

## Do's & Don'ts

1. Always listen carefully to the teachers and follow instructions.
2. Do not run and rush in practical work.
3. Don't talk aloud or crack jokes in lab.
4. Know the location of power ON/OFF switch of the lab.
5. Wear good strong shoes.
6. Bags should be stored away, during practical sessions.
7. Do not use a machine, until you have not been shown how to operate.
8. Use proper safety devices while using machines.
9. Keep hands, hairs and clothing away from moving parts of machinery.
10. Use hand tools carefully, keeping both hands behind the cutting edge.
11. Report any damage / faults to machines / equipments to the Lab incharge.
12. keep your workbench tidy and never distract another student.
13. Do not eat food, drink, or chew gum in the lab.
14. On completion of practical work return the tools.

Teacher's Signature \_\_\_\_\_

## Safety Precautions

When operator enters into the workshop, he should first observe safety to save himself and others.

### \* Precautions when using machines

- 1) Do not lean against the machines, it is a bad practice and also a dangerous one.
- 2) Do not work on a machine in bad light.
- 3) Never switch on a machine unless or otherwise you know all mechanism and operation of machine.
- 4) When using any grinding parts, protect the eyes by wearing goggles or using shields.
- 5) Do not clear metal chips by hand, use wire brush for clearing.
- 6) Be in a habit of cleaning the machine, equipments and tools regularly.

### \* Precautions in Workshop

- 1) Keep the workshop neat and tidy. Many accidents are caused due to tools tipping over left, trying over gangways.
- 2) Do not run on in the workshop. Walk carefully.
- 3) See that the floor is free from slippery substances.
- 4) Keep gangways clean and clear.
- 5) Everything should be in place and resting should be provided to throw waste metal pieces.
- 6) Workshop should have proper lighting and ventilation.

### \* Precautions while using hammer.

- 1) There should be no grease or oil on the handle.
- 2) Hammer head should not be projecting outward.

3) Handle should not be too long or too short.

\* Precautions while using chisel

- 1) It should be handled carefully and must be grounded.
- 2) Goggles must be used while chipping.

\* Precautions while using file

- 1) The finger of left hand must be crooked under file as this may injure fingers.
- 2) Metal chips must not be removed while doing job by bare hands where brush is used.
- 3) Files without handles or those with crook must not be used.

\* Precautions during welding

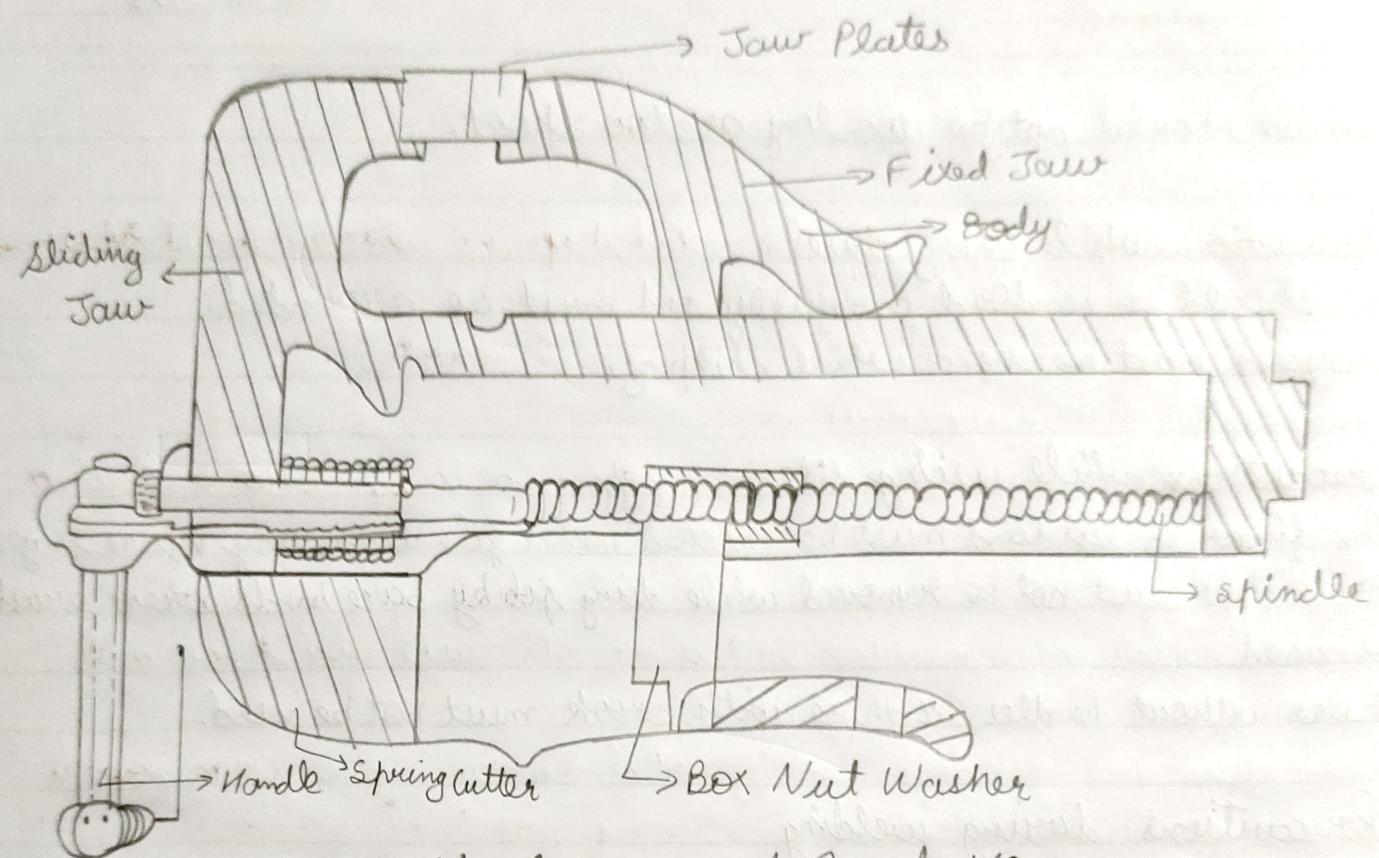
- 1) We should never use oxygen cylinders near inflammable substances.
- 2) Acetylene or oxygen cylinder must be kept separately.
- 3) Do not weld in confined space without adequate ventilation.
- 4) We should always use goggles while welding.
- 5) Make sure that connections are air tight by using soap water.
- 6) Never use matches for lighting while welding.
- 7) When welding is to be stopped, close the cylinder valve and release all the gas pressure from regulators and hoses by opening torch. When regulator shows zero, release pressure, adjusting screw and closing valves.

\* Precautions on Clothing

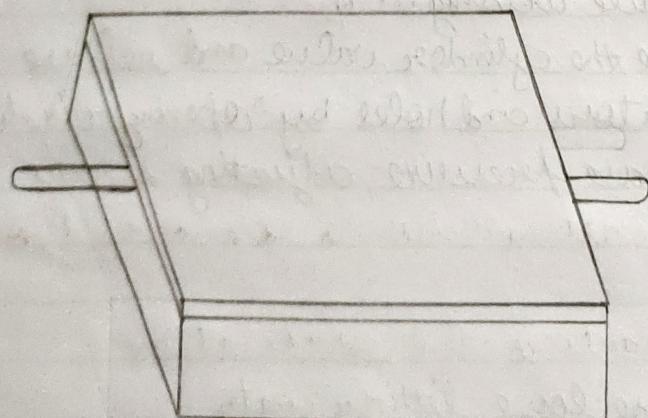
- 1) Tight fitting coats are safer than those loose fitting coats.
- 2) Avoid wearing rings, long sleeved shirts and watches while working.
- 3) Clear covered footwear having thick soles and tough above.
- 4) Hair must be combed well and kept away from danger.

X

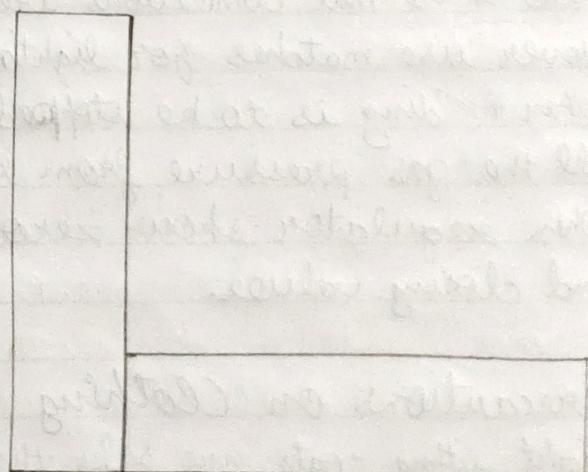
Teacher's Signature \_\_\_\_\_



\* Sectional View of Bench Vice,



\* Surface Plate



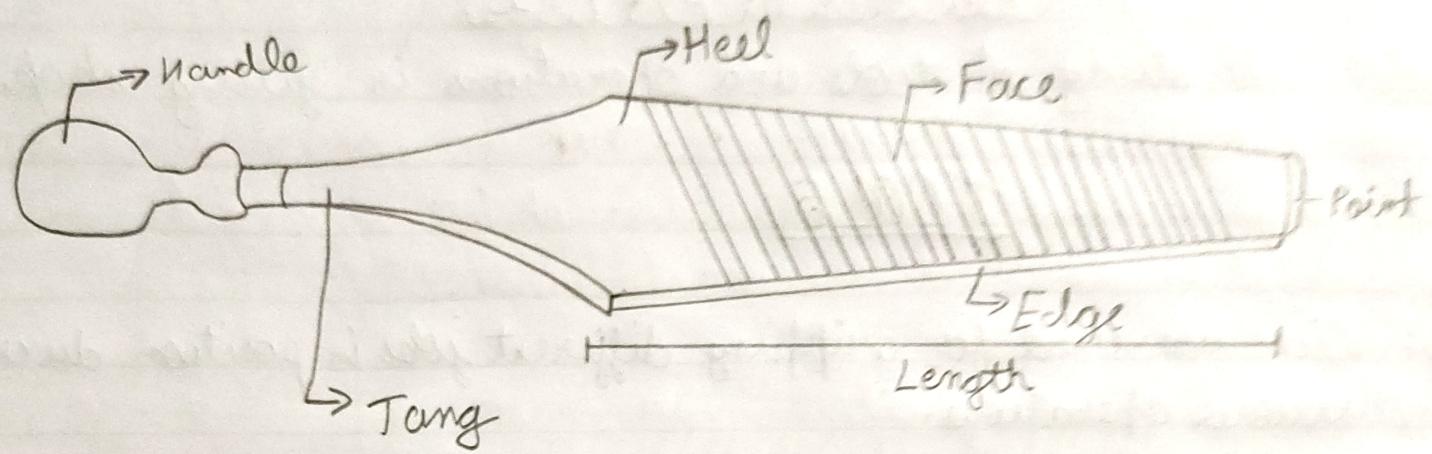
\* Try Square

## EXPERIMENT-1.

Object: To study of tools and operations in fitting shop.

### TOOLS

- Vices: Vices are used for gripping different jobs in position during various operations.
- Material: Main body and Detachable jaws are made of case steel. Screw is of mild steel.
- V-Block: It is usually works in conjunction with a U-clamp and is used to support the work in marking and drilling.
- Surface Plate: - It is used for testing trueness of finished surfaces, testing a try square. It made of cast iron.
- Try Square: It is used for testing true surface at right angles or testing the trueness of naturally normal surfaces.
- Bevel Protector: It consists of a steel dial divided into 360 divisions. Dial can be rotated around the center. The lines at any angle can be marked or measured by the straight eye. Straight edge can be slide along the length.
- Combination Set: It is a multipurpose instrument that can be used as protector, a level, a meter, a center square and a try square.



\* Files

- Files: Files is used to remove extra material by rubbing the metal. Files are available in a number of sizes and degree of coarseness.

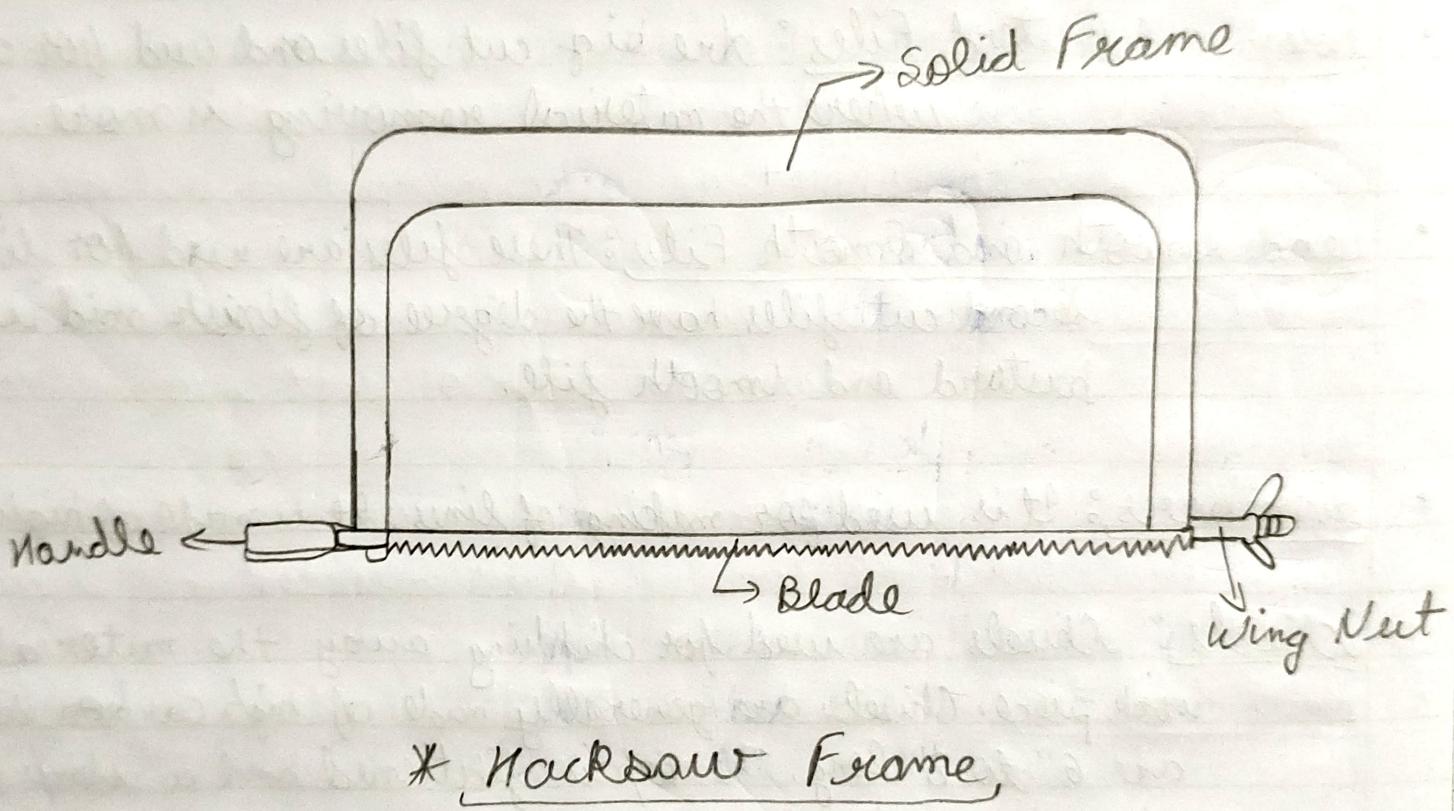
\* Classification of Files on the Basis of Grade:

- 1) Rough (20 Teeth per inch)
- 2) Bastard (30 Teeth per inch)
- 3) Second cut (40 Teeth per inch)
- 4) smooth files (50-60 Teeth per inch)
- 5) Dead smooth (100 Teeth per inch)

- Rough and Bastard Files: Are big cut files and used for cutting where the material removing is more.
- Dead smooth and Smooth Files: These files are used for finishing work. Second cut files have the degree of finish mid way between bastard and smooth file.
- Scribers: It is used for making of lines. It is made of high carbon steel.
- Chisels: Chisels are used for clipping away the material from the work piece. Chisels are generally made of high carbon steel. They are 6" to 8" long. The top is flattened and a sharp cutting edge is made.

\* Types of Chisels:

- 1) Flat chisels
- 2) Cross cut chisels
- 3) Half round chisels
- 4) Diamond point



Classification :- Chisels are classified with their shape & width of the cutting edge.

Cutting of chisels is kept as:-

- (a) For hard materials -  $70^\circ$  to  $75^\circ$
- (b) For medium hard -  $60^\circ$
- (c) For soft materials -  $40^\circ$

\* Hawksaw :- It is used for cutting rods, flats etc. in fitting. It consists of a metal frame, fitted with a wooden handle, carrying metal clips with wing nuts at its end to hold and stretch the metal blade. Teeth of the blade are generally forward cut. The hacksaw should be used in straight direction otherwise it will result in breaking of blades.

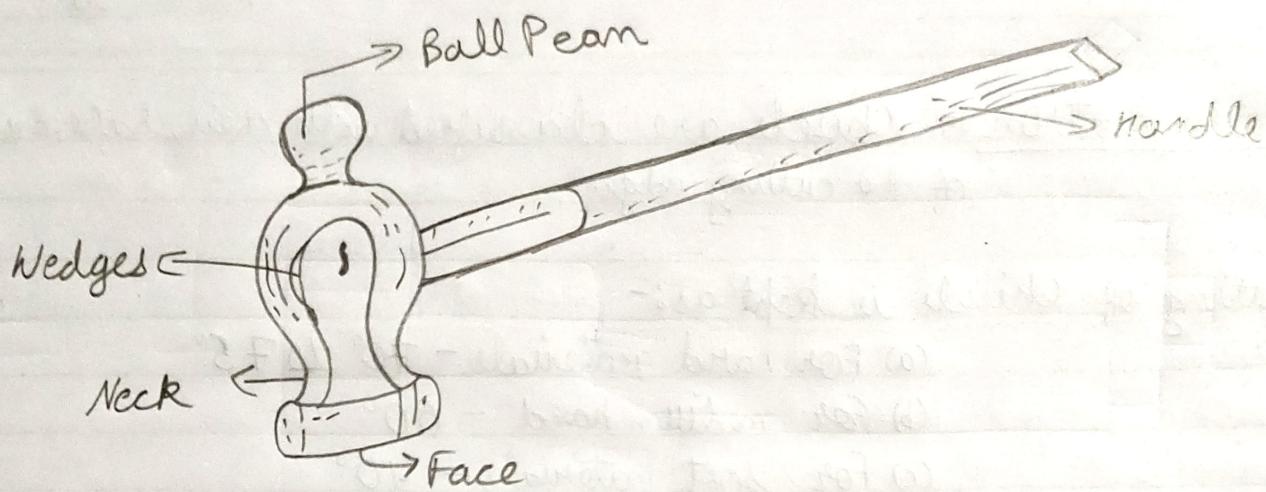
The thickness and width of blade are 1mm and  $\frac{1}{2}$ " respectively.

Blades are classified as under:-

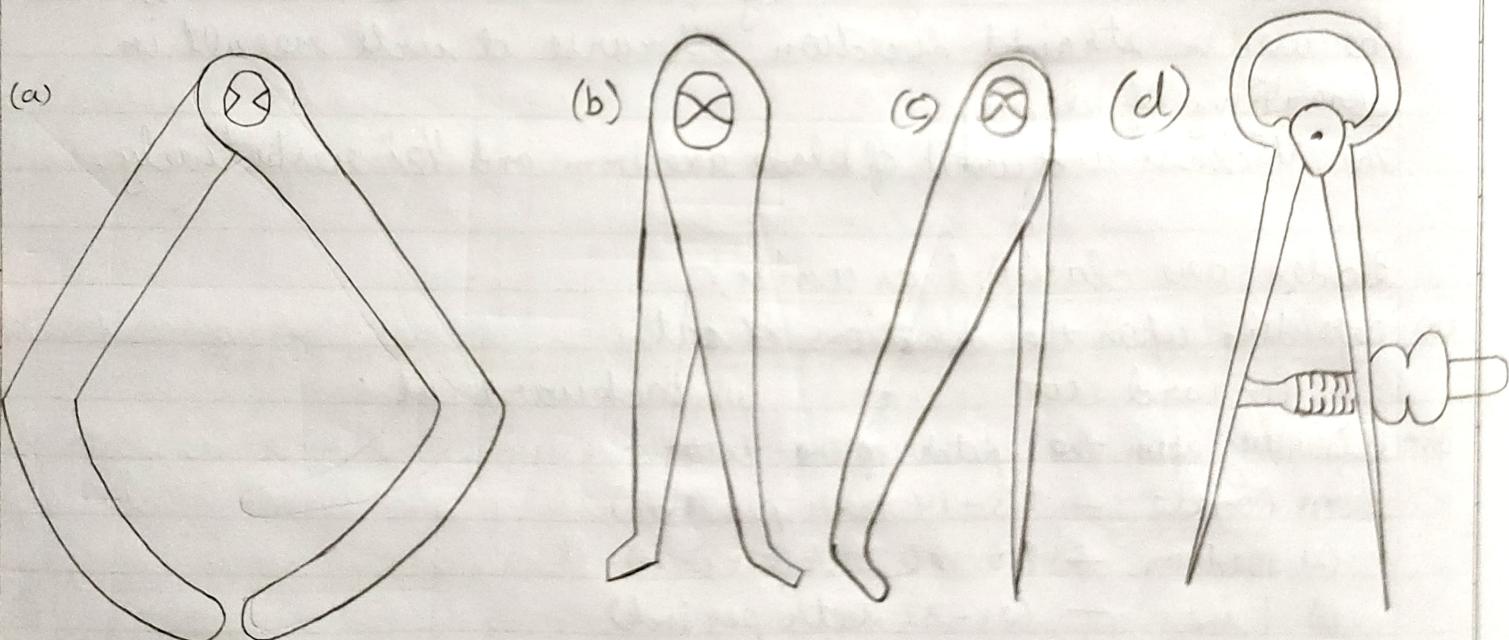
- (a) Depending upon the directions of cut.
  - (i) Forward cut
  - (ii) Backward cut
- (b) Depending upon the pitch of the teeth
  - (1) Coarse - (8-14 teeth per inch)
  - (2) Medium - (16-20 teeth per inch)
  - (3) Fine - (24-32 teeth per inch)

\* Universal Marking Surface Gauge :- It consists of a heavy base, a scriber and a bar. The scriber can be adjusted to any position with the help of screw and nut. It is used for marking purpose.

\* Steel Rules :- It is made of stainless steel and are available from  $\frac{1}{2}$  feet



\* Ball Pean Hammer



\* Out-side  
Calliper

\* Inside  
Calliper

\* Spring  
Calliper

\* Odd leg  
Calliper

to 2 feet. These are marked in inches or millimeters.

\* Punches: It is used for making round indentation on the metal surface for providing location of marking for further operations such as cutting, sawing, drilling and chipping etc.

(a) Dot Punches: It is used for marking dotted lines. Punching angle is  $60^\circ$ .

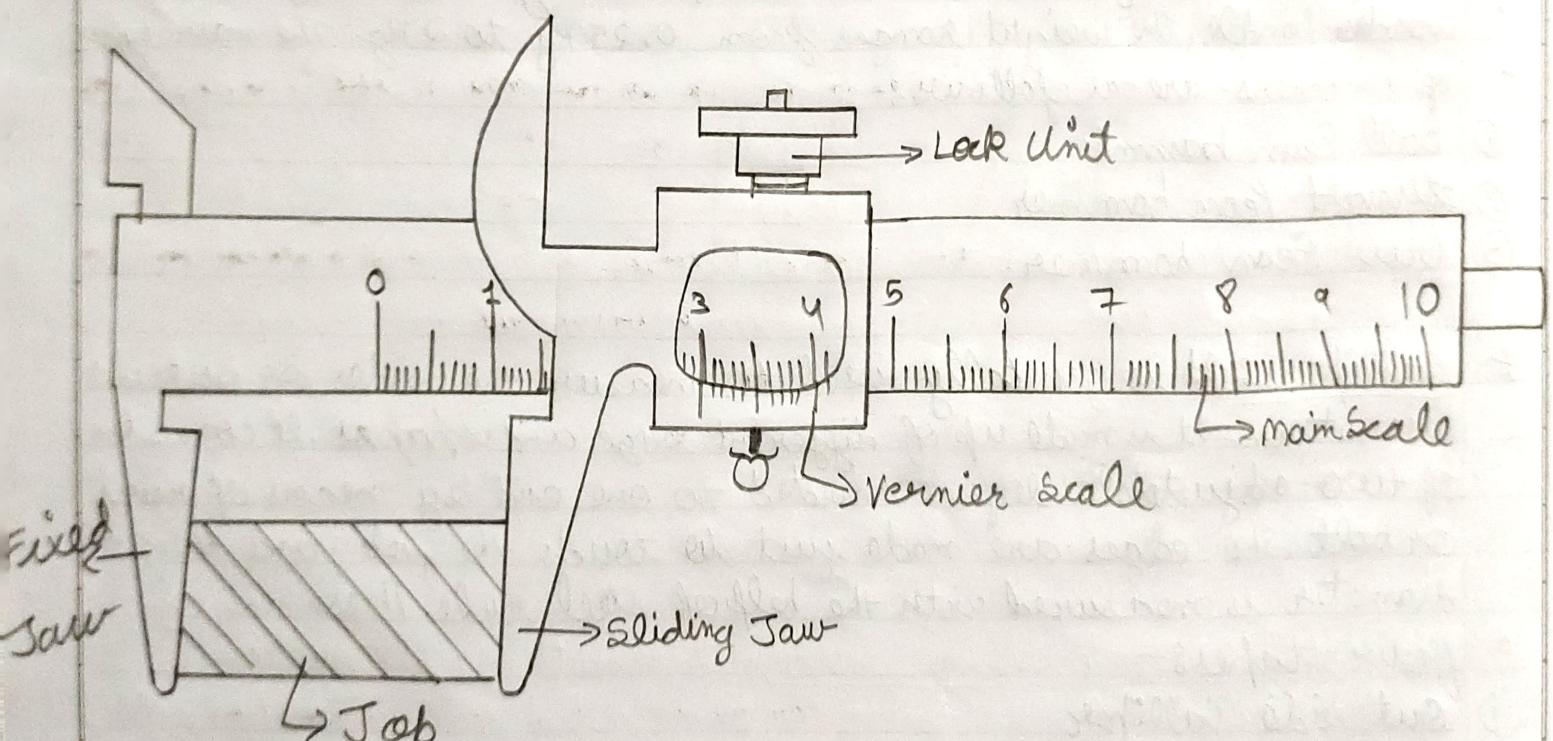
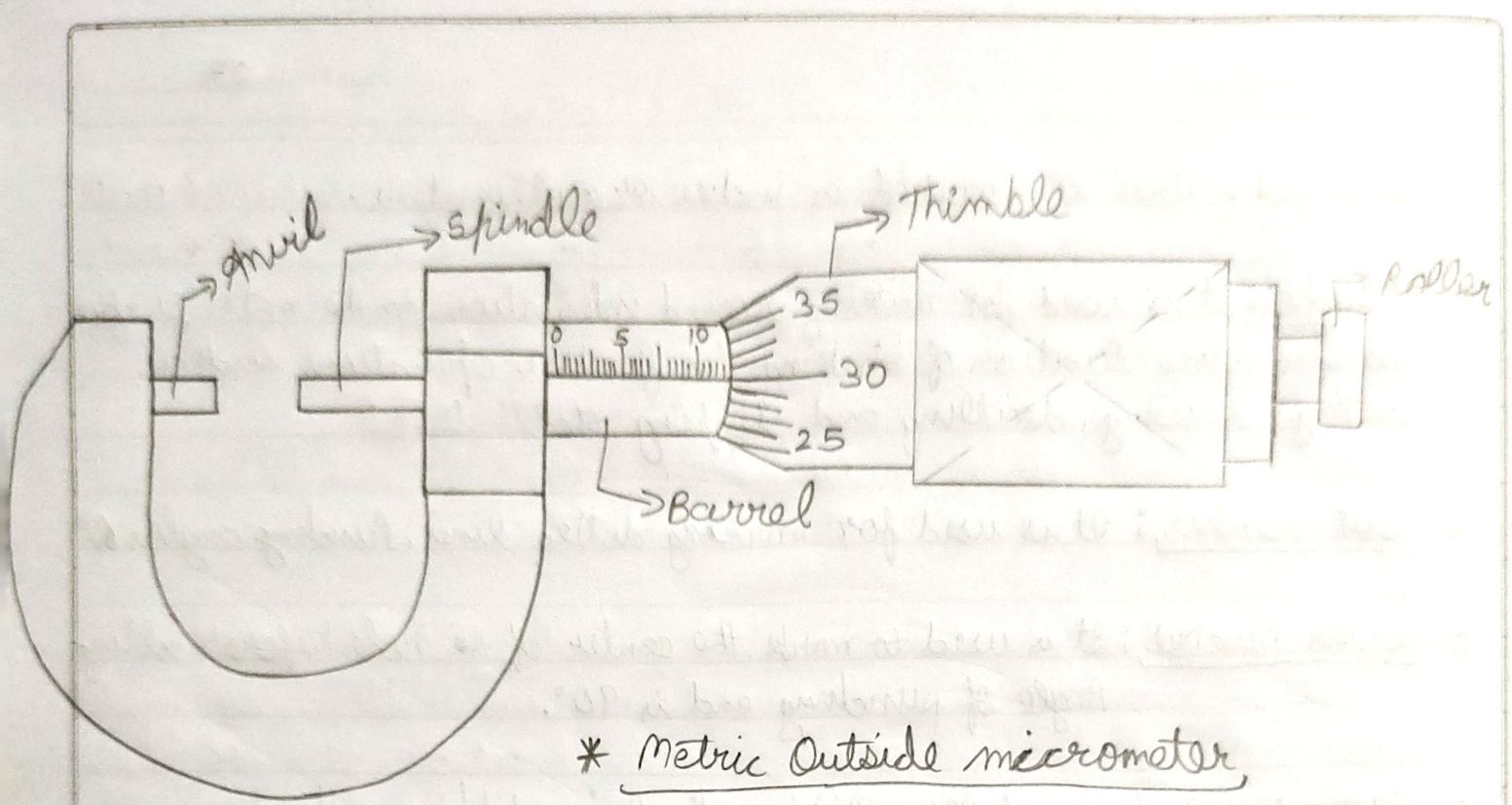
(b) Center Punches: It is used to mark the center of the hole before drilling. Angle of punching end is  $90^\circ$ .

\* Hammers: are used for striking chisels in chipping and cutting & the punch in marking. A hammer consists of a heavy iron body with a wooden handle. The weight ranges from 0.25 kg to 2 kg. The main types of hammers are as follows:-

- ① Ball Pein hammer
- ② Straight Pein hammer
- ③ Cross Pein hammer.

\* Callipers: It is generally used to measure the inside or outside diameters. It is made up of different size and shapes. It consists of two adjustable legs connected to one end by means of rivet or bolt. The edges are made just to touch the job, and then the diameter is measured with the help of steel rule. These are of four types:-

- 1) Out side calliper
- 2) Inside calliper
- 3) Spring calliper
- 4) Odd leg calliper



\* Vernier Calliper

\* Micrometer: It is used for measuring diameter or thickness of any job. It is more precision than vernier calliper. It consists hook type frame. A hard anvil is screwed on one end. On the second end a spindle moves to and fro carrying another small anvil on its end. The graduation on micrometer is available in inches as well as in millimeters.

\* Vernier Calliper: It is used for measuring lengths and diameter. It can be used for measuring external & internal diameters. It can be used for measuring external and internal dimensions. The minimum dimension that can be expressed on vernier calliper is known as least count. Material of all parts is stainless steel.

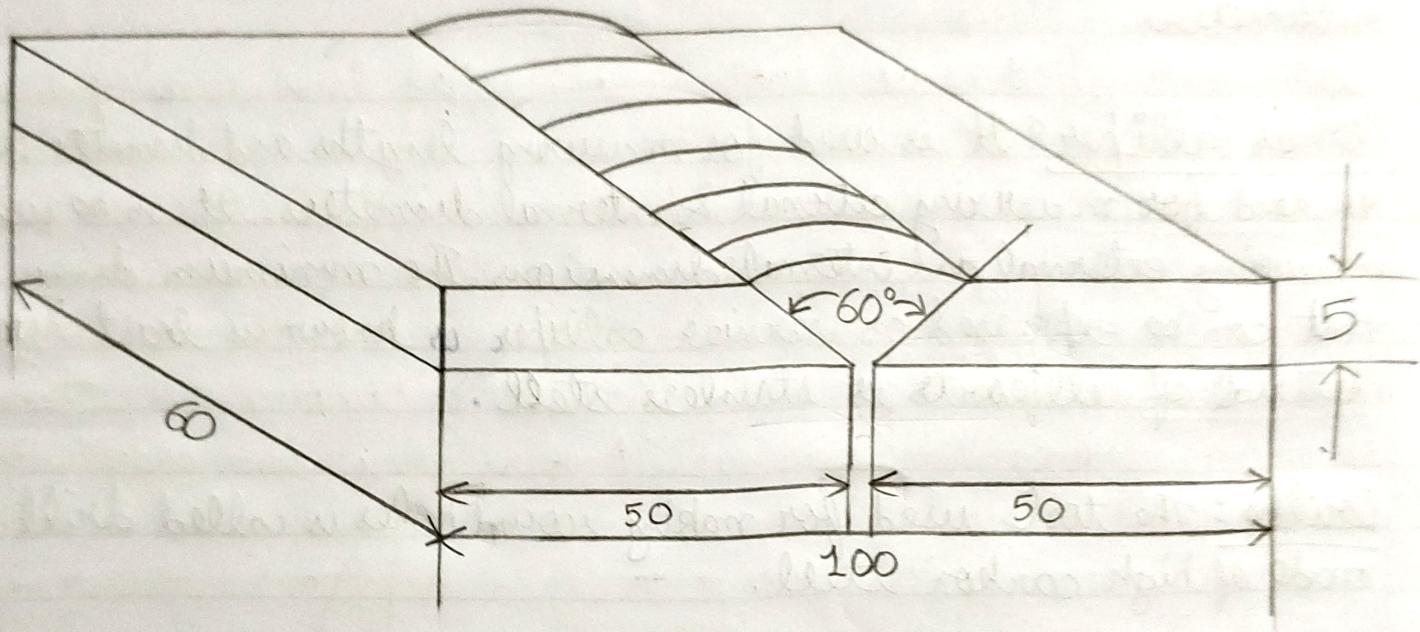
\* Drills: The tools used for making round holes is called drill. It is made of high carbon steel.

\* Taps: These are used for making internal threads in cylindrical holes or cleaning damaged threads in similar parts.

\* Dies: These are used for cutting external threads in cylindrical parts such as bolts and pipes. Dies are made of tool steels

\* Gauges: It is used to check the diameter of wires. It is made up of a steel sheet disc.

— X — X — .



## Experiment - 2

### Object

To make a single V shape Butt joint with the given piece of mild steel by using arc welding.

### Equipment

AC welding set, air/oil cooled transformer

### Tools Used

- ① Electrode Holder
- ② Earthing Clamp
- ③ Hand screen
- ④ Hand Gloves, Apron & leather shoes
- ⑤ Wire Brush
- ⑥ Tongs
- ⑦ Chipping Hammer
- ⑧ Chipping Goggles
- ⑨ Welding Table, etc.

### Material Required

Two mild steel pieces of size 60 X 50 X 5 mm

Electrode - 3.15 mm Ø

welding position - D/N (Down Hand)

Current required - 90 to 120 Amp.

### Procedure

- ① Cut the work pieces according to given dimensions.
- ② To make the pieces V shaped, first punch the piece its width side 1mm and then punch it at  $30^\circ$  from the punching line.  
similarly the second piece is also been punched. So the included angle.

both the pieces is  $60^\circ$  and then the punching lines are filed. Hence the V shape is made.

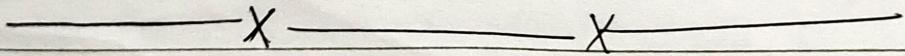
- ③ Start the welding machine and set the current 90-120 amp.
- ④ Connect earthing clamp to the base plate & keep the job on base plate.
- ⑤ Put electrode in the electrode holder.
- ⑥ Now both the pieces are kept in front providing the gap of 1mm b/w to avoid distortion and to get good penetration and fusion in pieces.
- ⑦ Now put the tag on the upper and lower side of pieces and one tag on the opposite side of pieces at centre to stop distortion. The welding bead is made.
- ⑧ Chip off the slag by chipping hammer & clean the joint by wire brush.

### Result

A proper V shape Butt joint has been achieved/made.

### Precautions

- ① Never look at the arc by naked eyes. Use the welding screen or goggles.
- ② Always wear the safety hand gloves, apron & leather shoes.
- ③ Never chip slag while it is hot, without wearing chipping goggles.
- ④ Avoid use of damaged tools.
- ⑤ Always use tong for holding the heated job.



## Experiment - 3

### Object

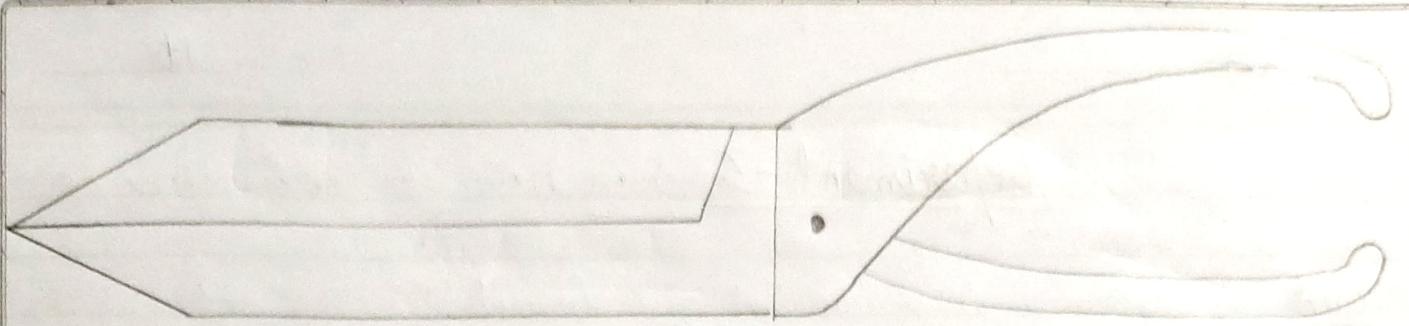
Study of tools and operations in sheet metal shop.

### Introduction

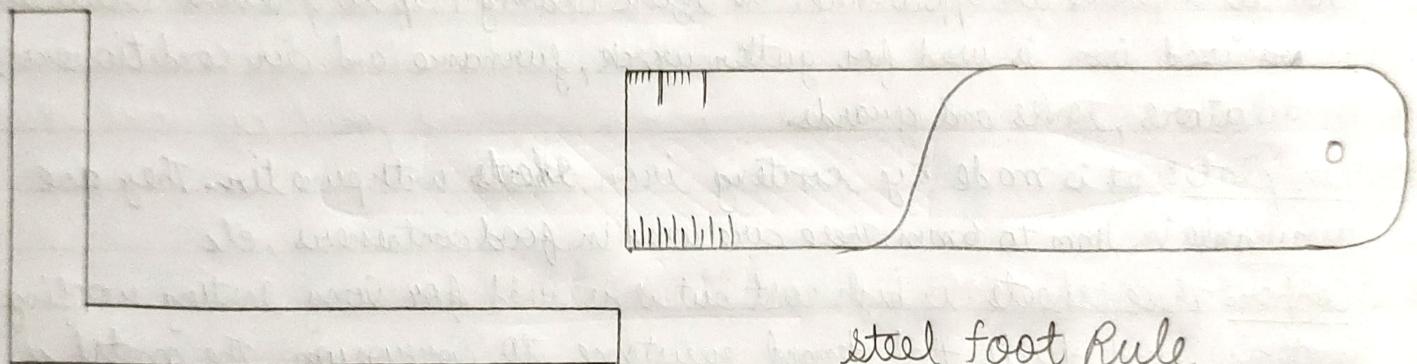
- ① Galvanized iron: This is soft steel coated with zinc to resist corrosion and to improve its appearance. The zinc coating helps to prevent oxidation. Galvanized iron is used for gutter work, furnaces and air conditioners, ventilators, tanks and guards.
- ② Tin plate: It is made by coating iron sheets with pure tin. They are available in 1mm to 6mm. These are used in food containers, etc.
- ③ Copper: These sheets are high cost but it is used for long lasting roofing material and ducts that demand resistance to corrosion. The metal is easily fabricated because of its malleability.
- ④ Aluminium: It is rust proof metal, light and has long wearing qualities. It is used for boats, flashing, roofing material as a house siding and other industrial products.
- ⑤ Stainless steel: It has a high percentage of chromium. It has a higher tensile strength and hardness than ordinary steel, therefore is harder to work. It has good corrosion resistance. Stainless steel used for sink and other products that require strength, hardness, beauty and resistance to corrosion.

The term sheet metal implies metal and alloys in sheet condition to thickness ranging from 10 swg and thinner. Plates are above to 10 swg thickness.

### Tools Used in Sheet Metal Shop

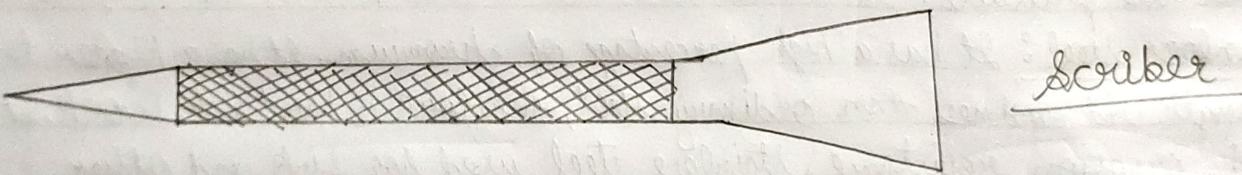


straight shear

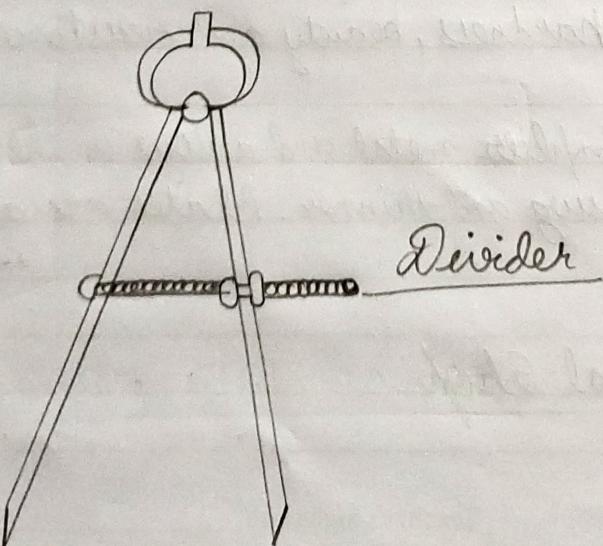


steel foot Rule

steel square



Scriber



Divider

### Cutting tools:

- 1 Straight shear → The main purpose of the shear is to cut the sheet along the lines scribed on it. The line may be straight line or curve. For cutting along straight lines, straight shear is used whose blades are straight.

### Marking tools:

These are used to mark the sheet according to required dimensions.

Various marking tools are -

- 1 Steel rule → These are available in variety of sizes. The rule could be steel foot rule, folding rule or tape rule.
- 2 Steel square → It is a L-shaped piece of hardened steel. It is used to make square corners. It is also used for checking & making right angles.
- 3 Scriber → It is used to mark lines on metallic sheets. It is made up of hardened steel.
- 4 Divider → It is used for scribing arcs and circles on the metallic sheets. It is also made up of hardened steel. One leg is rested at indentation point & the other leg is used to scribe arc and circles.

### Punches:

The following types of punch made of tool steel are commonly used for sheet metal work:

- 1 Prick punch → These punches are used for making small dots or indentation marks for locating the center position for dividers or trammel points. The punches have tapered point ground to  $30^\circ$  angles.
- 2 Center punch → These are used for marking the location of points and center of hole to be drilled. Its taper point is ground to  $90^\circ$  angles.



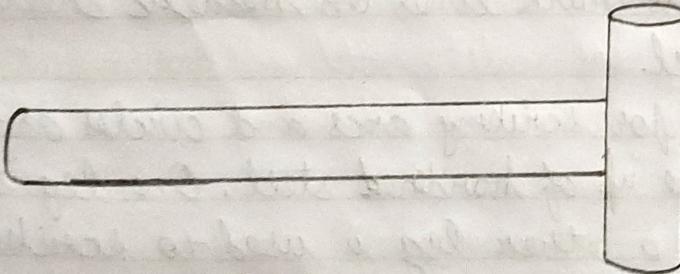
Prick Punch



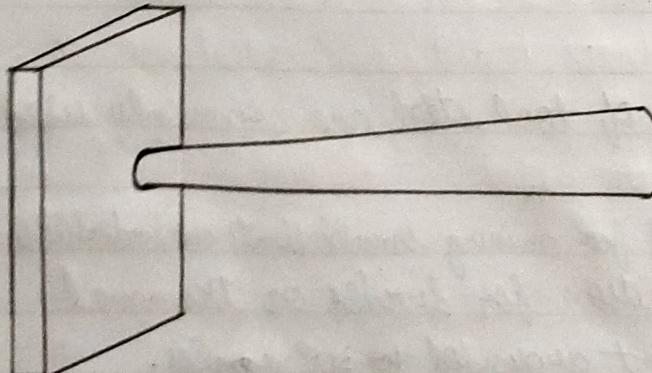
Center Punch



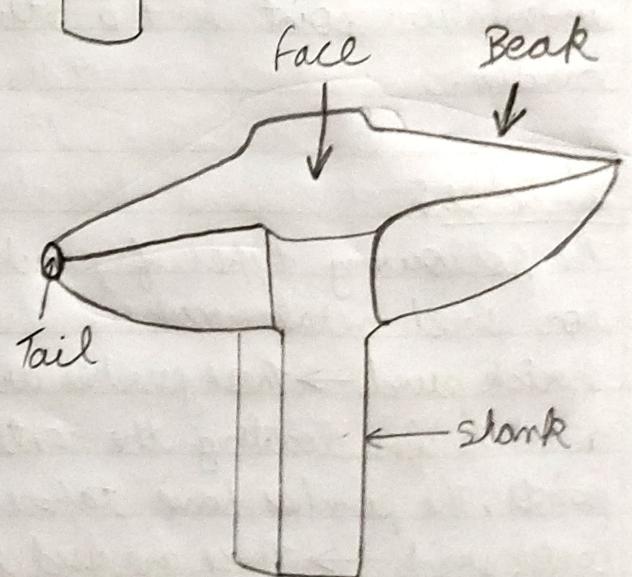
Dot Punch



Mallet



Square Face Hammer



Pick Iron

3 Dot punch → It is used for making dotted lines. It is made up of high carbon steel or high-speed steel. One end is sharpened. Hammering is done on the second end while working. Its taper point is ground to  $60^\circ$  angle.

### striking and supporting tools:

The hammers are used in sheet metal shop for bending of sheets, flattening of sheets, riveting work, to give hollow or curved shape, for locking seam joints, etc. For these operations, the following hammers are generally used:-

1. Mallet → This is the most used hammer in any sheet metal shop. These are made of good quality hard wood, plastic, hard fibre. These are used whenever working on soft metal.
2. Square face hammers → This hammer is also called setting hammer and has a square flat face. It is used for flattening the seams without damaging the metal sheet.

### Stakes

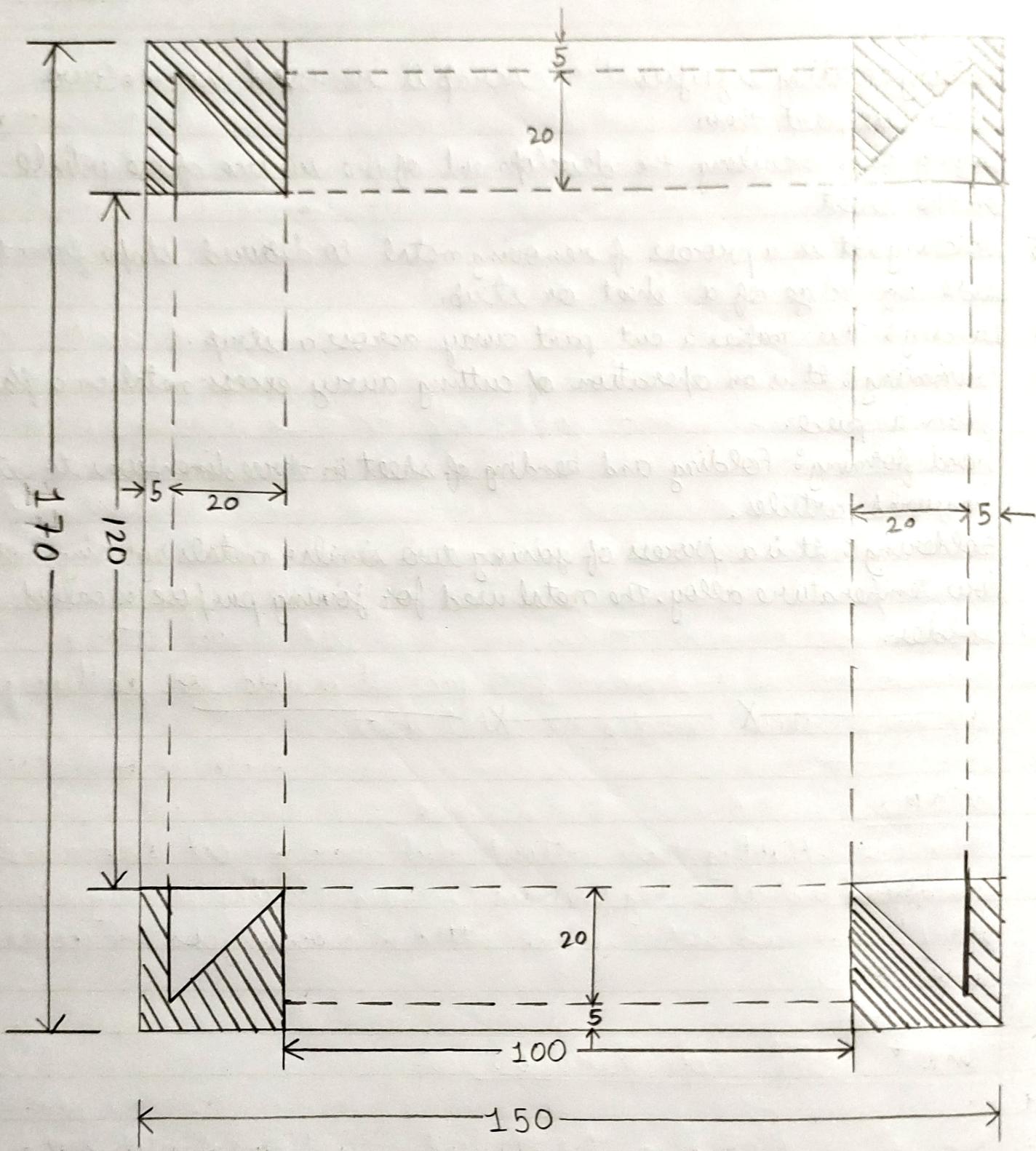
These are supporting tools without which nearly most of the basic operations such as bending, seaming, forming, riveting, punching, etc. cannot be carried out. They are fitted in wood & jobs are worked upon them.

## Sheet Metal Shop Operations

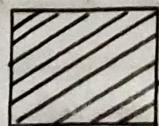
- 1 Measuring and Marking : The standard marked size of metal sheet are quite large. So, for marketing articles, the required dimension are measured and marked on the sheet.
- 2 Cutting off : This means severing a piece from strip with cut along single line.

- 3 Parting: Parting signifies that scrap is removed b/w the two pieces to part them.
- 4 Laying out: Scribing the development of the surface of the article on the sheet.
- 5 Notching: It is a process of removing metal to desired shape from the side of edge of a sheet or strip.
- 6 Lancing: This makes a cut part away across a strip.
- 7 Trimming: It is an operation of cutting away excess metal in a flash from a piece.
- 8 Hand forming: Folding and bending of sheet in three dimensions to get required articles.
- 9 Soldering: It is a process of joining two similar metals by using another low temperature alloy. The metal used for joining purpose is called solder.

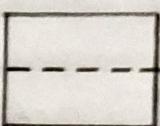
— X — X —



To be notched



Folding Lines



## Experiment - 04

### Object

To make a rectangular tray with the help of given C.I. sheet metal piece.

### Material Required

The material to be used for making rectangular tray is GI sheet of 28 swg thickness, the size of the sheet as per development is 170 mm X 150 mm.

<u>Tools Required:</u>	1 Straight Shear (Snip)	6 Wood mallet
	2 Scriber	7 Bick Scion
	3 Try square	8 Steel Rule (foot rule)
	4 Pencil	9 smooth file
	5 Bench Vice	10 Standard Wire gauge (SWG)

### Development of Sheet Metal component

When the complete surface is open out and laid on plane, the surface of the solid has 'developed' and the figure obtained is called development, is the true length of the corresponding line on surface are normally developed with the inside face up.

The knowledge of development of surface is frequently required in the design and manufacturing of an object, practical applications of development occur in sheet metal work, pattern making, etc.

Notching is used to cut away a portion of metal to prevent overlapping and bulging on seams and edges. The notching is done on blanks or pattern prior to forming process.

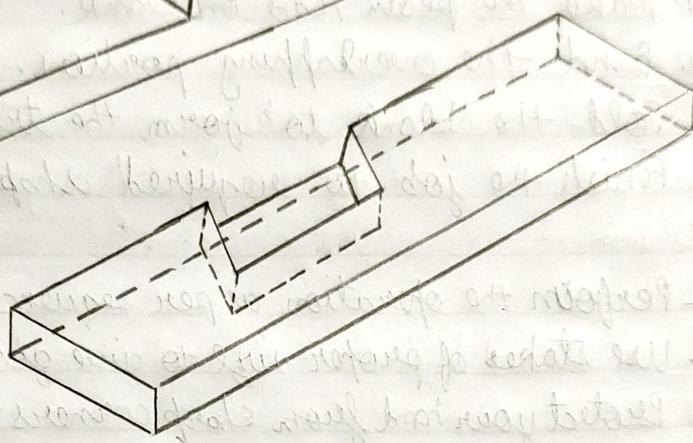
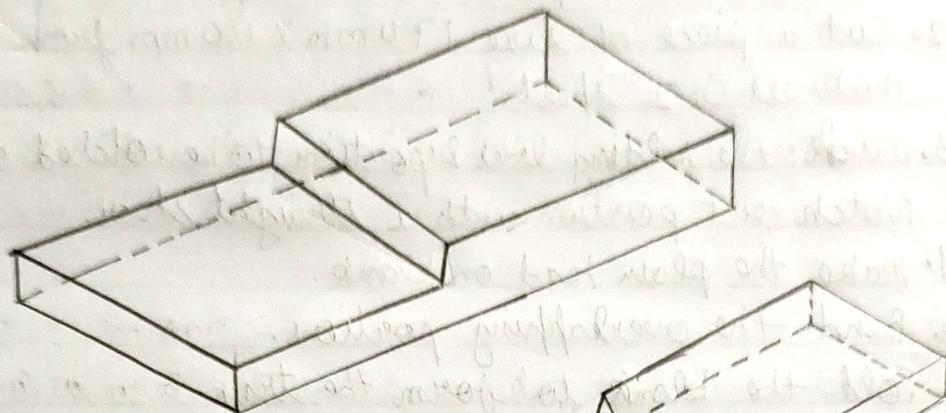
Procedure:

1. Draw the development of the tray.
2. Cut a piece of size 170 mm X 150 mm from 28SWG thickness GI sheet.
3. ~~Mark~~ the folding lines & portion to be notched on blank.  
Notch out portion with a straight shear.
4. Make the plain head on blank.
5. Bend the overlapping portions.
6. Fold the blank to form the tray.
7. Finish the job to required shape & size.

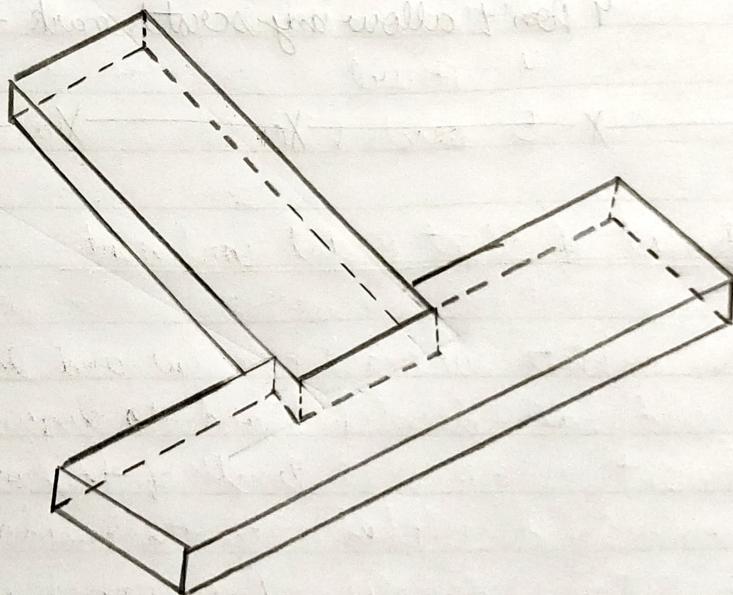
Precautions:

- 1 Perform the operation as per sequences given in the procedure.
- 2 Use stakes of proper size to give good shapes to the job.
- 3 Protect your hand from sharp corners of edges of the sheet.
- 4 Don't allow any scratch mark to come on the sheet surface.

— X — X — X — X —



Half Lap-T  
joint



Size = 120 X 40 X 40 mm (Two piece) All dimensions are in mm

## Experiment - 05

### Object

To make a half lap T joint in carpentry shop.

### Material Required

Two wooden piece of size - (120 X 35 X 35 mm)

Tools & Equipment Required Steel scale, Scriber/Pencil, Try square, cross cut/Rip saw, Carpentry bench vice, working table, Iron jack plane, Smooth planer and Rasp file, etc.

Process involved 1 Measuring & Marking      2 Planning  
3 sawing.      4. Half lap T joint making practice

Procedure

- Plane one face of work piece & check the trueness of this face with try square.
- Then plane another adjacent side and check its trueness & high angle position with help of try square.
- Carry out marking as per given drawing.
- Remove extra material by sawing & planing respectively.
- Prepare other work piece following the same procedure.
- After preparing both work pieces, assemble both pieces and do fit, etc. If required, for matching the joint.

### Result

A proper half lap T joint has been prepared according to given dimensions.

- Precautions
- I Work piece should be well tight in vice in proper position
  - II Teeth of saw should be well set and sharpened.
  - III Tools should be ready and in good conditions
  - IV During making, keep suitable margin desired as per the operation to be carried out.

Y

X

X