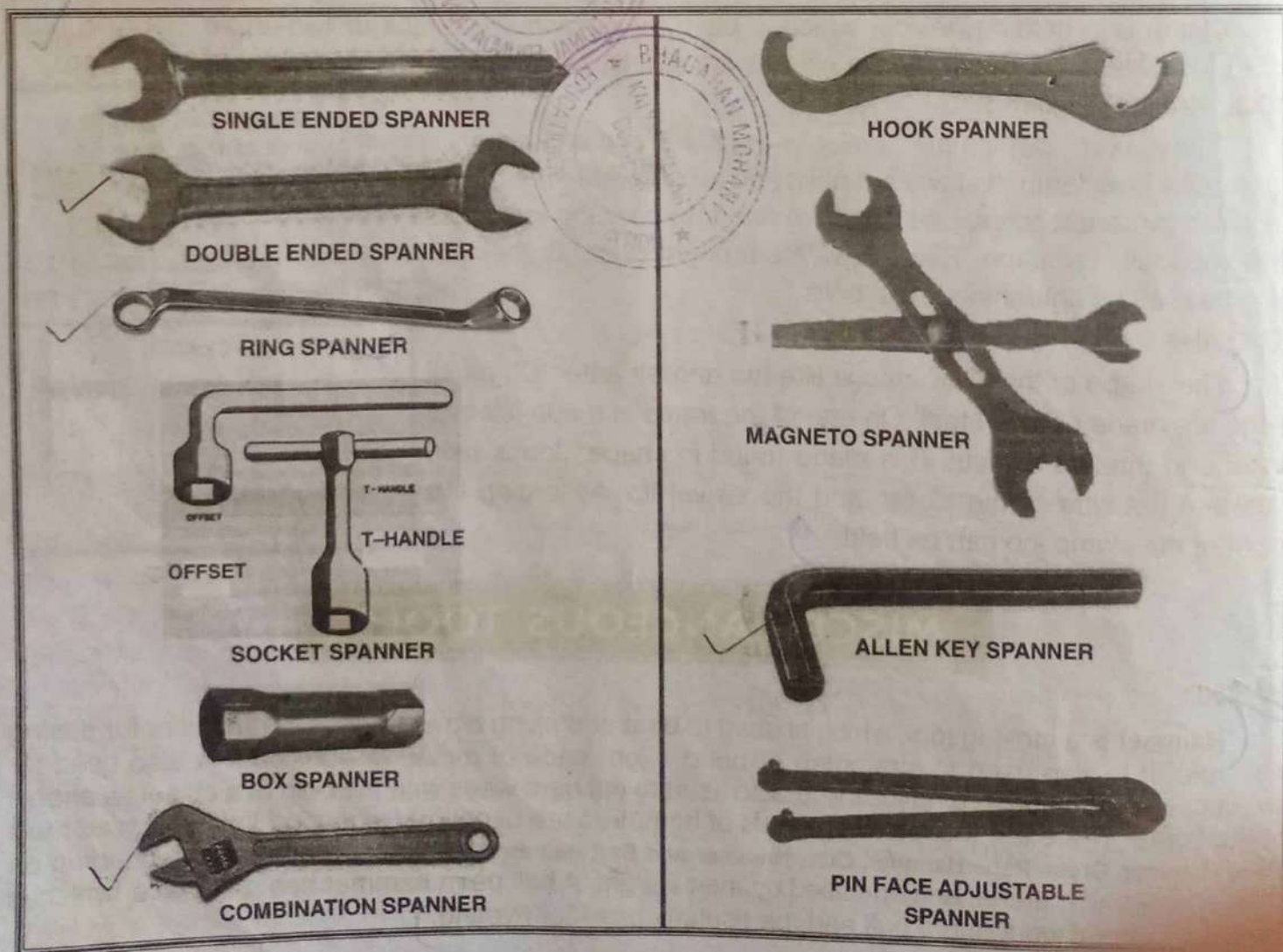
Hammer is a striking tool, which is used to beat or striking blows on jobs or metals or for driving nails etc. It is also used to straighten or bend a job made of metal. In addition it is also used for riveting, chipping and forging jobs and also used to cut hard wires with the help of a chisel as shown in the figure. There are the following types of hammers are used in engineering fields such as : Ball Peen Hammer, Cross Peen Hammer, Claw Hammer and Soft Hammer. Hammers are named depending on 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.





**SPANNERS :**

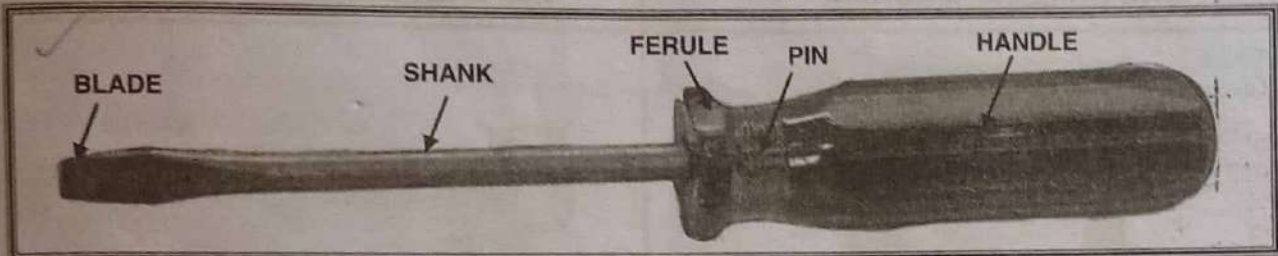
A spanner is a tool used for tightening and opening nuts and bolts. It is usually made of forged steel. They are named according to their applications. The size of the spanner denotes the size of the bolt on which it can work. Generally, spanner are made of drop forge steel or carbon steel. In workshop, there are different types of spanner are used such as : Single ended, Double ended, Ring, Socket, Box, Combination, Hook, Adjustable, "T" Socket, Magneto, Allen Key and Pin Face Adjustable Spanner.





## SCREW DRIVER :

Screwdriver is a mechanical tool which is used for tightening and opening screws. The length of its 'bit' is called its length. The length of a common screwdriver is 5 cm. Generally, the 'bit' is made flat at the tip but some special screwdrivers have 'cross bit' and 'U - shaped bit'. Screwdrivers with flat tips and star are shown in the given figure. A screwdriver is designed to turn screws. The blade is made of steel and available in different lengths and diameters. The grinding of the tip to the correct shape is very important. A Phillips (star) screwdriver is specially designed to fit the head of Phillips screw. The end of the blade is fluted instead of flattened. A screw driver has three main part such as : Handle, Shank and Blade.



### HANDLE :

Basically, wooden or plastic handles are fixed to the screw drivers. In order to shape the wooden handle from being broken, an iron ring is fixed to the handle.

### SHANK :

The middle part between the blade and the handle is called shank on its lower part tip or blade is made. On the upper part either there is a hole through which a wire is passed or this end is made flat so that when this part is fixed the handle, it does not allow the shank to move separately. Shanks are made of carbon steel.

### BLADE :

The blade is lower part of shank. It is also known as tip. This part is hardened and tempered.

### LENGTH OF THE SCREW DRIVER :

Length of a screw driver is measured excluding handle. The length of screw driver varies from 50 millimeter i.e. 2" to 18". Different types of screw drivers are available such as : Ordinary Flat, Offset, Ratchet, Philips, Watch Maker and Carpenter Screw Driver.

## EQUIPMENT / MACHINES

### DRILLING MACHINE :

For boring holes in metal or wood, drill and drilling machine is used, where drill is a tool which is fitted in a drill machine and then moved. When the drill rotates on the metal it bores a hole. Holes are drilled for fastening parts with rivets, bolts or for producing internal threads. It is the most versatile machine used in a fitting shop for the purpose.

As different types of drills are used for boring holes in different metals likewise, there different types of drilling machines such as : Hand Drill, Breast Drill, Ratchet Brace, Electrical Hand Drill and Pneumatic Drill machine.



BENCH DRILLING MACHINE





**SURFACE GRINDER :**

A **surface grinder** having an emery wheel is generally used in a fitting shop and is useful in removing waste metal and sharpening drills, chisels, and other cutting tools. The hardness or softness of the wheel is dependent on the amount and kind of binding material used. For this grinder, the job is held directly by magnetic chuck or work table race—protecting table of planing or shaping machine is also used. According to the spindle, they are of the following type such as : Vertical and Horizontal Spindle Grinder.



**SAFETY AND CARE OF GRINDING WHEELS :**

- Before fitting a new grinding wheel, it should be verified that there are not cracks.
- Grinding wheel can set broken in case of a fall. Therefore, these should be handled carefully.
- Grinding wheels should not be used without flange.
- While using wheel dress alertness should be observed else they would be broken.
- Grinding machine should be fitted properly.
- Grinder should not be moved at more than the fixed speed.
- As far as possible grinder wheel should be used from side.
- As far as possible, grinder wheel should be covered, when not in use.

**POWER HACKSAW :**

**Power Hacksaw** is quite similar to hand hacksaw with the addition of a suitable driving mechanism. The drive is by a belt driven electric motor. Suitable mechanisms are provided whereby the length of the stroke and the weight applied may be varied.





**JOB NO. 01**

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO. : ..... MARKS : ..... COMPLETE : .....

*Sign. of Sr. Lect./Lecturer***AIM OF THE EXPERIMENT :****To Prepare and Make a Stud and a Square Nut :****OBJECTIVES OF THE EXPERIMENT :**

- Mark the material with a scribe as per drawing.
- Punch the material with a Dot-punch on the marked line.
- Drill the material using a pillar – drilling machine to make a hole.
- Fill the two adjacent sides of the material to Right angle.
- Tap the drilling hole to make internal thread.
- Make external thread with the help of a die.
- Chamfer the sharp edges of the job.

**TOOLS AND EQUIPMENT REQUIRED :**

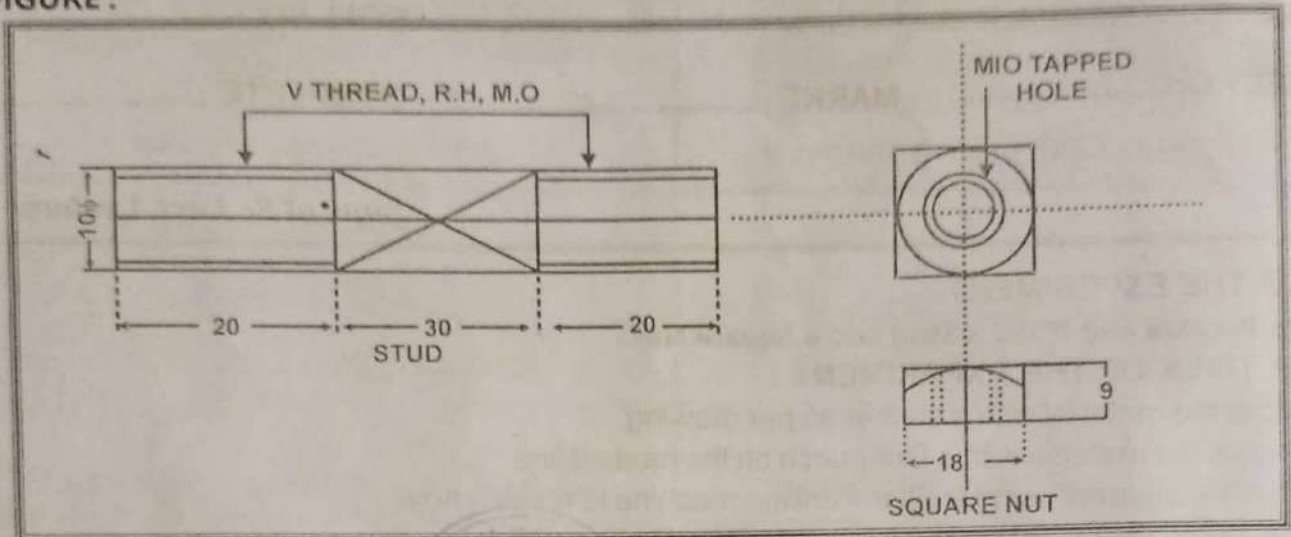
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Bench Vice	125 mm	
02	Try Square	100 mm	
03	Hackwsaw Frame	Adjustable	
04	File Bastard	300 mm	
05	File Flat second cut	200 mm	
06	Outside slide caliper	150 mm	
07	Steel Rule	300 mm	
08	Surface gauge	150 mm	
09	Surface Plate	100 × 500 × 25 mm	
10	Angle Plate	150 × 150 × 100 × 25 mm	
11	Drilling machine with m/c Vice	As per required	
12	Drill Bit H.S.S.	8.5 p	
13	Drill chuck with key		
14	Die	M 10	
15	Die Stock		
15	Tap set	M 10	
16	Tap wrench		
17	Dot punch		
18	Ball Peen hammer	700 gm.	



**Raw Material Required :**

- a. M.S. Rod : As Per Specified Given Job Diagram.
- b. M.S. Flat : As Per Specified Given Job Diagram.

**JOB FIGURE :**



**PROCEDURE :**

**For Stud :**

- a. Rub Emery cloth to remove rust and loose scale.
- b. File to required length
- c. Square the middle portion with a file
- d. Make external threads on both the ends with the help of a die.
- e. Chamfer both the ends

**For Nut :**

- a. Apply marking media
- b. Mark and center the job
- c. File, Flat and square to 18 × 18 × 9 mm
- d. Chamfer the corners by chipping and filing
- e. Drill a Hole
- f. Make a Internal thread by tapping
- g. Finish to dimension.

**OBSERVATION TABLE :**

Tolerance :  $\pm 0.25$  mm.

	DESIRED DIMENSION IN MM	ACTUAL DIMENSION IN MM	DEVIATION FROM ALLOWABLE TOLERANCE	REASONS FOR DEVIATION
Length of the Stud				
Length of thread portion				
Dia of the stud				
Side of the Nut				
Thickness of Nut				



## CONCLUSION :

Explain the reasons for deviation from the given specification of the finished job. Suggest methods for improvement of quality of the job.

## ASIGNMENT QUESTIONS

- What is the size of the drill hole for 10 mm tap ?
- How internal and external threads are cut manually ?
- What tool you will use for tapping ?
- What is the difference between Nut and Bolt ?
- Describe different part of a Thread ?
- What do mean by Chamfer ?
- Draw the sketch diagram of the given job ?

## WRITING SPACE FOR ASSIGNMENT





**JOB NO. 02**

DATE : ..... BRANCH : ..... SECTION : .....  
 NAME : ..... ROLL NO. : .....  
 REGD. NO. : ..... MARKS : ..... COMPLETE : .....

*Sign. of Sr. Lect./Lecturer*

**AIM OF THE EXPERIMENT :**

To Prepare a Divider :

**OBJECTIVES OF THE EXPERIMENT :**

- Use hacksaw to cut the required material after marketing.
- File the material to obtain the required Dimension.
- Join two components by riveting.

**SET UP OF JOB :**

*Equipment Required :*

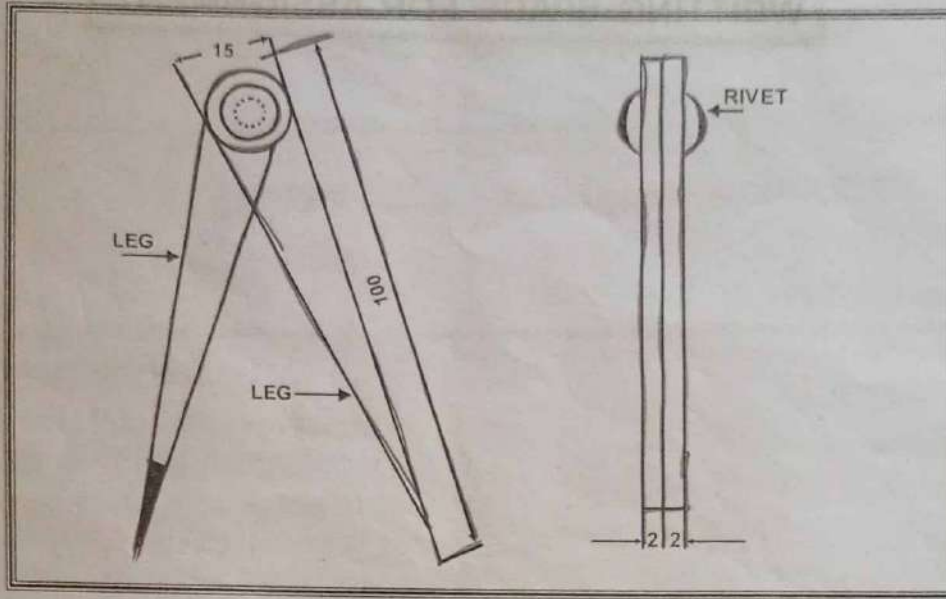
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Bench Vice	125 mm	
02	Try Square	100 mm	
03	File Flat bastard	300 mm	
04	File flat second cut	250 mm	
05	File half-round	150 mm	
06	File triangular	150 mm	
07	Hacksaw frame with blade	300 mm	
08	Surface plate	500 × 500 × 25 mm	
09	Scriber	150 mm	
10	Centre punch	100 mm	
11	Ball Peen hammer	200 gm	
12	Radius and fillet gauge		
13	Drilling machine with machine vice		
14	H.S.S. Drill Bit	6mm	
15	Spring divider	150 mm	
16	Chisel flat	100mm	

*Ramaterial Required :*

- M.S. Sheet 110 × 20 × 2 mm : As Per Specified Given Job Diagram.
- M.S. Rivet 6 mm : As Per Specified Given Job Diagram.



**JOB FIGURE :**



**PROCEDURE :**

- File the two adjacent edges of the sheets to right angle.
- Apply the marking media to mark the job as per sketch and punch the marking line.
- Remove the extra material by sawing and chipping and then file the job to the required shape.
- File the holes on the two pieces and clean the burrs.
- Assemble the two parts by riveting
- Finish all sides, edges and surfaces properly.

**OBSERVATION :**

Tolerance :  $\pm 0.25\text{mm}$ .

	Desired dimension in mm	Actual dimension in mm	Deviation after considering allowable Tolerance
Length of Leg			
Outside Radius			

**CONCLUSION**

Explain the reasons of deviation between the given specification and the finished job. Suggest methods for improvement of quality of the job.

**ASSIGNMENT QUESTIONS**

- How Riveting is done ?
- What is the shape of the Rivet Head ?
- Write down the different types of Riveting ?
- Write down the names of different types of Riveting Tools ?
- What is the function of the divider ?
- Draw the sketch diagram of the given job ?



**JOB NO. 03**

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO.: ..... MARKS : ..... COMPLETE : .....

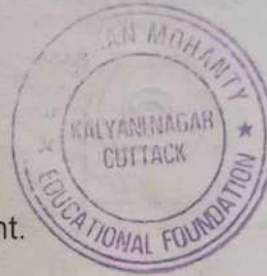
Sign. of Sr. Lect./Lecturer

**AIM OF THE EXPERIMENT :**

To Prepare and Make a Paper Weight :

**OBJECTIVES OF THE EXPERIMENT :**

- Use hacksaw to cut the material after making
- File the material to required size and shape.
- Drill and tap the hole in the material to make
- Internal thread.
- Make external thread with the help of a die.
- Assemble the two parts to make a paper weight.

**SET UP OF THE JOB :****Equipment Required :**

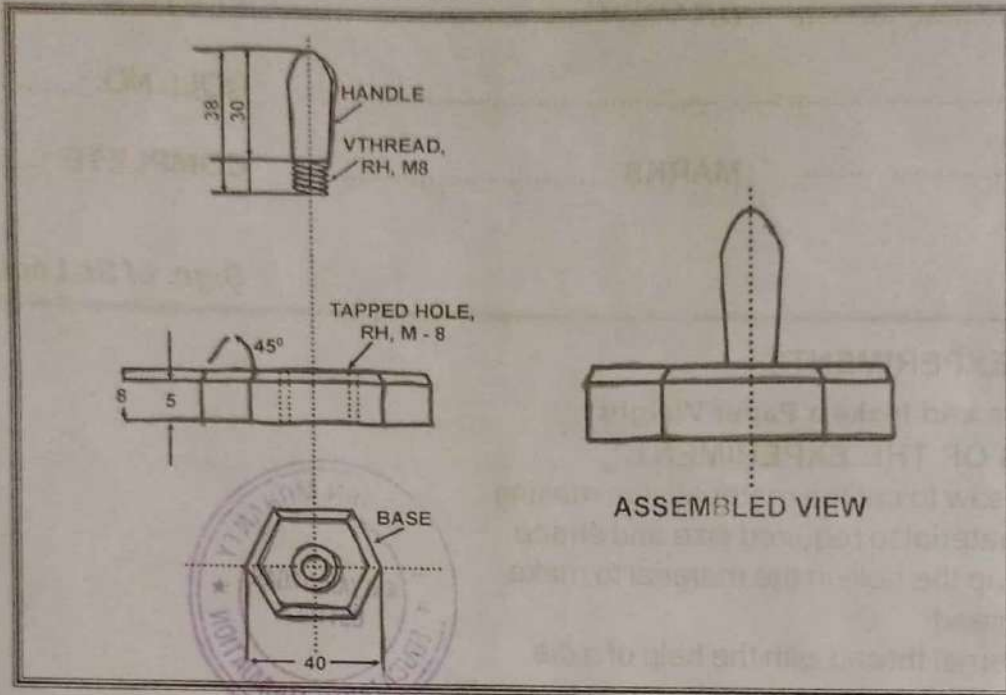
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Bench Vice	125mm	
02	Try Square	100mm	
03	Hacksaw frame with blade	300mm	
04	File flat Bastard	300mm	
05	File Flat second cut	250mm	
06	File half round	150mm	
07	Divider	100 mm	
08	Surface gauge	150mm	
09	Surface Plate	500 × 500 × 25 mm	
10	Scriber	150 mm	
11	Drilling machine with machine Vice	As per available	
12	Drill Bit	6.5 p	
13	Tap set	M8	
14	Die	M10	
15	Die with stock	Adjustable	
16	Angle Plate	150 × 150 × 100 × 25 mm	
17	Centre punch	100 mm	
18	Ball peen hammer	200 gm	



**Raw Material Required :**

- a. M. S. Rod and M.S. Flat Rod : As Per Specified Given Job Diagram.

**JOB FIGURE :**



**PROCEDURE :**

- Cut the raw material M.S. Flat and M.S. Rod as Per Specified Given Job Diagram.
- File the adjacent side to right angle.
- Apply the marking media.
- Mark the hexagon, chamfer and punch on the marking line.
- Drill the hole for tapping at the centre of the hexagon.
- Tap the drilled hole with a tap.
- Chamfer the hexagon by filing.
- File the mild steel rod to bring it to required shape of handle.
- Mark external thread on one end of the rod using a die.
- Assemble the hexagon base and the handle to make a paper weight and finish all sides.

**OBSERVATION :**

Tolerance :  $\pm 0.25\text{mm}$ .

	DESIRED DIMENSION IN MM	ACTUAL DIMENSION IN MM	DEVIATION AFTER CONSIDERING ALLOWABLE TOLERANCE	REASONS FOR DEVIATION
Side of the hexagon				
Height of handle				
Distance between two corners				
Distance between two flats				



## CONCLUSION :

Explain the reasons for deviation between the given specification and the actual measurements of the job.

## ASIGNMENT QUESTIONS

1. Name the different types of files for this job.
2. Describe the method of making a hexagon on a M.S. Flat.
3. Name the tools to be used for Marking Operation and Cutting Operation ?
4. What are the measuring tools to be used to prepare the job ?
5. Name the different parts of a ball peen hammer ?
6. Draw the sketch of the given job ?

## WRITING SPACE FOR ASSIGNMENT



# SHEET METAL

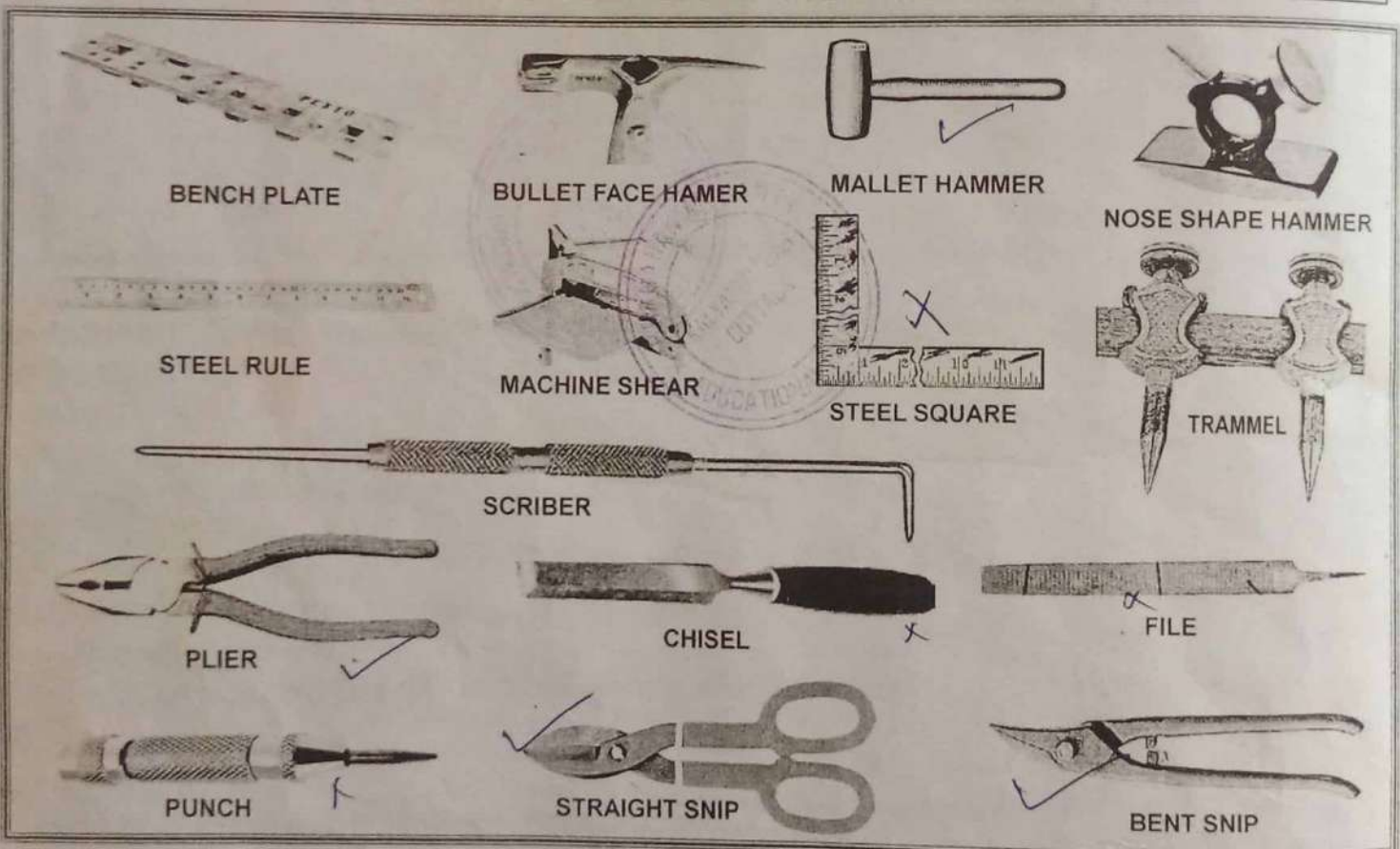
## INTRODUCTION :

Many engineering and household articles such as bones, cans, funnels, duets etc are made from a flat sheet of metal, the process being known as tin smithy. For this, the development of the article is first draw on the sheet metal, then cut and folded to form the required shape of the article. The edges of the article are then secured through welding, brazing, soldering and riveting etc.

## HAND TOOLS :

Sheet metal worker does most of his job with the help of hand tools. These hand tools are :

a. Sheet Metal Hammer	b. Scriber	c. Rule	d. Divider
e. Trammel	f. Steel Square	g. Chisel	h. Punch
i. Pliers	j. File	k. Snip	l. Shears



## SHEET METAL HAMMER :

Light weight hammers and mallets are used in sheet metal work. Ball peen hammer has a cylindrical, slightly curved face and a ball head. It is a general-purpose hammer, used mostly for riveting in sheet metal work. Cross peen hammer has a tapered peen end and is perpendicular to the handle. Mallet is used for bending and folding work. Bullet head or bullet face hammer are used to make the job made of light sheets hollow and riveting hammer is used for reveal joint jobs in sheet metal work.

**SCRIBER :** This tool is used for marking in sheet metal jobs.

**RULE :** In sheet metal jobs a number of rules are used for measuring purposes. These have been discussed in detail in the chapter on measuring tools.

## DIVIDER :

Divider is used in sheet metal jobs for circle marking. With the divider we can also do marking the parts of a job.

**TRAMMEL :** This is also a marking tool which has been discussed in the chapter on "Marking Tools".



## **STEEL SQUARE :**

For right angle marking in sheet metal jobs steel square is used. In addition, this is also used for checking the right angle of the jobs.

## **CHISEL :**

Several types of chisels are used for cutting metal sheets in different ways. These have been discussed in details in chapter on "Cutting Tools".

## **PUNCH :**

Punch is used in sheet metal jobs for punching or deep marking. Their detailed description is given in the chapter on "Marking Tools".

## **PLIERS :**

Pliers are used for holding or cutting small jobs or wires etc. These have been described in detail in the chapter on "Dismantling, Assembling and other Tools".

## **FILE :**

Several types of files are used for smoothing metal sheets. We can read about them in detail in the chapter on "Cutting Tools".

## **SNIPS :**

Snip is used for cutting thin sheet metal up to 20 S.W.G (Standard Wire Gauge). There are several types of snips available for making straight and circular cut, the most common being straight snip and curved or bent snip. The straight snip has straight blade for straight-line cutting while curved or bent snip has curved blade for making circular cut. Both the snips are very light and can be easily handled by only hand. These are the following two types such as : Straight Snip and Bent Snip.

## **SHEARS :**

This is also used like snip for cutting metal sheets but it is used to cut thicker sheets as compared to snip. This is of two types such as : Stock Shear and Block Shear.

## **SHEET METAL BENCH TOOL :**

- a. Vice
- b. Stakes
- c. Groover
- d. Bench Plate

## **VICE :**

Vice is used in sheet metal works for holding sheets or jobs. Normally, parallel jaw vice is used in sheet metal works.

## **STAKE :**

Stake is the sheet-metal worker's anvil, used for bending, seaming or forming, using the hammers and mallets. They actually work as supporting tools as well as forming tools. They help in bending operation. They are of different shapes and sizes to suit the requirements of the work.

The double seaming stake is used to make double seam. The beak horn stake is used for riveting, forming round and square surfaces, bending straight edges and marking corners. The bevel edges square stake is used to form corners and edges. The hatchet stake is used to make straight sharp bend and for folding and bending edges. Small tools and pipes may be formed on the needle case stake and cone-shaped articles may be formed on blow-horn stake. The hollow mandrel stake is used for riveting, seaming and forming.

## **GROOVERS AND RIVET SETS :**

Hand Groovers are used to groove and flatten a seam. This available in many shapes. Rivet set is a hardened steel tool with a hollow in one end. It is used to shape the end of a rivet into a round or smooth head.

## **BENCH PLATE :**

The bench plate is a special type of plate made of carbon steel. Different types of holes, round, square, in different shapes and sizes are made in this plate. Different types of stakes are fixed in these holes and used.



**JOB NO. 04**

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO. : ..... MARKS : ..... COMPLETE : .....

*Sign. of Sr. Lect./Lecturer*

**AIM OF THE EXPERIMENT :**

To Prepare and Make a <sup>Square</sup> Taper Tray :

**OBJECTIVES OF THE EXPERIMENT :**

- Use snips to cut the sheet for the development of a taper square tray
- Make Double Hem on the edges.
- Bend the sheet on hatchet stake.
- Soft solder lap joint.

**SET UP OF THE JOB :***Equipment Required :*

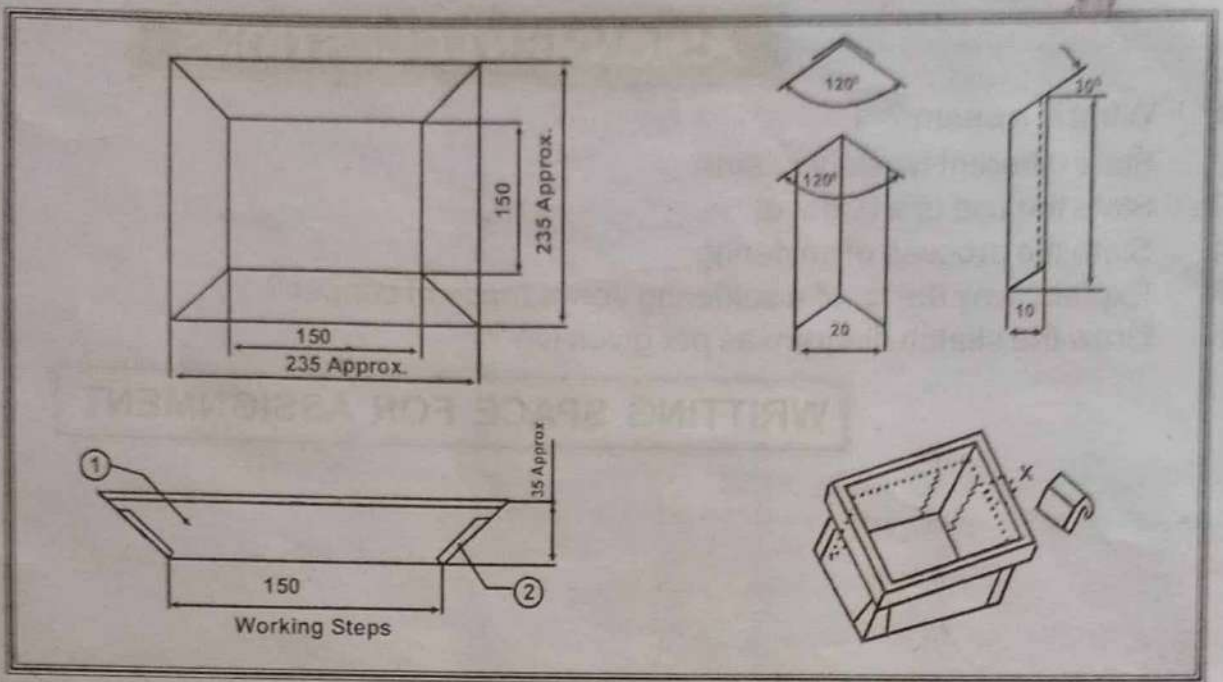
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Steel Rule		
02	Folding Rule		
03	Straight Edge		
04	Try Square		
05	Scriber		
06	Divider		
07	Punch		
08	Chisel		
09	B.P. Hammer		
10	Snip		
11	Soldering Iron		
12	Mallet		

*Raw Material Required :*

- M.S. sheet : As Per Specified Given Job Diagram.
- Soft solder : As Per Specified Given.



**JOB FIGURE :**



**PROCEDURE :**

- Check the size of the sheet as per the sketch using a steel Rule.
- Level the sheet on a leveling plate by a mallet.
- Mark out the development of the sheet by the parallel line method as per dimension.
- Cut away waste material
- Cut the four corner flaps and bend to 120°.
- Bend the 4 edges to double Hem on the outside.
- Clamp the work on the scribed line.
- Bend the all the 4 sides as per drawing.
- Check the size and shape (Make corrections, if necessary).
- Solder the four flaps on the outside, each on one corner.
- Painting the tray with red oxide by Brush Paint. Give a finished coat either by spray painting or hand painting.

**OBSERVATION :**

	DESIRED DIMENSION IN MM	ACTUAL DIMENSION IN MM	DEVIATION IF, ANY
Length of the tray			
Width of the tray			
Depth of the tray			
Angle of inclination			

**CONCLUSION :**

Explain the reasons for deviation between given specification and finished job. Suggest suitable methods for improvement of quality of the job.



## JOB NO. 05

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO. : ..... MARKS : ..... COMPLETE : .....

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### AIM OF THE EXPERIMENT :

To Prepare and Make a Funnel :

### OBJECTIVES OF THE EXPERIMENT :

- Use snip to cut the sheet for the Development of funnel
- Make a seam on the edge
- Bend the sheet metal on a taper bar
- For forming a conical shape
- Join the sheet with grooved lokc seam using grooves
- Solder the sheet-metal to obtain a leak proof joint.

### SET UP OF THE JOB :

Tools Required :

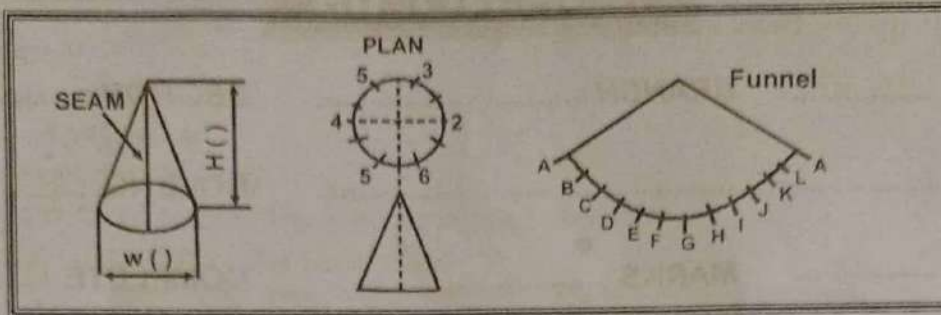
SL. NO.	NAME OF TOOLS	SPECIFICATION / TYPE	QUANTITY
01	Steel Rule	300mm	
02	Divider		
03	Band Snip	1200 mm	
04	Chisel		
05	Straight edge		
06	Hammer		
07	Try Square		
08	Snip (Straight)		
09	Scriber		
10	Soldering Iron		
11	Mallet		

### Raw Material Required :

- G. I. Sheet : As Per Specified Given Job Diagram.
- Soft-solder : As Per Specified Given.



**JOB FIGURE :**



**PROCEDURE :**

- a. Check the size
- b. Level the sheet on a leveling plate by a mallet.
- c. Mark out the development of funnel as per dimensions.
- d. Cut away the the waste material.
- e. Bend the sheet over a metal cone in order to get the desired shape.
- f. Similarly, another sheet metal is cut to the required dimension and bend over a taper rod to form a tail of a funnel.
- g. Insert the tail in the cone of the funnel and solder.

**OBSERVATION :**

	DESIRED DIMENTION IN MM	ACUTAL DIMENSION IN MM	DEVIATION IF, ANY
Height of the cone			
Diameter of the cone			

**CONCLUSION :**

Explain the deviation between the given specification and the finished job. Suggest suitable methods for improvement of quality of the job.

**ASIGNMENT QUESTIONS**

1. What is a Hem ?
2. State the method of bending sheet – metal by “Manual Bending”.
3. What is the use of a groover ?
4. Name different types of tools and equipment in sheet metal ?
5. What is Seam ?
6. What is Corasion ?
7. Draw the given Job diagram ?
8. What is the different between hard solder and shoft solder ?
9. Which are the commonly used sheet metal joints ?
10. What are the different operations that are performed under sheet metal trade ?



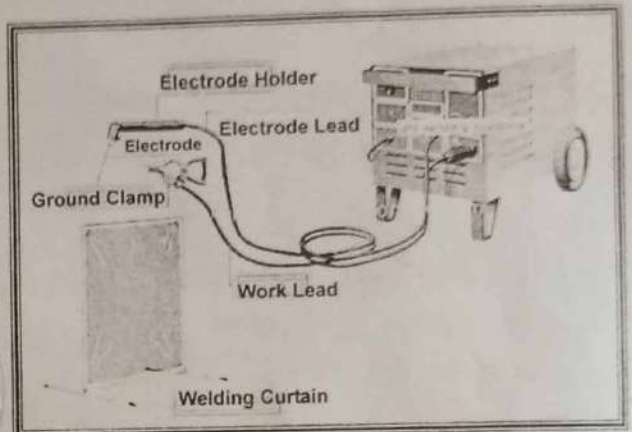
# WELDING

## INTRODUCTION :

**Welding** is the process of joining two similar or dissimilar metal pieces. In this process, the two metallic pieces are joined by the application of heat. It results in a joint that is equivalent in composition and characteristics of the metals joined. The various welding processes such as : *Electric Arc, Gas, Thermit, Resistance and Friction Welding*. In gas and arc welding, the work pieces are melted along a common edge to their melting point and then a filler metal is introduced to form the joint on solidification. In fact, welding is a quick, cheap and simple technique of joining the metallic pieces.

## ELECTRIC ARC WELDING :

The heat required for joining the metals is obtained from an electric arc. Transformers or motor generator 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 arc melts the surfaces, so that the metals to be joined are actually fused together. The given figure shows the principle of arc welding using a transformer. In addition to the welding machine, certain accessories are needed for carrying out the welding work.



## WELDING CABLES :

**Welding cable** is used to connect the job with the earth line and the electrode holder with the main line (Phase Line). Highly insulated aluminium or copper cables are used for the purpose. Two welding cables are required, one from the machine to the electrode holder and the other from the machine to the ground clamp or the other negative charge.

## ELECTRODES :

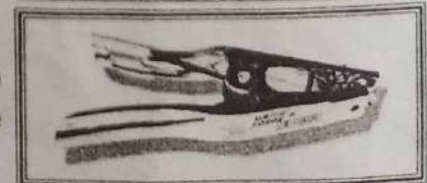
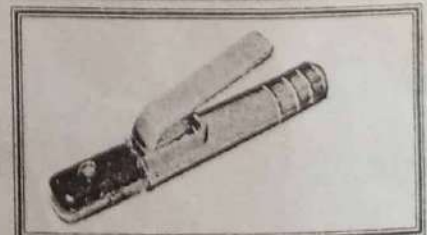
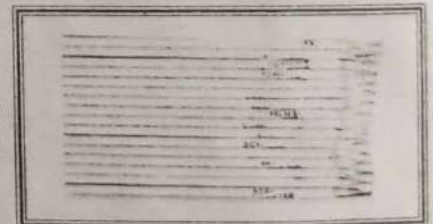
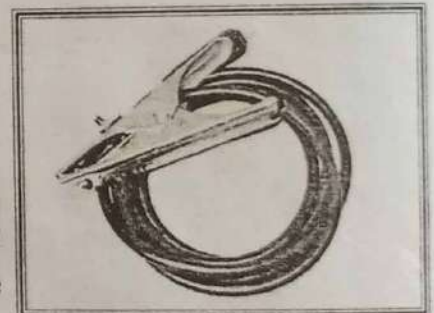
Filler rods used in arc welding are called electrodes. They are generally made of a rod of alloying elements suitable for the job, coated with a flux. Flux acts as an insulator of electricity.

## ELECTRODE HOLDER :

It consists of a handle and jaw. 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. The jaws of the holder are insulated.

## GROUND CLAMP :

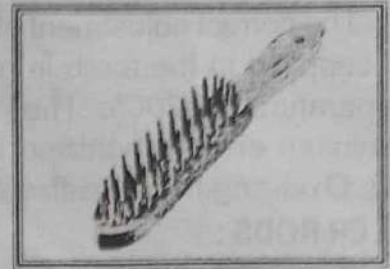
It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit. It should be strong and durable and have a low resistance connection.





### 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 formed 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.



### WORKING TABLE :

It is made of steel plate and pipe. It is used for positioning the parts to be welded properly.

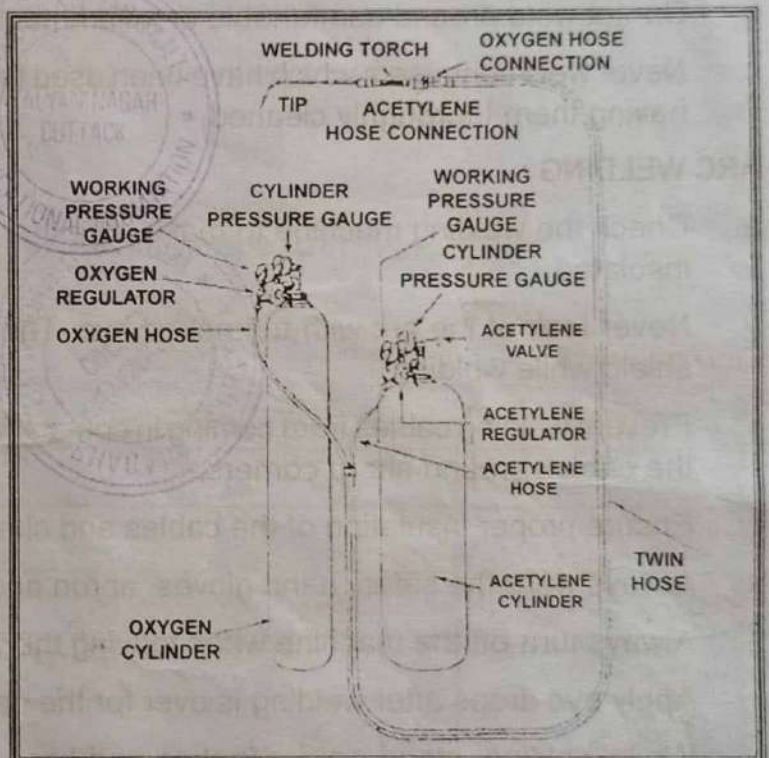
### FACE-SHIELD :

The 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 whenever the work can be done with one hand. The helmet type, though not comfortable to wear, but leaves both hands free for the work.



### GAS WELDING :

Oxyacetylene flame is commonly used for gas welding. It consists of the supply of oxygen and acetylene under pressure in 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 gauge, 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 and the flame may be controlled by adjusting the oxygen and acetylene supply.

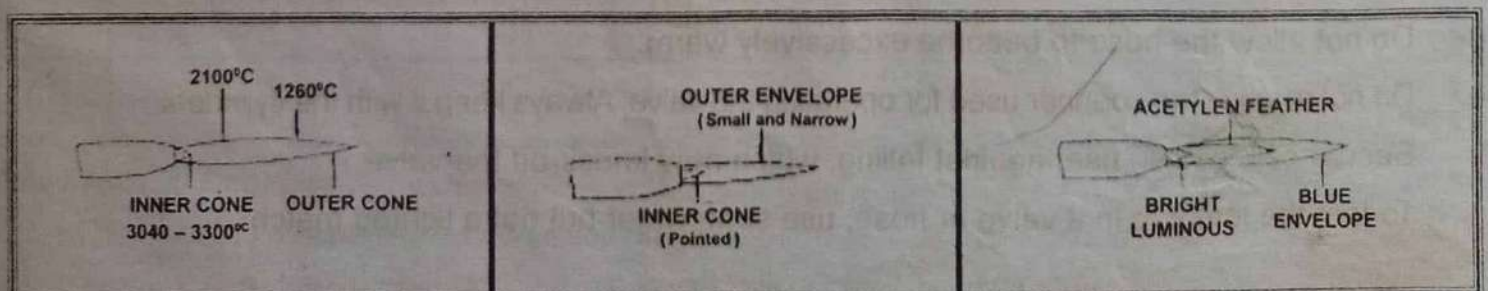


### GOGGLE :

The goggles with blue glass are used to protect the eyes from glare and flying bits of hot metal.



### TYPES OF FLAMES :





The correct adjustment of the flame is important for effective welding. When oxygen and acetylene are supplied to the torch in nearly equal volumes, a neutral flame is produced having a maximum temperature of 3200°C. The neutral flame is widely used for steel, stainless steel, cast iron, copper aluminium etc. Carbonizing flame produced with an excess of acetylene, is needed for welding lead. Oxidizing flame with excess of oxygen is used for welding brass.

#### FILLER RODS :

For oxyacetylene gas welding, filler rods are not coated. However, mild steel welding rods are usually copper coated to prevent rusting.

#### SAFETY PRACTICES :

##### GENERAL :

- a. Always weld in a well ventilated place. Flames given off from welding are unpleasant and in some cases may be injurious, particularly from galvanized or coated parts.
- b. Do not weld around combustible or inflammable materials, where sparks may cause a fire.
- c. Never weld containers which have been used for storing gasoline, oil or similar materials, without having them thoroughly cleaned.

##### ARC WELDING :

- a. Check the welding machine to make sure that it is properly earthed and all leads are properly insulated.
- b. Never look at the arc with the naked eye. The arc can burn eyes severely. Always use a face-shield while welding.
- c. Prevent welding cables from coming in contact with hot metal, water, oil or grease. Avoid dragging the cables around sharp corners.
- d. Ensure proper insulation of the cables and check the openings.
- e. Always wear the safety hand gloves, apron and leather shoes.
- f. Always turn-off the machine when leaving the work.
- g. Apply eye drops after welding is over for the day, to relieve the strain on the eyes.
- h. While welding, stand on dry footing and keep the body insulated from the electrode or bare parts of the electrode holder and the work.

##### GAS WELDING :

- a. Always wear welding goggles while doing gas welding.
- b. Always use the spark lighter to light the torch, never use a matchbox.
- c. Do not allow blow pipe to heat cylinders, hoses or any other equipment.
- d. Do not allow the hose to become excessively warm.
- e. Do not use the spanner used for operating the valve. Always keep it with the cylinders.
- f. Secure the cylinders against falling, which may knock-off the valve.
- g. To test the leakage in a valve or hose, use soap water but not a lighted match.



**JOB NO. 06**

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO. : ..... MARKS : ..... COMPLETE : .....

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**AIM OF THE EXPERIMENT :**

To Prepare and Make a Lap Fillet Joint in Flat Position by Gas Welding :

**OBJECTIVES OF THE EXPERIMENT :**

- Set the job for flat position welding.
- Set gas pressure according to the nozzle size.
- Tack welding of two pieces to form lap fillet joints.
- Maintaining correct overlapping.
- Fusion welding of lap fillet joint using correct filler rod and nozzle size.

**SET UP OF THE JOB :****Equipment Required :**

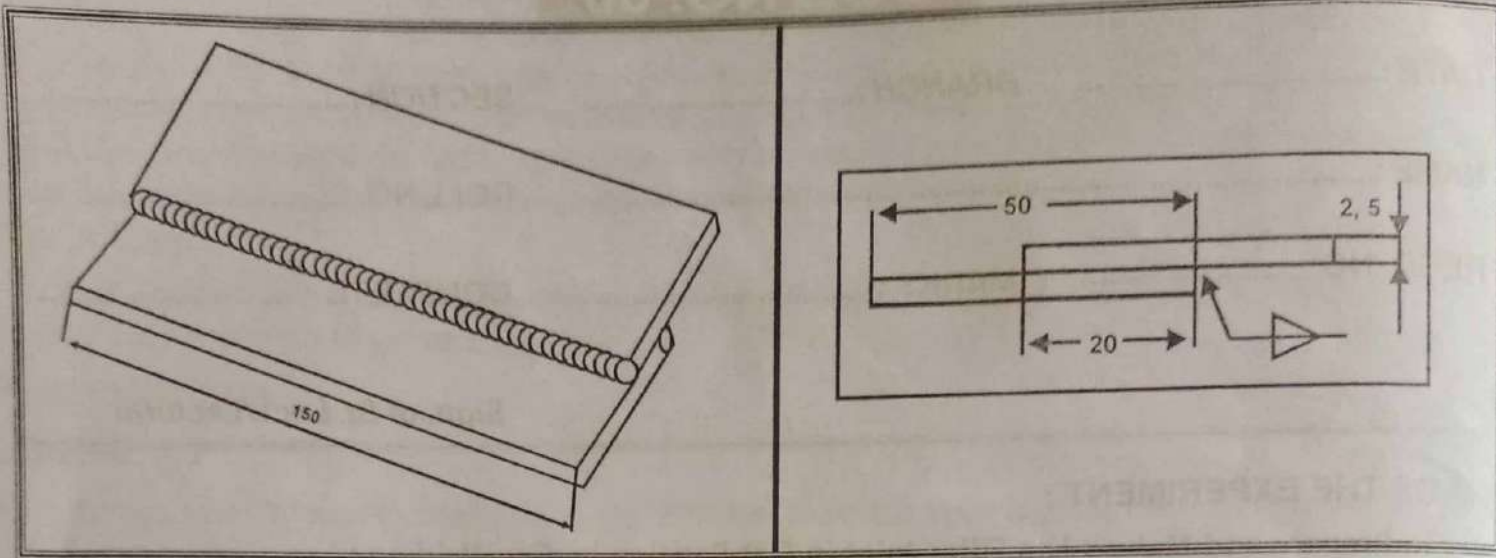
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Welding torch		
02	Welding nozzle on tips		
03	Pressure Regulator		
04	Hose Pipes and Fittings		
05	Goggles		
06	Gloves		
07	Spark Lighter		
08	Oxygen Gas Cylinder with Regulator		
09	Acetylene Gas Cylinder with Regulator		
10	Wire Brush		

**Raw Material Required :**

- M.S. Sheet : As Per Specified Given Job Diagram.
- Copper Coated mild steel filler rod : As Per Specified Given Job Diagram.



**JOB FIGURE :**



**PROCEDURE :**

- a. File flat and square
- b. Clean for Welding.
- c. Set the work pieces on welding table to form a lap joint with correct overlapping as per sketch.
- d. Set the gas welding plant and attach the nozzle.
- e. Set a pressure of 0.15 kg/cm<sup>2</sup> for both oxygen and acetylene gas.
- f. Select C.C.M.S. filler rod of 1.6 mm dia.
- g. Wear safety apron, goggles and gloves.
- h. Set the natural gas flame.
- i. Tack weld the pieces at both the ends and middle.
- j. Clean the tacks with a wire brush and set on the welding table in flat position.
- k. Start welding using leftward technique.
- l. Stop at the left edge and fill the corner to complete the weld.
- m. Extinguish the flame, cool the nozzle and place the blowpipe in safe place.
- n. Clean the welded joint and inspect visually for correct size of fillet weld.
- o. Weld the job from the other side following the above process.

**OBSERVATION :**

	DESIRED QUALITY	ACTUAL QUALITY	WHETHER ACCEPTABLE OR NOT
Nature of overlapping	Proper		
Quality of the welded joint	Uniform in nature		
Finishing	Smooth without blowholes		



**SAFETY PRECAUTIONS :**

- a. As per as possible use a spark lighter for lighting the flame.
- b. Oil, petrol and other explosives should be kept away from the welding plant.
- c. Use goggles while welding.
- d. Oil and petrol tanks should be perfectly emptied before welding them.
- e. Do not take the job in your hands.

**ASIGNMENT QUESTIONS**

- 1. How many types of gas welding flames are there and what are they ?
- 2. What types of flames are necessary for brass welding ?
- 3. What precautions are necessary in handling oxygen and acetylene cylinder ?
- 4. What is the difference between brazing and welding ?
- 5. What is the colours of oxygen and acctelyne cylinder ?
- 6. What is the difference between horizontal and vertical welding ?
- 7. Write down the different methods of electric arc welding ?

**WRITTING SPACE FOR ASSIGNMENT**





**JOB NO. 07**

DATE : ..... BRANCH : ..... SECTION : .....  
NAME : ..... ROLL NO. : .....  
REGD. NO. : ..... MARKS : ..... COMPLETE : .....

Sign. of Sr. Lect./Lecturer

**AIM OF THE EXPERIMENT :**

To Prepare and Make a Square Butt Joint by Arc Welding :

**OBJECTIVES OF THE EXPERIMENT :**

- a. Set the job for square butt joint.
- b. Tack weld two pieces to form square butt joint.
- c. Weld along the joint with correct arc length, correct electrode angle and uniform welding speed.

**SET UP OF THE JOB :**

*Equipment Required :*

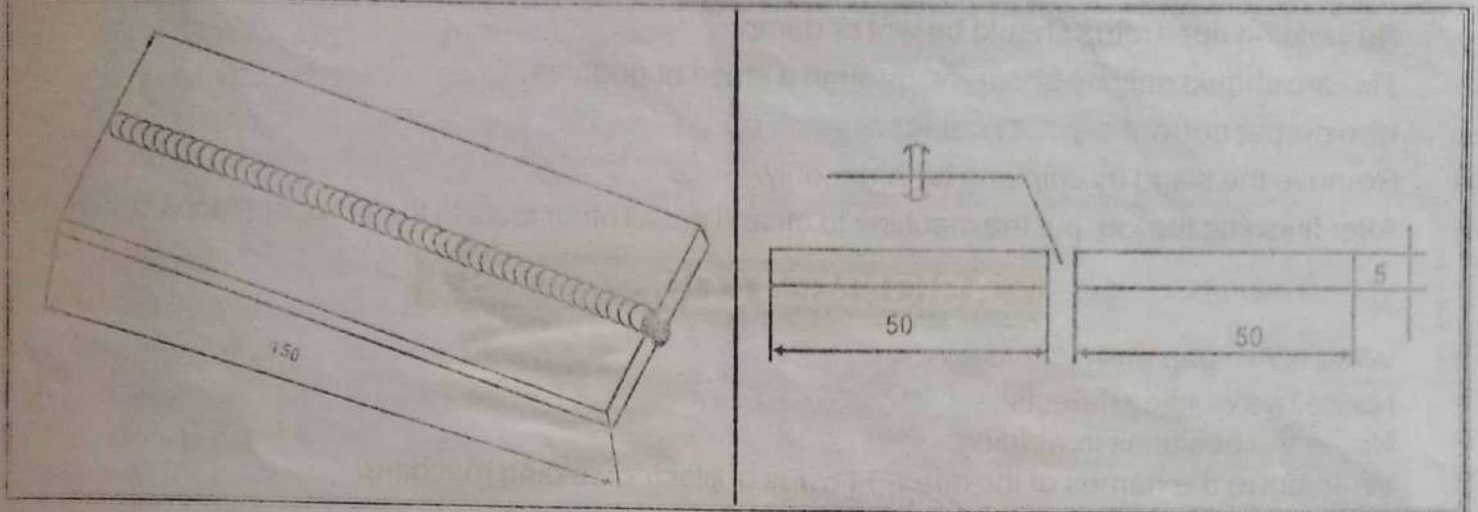
SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Arc welding transformation		
02	Electrodes		
03	Electrode holder		
04	Cable and cable connectors		
05	Chipping hammer		
06	Wire brush		
07	Welding screen or helmet		
08	Gloves		
09	Apron		
10	Pedestal grinding machine		

*Raw Material Required :*

- a. M.S. flat : As Per Specified Given Job Diagram.
- b. M.S. electrode : As Per Specified Given Job Diagram.



**JOB FIGURE :**



**PROCEDURE :**

- a. **File** flat and square
- b. **Clean** the job pieces
- c. **Check** the dimensions of two pieces.
- d. **Set** the pieces on welding table as butt joint with gap in alignment as per the drawing.
- e. **Select** the 10 S.W.G. electrodes and set the current of 120 amp.
- f. **Tack** the pieces at both the ends and at centre.
- g. **Check** the alignment of tack pieces and reset it, if necessary.
- h. **Place** the joint in flat position on the welding table.
- i. **Select** 8 S.W.G. electrode and set a current of 150 ampere.
- j. **Deposit** the first bead along the joint line with correct arc length, correct electrode angle and uniform welding speed.
- k. **Chip** the slag from the bed with a chipping hammer and brush with a wire brush and inspect.
- l. **Clean** the backside of the first bead thoroughly and gird the tacks.
- m. **Deposit** the second bead on this side, using the same settings.
- n. **Chip** the slag from the bead with a chipping hammer and brush with a wire brush.

**OBSERVATION :**

	DESIRED QUALITY	ACTUAL QUALITY	WHETHER ACCEPTABLE ON NOT
Alignment of the job	Must be in the same plane		
Quality of the welded joint	Uniform in nature		
Finishing	Smooth without blowholes		



## SAFETY PRECAUTIONS :

- a. No welding apparatus should be wet or damp.
- b. The arc should only be observed through a shield or goggles.
- c. Use proper current capacity cables.
- d. Remove the slagg by chipping hammer only.
- e. After finishing the job, put the machine to off and put all other tools to their proper places.

## ASIGNMENT QUESTIONS

1. What is Arc gap and Arc blow ?
2. Name two welding defects.
3. Name the positions in welding.
4. Write down the names of the different types of electric welding machine.
5. Write the different faults in arc welding ?
6. Write down the different types of arc length ?
7. What are the advantages of arc welding ?

## WRITTING SPACE FOR ASSIGNMENT





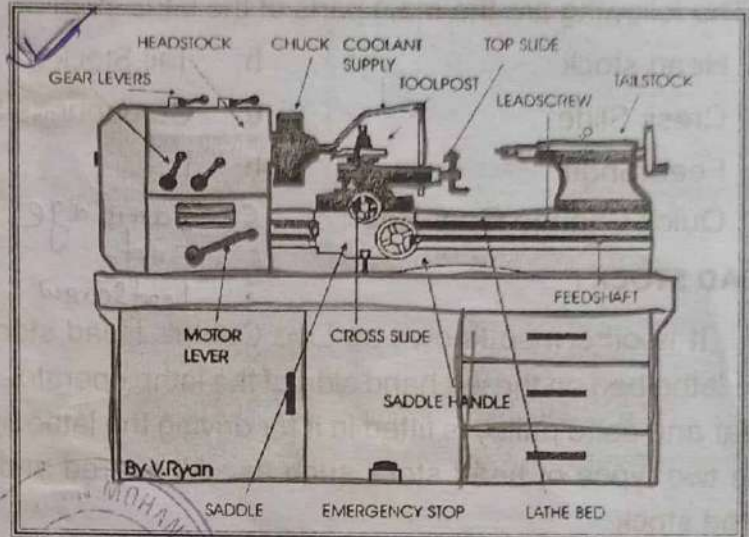
# TURNING

## INTRODUCTION :

Turning is the machining process to bring the raw material to the required cylindrical shape and size by metal removal from the work surface. This is done by feeding a cutting tool against a rotating workpiece. This machine tool on which turning is carried out is called lathe.

## WORKING PRINCIPLE :

Lathe removes considerable materials from rotating workpiece in the form of chips with the help of tools, which is feed against the rotating workpiece. The tool material should be harder than the workpiece and the lather had surely and rigidly on the machine. The tool may size linear machine in any direction. A lathe is used to produce cylindrical surface and plane surface at right angle to the axis of rotation. It can also produce a taper below.



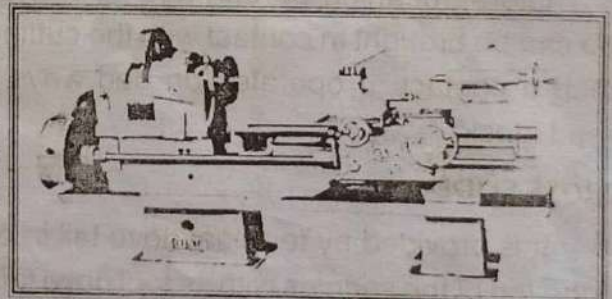
A lathe, basically consists of a bed to provide support a head stock across side to transverses the tool and tool post mounted on the across the spindle is driven by a motor through the gear box to obtain a long speed to carriage moves over the bed side which is paralld to workpiece and spindle provides transverse. It was the modern engine lathe which is equiped well, all necessary accessories for acurate tool room work. It is generally bed driven machine with considerable range is spindle and feeds.

## TYPES OF LATHE :

Lathe machines are used in workshops can be divided into following types such as : Centre, Production, engine and Special Lathe.

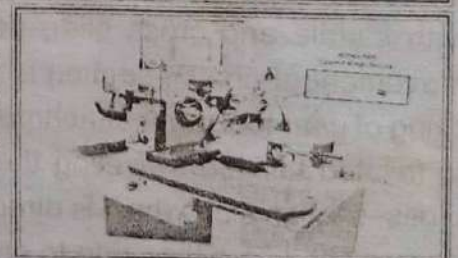
### CENTRE LATHE :

The Centre Lathe is also known as SS and SC Lathe, which is used for surface and screw body. Various types of lathe machines are available under this type i.e., Hand Lathe, Bench Lathe, Foot Lathe, Tool and Engine Lathe.



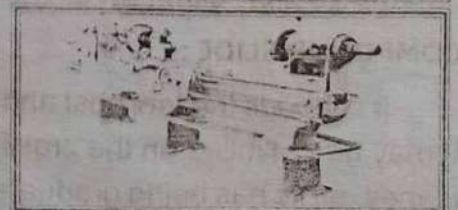
### PRODUCTION LATHE :

Production Lathes are used when a particular job is to be produced in a large quantity. There are three kinds of production lathe machines are available such as : Capstan Lathe, Turret Lathe and Multi Spindle Lathe.



### SPECIAL LATHE :

Special types of lathe machines are used for specific purposes. For example : Relieving Lathe, which are used are providing relief to milling cutters or tap. There are three types of lathe are available under this section such as : Axial turning Lathe, Copying Lathe and Relieving Lathe.





## ENGINE LATHE :

Engine Lathe machines is normally used by fitters in the workshop, when electric motors were not invented. This machines are operated with steam engines.

### MAIN PARTS OF THE LATHE :

The following are the main parts of the lathe such as :

- |                          |                    |               |
|--------------------------|--------------------|---------------|
| a. Head stock            | b. Tail Stock      | c. Carriage   |
| d. Cross Slide           | e. Compounds Slide | f. Bed        |
| g. Feed Shaft            | h. Legs            | i. Lead Screw |
| j. Quick Change Gear Box | C - Carriage       |               |

### HEAD STOCK :

It is otherwise known as Live Centre. Head stock is fitted on the lathe bed on the left hand side of the lathe operator. The required gear and cone pulley is fitted in it for driving the lathe spindle. There are two types of head stock such as : All geared and Cone pulley head stock.

### TAIL STOCK :

The tail stock is otherwise known as Dead Centre. It is fitted on the lathe machines bed, on the right hand side of the lathe operator. It can be moved any desired space on the lathe bed in case of need. It is used for centre to centre turning of lengthy workpiece.

### CARRIAGE :

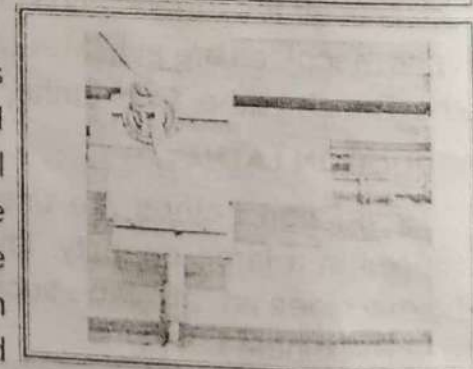
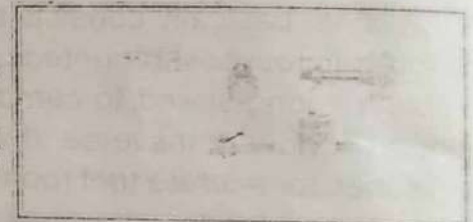
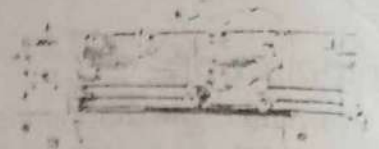
Literal meaning of "carriage" is to carry. Through carriage, a job can be brought in contact with the cutting tool or withdrawn from such a contact. It operates on bed ways between tail stock and head stock.

### CROSS SLIDE :

It is provided by terminal dove tail in one side and assembles in the top of the saddles with its tool dove tail. A taper grip is provided with saddle and cross slide dovetail to permit required but full movement of cross -section is provided with T-section to enable fixing of gear tool parts attachment from side is generated in degree to failated tailated swiveling the compound next is movement on cross-section side which is directly assembles with cross slide and be swiveltd on either side to give desire angle to compound next.

### COMPOUND SLIDE :

It supports the tool post and cutting tools in its various positions. It may be swivelled on the cross slide to any angle in the horizontal planes, as its has being graduated suitably. Its necessary in turning.





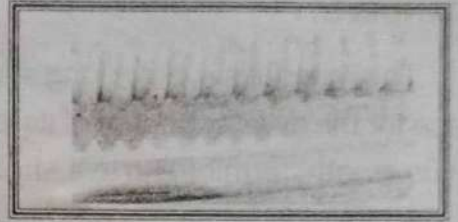
## BED :

All the parts of the lathe machine are fixed to the bed. The saddles of the carriages slide on the beds. There are three types of beds such as : 'V' Bed, Flat Bed and Combination Bed.



## LEAD SCREW :

It is a part of lathe machine, which is used for thread cutting operation. It has acme thread having angle  $29^\circ$ .

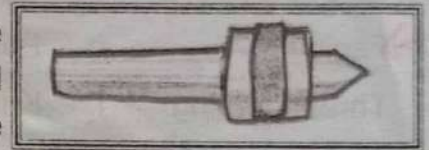


## LATHE ACCESSORIES :

- |   |             |               |
|---|-------------|---------------|
| a. Lathe centre (Live Centre and Dead Centre) | b. Chuck    |               |
| c. Catch Plate                                | d. Carriers | e. Face Plate |
| f. Steady Rest                                | g. Mandrels |               |

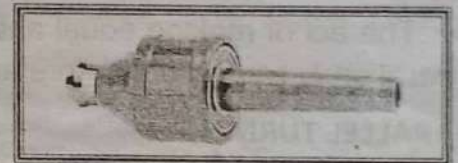
## LATHE CENTRE :

To provide support to lengthy jobs on lathe machines, centres are used. These are used by fitting them into tail stock's spindle and head stock's spindle. These can be divided into two parts such as : Live Centre and Dead Centre.



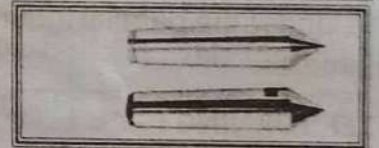
## LIVE CENTRE :

These are fitted in head stock's spindles. These are driven with the power of the machine.



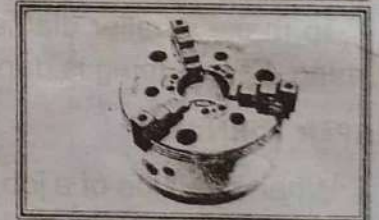
## DEAD CENTRE :

These centres are fitted in centre tail stock spindle and they provide support to the other end of the job.



## CHUCK :

Chuck is normally used to provide a strong grip to catch the job on the lathe machine. These are easily fitted on the threading to the end of head stock spindle. Generally these are two types such as : Three Jaw and Four Jaw Chuck.



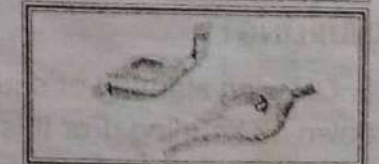
## CATCH PLATE :

The catch plate is also known as driving plate. It is a round ordinary plate of cast iron. Grooves facing each other are cut in this plate. Bent tail type job carrier is put in it and job is revolved. Threads exist in its centre and with their help head is fixed in the spindle.



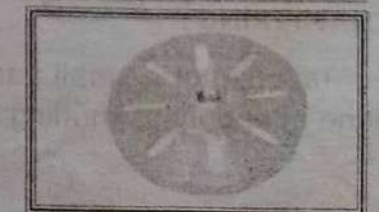
## CARRIERS :

The carriers is also known as Dog. It is used with the catch plate. The job is tied in the carrier and fitted in the catch plate.



## FACE PLATE :

There are a number of jobs of such as shape that these can not be fitted into the centres or clamped with the help of chucks for the purpose of turning. Such jobs are gripped by the face plate. This plate is also like the catch plate but it has a number of grooves on it.





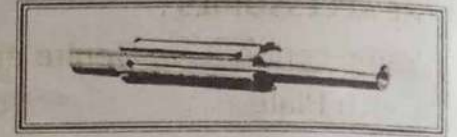
### STEADY REST :

Steady rest is used for such cylindrically long jobs which are likely to get resilient at the time of turning. These are of two types such as : Fixed Steady Rest and Travelling Steady Rest.



### MANDRELS :

The mandrel is like a long straight stake of steel. It has a rounded face for the greater portion of its length, terminating in a short, portion of its length, terminating in a short, flat anvil. It has drill holes at both the ends and its surface which comes into contact is hard and smoothly finished.



### LATHE OPERATIONS :

- a. Facing
- b. Parallel turning
- c. Step turning
- d. Taper turning
- e. Thread turning
- f. Knurling
- g. Chamfering

### FACING :

The act of making equal and plain ends of a job in their actual length is called facing. Facing operation is carried out before any other operations are done on the job.

### PARALLEL TURNING :

Under the parallel turning, turning is done on the entire length of the job according to its maximum diameter.

### STEP TURNING :

To make smaller diameter on a plain round shaft than the diameter of the shaft is called step turning. Step turning is done after the facing and parallel turning operations.

### TAPER TURNING :

When one side of a job with parallel diameter, is cut turned completely or partially, to reduced its diameter, lathe operation is called **taper turning**. The angle of the taper is made according to the need, more or less internal or outer.

### THREAD TURNING :

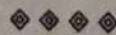
In the workshops where there is need for cutting tapers frequently, taper turning is used. This attachment is fixed behind the carriage.

### KNURLING :

Drawing slanting or square projecting lines on the surface of a job in order to have better grip is known as knurling. For this purpose a special knurling tool is used.

### CHAMFERING :

Tapering of a small part of a job at its edge or corner is known as chamfering. Chamfering is done after boring, knurling etc.





# JOB NO. 08

DATE : ..... BRANCH : ..... SECTION : .....

NAME : ..... ROLL NO. : .....

REGD. NO. : ..... MARKS : ..... COMPLETE : .....

*Sign. of Sr. Lect./Lecturer*

**AIM OF THE EXPERIMENT :**

To Prepare Different types of Job Operation By S.S and S.C. Lathe :

**OBJECTIVES OF THE EXPERIMENT :**

- a. To know and identify the sliding surfacing and screw cutting (SS and SC) lathe machine.
- b. To know and identify the main parts of the SS and SC lathe machine.
- c. To know main functions of the different parts of the lathe machine.
- d. To know different operations such as facing, centering, plain turning, step turning taper turning and grooving etc.

**TOOLS AND EQUIPMENT REQUIRED :**

SL. NO.	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Facing Tool		
02	Grooving Tool		
03	Tapping Tool		
04	Revolving Centre / Dead Centre		

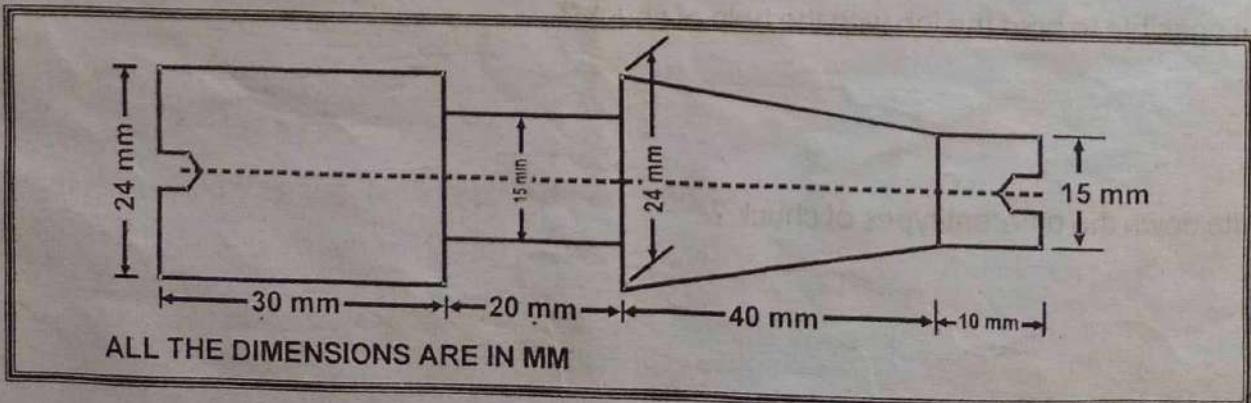
**MEASURING INSTRUMENT :**

- a. Slide Caliper                      b. Outside Caliper                      c. Steel Rule

**Raw Material Required :**

- a. M.S. Round Rod : As Per Specified Given Job Diagram.

**JOB FIGURE :**



24  
15



**PROCEDURE :**

1. At first study the drawing from the blackboard carefully.
2. Then cut the metal by the help of power hacksaw according to given specification.
3. Then hold the job by the help of chuck
4. Then facing the job by the facing tool.
5. Then drill centre hole is mounted on the tail stock.
6. Set the job between chuck and tail stock.
7. Then grooving the job according to the required dimension.
8. Then tapering the job by the tapering tool.
9. Then finished the job according to the required dimension. ✓

**OBSERVATION :**

Tolerance :  $\pm 0.25\text{mm}$ .

	DESIRED DIMENTION IN MM	ACUTAL DIMENSION IN MM	DEVIATION AFTER CONSIDERING ALLOWABLE TOLERABCE	REASONS FOR DEVIATION
Maximum Dia of Taper				
Minimum Dia of Taper				
Groove Dia				
Length of the Job				

**CONCLUSION :**

Explain the reasons for deviation from the given specification of the finished job. Suggest methods for improvement of quality of the job.

**ASIGNMENT QUESTIONS**

1. Draw the job sketch.

Ans.:

2. Is it possible to hold the job with the help of chuck ?

Ans.:

3. Write down the different types of chuck ?

Ans.:



4. What do you mean by taper ?

Ans.:

5. Write down the different types of taper ?

Ans.:

6. What is the difference between hollow spindle and solid spindle ?

Ans.:

7. What is the difference between live centre and dead centre ?

Ans.:

8. What is the difference between revolving centre and dead centre ?

Ans.:

9. What is the difference between Universal chuck and Independent chuck ?

Ans.:

10. What are the different angles on lathe cutting tools ?

Ans.:

11. What are the jobs that can be done on a lathe machine ?

Ans.:

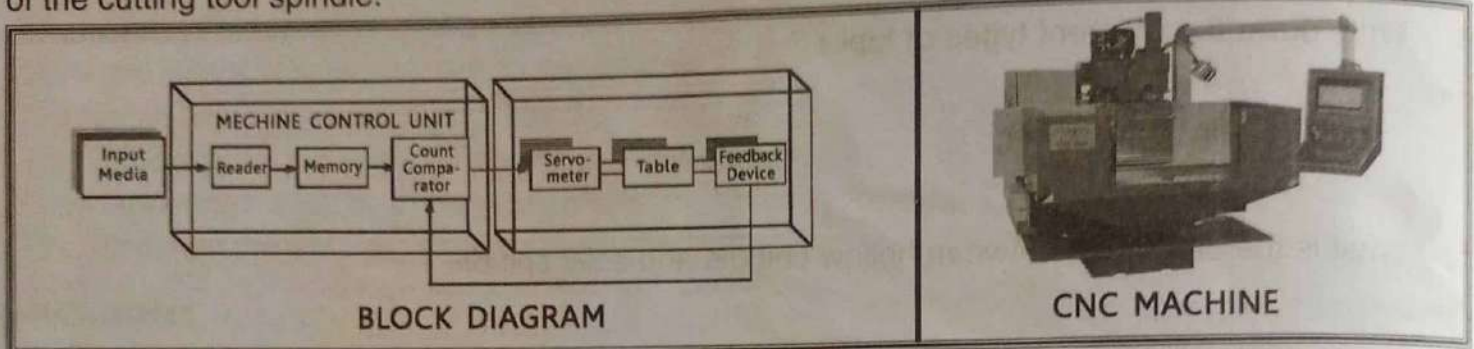
12. What is meant by speed, cutting speed and feed ?

Ans.:



# CNC MILLING / LATHE MACHINE

A **Milling Machine** is a machine tool used for the shaping of metal and other solid materials. Milling machines exist in two basic forms: horizontal and vertical, which terms refer to the orientation of the cutting tool spindle.



**Milling machines** can perform a vast number of operations, some very complex, such as slot and keyway cutting, planing, drilling, diesinking, rebating, routing, etc. Cutting fluid is often pumped to the cutting site to cool and lubricate the cut, and to sluice away the resulting swarf.

## Types of CNC Milling Machine :

CNC Milling machines will nearly always use SK (or ISO), CAT, BT or HSK tooling. SK tooling is the most common in Europe, while CAT tooling, sometimes called V – Flange Tooling, CAT tooling comes in a range of sizes designated as CAT – 30, CAT – 40, CAT – 50, etc.

## Machining Operations :

The three principal machining processes are classified as turning, drilling and milling. Other operations falling into miscellaneous categories include shaping, planing, boring, broaching and sawing.

- ◆ Turning operations are operations that rotate the workpiece as the primary method of moving metal against the cutting tool.
- ◆ Milling operations are operations in which the cutting tool rotates to bring cutting edges to bear against the workpiece.
- ◆ Drilling operations are operations in which holes are produced or refined by bringing a rotating cutter with cutting edges at the lower extremity into contact with the workpiece.
- ◆ Miscellaneous operations are operations that strictly speaking may not be machining operations in that they may not be swarf producing operations but these operations are performed at a typical machine tool. Burnishing is an example of a miscellaneous operation.

## Types of Machining Operation :

There are many kinds of machining operations, each of which is capable of generating a certain part geometry and surface texture. In turning, a cutting tool with a single cutting edge is used to remove material from a rotating workpiece to generate a cylindrical shape. The speed motion in turning is provided by the rotating workpart, and the feed motion is achieved by the cutting tool moving slowly in a direction parallel to the axis of rotation of the workpiece.

**Drilling** is used to create a round hole. It is accomplished by a rotating tool that is typically has two cutting edges. The tool is fed in a direction parallel to its axis of rotation into the workpart to form the round hole.

**In Boring**, the tool is used to enlarge an already available hole. It is a fine finishing operation used in the final stages of product manufacture.

**In Milling**, a rotating tool with multiple cutting edges is moved slowly relative to the material to generate a plane or straight surface. The direction of the feed motion is perpendicular to the tool's axis of rotation. The speed motion is provided by the rotating milling cutter. The two basic forms of milling are : **Peripheral** and **Face milling**



Other conventional machining operations include shaping, planing, broaching and sawing. Also, grinding and similar abrasive operations are often included within the category of machining.

### **Cutting Tool (Machining) :**

A cutting tool has one or more sharp cutting edges and is made of a material that is harder than the work material. The cutting edge serves to separate chip from the parent work material. Connected to the cutting edge are the two surfaces of the tool such as : Rake Face and Flank.

#### **Rake Face :**

The Rake Face which directs the flow of newly formed chip, is oriented at a certain angle is called the rake angle "±". It is measured relative to the plane perpendicular to the work surface. The rake angle can be positive or negative.

#### **Flank :**

The flank of the tool provides a clearance between the tool and the newly formed work surface, thus protecting the surface from abrasion, which would degrade the finish. This angle between the work surface and the flank surface is called the relief angle. There are two basic types of cutting tools such as : Single Point Tool and Multiple-cutting-edge Tool.

#### **Shape :**

Several standard shapes of milling cutter are used in industry today, which are explained in more detail below.

#### **Flutes / Teeth :**

The flutes of the milling bit are the deep helical grooves running up the cutter, while the sharp blade along the edge of the flute is known as the tooth. The tooth cuts the material, and chips of this material are pulled up the flute by the rotation of the cutter.

#### **Helix Angle :**

The flutes of a milling cutter are almost always helical. If the flutes were straight, the whole tooth would impact the material at once, causing vibration and reducing accuracy and surface quality.

#### **Center Cutting :**

Some milling cutters can drill straight down (plunge) through the material, while others cannot. This is because the teeth of some cutters do not go all the way to the centre of the end face.

#### **Roughing or Finishing :**

Different types of cutter are available for cutting away large amounts of material, leaving a poor surface finish (roughing), or removing a smaller amount of material, but leaving a good surface finish (finishing). A roughing cutter may have serrated teeth for breaking the chips of material into smaller pieces.

#### **Coatings :**

The right tool coatings can have a great influence on the cutting process by increasing cutting speed and tool life, and improving the surface finish. Polycrystalline Diamond (PCD) is an exceptionally hard coating used on cutters which must withstand high abrasive wear.

#### **Shank :**

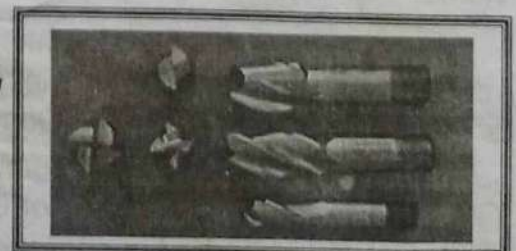
The shank is the cylindrical (non-fluted) part of the tool which is used to hold and locate it in the tool holder. A shank may be perfectly round, and held by friction, or it may have a Weldon Flat.

#### **Types of CNC Milling Machine :**

The different types of CNC milling machines are : End mill, Slot drill, Roughing end mill, Ball nose cutter, Slab mill, HSS slab mill, Side-and-face cutter, Side and face cutter, Involute gear cutter.

#### **End Mill :**

End mills (middle row in image) are those tools which have cutting teeth at one end, as well as on the sides. The words *end mill* are generally used to refer to flat bottomed cutters, but also include rounded cutters (referred to as *ball nosed*) and radiused cutters (referred to as *bull nose*, or *torus*). They are the most common tool used in a vertical mill.





### Slab Mill :

Slab mills are used either by themselves or in gang milling operations on manual horizontal or universal milling machines to machine large broad surfaces quickly. They have been superseded by the use of carbide-tipped face mills which are then used in vertical mills or machining centres.

### Side and Face Cutter :

The side-and-face cutter is designed with cutting teeth on its side as well as its circumference. They are made in varying diameters and widths depending on the application. The teeth on the side allow the cutter to make *unbalanced cuts* (cutting on one side only) without deflecting the cutter as would happen with a slitting saw or slot cutter (no side teeth).

### Hob :

These cutters are a type of form tool and are used in hobbing machines to generate gears. A cross section of the cutters tooth will generate the required shape on the workpiece, once set to the appropriate conditions (blank size). A hobbing machine is a specialised milling machine.

### Face Mill :

A face mill consists of a cutter body (with the appropriate machine taper) that is designed to hold multiple disposable carbide or ceramic tips or inserts, often golden in color. The tips are not designed to be resharpened and are selected from a range of types that may be determined by various criteria, some of which may be: tip shape, cutting action required, material being cut.

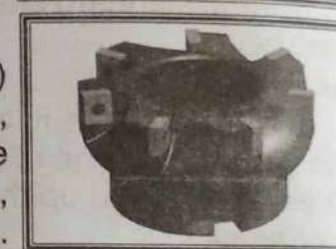
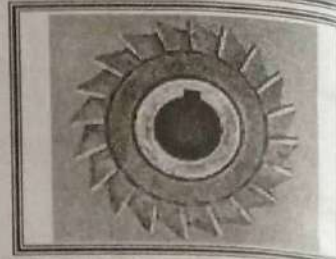
### CNC LATHE :

CNC lathes are rapidly replacing the older production lathes (multispindle, etc) due to their ease of setting and operation. They are designed to use modern carbide tooling and fully utilize modern processes. The part may be designed and the toolpaths programmed by the CAD/CAM process, and the resulting file uploaded to the machine, and once set and trialled the machine will continue to turn out parts under the occasional supervision of an operator.

The machine is controlled electronically via a computer menu style interface, the program may be modified and displayed at the machine, along with a simulated view of the process. The setter/operator needs a high level of skill to perform the process, however the knowledge base is broader compared to the older production machines where intimate knowledge of each machine was considered essential. These machines are often set and operated by the same person, where the operator will supervise a small number of machines (cell).

The design of a CNC lathe has evolved yet again however the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed. The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues.

With the advent of cheap computers, a free operating systems such as Linux, and open source CNC software, the entry price of CNC machines has plummeted. *For example* : Sherline makes a desktop CNC lathe that is affordable by hobbyists.



CNC LATHE



CNC LATHE WITH MILLING CAPABILITIES