



Manufacturing Practice /Workshop Practice

Sheet Metal Shop

Introduction- Sheet Metal and Plate Metal Work has its own significance as a useful trade in Engineering work and also our day-to –day needs. It is necessary to understand the construction and working of many Hand Tools, Sheet Metal working Machine and the basic principle of different operations performed in order to attain proficiency in the trade.

However, it should be understand very good knowledge of Projective Geometry, particularly of the Development of the Surface, and at least process involves a careful study and practice of this principle in order to get successful results. Laying out of patterns and cutting metal plats to correct sizes and shapes entirely depends upon the same.

METALS USED IN SHEET METAL WORK:

A metal plate of thickness less than 4 mm is considered as sheet. The size of the sheet is specified by its length, width and thickness in mm. 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

SWG									
(No.)	16	17	18	19	20	22	24	27	30
Thickness (mm)	1.62	1.42	1.22	1.02	0.91	0.71	0.56	0.42	0.37

The following metals are generally used in sheet metal work:

i. Black Iron Sheet

It is the cheapest among ail. 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.

ii. 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 GI sheets

iii. 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 GI sheets. It is used in kitchenware, food handling equipment, chemical plants etc.



iv. 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 GI and stainless steel. Because of high thermal conductivity, it is used for the radiator of automobiles, domestic heating appliances etc.

v. 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.

vi. 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.

vii. 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.

3. HAND TOOLS:

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. Joining Tools

I. MEASURING TOOLS

The following types of tools are commonly used in sheet metal shops to measure the dimensions of work pieces.

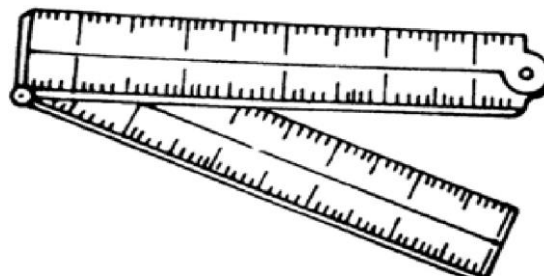
Steel Rule : It is used for measuring and layouting small works with an accuracy up to 0.5 m



Steel Rule

Folding Rule :

It is used for measuring and laying out larger work pieces accuracy upto 0.5 mm.



Folding Rule

Circumference Rule :

It is used to find out directly the circumference of a cylinder. One of the edge is marked with diameters and the values of circumference corresponding to each diameter is marked in the other edge.

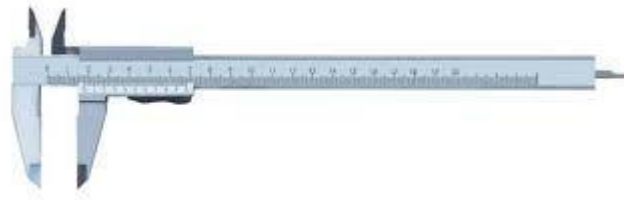


Circumference Rule



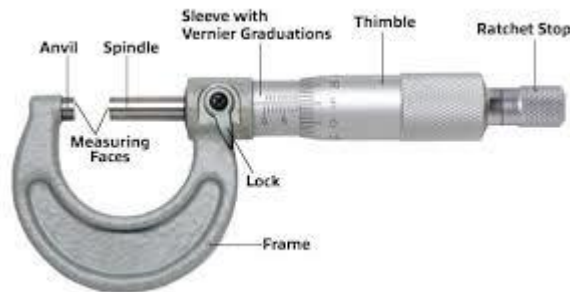
Vernier Caliper :

It is used for measuring dimensions upto 0.02 mm.



Vernier Caliper

Micro Meter : This is used to measure the thickness of the metal sheet accurately upto 0.01 mm.



Micro Meter

Sheet Metal Gauge :

This is used to measure the thickness of the sheet.



Sheet Metal Gauge

MARKING TOOLS:

Scriber:

It is used to scribe or mark line on a metal surface for a variety of purposes. It is a metalworker's pencil.



Scriber

Trammel: 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.



Trammel

Punches: It is used in sheet metal work for marking on sheet, locating centers. There are two types of punches. a) Dot punch and b) Prick punch.



Punch

Divider: Dividers are used to draw circle or arcs on sheet metal and to divide the lines into two equal parts.



Divider



CUTTING TOOLS:

To cut the sheet metal as per the pattern drawn and to make holes for rivets etc., the following types of tools are used.



A snip is a hand shear used to cut thin sheets of gauge size number 20 or above. It works like ordinary scissors. There are several types and sizes of snips available to cut along straight lines or curved lines.

Shear Machine: It is a cutting Machine using for cutting sheet.



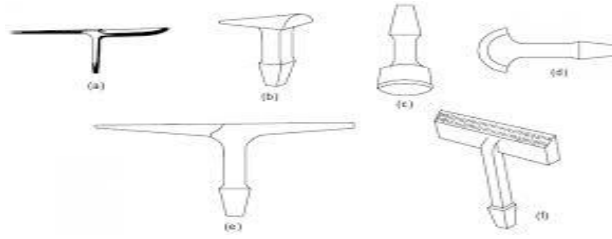
Shear Machine

FORMING TOOLS:

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

Stakes:

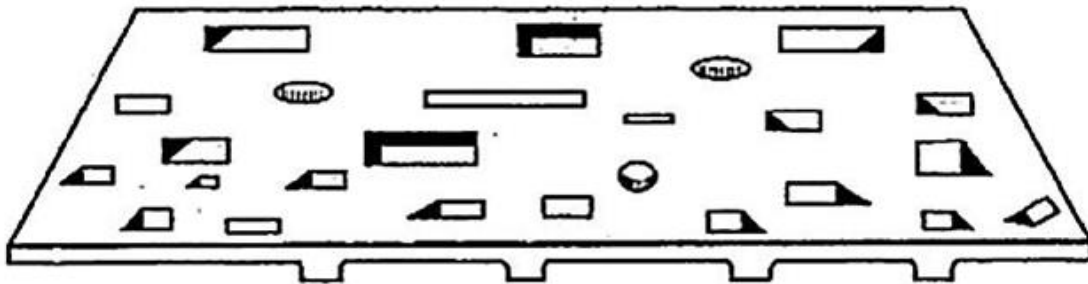
Stakes are the sheet metal anvils used for bending, seaming and forming by using a hammer or mallet. They work as the supporting tool as well as the forming tools. They are made in different sizes and shapes depending upon the job requirement.



Stakes

Stake Holder

The stake holder used in sheet metal shop is a rectangular bench plate.



Stake Holder

HAMMERS:

The sheet metal is shaped by hammering or striking with mallet, after keeping the work on suitable form of stake. The hammers used for sheet metal work are (a) *Setting hammer*, for setting down the edge while making double seam, (b) *Raising hammer* for forming curved or hollow shape from flat piece, and (c) *Riveting hammer* for riveting purpose. *Mallets* are soft hammers used to give soft blows which will not damage the sheet at the same time will shape them.



Hammer & Mallet



JOINING TOOLS:

The tools exclusively used for making and finishing joints are:

- a) Hand grooves b) Rivet set c) Soldering irons

Hand Groovers: Hand groovers are used to flatten and shape joints made in sheet metal. The tool has a groove of required width and depth like a die. This groover is placed over the joint (double hem or lock seam) and hammered from the top of it, to shape the joint that of the groove.



Groover

Rivet Set:

Rivet set is made of tool at the bottom of the rivet set there is a deep hole and a cup shaped hole. The deep hole is used is used to draw a rivet through sheet metal and cup shaped hole is used to form the finished head of river. Another hole on the side of the set is to release the burrs that are punched. Dollies are used to backup rivets, when it is not possible to support the job on a bench.



Rivet Set



Joining Operation:

SOLDERING IRON:

A soldering iron consists of a copper block, fixed on an iron rod with a wooden handle. It is made dolly in various shapes and sizes to suit the use as shown in figure. The purpose of the copper block is to act as a heat source for melting and spreading the solder (filler metal) at the joining area. The soldering iron (copper) is heated using furnace, blower or by electrical resistance.



Soldering Iron

Brazing : It is similar to soldering, but it gives much stronger joint. The major difference is that use of a harder filler material called spelter and its melting point is higher than solder., but lower than the metal being joined. In brazing operation the two metal pieces are to be joined must be cleaned. Flux (Borax) is applied on the joint and heated to a temperature just above the melting point of the spelter. The liquid spelter is distributed between the surfaces by capillary action. After solidification it forms strong joint.

Spot Welding : The spot welding is used for joining the sheets by application of heat and pressure at specific locations called spots. In this, the sheets to be joined together are held between two electrodes at required located spots. Normally a high amperage current and low voltage is passed through electrodes causing local heating at that spots. The pressure applied on the electrodes squeezes the sheet metal at various locations thus joining the two sheets together to form a joint.



Spot Welding Machine



Sheet Metal Operation:

The major types of sheet metal operations are given below.

1. Shearing
2. Bending
3. Drawing
4. Squeezing

Shearing

Shearing is the process of cutting across a sheet or strip. The various shearing operations include

- | | |
|-----------------|--------------|
| (a) Cutting off | (b) Parting |
| (c) Blanking | (d) Punching |
| (e) Piercing | (e) Slitting |
| (g) Trimming | |

Cutting Off: It is the operation of shearing the piece from sheet metal with a cut along a single line.

Parting : This means that the strip is removed between the two pieces to part them.

Blanking : It is the operation of cutting the flat sheet to the required shape and size using punch and die.

Punching : It is the operation of making only circular holes in a sheet metal.

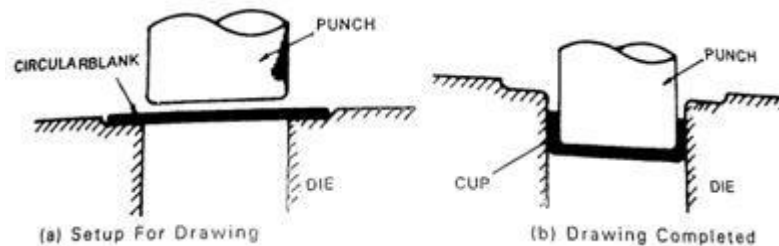
Piercing : It is the operation of making a hole of any shape in a sheet metal by punch and die.

Slitting : It is the operation of cutting the sheet metal in a line along the length.

Trimming : It is the operation of finishing the edges of a part by removing excess metal around it.

Bending : It is the folding operation by using suitable tools. It may be done over stakes. The common forms of bending the sheet metal is single bend and double bend etc.

Drawing : It is the process of producing thin walled hollow or vessel shaped parts from the sheet metal. Again this process can be divided into two types. a) Deep drawing and shallow drawing. In deep drawing, the height of the component is greater than the diameter or width. In shallow drawing the height of the component is less than the diameter or width.





Squeezing : It is the quick and widely used method. The operation involves severe cold deformation and it requires a greater amount of pressure to deform the metal at cold state.

The most commonly used squeezing operation are sizing, coining, hobbing, riveting.

Sizing : This operation is used for surfacing or flattening. A special die is needed for every job.

Coining : This is a process of making impressions or raising of images by a plastic flow by using a punch and die.

Hobbing : It is the process of producing cavities into surface of material by pressing with a special punch called hub.

Riveting : It is the process of fastening the two metal sheets by inserting metal pin in to the sheets and spreading out by hammering to form the rivet head.

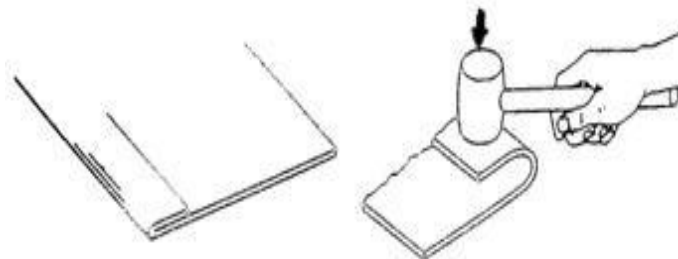
Sheet Metal Joint:

Hem and Seam Joints

Hem Joint : Hem is an edge or border made by folding. It strengthens the edges and eliminate the sharp edges. Hems are three types

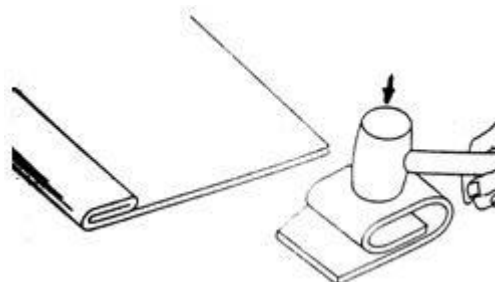
- Single hem
- Double hem
- Wired edged hem

Single Hem : It is made by single folding of the edge of sheet metal.



Single Hem

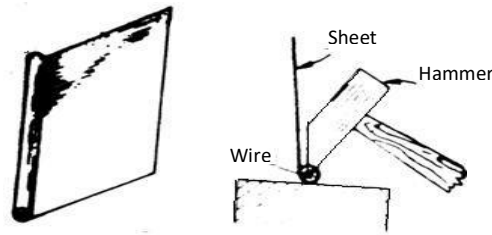
Double Hem : It is made by folding the edge over twice to make it smooth. It provides much greater strength than single hem.



Single Hem



Wired Edged Hem : It consists of holding a piece of sheet metal around a wire of given diameter.

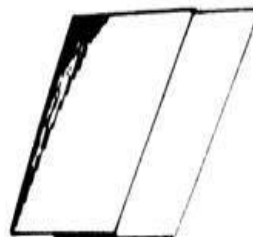


Wired Hem

Seam Joint : It is the joint formed by two edges of sheet metal. The process of joining the edges are called seaming. Different kinds of seams are given below.

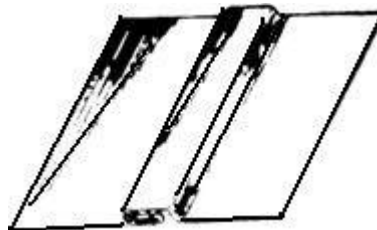
- a) Lap seam
- b) Groove seam
- c) Single seam
- d) Double seam
- e) Dovetail seam
- f) Flanged Seam

Lap Seam : It is a simple type of seam which consists of lapping the edge of one sheet over the other and the joint is made by soldering or riveting.



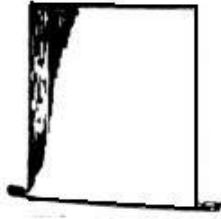
Lap Seam

Grooved Seam : It is made by hooking two single hems together



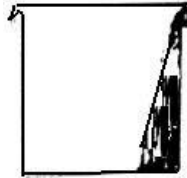
Grooved Seam

Single Seam : Single seam is used to join a bottom to vertical bodies of various shapes.



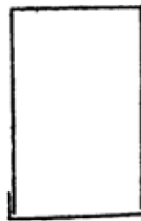
Single Seam

Double Seam : It is similar to single seam with the difference that its formed edges bent upwards against the body.



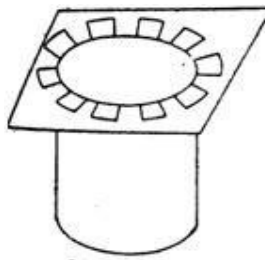
Double Seam

Flanged Seam : It is used to join the bottom of a container to its body.



Flanged Seam

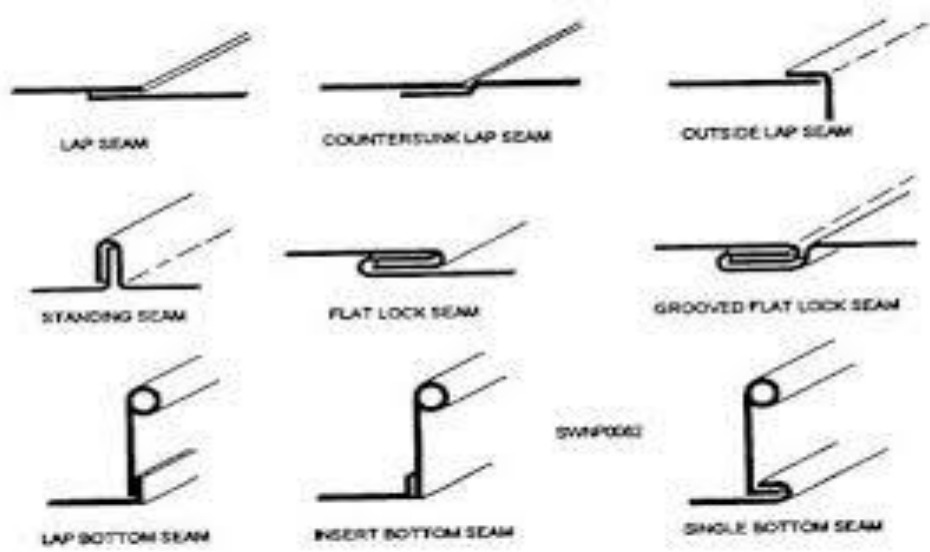
Dovetail Seam : It is used to join sections such as one pipe to another pipe or a sheet to pipe. It consists of narrow strips of metal which are formed by slitting the end of pipe.



Dovetail Seam



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