SHEET METAL SHOP

EXPERIMENT NO.

AIM : To study different types of tools used in Sheet metal shop.

INTRODUCTION

Sheet metal work is generally regarded as the working of metal from 16 gauge down to 30 gauge with hand tools and simple machines into various forms by cutting, forming into shape, and joining. Many important engineering articles made up of sheet metal and their application are in aircrafts, heating and air conditioning systems, roof work, automobiles, trains, ships, furniture and a number of industrial and house hold appliances like hoppers, canister, guards, pipes, elbows, boxes and funnels, pans, buckets etc.

A metal plate of thickness less than 5 mm is considered as sheet. The size of the sheet is specified by its length, width and thickness in mm.. The larger the gauge number, the lesser the thickness. In British system, the thickness of sheet is specified by a number called Standard Wire Gauge (SWG). The commonly used gauge numbers and the equivalent thickness in mm are given below:

S.No	Gauge No	S W G mm
1	16	1.63
2	18	1.22
3	20	0.92
4	22	0.70
5	24	0.56
6	26	0.45
7	28	0.38
8	30	0.32

METALS USED IN SHEET METAL

Following are the metals that are generally used in sheet metal shop.

(1) Black Iron Sheet

It is the cheapest among all. It has a bluish-black appearance and is uncoated sheet. Being uncoated, it corrodes rapidly. It is prepared by rolling to the desired thickness, then annealed by pleasing in a furnace and then set aside to cool gradually. The use of this metal is limited to articles that are to be painted or enameled such as stovepipes, tanks, pans etc.

(2) Galvanized Iron

It is soft steel coated with molten zinc. This coating resist rust, improves appearances, improves solderability, and improves water resistance. It is popularly known as G.I. sheets. Articles such as pans, buckets, furnaces, cabinet etc. are made from Gl sheets.

(3) Stainless Steel

It is an alloy of steel with nickel, chromium and traces of other metals. It has good corrosive

resistance. The cost of stainless steel is very high but tougher than Gl sheets. It is used in kitchenware, food handling equipment, chemical plants etc.

(4) Copper

It is a reddish colored metal and is extremely malleable and ductile. Copper sheets have good corrosion resistance as well as good appearances but costs are high as compared to Gl and stainless steel. Because of high thermal conductivity, it is used for the radiator of automobiles, domestic heating appliances etc.

(5) Aluminium

Aluminium cannot be used in its pure form, but is used in alloy form. Common additions are copper, silicon, manganese and iron. It has many qualities like high ratio of strength to weight, corrosion resistant qualities, and ease in fabrication and whitish in color. It is used in manufacturing of a number of products such as refrigerator trays, household appliances, lighting fixtures, window work, construction of airplanes and in many electrical and transportation industries.

(6) Tin Plates

It is an iron sheet coated with the tin to protect it against rust. This metal has a very bright silvery appearance and is used principally in making food containers, cans and pans.

(7) Lead

It is a very soft, malleable, low melting point and possesses high resistance to acid corrosion. It is having low mechanical strength so it is used to provide lining to the highly corrosive acid tanks. It is also used in radiation shielding.

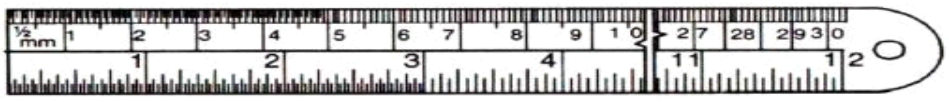
TOOLS USED IN SHEET METAL

For measuring, marking, cutting and forming, various types of hand tools are used in sheet metal work. A list of them is given below:

1. Measuring tools
2. Marking tools
3. Cutting tools
4. Forming tools
5. Miscellaneous tools

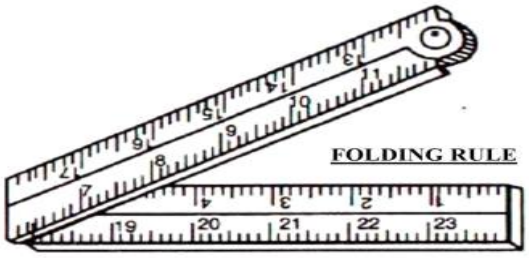
1. Measuring tools

a) Steel rule: This is particularly useful in measuring and laying out small work. It is stiff, straight steel strip. On one of the flat faces, graduations are marked in inches and centimeters. The least count is 1 mm.

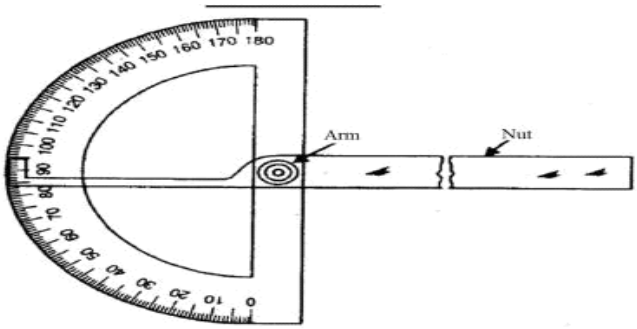


STEEL RULE

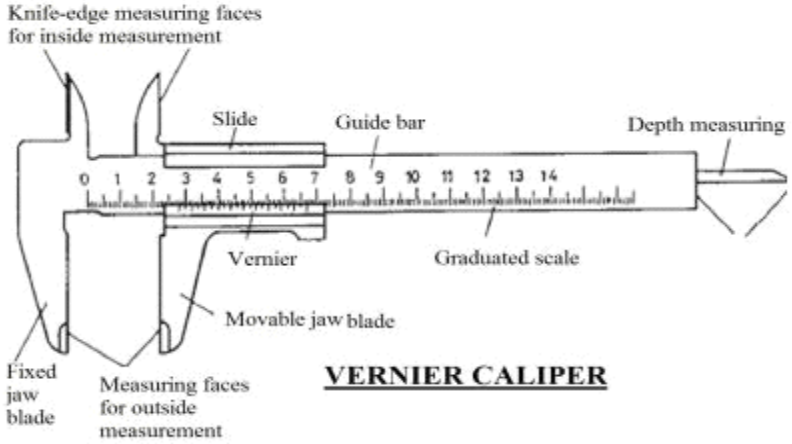
b) Folding rule: The folding rule is very helpful in measuring and laying out large work, the accuracy being 0.5mm.



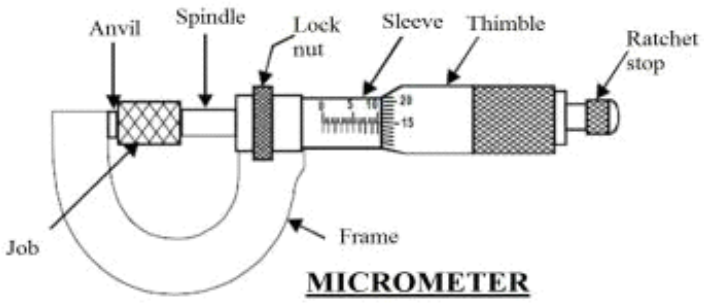
c) Swing blade protractor: This is used for marking and measuring angles.



d) Vernier caliper: A Vernier caliper is a precision measuring instrument. It used to measure up to an accuracy of 0.02mm.

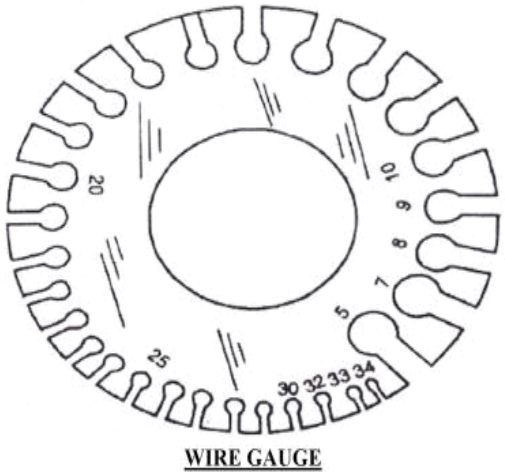


e) Micrometer caliper: This is used to measure the thickness of metal sheets accurately upto 0.01mm



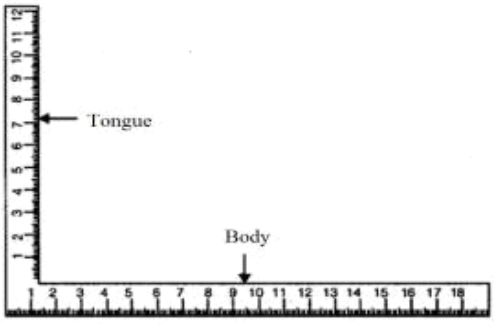
MICROMETER

f) Wire gauge: The wire gauge is used to check the diameter of wires or thickness of sheet metal. The commonly used wire gauge is imperial standard wire gauge (known as SWG).The most common wire gauge used in sheet metal has 21 slots with gauges varying from 4 to 24.



WIRE GAUGE

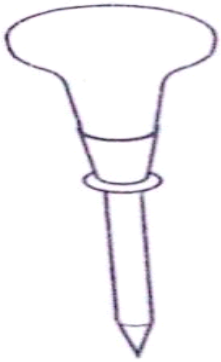
g) Steel square: It is a L-shaped piece of hardened steel for measuring and marking. It is used for marking in the perpendicular direction to any base line. The short arm of the square or blade and the corner is called the heel. The size of a L-square is specified by the length of the body and the angle.



STEEL SQUARE

2. Marking tools

a) Scratch awl : These are used for marking or layout purposes. A scratch awl is used where the marking lines are deeper, and the pressure is exerted over the wooden handle.



SCRATCH AWL

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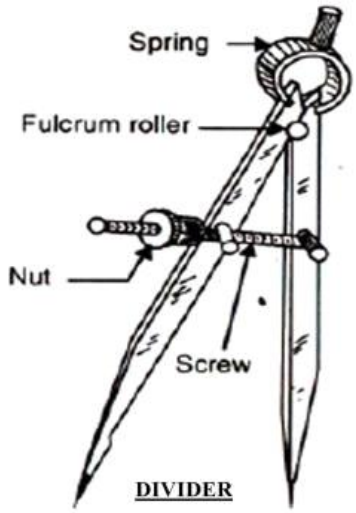
b) scriber: The scriber is used to make sharp clean lines on sheet metal surfaces. The body of the scriber is knurled for a proper grip. The tips of the scriber and scratch all are hardened and tempered. They are tapered to 15° to 20° to get a sharp point

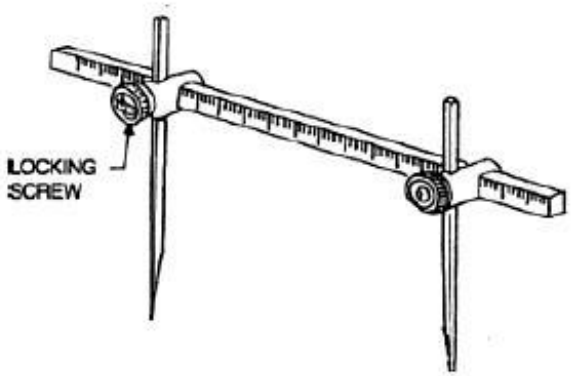
SCRIBER

c) Dividers: It has two straight legs sharpened at one end, hinged at other end. This is used for marking circles, arcs, laying out perpendicular lines, bisecting lines, etc.



DIVIDER

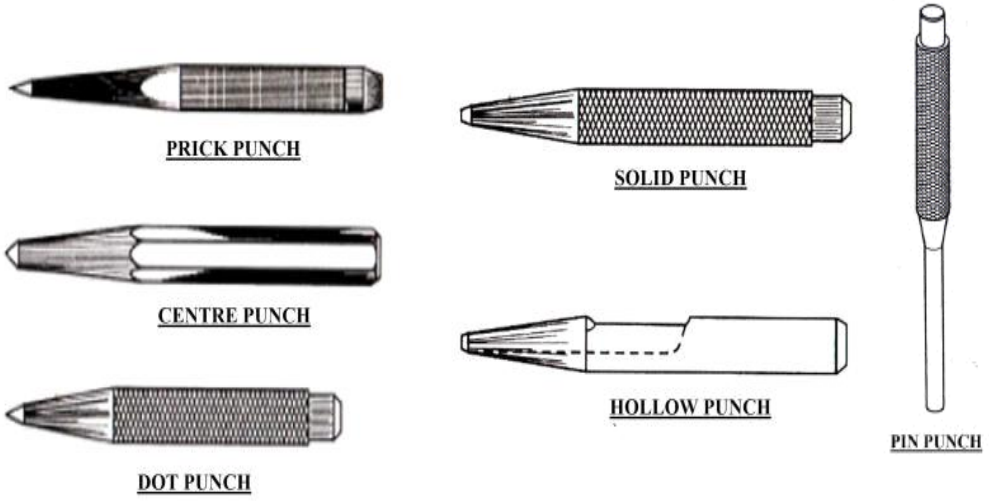
d) Trammel points: These are used for drawing large circles and arcs that are beyond the limit of dividers. It has two straight, removable legs tapered to a needle point mounted on separate holders which slide on steel (or wooden) bar and held in position by thumb screws.



e) Punches:

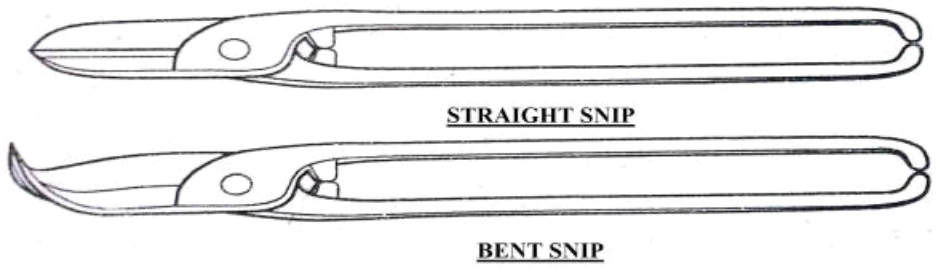
- **Centre punch - 90°:** It is used to mark centers to be drilled or mark centre for drawing circles on jobs.
- **Dot punch - 60°:** It is a light type centre punch and is used to scribe lines with a chain of dots.
- **Prick punch -30°:** It is sharply pointed punch and penetrates small mark but deeper along the Scribed line.
- **Solid punch:** In riveting sheet metal, holes must be equally spaced and lined up. The holes in the metal are usually punched with solid punches.
- **Hollow punch:** These punches are also used punch holes in thin sheet metal, leather, plastic-cork etc. Hollow punches have sharp, tubular end.

- **Pin punch:** Pin punches are used to drive locating or locking pins, dowels and rivets out of their holes. Pin punches are available in a set of 5 pins of dia.3, 4, 5, 6 and 8mm.

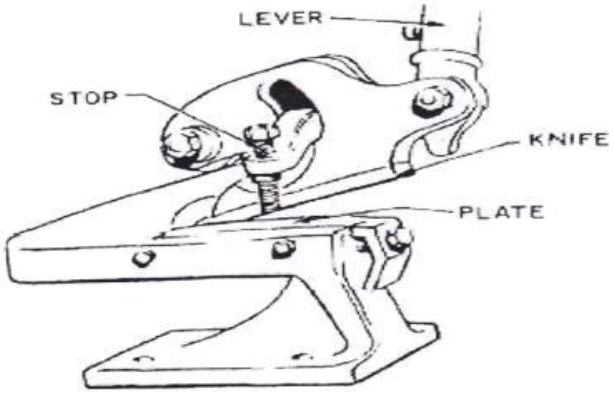


3. Cutting Tools

a) Snips: These are usually called hand shear and are cutting tools like scissors. There are several types of snips available for making straight or circular cuts, but the most common are Straight snips and Bent (circular) snips. Straight snips are used for making straight cuts and large external curves. Bent snips have curved blades for making circular cuts. They are also used for trimming cylindrical or conical work in sheet metal. Snips are specified by the overall length and the shape of the blade.

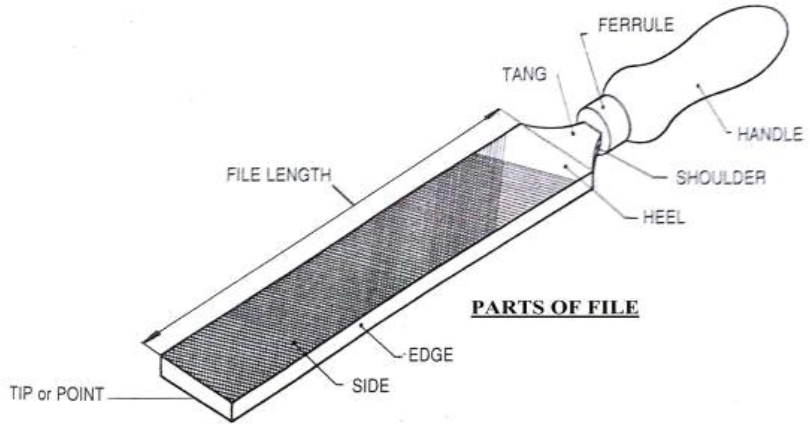


b) Bench shear : Bench shears are used to cut sheets which cannot be cut with hand shears. The bench shear possesses a fixed lower blade and a moving upper blade. The sheet being cut is prevented from tilting by a clamping device which can be adjusted to the thickness of the sheet. The knife-edge cutter of the upper blade is curved so that the opening angle at the point of cut remains constant.



BENCH SHEAR

c) Files: The most widely used hand tool to be found in an engineering workshop is the file. A file is a hardened piece of high grade steel with slanting rows of teeth. It is used to cut, smooth or fit metal parts. It cuts all metals except hardened steel' the head is next to the handle. The safe edge or side of a file is that which has no teeth. Files are classified and named according to the three principle factors-sizes, type or cut of teeth and sectional form.



PARTS OF FILE

- **Size:** The size of a file is its length. This is the distance from the point to the heel, without the tang.

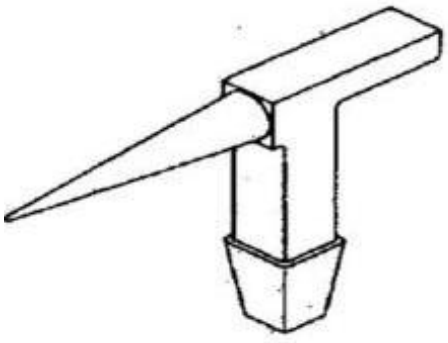
- **Cut of teeth:** Cuts of files are divided into two groups: (1). single cut (2) Double cut. On single cut files the teeth are cut parallel to other across the file is an angle of about 60° to the centre line of the file. Double cut files have two sets of teeth; the over cut teeth being cut at about 60° and the up cut at 75 to 80° to the centre line. Single cut and double cut files are further divided according to the coarseness or spacing between the rows of the teeth. In descending order of roughness they are listed as,
  1. Rough (R) 2.Bastard (B) 3 Second cut (SC) 4.Smooth (s) 5.Death smooth (DS)

4. FORMING TOOLS:

Shaping of the sheet metal such as folding, bending, curling, etc., are done by using the following types of forming tools.

4.1. Stakes: The stakes are steel anvils used to perform operations like bending, seaming or forming on sheet metal, when suitable machines are not available. The stakes are available in various shapes and sizes.

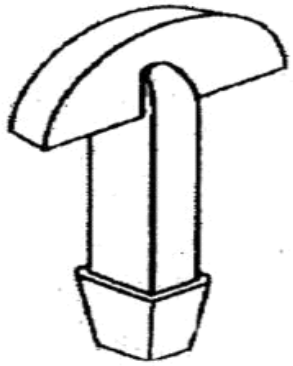
a) Beak horn stake: The beak horn stake has a round tapered horn at one end and a square tapered horn at the other end. The round tapered end may be used for many purposes like bending of sheet metal into cylinders and conical shapes, for setting down seams when used with a grooving punch or a seam set, for truing work to make circular when the seam is folded or soldered etc.



b) Blow horn stakes: The blow horn stakes has a short tapered horn at one end and a long tapered horn at the other end. It can be held in a vice or in square hole in a wooden block or bench top. It is used for forming, riveting operations.

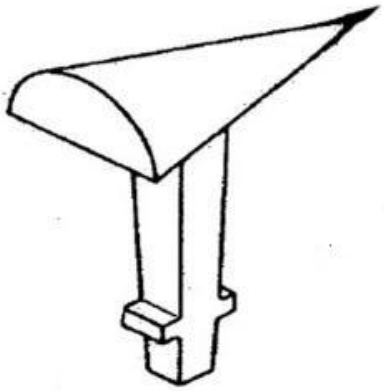
c) Hatchet Stake: It consists of a horizontal sharp straight edge and is used for making sharp bends, folding the edges of the sheet metal.

d) Half Moon Stake: This stake has a sharp edge in the form of an arc of a circle, beveled along one side. It is used for circular folding and seaming.



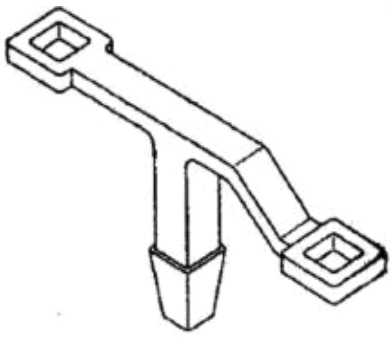
HALF MOON STAKE

e) Funnel Stake: This stake is used when shaping and seaming funnels and tapered articles.



FUNNEL STAKE

f) Horse head Stake: It is double ended holder for small stakes - one of which is cranked downwards for clearance purpose and has square holes at both ends. It is used for working beads, flats etc. on cylindrical work.



HORSE STAKE

g) Pipe stake : It is used for hollow objects.

h) Bevel Edge Square stake : It is used to form corner and edges

4.2 Hammers: The sheet metal is shaped by hammering or striking with mallet, after keeping the work on suitable form of stake. They are many types of hammers, but the most commonly used hammers, in sheet-metal work are follows:

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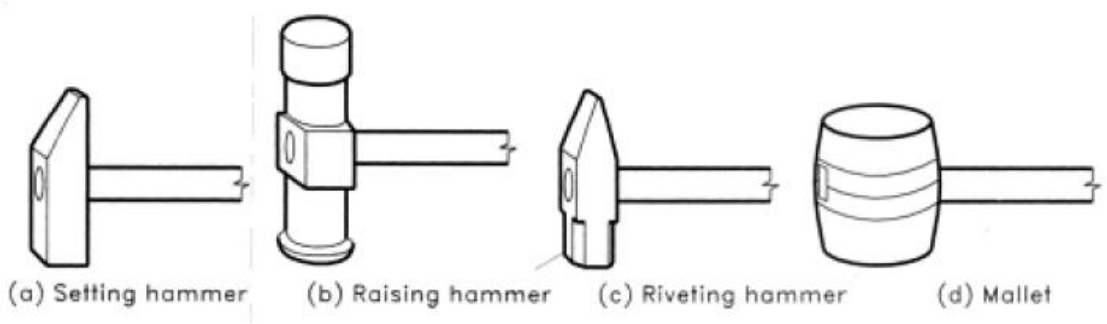
a) Riveting hammer: The riveting hammer has a square, slightly curved face with beveled edges to prevent the head of the hammer from marking the metal. The peen side is double tapered and has a slightly rounded end. It is used for spreading rivets and for hammering a rivet set.

b) Setting hammer: The setting hammer has a square, flat face and a tapered peen with beveled end. The flat face is used for flattering seams without damage to the metal while peen end is used for peening operation.

c) Raising hammer: The raising hammer has an oblong flat face with concern slightly rounded off. It is used in raising circular discs and many other raising and bumping operations.

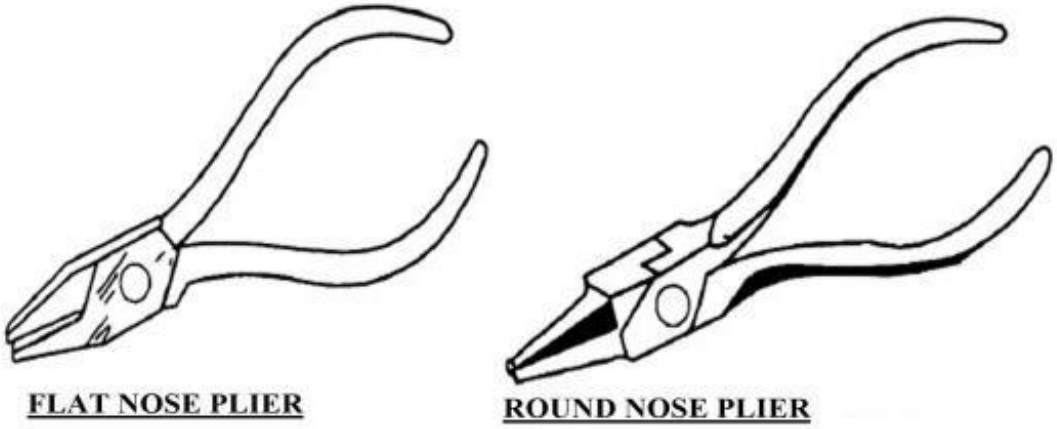
d) Mallets: The mallets may be made from hide, fiber or wood. The best size of mallet is 5cm diameter. These may be obtained in various shapes to suit special work.



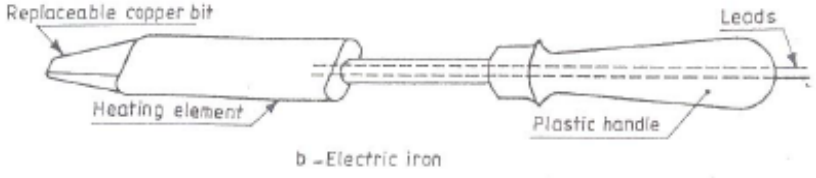
5. Miscellaneous tools

a) Pliers: The pliers are used in sheet metal made up of tool steel , having serrations for gripping purpose, used for holding, cutting and bending work.

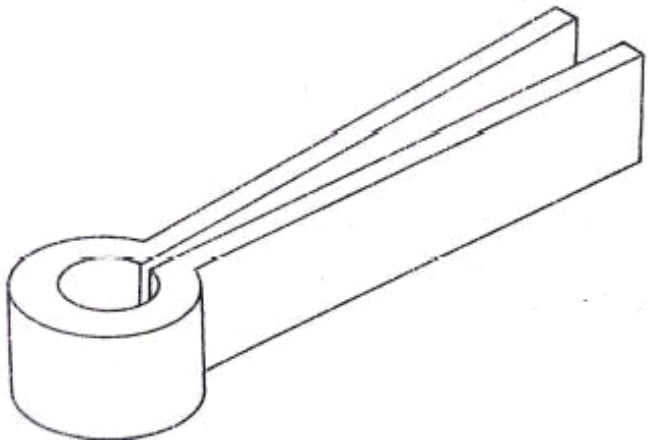
- **Flat nose plier:** The flat nose plier has flat jaws with small grooves. It is used for forming and holding work.
- **Round nose plier:** The round nose plier has long jaws rounded on the outside. It is used for holding and forming the various shapes and patterns.



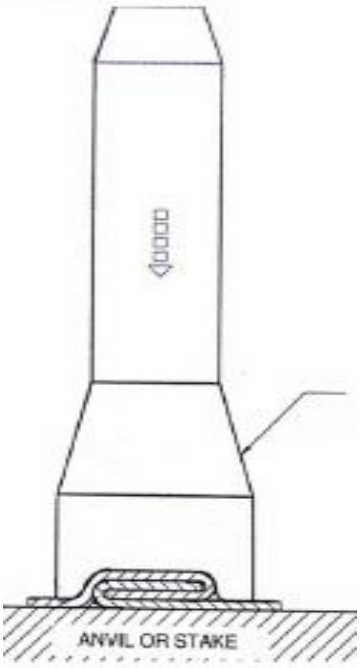
b) Soldering Iron: It consists of a forged piece of copper fastened to iron rod with a wooden handle on one end . It is used to join two pieces of metal by means of an alloy of tin and lead.



c) Folding bar: Folding bar is a rectangular bar whose edges are brought together with a ring neck. This is used for bending and folding on sheet metals.



d) Groover: A groover is a hand tool used for closing and locking of seams the end of the tool is recessed to fit over the lock making the grooved seams.



GROOVER

EXPERIMENT NO.

AIM: To prepare a Square tray of given dimensions (l = 100 mm, b = 100 mm, h=20 mm) using a Galvanized iron (G.I) sheet.

MATERIAL REQUIRED: Galvanized iron sheet (150 mm x 150mm x 26 gauge)

TOOLS REQUIRED: Steel rule, scriber, stakes, straight snip, mallet, nose pliers, divider, Try square.

SEQUENCE OF OPERATIONS:
1. Cleaning & marking
2. Cutting
3. Bending
4. Edge folding
5. Joining
6. Finishing

PROCEDURE:
1. Prepare the development of the square tray as per the dimensions given (l = 100 mm, b = 100mm, h = 20mm) with folding allowances.
2.Mark and cut a piece of appropriate dimension from the G.I sheet
3. Place it on flat surface and straighten with the help of mallet.
4. The size of given sheet is checked with the steel rule.
5. Clean the sheet and mark the development using steel rule, scriber and divider.
6. Remove the unwanted material by using a straight snip.
7. Bend the sheet at required markings at 90° to get the shape using suitable stake and mallet.
8. Now the bent edges are made to overlap each other and stuck with a mallet to get the required joint.

PRECAUTIONS:
1. Since the sheet metal has sharp edges, cutting should be done carefully along the marked lines.
2. Care should be taken while bending.
3.Do not handle cut pieces with bare hands. Use hand gloves.
4. Excessive hammering of mallet during edge folding and finishing should be avoided.
5.Extra allowance must be provided in the sheets while cutting so that finished product is of correct size and finish.

RESULT: The Rectangular tray of required dimensions is obtained

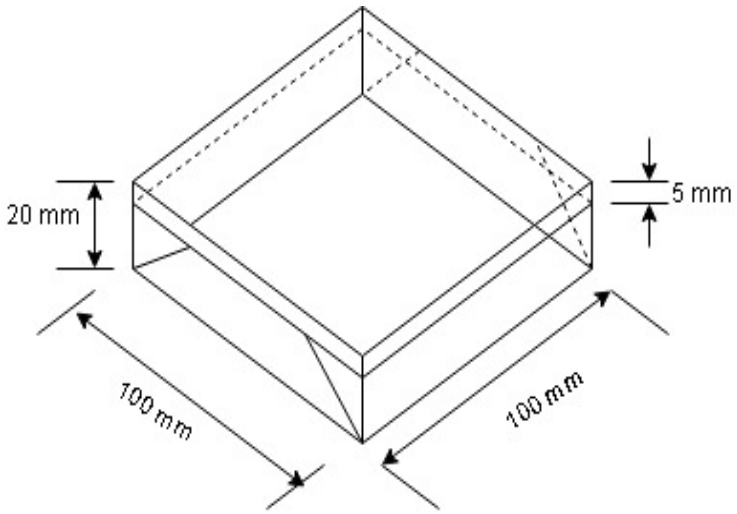


Fig.1 G.I sheet Square Tray dimensions

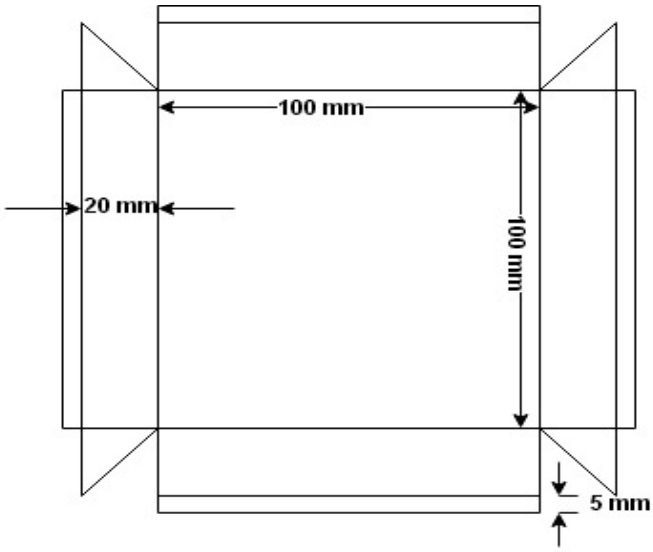
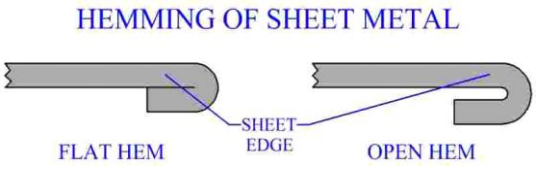


Fig.2 Development of Tray

Note 1. Extra allowance of 5 mm is added in development for hemming of edges.

Note 2. Hemming is a metalworking processes in which a sheet metal edge is rolled over onto itself.



Experiment No.

AIM: To prepare a funnel of given dimensions using a Galvanized Iron (G.I) sheet.

MATERIAL REQUIRED: Galvanized iron sheet of 26 gauge.

TOOLS REQUIRED: Steel rule, scriber, stake, curved snip, mallet, nose pliers, Straight snip, soldering iron, solder, flux, , file, spring divider

SEQUENCE OF OPERATIONS:
1. Cleaning & marking,
2. Cutting,
3. Edge-folding,
4. Bending,
5. Joining,
6. Finishing.

PROCEDURE:
1. Prepare the development of the funnel as per given dimensions with allowance.
2. Choose G. I sheet size to accommodate the development.
3. Place it on flat surface and straighten with the help of mallet
4. Clean the G.I sheet and mark the development of funnel on sheet using steel rule, scriber and divider.
5. Remove the unwanted material by using a curved snip and straight snip..
6. Bend the sheet at required markings to get the desired shape using mallet and suitable stake.
7. The pieces are assembled with proper alignment and soldering is done.
8. File all the sharp corners with file
9. The Funnel of required dimensions obtained.

PRECAUTIONS:
1. Cutting along the marked lines should be done carefully.
2. Selection of stake is important for the required shape.
3. Excessive hammering of mallet during edge folding and finishing should be avoided.
4. Be careful while working on sharp edges of sheets to avoid injury.
5. Extra allowance must be provided in the sheets while cutting so that finished product is of correct size & finish.
6. Do not handle cut pieces with bare hands. Use hand gloves.

RESULT: The Funnel of given dimensions is obtained.

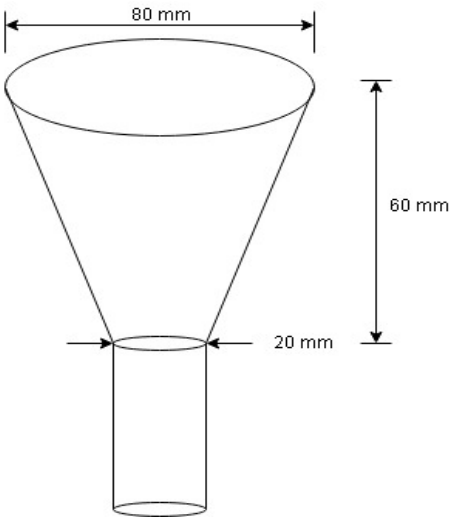


Fig.1 G.I sheet Funnel

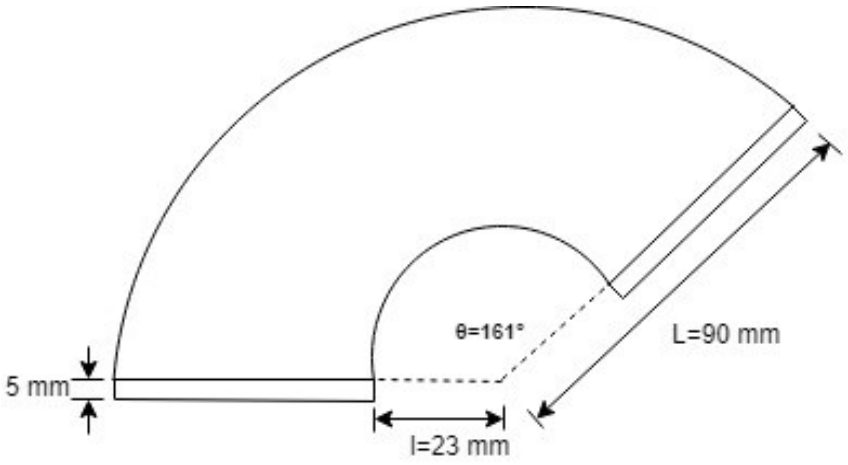


Fig.2 Development of frustum part of funnel

Note: The angle subtended by the arc of the sector is calculated from the relation.

$$\theta = 360^\circ \times \frac{Radius\ of\ the\ base\ circle\ of\ the\ cone}{Slant\ height\ of\ cone}$$

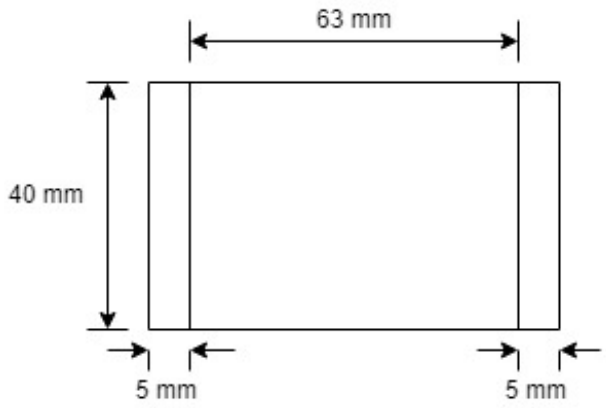


Fig.3 Development of cylindrical part of funnel

Note: 1. Extra allowance of 5 mm is added in development of cylindrical and frustum part for seaming

Note : Seaming is a metal working processes in which edges of two different materials are joined together.