

# SHEET METAL SHOP



## **SAFETY PRECAUTION**

1. Since in sheet metal work we used sharp tools to cut sharp cutting edges. Be careful on working on sharp edges to avoid injury.
2. Avoid using any tools whose edges are blunt or out of order.
3. Appropriate cutting tools and machine must be used for cutting tin sheets.
4. Extra allowance must be provided in the sheets while cutting so that furnished product is of correct size and finish.

## **LIST OF EXPERIMENT**

1. To study the different type of hand tools, used in sheet metal shop.
2. To make a Rectangular box using G.I Sheet as per given dimension

## **Experiment No.1**

**OBJECTIVE:** - To study the different types of sheet, joints, sheet metal operations and hand tools, of sheet metal shop.

### **INTRODUCTION**

Sheet metal working covers the use of thin metallic sheets with hand tools and sheet metal machines. Many important engineering articles made up of sheet metal such as air conditioning ducts, making component of aircraft industry, agriculture implements, decorative articles and household goods. For effectively working in sheet metal one should have knowledge of hand tools, sheet metal machines, properties of metals and thorough knowledge of projective geometry i.e. development of surfaces.

### **TYPES OF METAL SHEET**

#### **1. Ferrous Sheet**

- i) **Mild Steel sheets** – These are black iron sheets, suspected to rust and corrosion, mostly used for making water tanks and fabrication works.
- ii) **Galvanized Iron (GI Sheet)** –It is soft steel sheet coated with zinc, which is corrosion resistance due to zinc coating, used for making air-conditioning ducts, boxes, buckets, coolers etc.
- iii) **Stainless steel sheets** – It is an alloy of high-grade steel with chromium, nickel, phosphorous and manganese. It is used in household goods, food-processing plants etc.
- iv) **Tin Plate:** - steel coated with tin is called Tin steel. It is used for making food containers.

#### **2. Non-ferrous sheets**

- i) **Aluminum Sheets** – It is two and half times lighter than iron but lacks in tensile strength. Small percentage of other elements like copper, manganese and silicon is added to make it suitable for production in aircraft industry and other industrial goods. It is also called aluminum alloy sheets.
- ii) **Copper and Brass sheets** – These are non-ferrous sheets used in electrical industry and various other industrial and household articles.

### **MEASUREMENT OF SHEETS**

Thickness of sheet is generally measured by gauge number, which is obtained by actually measuring the sheet thickness with a sheet gauge or wire gauge. Each slot in the standard wire gauge is numbered, a number, which represents gauge number such as 20 SWG (Standard Wire Gauge). The more the SWG number, lesser is the thickness of sheet.

## TOOLS USED IN SHEET METAL

### Marking Tools

1. **Steel Rule:**

Available in different sizes, it could be steel foot rule, folding rule or tape rule. (See fig. 1)

2. **Scriber:**

It is a steel wire with one end sharp and hardened to mark lines on metallic sheet. (See fig.2).



fig.1

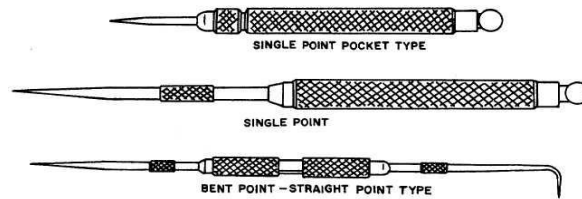


fig.2

3. **Divider:** It is used to scribe arcs and circles on metallic sheets. (See fig. 3)

4. **Trammel points:** It is used for drawing large circles and arcs. (See fig. 4)



Fig. 3



Fig. 4

3. **Punches:** Following punches are used in Sheet metal work.

(a) **Prick Punch:** Used for making indentation marks for locating center position for dividers, it has a taper angle of 30° (See fig. 5)

(b) Centre Punch: Used for marking the location of points and centering hole to be drilled. It has a taper angle of 90°. (See fig. 6)



Fig. 5



Fig. 6



Fig.7

## Cutting Tools

**Hollow Punch:** Hollow punch is used to cut circular holes on thin sheets. (See fig. 7)

**Straight Snips:** It's blades are straight and it is used to cut 22 SWG or lighter sheets along straight line. (See fig. 8)

**Bent snip:** Blades are curved back from the cutting edges; it is used to cut discs and round articles from sheets. (See fig. 9)



Fig. 8



Fig. 9

**Chisels:** This is used for cutting sheets, rivets and bolts.

## Striking Tools

**Hammers:** Hammers are used for bending of sheets, smothering of sheets, locking of joint and riveting work.

(a) **Ball Peen Hammer:** General purpose, face is slightly curved, and head is round (See fig.10).

(b) **Square face hammer:** It has square flat face, used for flattening of seams (See fig.11)



Fig. 10



Fig. 11



Fig. 12

(c) **Raising Hammer:** It is used to form flat surface of sheet into curved surface. (See fig.12)

(d) **Riveting Hammer:** Face is square slightly curved with beveled edges. (See fig.13)

(e) **Mallet:** Made of good quality of wood or plastic used whenever light force is required. (See fig.14)



Fig. 13



Fig. 14

## **Supporting Tools**

1. **Stakes** – Stakes are used to support sheets in bending, seaming, forming, riveting, punching etc. Some commonly used stakes are:

(a) **Hand stake:** It is handy with flat face, two straight edges one concave edge, other convex edge, used for pressing the inner sides of straight joint.

(b) **Half Round stake:** It is used for pressing round seam joint on inner side. (See fig. 15)

(c) **Taper stake:** It is used for rounding of tapering jobs such as conical jobs. (See fig. 16)



Fig. 15



Fig. 16

(d) **Grooving stake:** It is made up of forged steel, used for grooves of different sizes. (See fig. 17)

(e) **Horse stake:** There are two square holes for holding two stakes at a time for carrying out different operations. (See fig. 18)



Fig. 17

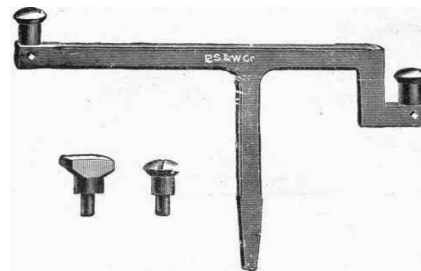


Fig. 18

## **SHEET METAL JOINTS**

**Lap Joint** – It can be prepared by means of soldering or riveting.

**Seam Joint** – When two or more sheets are folded and fastened together is called seam joint.

There are two types of seam joints.

i) Single Seam Joint

ii) Double Seam Joint

**Groove Seam Joint** – In this joint two single edges are hooked together and flattened with a small mallet to make them tight, seam is then grooved with a hammer and a hand Grover.

**Wired Edge** – It is one of the methods of strengthening the thin metal by turning over the edge on a wire in it.

**Hinged Joint** – It is used for easy movement of opening or closing doors, window etc.

**Cap Joint** – It provides another useful form of locked seam joint.

**Hem Joint-** This is turning over the edge of the sheet to give the strengthening on the edge of the sheet.

## **SHEET METAL OPERATIONS**

1. **Measuring and Marking** – Sizes are marked on large sheet to cut the latter into small pieces.
2. **Development of Surface (Laying Out)** – Operation of scribing the development of surface of the component on the sheet together with the added allowance for overlapping, bending, hammering etc.
3. **Cutting and shearing** – The term shearing stands for cutting of sheet metal by two parallel cutting edges moving in opposite direction.
4. **Hand Forming** – It stands for shaping, bending of sheet in three dimensions in order to give the desired shape and size of final product.
5. **Nibbling**– It is a process of continuous cutting along a contour which may be of straight or irregular profile.
6. **Piercing and Blanking**– Piercing is basically a hole punching operation while blanking is an operation of cutting out a blank.
7. **Edge Forming or Wiring**– Edges of sheet metal products are folded to provide stiffness to the products and to ensure safety of hand due to sharp edges
8. **Joint Making**– Sheet metal parts can be joined by folded joints, riveting, welding, brazing, soldering, self-tapping screws, screwed fastening, and by adhesives.
9. **Bending**– Bend in sheet metal is to be bent at different angles to shape it to required form.
10. **Circle Cutting**– It is an operation of cutting circular blanks or curved contours with the help of circular cutting machines.
11. **Hollowing**– It is the process whereby a flat sheet metal is beaten up into spherical shape by placing the metal upon a sand bag or hollowing block, beating with hollowing hammer, starting from boundaries towards center.
12. **Raising**– It is the process of hammering the metal from oxide to form a hollow article, working around from center towards edge.
13. **Turned over Edge**– It is the method of strengthening the thin metal at edge. The edges are turned with some radius.
14. **Swaging**– This is also a method of strengthening thin sheet metal by making impressions in the bodies. It is done by machine or by hand.



**Outcomes:** - On successful completion of this experiment, the students will be able to:

- 1 Acquire practical knowledge of different types of sheet and their practical uses.
- 2 Understand the proper uses of hand tool and demonstrate it.
- 3 Knowledge of different sheet metal joints & operation.

## **Experiment No. 2**

**Objective:** - To make a Rectangular box using G.I Sheet as per given dimension.

**Tools Required:** - Straight snip, steel rule, scribe, Mallet, Hammer, Stakes, pliers, soldering iron, solder, flux, bench vice, file, spring divider.

**Materials used:** - Galvanized iron sheet 28 SWG.

**Drawing:** - (See fig.19).

**Theory:-**

### **Development of surfaces of various objects**

A layout of the complete surface of a three dimensional object on a plane is called the development of pattern. Development is the term frequently used in sheet metal work where it means the unfolding or unrolling of a detail into a flat sheet called pattern.

Practically, the development consists of drawing the successive surfaces of the object in its true shape and size with common edges joined together.

### **Methods of pattern development**

There are three methods in general use by means of which surface of solids may be geometrically developed.

- (i) **Radial Line Method:** - a radial line method is used for those objects such as cones and pyramids, the sides of which converge to an apex.
- (ii) **Parallel Line Method:** - This method can be applied to the development of pattern for elbows, T-pipes intersection of pipes of equal diameter, cylindrical articles.
- (i) **Triangulation Method:** - This method is universally applied to solve a large number of developments

### **Procedure:**

1. Draw a lay out as shown in development on drawing sheet.
2. Cut the pattern to shape along the line using a suitable snip.
3. Mark on the G.I Sheet as per the pattern and cut to required shape.
4. Make the hem edge using mallet and stake.
5. Make closed folds on both ends for lock seam joint
6. Make square folds on lines marked A, B, C, D, E, & F
7. Make lock seam joint after joining both the ends.
8. Make a bottom piece from G.I Sheet taking required allowance for double lock seam joints as shown in diagram.
9. Join the bottom piece with square box by double lock seam joint using stakes and mallet.
10. Do the soft soldering operation on the corners of double lock seam joints?
11. File all the sharp corners with file.

### **Precautions:-**

1. Be careful while working on sharp edges of sheets to avoid injury.
2. Do not use blunt cutting edges tool.
3. Appropriate cutting tools and machines must be used for cutting tin sheets.

4. Extra allowance must be provided in the sheets while cutting so that finished product is of correct size & finish.

**Outcomes:** - On successful completion of this experiment, the students will have the practically knowledge that how to prepare sheet metal object.

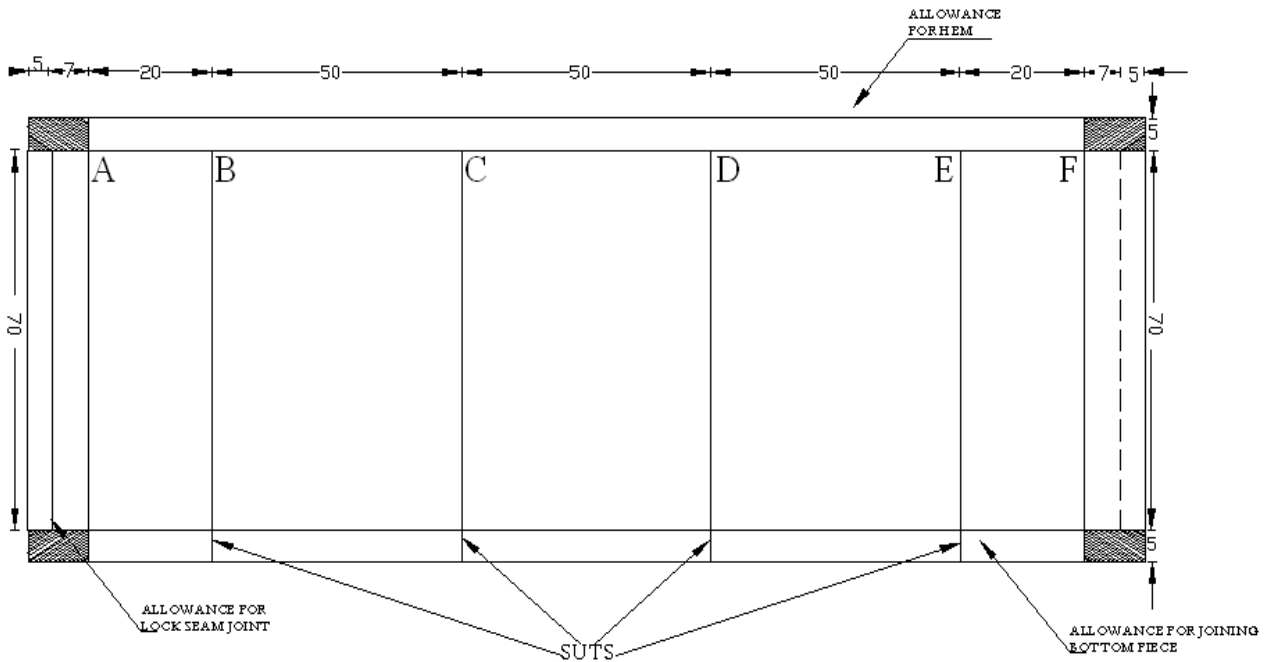
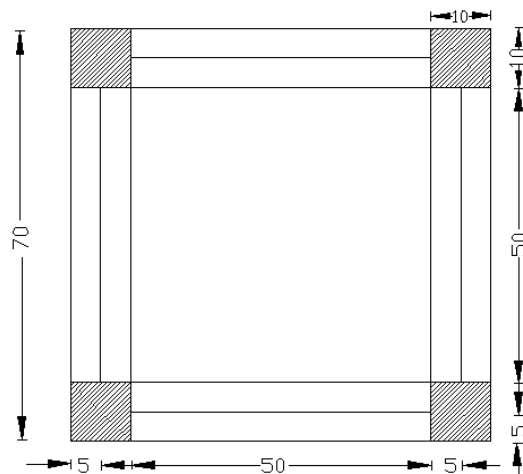


Fig. 19 Development of Rectangular Box



Where,



=Cutting Area

**Note:** All Dimensions are in “mm”

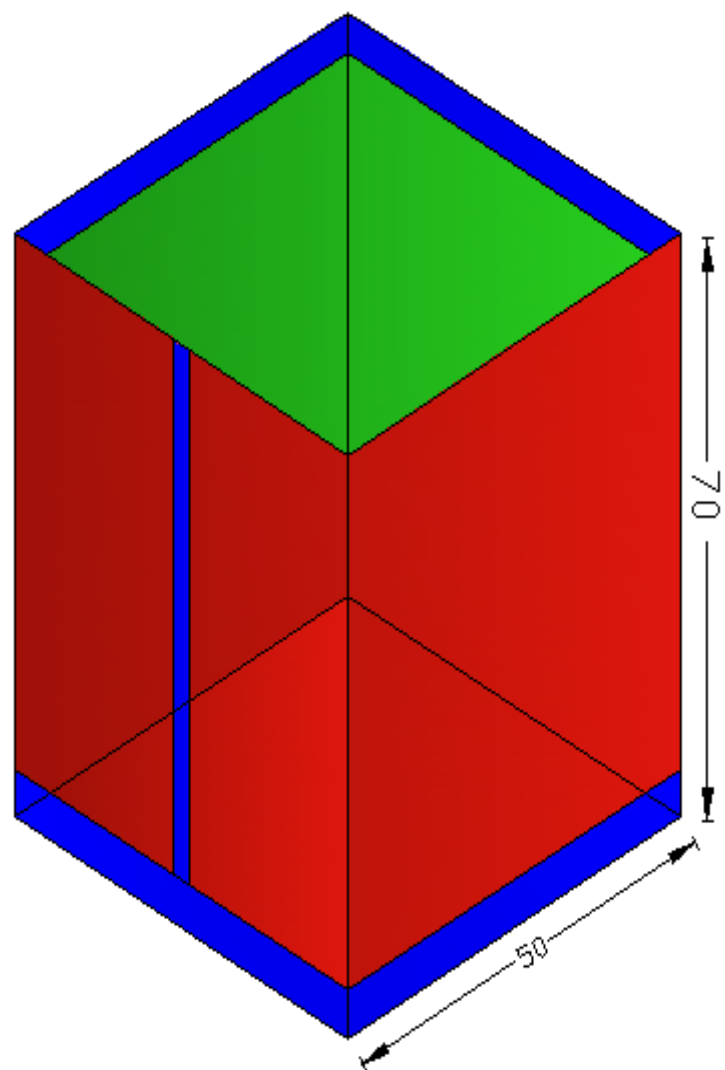


Fig. 20