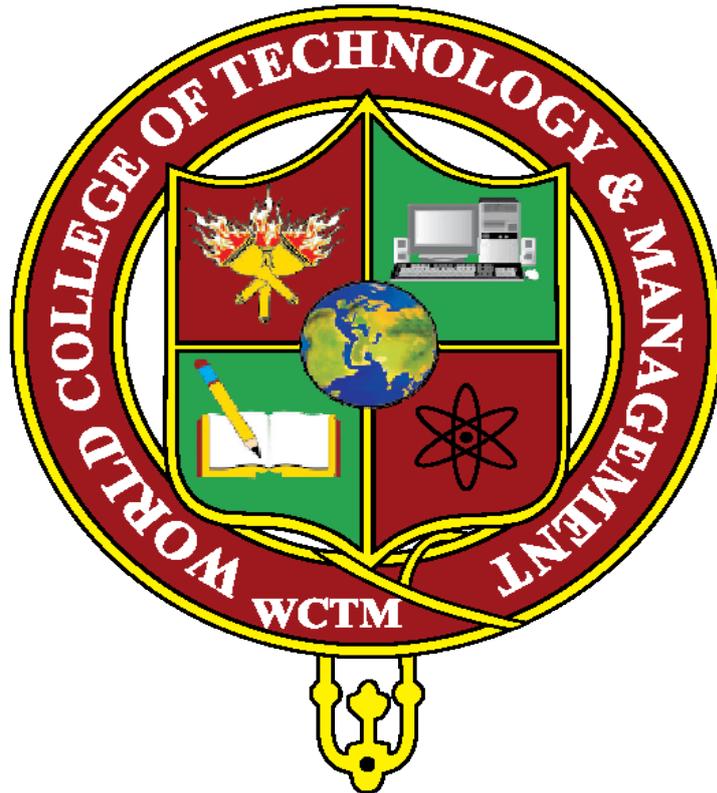


LABORATORY MANUAL
WORKSHOP TECHNOLOGY LAB

ME - 105 - F



B.TECH, I & II SEMESTER

World College of Technology & Management, Gurgaon

CARPENTRY SHOP

Introduction

Carpentry may be designed as the process of making wooden articles and components such as roofs, floors, partitions, doors and windows. Carpentry involves cutting, shaping and fastening wood and other materials together to produce a finished product. Preparation of joints is one of the important operations in wood work. Joinery denotes connecting the wooden parts using different points such as lap joints, mortise and T- joints, bridle joints, etc.

Carpentry Tools

Carpentry tools are used to produce components to an exact size.

The types of carpentry tools are as follows.

1. Marking tools
2. Measuring tools
3. Holding tools
4. Cutting tools
5. Planning tools
6. Boring tools
7. Striking tools
8. Miscellaneous tools

Marking tools

It is used to marking lines parallel to the edges of a wooden piece. It consists of a square wooden stem with a sliding wooden stock on it. On the stem, a marking pin is attached which is made up of steel. This stem is provided with a steel nail to scratch the surface of the work. It consists of two pins; the distance between the pins is adjustable. It is used to draw parallel lines on the stock.

Measuring tools

The carpentry measuring tools are classified as follows

1. Steel tape
2. Steel rule
3. Caliper

Steel tapes and steel rules are mainly used for measuring short and lengths in millimeters.

A try square is used for testing squareness and marking of joints.

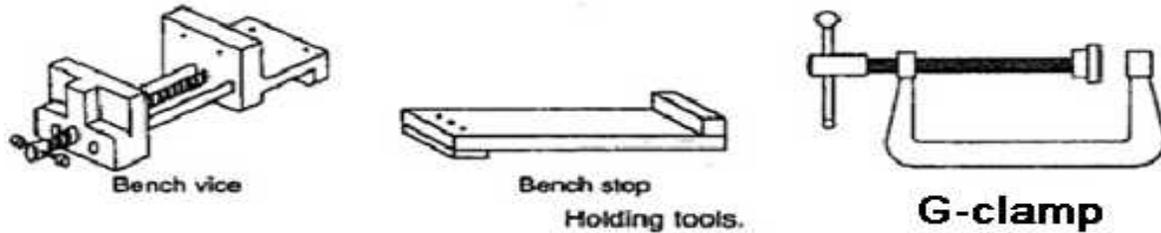
A meter square is used for marking and measuring an angle of 45 degree.

A bevel square is used for marking and listing angles between 0 degree to 180 degree.

Calipers are used for the precision measurement of cylindrical surface. Inside calipers are used for measuring outside diameter and outside calipers are used to measure inner diameter of a pipe.

Holding tools

The carpentry holding tools are shown in fig.



Carpentry vice

A carpentry vice is the common work holding device. It consists of one fixed jaw and one movable jaw. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle.

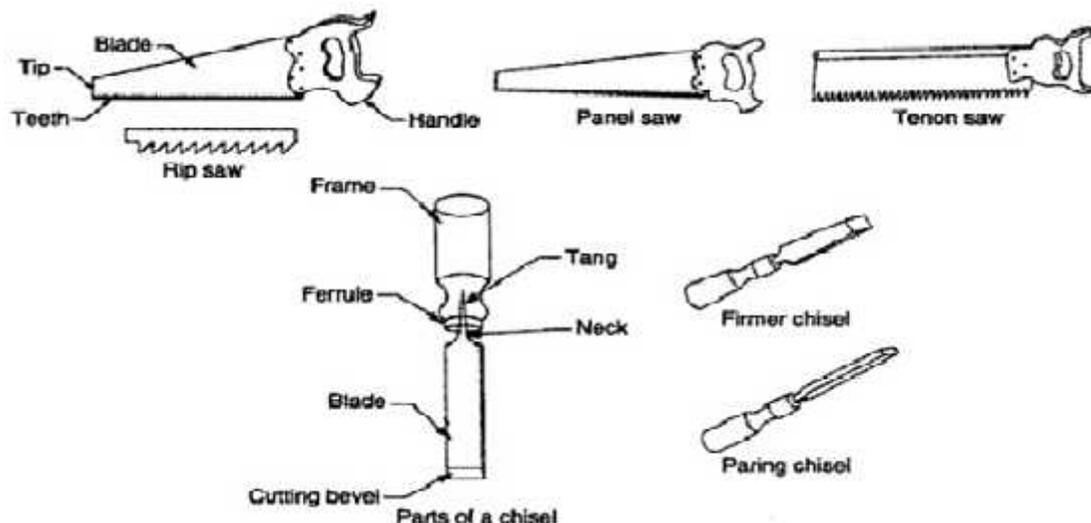
Bar clamp

The bar clamp (or) sash cramps are generally used in pairs in gluing up operations at the final assembly of joinery work. It is made up of a steel bar of T-section, wine malleable iron fittings and a steel screw.

G-clamp

G-clamp is made up of malleable iron with acme threads of high quality steel .It can be used for clamping small work when gluing up.

Cutting Tools



Saws

A saw is used to cut wood into pieces. There is different type of saws, designed to suit different purpose. A saw is specified by the length of its tooled edge. The following saws are used in the carpentry section.

Rip Saw

The blade of rip saw is either straight or skew-backed. The teeth are so set that the cutting edge of this saw makes a steeper angle about 60° .

Cross Cut saw

This is similar in shape of a rip saw. It is used to cut across the grain of the stock. The correct angle for cross cutting is 45° . The teeth are so set that the saw kerf is wider than the blade thickness. This allows the blade to move freely in the cut without sticking.

Tenon or back saw

A tenon saw is used for fine and accurate work. It consists of a very fine blade, which is reinforced with a rigid steel back. The teeth are shaped like those of cross cut saw.

Chisels

Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50mm .Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle.

Firmer chisels

These are general purpose chisels and are used either by hand pressure or by a mallet. The blade of a firmer chisel is flat and their sloping face is at an angle 15° to 52° .

Boring Tools

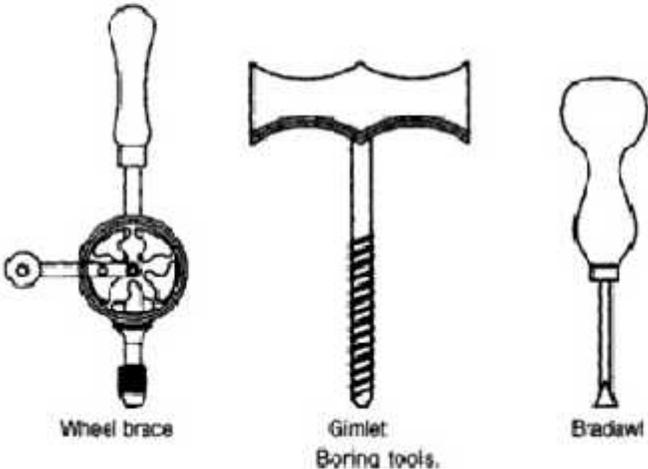
Boring tools are used to make holes in wood .Common types of boring tools are as follows.

1. Bradawl
2. Gimlet
3. Brace
4. Bit and drill

A brace holds and turns the bit and boring of a hole is obtained. A brace having two jaws is used for holding the bit in one end. It has two types, namely ratchet

brace and wheel brace. A bradawl and a gimlet are used for boring small holes. These tools are hand operated.

Striking Tools



Job No. -1

Aim: To make the T-joint the required dimensions from the given work piece.

Material Required: Soft wood of size 300 x 50 x 50 mm.

Tools Required

1. Jackplane
2. Carpentry vice
3. Try square
4. Marking gauge
5. Steel rule
6. Tenon saw
7. Rip saw
8. Firmer chisel
9. Mallet

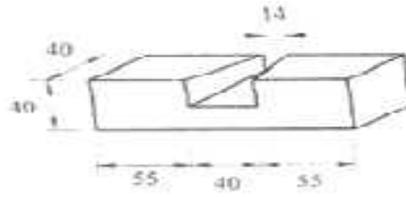
Procedure

1. The given work piece is firmly clamped in the carpentry vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planned faces are checked.
3. Now the other two surfaces are planned to get smooth surface.
4. The work piece is cut into two pieces by using the rip saw.
5. Using the steel rule and marking gauge, marking is done for T-joint on the two halves.
6. In one half, the unwanted portions of wood are removed by using the tenon saw and firmer chisel. The same procedure is done for the other half of work piece.
7. Using the jack plane, the other two faces of work piece is planned to the required size.
8. The finished two pieces are assembled to get together to form the T-joint.
9. Finally, the finished job is checked for required size and shape using the steel rule and try square.

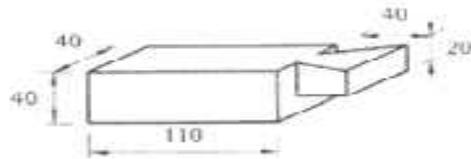
Result:

Thus the required T-joint is obtained.

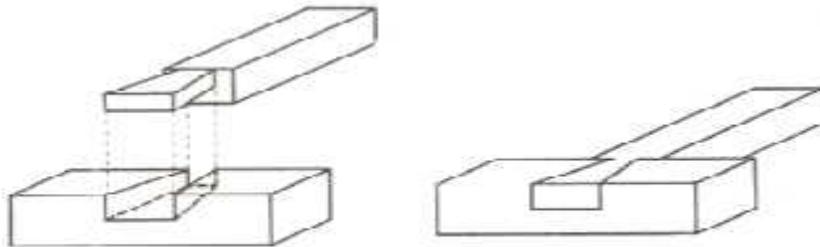
SAWING



CHISELING



FINISHING



Welding Shop

Introduction

Welding is metal joining process wherein localized coalescence is produced either by heating the metal to a suitable temperature, with or without the use of filler metal, with or without application of pressure. The filler material has similar composition and melting point temperature as that of the base metal. It is used to fill gap between the joint surfaces.

Types of welding

The welding process is divided into two main sub divisions.

Plastic welding

The pieces of metal to be joined are heated to the plastic state and then forced together by external pressure without the addition of filler material.

Forge welding

The work piece are placed in a forge or other appropriate furnace and heated within the area to be joined to the plastic condition. Then parts are quickly superimposed and worked into a complete union by hand or power hammering or by pressing together.

Resistance welding

In resistance welding, a heavy electric current is passed through the metals to be joined over limited area, causing them to be locally heated to plastic state and the welding is completed by the application of pressure for the prescribed period of time.

Fusion welding

In fusion welding, the metal parts to be joined are melted and then allowed to solidify pressure is not applied and filler metals may be used for this type of welding.

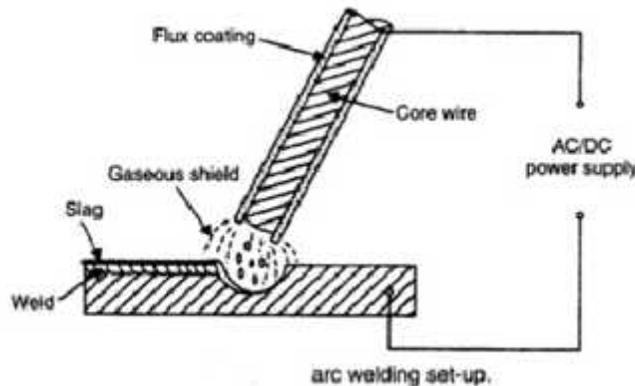
Gas welding

Gas welding is a process in which the required heat to melt the surfaces is supplied by a high temperature flame obtained by a mixture of two gases. Usually the mixture of oxygen and acetylene is used for welding purpose.

Electric Arc welding

Principle of operation

Electric arc welding is the process of joining two parts by melting their edges by an electric arc with or without the application of pressure and with or without use of filler metals.



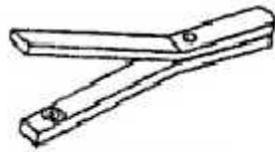
Thermit welding

Thermit welding is a fusion process in which weld is effected by pouring super heated liquid thermit steel, around the parts to be united with or without the application of pressure.

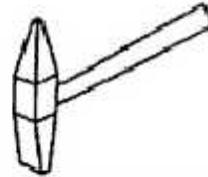
Welding Bead cleaning accessories



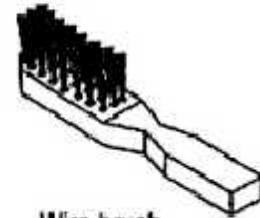
Face shield



Ground clamp



Chipping hammer



Wire brush

Chipping hammer

A chipping hammer is chisel-shaped one and it is used to remove the slag from the weld bead.

Wire Brush

A wire brush made up of stiff steel wire, embedded in wood, removes small particles of slag from the weld bead after the chipping hammer is used.

Hand Screen

It is a protective device used in arc welding. A hand shield is held in the hand of the welder and it is fitted with a suitable filter lens.

Helmet

It is used for shielding and protecting the face and neck of the welder and it is fitted with a suitable filter lens.

Tongs

Tongs are used to handle the hot metal-welding job while cleaning; they are also used to hold the metal for hammering.

Goggles

Chipping goggle is used to protect the eyes while chipping the slag. They are fitted with a plain glass to see the area to be cleaned.

Hand Gloves

Hand gloves are used to protect the hands from electrical shock, arc radiation and hot spatters.

Job No.- 1

Aim: To join the given two work pieces as a lap joint by arc welding.

Material used: Mild Steel plates.

Tools required:

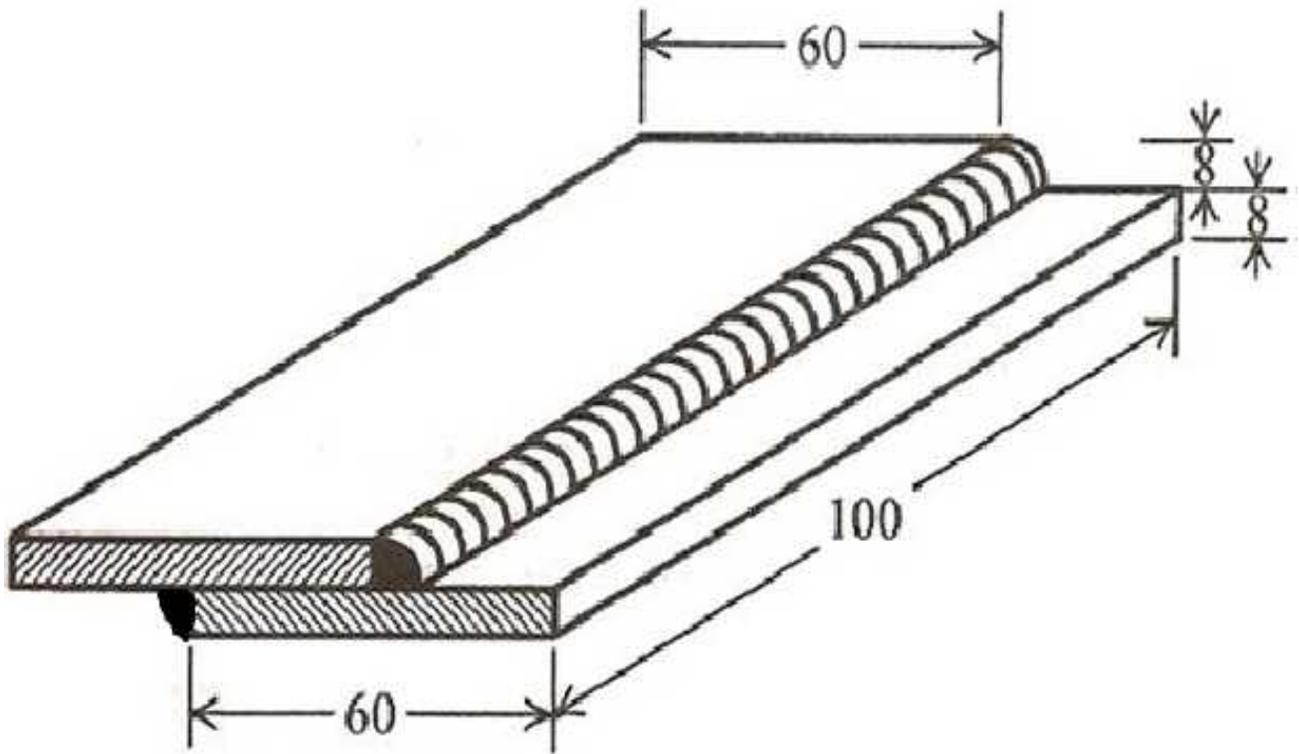
- Welding power supply
- Welding rod
- Electrode holder
- Gloves and apron
- Shield and goggles
- Flat file
- Chipping hammer
- Wire brush
- Earthing clamps

Procedure

1. First of all, the work pieces must be thoroughly cleaned to remove rust, scale and other foreign materials.
2. Then the given work pieces are placed on the table in such a way that one work piece is placed on the other work piece like the LAP joint is formed.
3. Appropriate power supply should be given to the electrode and the work pieces.
4. Now the welding current output may be adjusted.
5. When current is passed, arc is produced between the electrode and work pieces.
6. Then the welding is carried out throughout the length.
7. As soon as the welding process is finished, switch off the current supply and allow the work piece to cool.
8. Slag is removed by chipping process with the help of chipping hammer.
9. Finally using wire brush, welded portions are cleaned.

Result:

Thus the given two work pieces are joined as a lap joint by arc welding.



LAP JOINT

Forging Shop

AIM:- To Make the Pipe Clamp.

Tools and Equipment: Open Hearth Furnace, Anvil, Hammers, Chisel, Tongs, Flatter, Swages, Fullers, Hacksaw, Bending link etc.

Measuring Instruments: Brass Rule, Template, Try square etc.

Materials: Mild Steel Flat 30 mm+ 120mm long.

Drawing: - See Diagrams

Procedure:

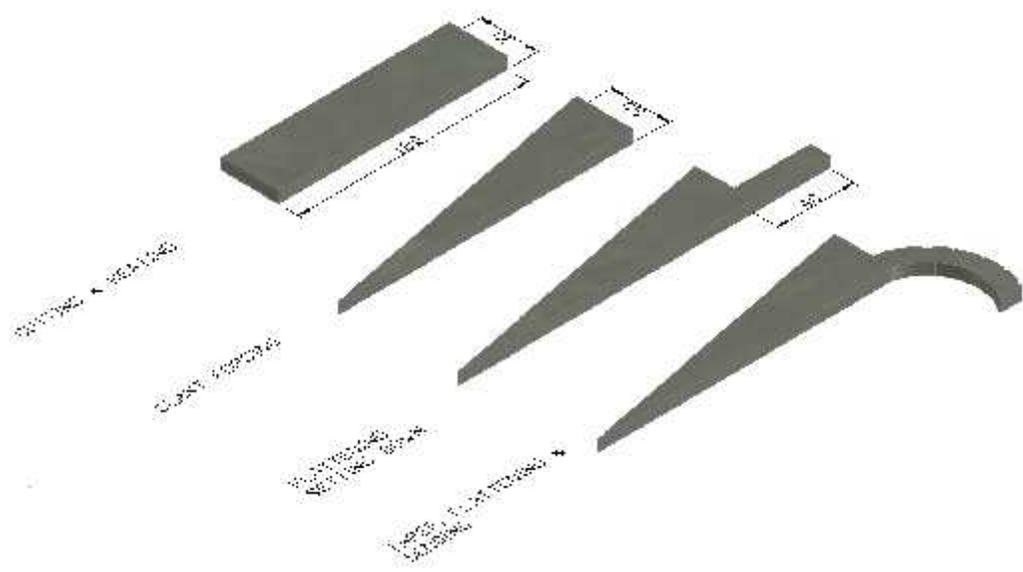
1. Check the tools and equipments required and see that they are in good working.
2. Do marking on the raw material by scale and cut the pieces as per dimension.
3. Start the forge and heat the job up to the forge temperature which depends on the materials (for steel 1080 to 1250⁰ C) or till the materials is red hot. (See figure A).
4. After the job is red hot, bring out from the forge and set on anvil with the help of close flat tongs and forge with hammer as shown in the figure (B).
5. Again make the job red hot and set down the other end about 20mm long Continue till the end elongates to about 40mm length. Make a uniform taper as round shown in the figure. (C).
6. Heat the job again and as shown in the figure. (D).
7. Heat the while job again and cut the excess metal to maintain dimensions. Then do finishing operation. See figure (D).

Precautions:

1. Don't wear wristwatches and finger ring while working.
2. Don't use mushroom-heated tools.
3. Always use suitable tongs and tools.
4. Equipment and tools should be cleaned of any oily substance.
5. Start hammering only on the red-hot job only.
6. Do not wear silky clothes, as they are prone to catch fire.
7. Do not touch the job with bare hands.
8. Make sure that the job is not affecting your body.

Questions for Viva Voice:

1. Explain the difference between smithy and forging?
2. What are uses of pipe clamp?
3. What are the materials of anvil?
4. Explain open fire and stock fire?



Job No.-1

AIM: Making a flat chisel

Tools used: Furnace, anvil, hammer, tongs, flatter, chisel grinder, steel rule, try square

Materials used: Mild steel round bar 20mmX150mm

Drawing: See Diagram

Procedure:

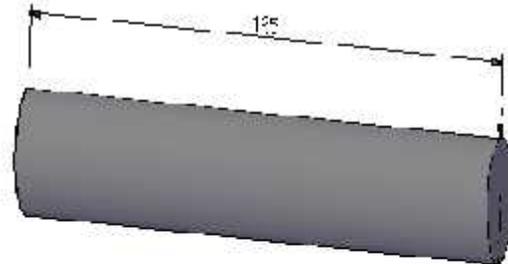
1. Do marking on the raw material by scale and cut the piece as per the dimension with the help of hexa frame. (See diagram)
2. Start the furnace and heat the job upto forgeable temperature (1250° C) or till metal is red hot
3. Keep the red hot metal piece on the anvil with the help of tongs. Then give octagonal shape to the job with flatter and hammer. (See diagram)
4. Re heat the octagonal job and place horizontally on the anvil with tongs and taper one end. To make chisel head with hammer. The other end of the job is taper flattening to make chisel mouth with flatter and hammer. (See diagram)
5. Heating the whole chisel again, cut the excess metal to maintain dimensions then do finishing with the chisel.(See diagram)
6. Keep the chisel in a restricted place for cooling in air.
7. After the job has cooled grind the cutting edge of the chisel to 60 ° angle. (See diagram)
8. Do hardening and tempering on the cutting edge of the chisel

Precautions

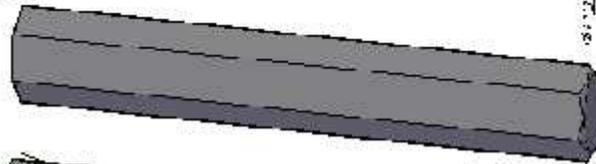
1. Don't wear wrist watch and finger rings while working
2. Don't use mushroom headed tools
3. Always use suitable tongs as per the job shape and size
4. Clean the oil substance from the tools
5. Heat the job carefully as per the forgeability of the metal
6. Start hammering on the red hot job only
7. Take great care during hammering of the job. Improper hammering may cause job to jump out of the tongs and hit somebody
8. Do not touch the hot jobs

MAKING A FLAT CHISEL

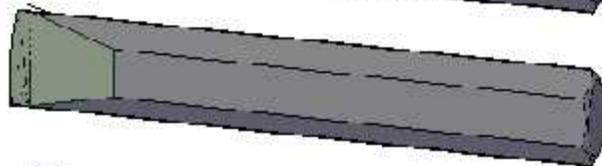
MARKING & HEATING



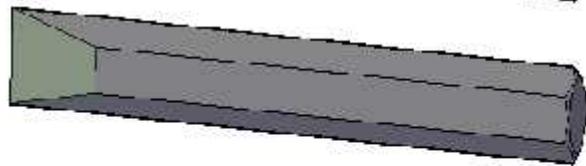
FORMING OCTAGONAL X-SECTION



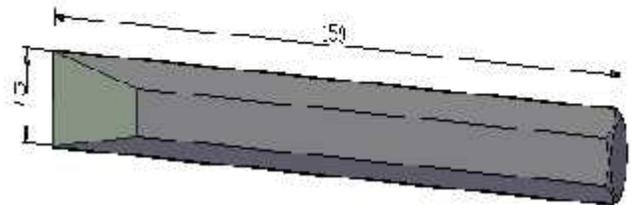
TAPERING & FLATTENING



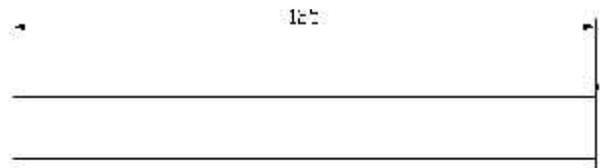
CUT EXCESS METAL



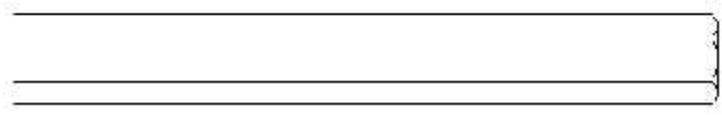
FINISHING & GRINDING



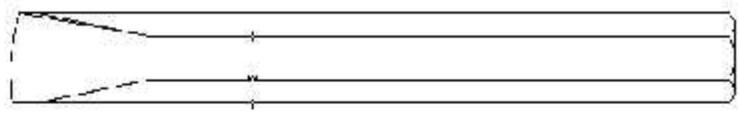
MARKING & HEATING



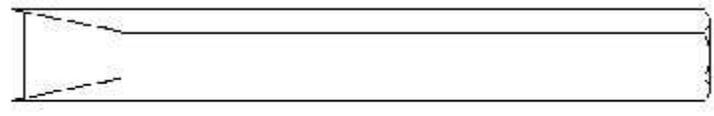
FORMING TAPER



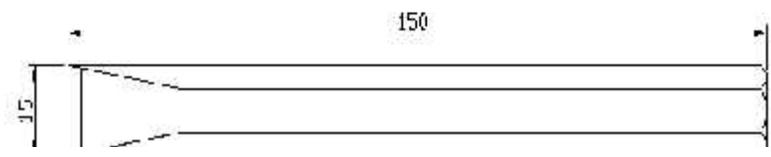
TAPERING & FLATTENING



CUT EXCESS METAL



FINISHING & GRINDING



SHEET METAL SHOP

Sheet metal work is applied to the working of thin metallic sheets with hand tools and sheet metal machines. Many important engineering articles made up of sheet metal and their application in air-conditioning ducts, aircraft industry, agriculture implements, decorative articles and household articles. 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 sheet Metal

1. Ferrous Sheet

- i) Mild Steel sheets – These are black iron sheets, susceptible to rust and corrosion, mostly used in water tanks and fabrication works.
- ii) Galvanized Iron (GI Sheet) – It is soft steel sheet coated with zinc, sheets have corrosion resistance due to zinc coating, used for making air-conditioning ducts, roofs, 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.
- 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 air-craft 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 and various other industrial and household articles.

Measurement of Thickness of Sheets

Thickness of sheet is generally indicated 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. The more the wire gauge number, less is the thickness of sheet.

Tools used in Sheet Metal

1. Common Hand Tools – Hammer, Files, Hacksaw, Chisels, Punches, Steel rule, Try square, Scriber.

Straight Snips – It is used to cut small thickness of sheets along straight line. To cut thickness of greater thickness shearing machine.

2. Bent Snip – The cutting blades are curved from cutting edge. It is used to cut discs and round articles from sheets.
3. Trammel Points – It is used for drawing large circles and arcs. It is two straight, removable legs tapered to the middle point and mounted on separate holders.
4. Mallet – Mallet is made up of good quality of hard wood; this is used whenever light force is required. Use of mallet does not spoil the surface of sheet; it is used for smothering of sheet.
5. Groover – It is a tool used to make a locked grooves seam in sheet metal joints.

Supporting Tools

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

1. Half Moon Stake – It is used for working the edges of discs.
2. Hatchet Stake – It is used for forming, binding and seaming the edges.
3. Bick Iron – It is used for forming long tapered cylindrical components.
4. Funnel Stake - It is used for forming conical components.
5. Pipe Stakes – It is used for forming pipes and hollow cylindrical surfaces.

Sheet Metal Joints and Strengthening Processes

1. Lap Joint – It can be prepared by means of soldering or riveting.
2. 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
3. Groove Seam Joint – In this two single edges are hooked together and flattened with a small mallet to make them tight, seam is then grooved with a hammer and hand groover.
4. Wired Edge – It is one of the methods of strengthening the thin metal by turning over the edge on a wire in it.
5. Hinged Joint – It is used for easy movement of opening or closing doors, window etc.
6. Cap Joint
7. Hem Joint

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) – It means the 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 metal 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.

Sheet Metal Machines

1. Shearing Machine – This is used to cut sheets. They are of two types:
 - i) Hand operated – Used for cutting thin sheets.
 - ii) Power operated – Used for cutting thick sheets.
2. Folding Machine – It is used for folding the sheet edges to form the joint.
3. Swaging Machine – It is provided with different types of contours on sheets to give strength to thin sheets.
4. Rolling Machine – It is used for shaping metal sheets into cylindrical objects, this machine consists of three rollers that can be adjusted for different radii.
5. Circular cutting machine – It is used for cutting circular discs.
6. Bench Shear – This machine is fixed on a bench and used for cutting comparatively thicker sheets.

Job No.-1

AIM: - To make a rectangular tray.

Tools and materials used: Steel rule, Scriber, Divider, Mallet, Stakes, Try square, snip straight (Tin cutter) Bench shear, file flat smooth, Nylon hammer, Tin sheet piece.

Materials used: - Galvanized iron sheet 28 SWG.

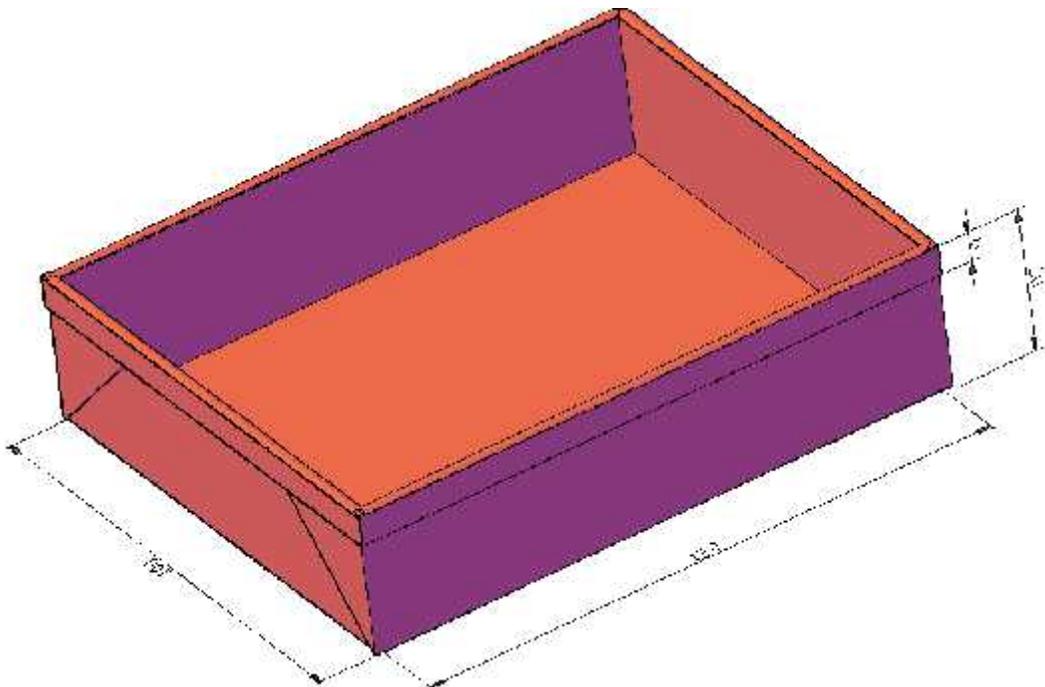
Drawing: - See Diagrams

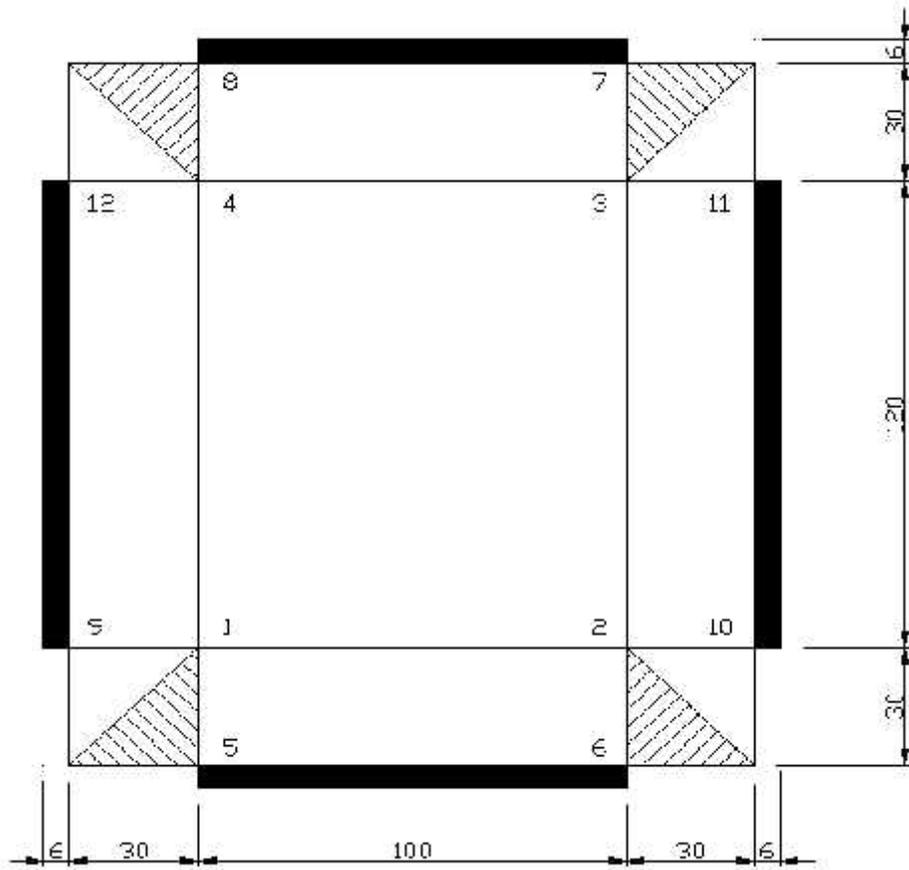
Procedure:

1. For developing the surfaces (lying out) draw plan, front view and end view of the required open rectangular box as shown in diagram.
2. Extend all the lines and cut these lines according to the height of the tray (i.e. 30 mm).
3. Addition strips of stocks are given along the edges for single hem allowance (6 mm).
4. All the four corner triangles are cut as shown in diagram for joint making.
5. Perform the operation of cuttings, shearing edges, hand forming, edge forming, joint making and bending in to rectangular tray by using above mentioned sheet metal tools by.
 - I. Square folding along 12, 23, 34, 41 lines.
 - II. Square folding of 15, 26, 37, 48, 2-10, 3-11, 19, 4-12,
 - III. Square fold for Hem 56, 78, 10, 11, 9-12.
6. File the sharp edges with a smooth flat file.

Safety Precautions:

- 1) Take precautions while working on sharp edges of sheets to avoid injury.
- 2) Appropriate cutting tools and machines must be used for cutting tin sheets.
- 3) Avoid using blunt cutting tools.
- 4) Extra allowance must be provided in the sheets while cutting so that finished product is of correct size and finish.





Black portion is to be bend (hem).
 Hatched portion is to be cut out.
 All Dimensions are in mm

Job No.-2

AIM: - To make a Square box using G.I Sheet as per the dimension

Tools and Equipment used :- 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 Diagrams

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.

Make a bottom piece from G.I Sheet taking required allowance for double lock seam joints as shown in diagram.

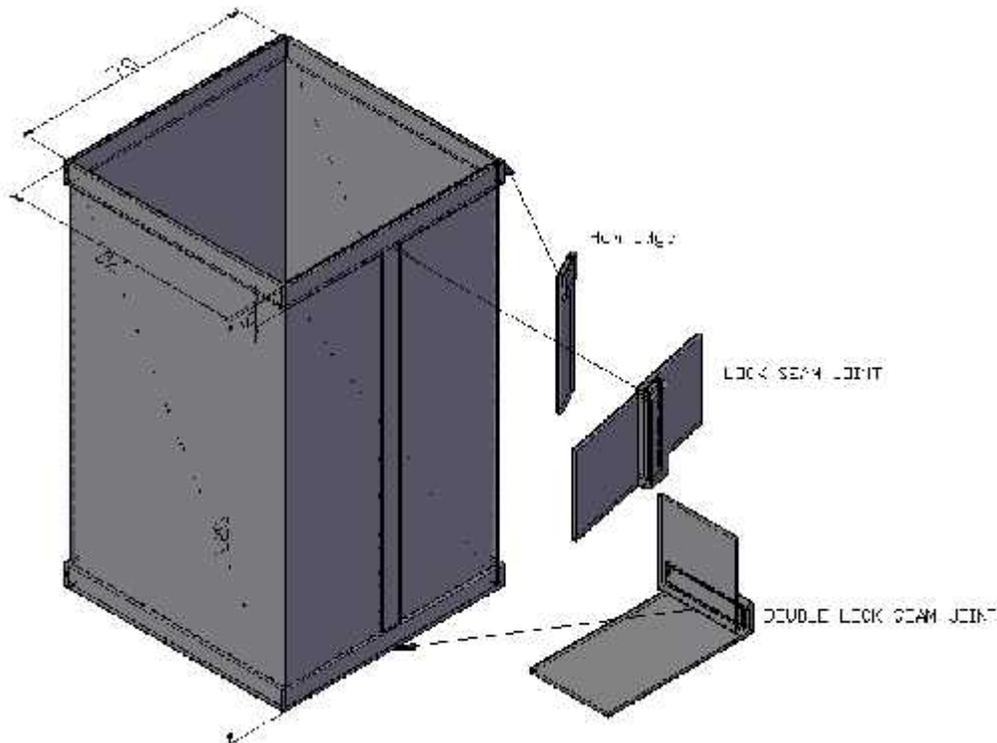
Join the bottom piece with square box by double lock seam joint using stakes and mallet.

Do the soft soldering operation on the corners of double lock seam joints.

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.



MACHINE SHOP

INTRODUCTION

The shop where most of the work is performed on different machine is called machine shop. In machine shop, the raw material is cut, machine, formed or shaped with the help of machine. Different machine used in machine shop are:

1. Lathe machine
2. Shaper
3. Milling machine
4. Planing machine
5. Drilling machine
6. Grinding machine
7. Threading machine

LATHE

A lathe is a powered mechanical device in which the work is held and rotated against a suitable cutting tool for producing cylindrical forms in the metal, wood or any other machinable material.

TYPE OF LATHE

- a) Precision lathe
- b) Tool room lathe
- c) Capstan and turret lathe
- d) Automatic lathe
- e) Speed lathe
- f) Engine lathe
- g) Bench lathe
- h) Special purpose lathe

THE PRINCIPLE OF LATHE

1. **BED:** The IT is the base or foundation of lathe. It is casting made in one piece. It holds or supports all other parts of lathe.
2. **HEAD STOCK:** It is a permanently fastened on the inner ways at the left hand end of the bed. It supports spindle and driving arrangements. All lathes receive their power through head stock.
3. **TAILSTOCK:** It is the counter part of head stock of is situated at the right end of the bed. It is used for supporting the work when turning on centers or when a long component is to be held in a chuck.
4. **CARRIAGE:** It is located between headstock. It can slide along bed guide ways and be locked at any position by tightening the carriage lock screws. It consist of following

Five main parts;

1. **APPRON:** It is fastened to saddle. It contains gears and clutches for transmitting motion from feed rod and hand wheel to the carriage. Also split nut which engages with the lead screw during threading. The Clutch mechanism is used for transmitting motion from feed rod whereas the split nut along with the lead screw moves the carriage during thread cutting.
2. **SADDLE:** It is made up of H shaped casting. It aids saddle to slide on bed guideways by operating hand wheels.

3. **COMPOUND REST:** It supports the tool post and cutting tool in its various positions. It may be swiveled on the cross-side to any angle in the horizontal plane.
4. **CROSS-SLIDE:** It is provided with a female dovetail on one side and assembled on top of saddle having a male dovetail.
5. **TOOL POST:** It is used to hold various tool holders and tools. Three types of tool post commonly used are;
 - a) Ring and rocker tool post.
 - b) Square head tool post.
 - c) Quick change tool post
6. **LEGS:** The legs are supports which carry entire load of the machine. Legs are casted and it is placed on the floor of the shop on foundation by grouting. The left leg acts as housing for the motor, the pulleys and the counter shaft at the same time the right leg acts as a housing for the coolant tank, pump and the connecting parts. **SPECIFICATION OF LATHE:** The size of the lathe is specified by one of the following ways:
 - A) Length of the bed.
 - B) Distance between centers
 - C) Diameter of the work which can be turned between the ways
 - D) Swing over carriage

Foundry Shop

FOUDRY: The place where jobs are prepared by melting and pouring the molten metal in to moulds is known as foundry.

MOULD: A mould is a cavity so prepared that it can be used to make casting by molten metal into it.

PATTERN: Pattern is a model of anything which is used to prepare moulds by placing it in sand.

CASTING: The molten metal poured in to mould, on cooling known as casting.

HAND TOOLS

1. **SHOWEL:** It consist of a iron pan with a wooden handle it can be used for mixing and conditioning the sand and then transferring the mixture in some container
2. **TROWELS:** These are used for finishing flat surface and corner in side a mould. Common shapes of trowels.
3. **LIFTER:** A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould.
4. **HAND RIDDEL:** It is used for ridding of sand to remove foreign material from it. It consist of a wooden frame fitted with a screen of standard wire mesh at the bottom.
5. **STRIKE OF BARE:** It is a flat bar made of wood or iron to strike off the excess sand from the top of a box after riming
6. **VENT WIRE:** It is a thin steel rod or wire carrying a pointed edge at one and a wooden handle or a bent loop at the other. after ramming and striking of the excess sand it is used to make small holes called vents in the sand mold to allow the exit of gasses and steam during casting.
7. **DRAW SPIKE:** It is a tapered steel rod having a loop or ring at it is one end and a sharp point at the other it is used to tap and draw patterns from the mould.
8. **RAMMER:** Rammer are used for striking the sand mass in the molding box to pack it closely around one pattern.
 - a) peen rammer
 - b) floor rammer
 - c) hand rammer
9. **SLICKS:** The are used for repairing and finishing the mould surfaces and edges after the pattern has been withdrawn the commonly used slices are heart and leaf square and heart spoon and bead and heart and spoon.
10. **SMOOTHER AND CORNER SLICKS:** they are also finishing flat and round surfaces round or square corners and edges.
11. **SWAB:** It is a hemp fiber brush used for moistening the edges of sand mould which are in contact with the pattern surfaces before withdrawing the pattern it is also used for coating the liquid blocking on the mould faces in dry sand moulds.
12. **SQRUE PIN:** It is a tapered rod of wood or iron which is embedded in the sand and later withdrawn to produce a hole called runner through which the molten metal is poured into the mould.
13. Bellow; it used to blow but the loose or unwanted sand from the surface and cavity of the mould.
14. **DRAW SCREWS AND RAPPING PLATE :** It is a long mild steel rod with a ring in one end and threaded at the other, there is a plate known as rapping plate consisting of several tapped holes.
15. **MOULDING BOXES :** The moulding boxes or flasks used in sand moulding are of two types;

- (a) Closed moulding boxes.
- (b) Open type of snap flasks.

16. **LADLES** : They are used to receive molten metal from the melting furnace and pour the same into the mould. their size is designated by their metal holding capacity. Small hand shank ladles, used by a single. Moulder, are provided with only one handle and are made in different capacities upto a maximum of 20kg.

CRUCIBLES : They are made of refractory material and are similar in shape to the ladles .They are used as metal melting pots. The raw material or charge is broken into small pieces and placed in them. They are then placed in crucible or pit furnaces which are coke fired.

PATTERN MATERIALS

- 1. Wood.
- 2. Iron.
- 3. Aluminum; Brass; Zinc etc.
- 4. Plaster .
- 5. Plastic.

TYPES OF PATTERNS

- 1. Solid or single piece pattern.
- 2. Two-piece or split pattern.
- 3. Multi-piece pattern.
- 4. Match plate pattern.
- 5. Gated pattern.
- 6. Skeleton pattern.
- 7. Sweep pattern .
- 8. Pattern with loose pieces.
- 9. Cope and drag pattern.
- 10. Follow board pattern.
- 11. Segmental pattern.

MOULDING AND CASTING PROCESSES:

1. MOULDING PROCESSES:

- a) Floor moulding.
- b) Bench moulding
- c) Pit moulding
- d) Machine moulding

2. ACCORDING TO THE MOULD MATERIALS

- i) Sand moulding
 - a) Green sand moulding
 - b) Dry sand moulding
 - c) Core sand moulding
 - d) Cement bonded sand moulding
 - e) Shell moulding
 - f) Skin dried sand moulding
 - g) Loam moulding
- ii) Plaster moulding
- iii) Metallic moulding

CASTING PROCESSES

1. Sand mould casting
2. Plaster mould casting
3. Metallic mould casting
 - a) Gravity or permanent mould casting
 - b) Slush casting
 - c) Pressed casting
 - d) Die casting
4. Centrifugal casting
5. Precision casting
6. CO₂ mould casting
7. Continuous casting

MOULDING SAND

Moulding sand is one of the most important materials in production of sand casting. Sand is formed by breaking up of rocks due to natural forces such as frost wind, rain and action of water.

- a. Natural sand
- b. Synthetic sand

TYPES OF SAND USED IN MOULDES

1. Dry sand
2. Green sand
3. Loam sand
4. Facing sand
5. Parting sand
6. Backing sand
7. Core sand
8. Oil sand
9. Molasses sand

COMPOSITION OF GREEN SAND

- | | |
|-------------------|---------|
| 1. Silica sand | 75% |
| 2. Coal dust | 8% |
| 3. Bentonite sand | 12% |
| 4. Water | 5 to 6% |

PROPERTIES OF MOULDING SAND

1. Porosity and permeability
2. Refractoriness
3. Adhesiveness
4. Cohesiveness
5. Chemical resistance
6. Plasticity
7. Moisture

MAIN CONSTITUENT OF MOULDING SAND

The principal constituents of moulding sand are

1. Silica sand
2. Binder
3. Additives
4. Water

BINDER: The purpose of adding to the binder to the moulding sand is to impart it sufficient strength & cohesiveness so to enable it to retain its shape after the mould has been rammed & the pattern with drawn. However it produce an obverse effect on the permeability of the sand mould.

The common binders used in foundry can be grouped as:

1. Organic binders
2. Inorganic binders

BINDERS

(ORGANIC)

1. Dextrin
2. Linseed oil
3. Molasses
4. Certain binders
5. Pitch
6. Resins, phenol formaldehydes

(INORGANIC)

1. Bentonite.
2. Kaolinite.
3. Limonite.
4. Ball clay.
5. Fire clay
6. Fullers earth

CORES: Core is a mass of sand that is put into the mould of from holes and cavities in the casting cores are prepared separately in core box.

- a) **HORIZONTAL CORE:** It is the most common and simple type of core. It is assembled into the mould with its axis horizontal. It is supported in the mould at its both ends.
- b) **VERTICAL CORE:** It is quit similar to a horizontal core except that it is fitted in the mould with its axis vertical.
- c) **BALANCED CORE:** It is used to produce a blind holes along a horizontal axis in a casting. As a matter of fact it is nothing but a horizontal core with the exception that it is supported only one end the other end remaining free in the mould cavity.
- d) **HANGING OR CIVER CORE:** A core which hangs vertically in the mould and has no support at is bottom is known as a hanging core. In such a case it is obvious that the entire mould cavity will be contained in the drag only.

CORE BOXES: A core box is a type of a pattern used fore making cores. It is made of wood, brass, aluminum or any suitable material.

TYPE OF BOXES

1. Half core box.
2. Dump core box
3. Split core box
4. Right and left core box
5. Gang core box

Job No.-1

Aim: To prepare a two-pieces mould by floor moldings process and sand mould casting.

Tools & Equipment used: Pattern, Moulding boxes, Rammer, Well prepared moulding sand (green sand), Trowel, Wood smother, Strike off bar, Spure cutter, Draw spike, Lifter, Slicks, Bellow, Small brush, Mallet, Vent wire, Furnace, Chisel, Hummer, Wire brush, Hacksaw, grinder, and file.

Materials required: Lead (Melting Temperature = 350°C)

Drawing: See Diagram

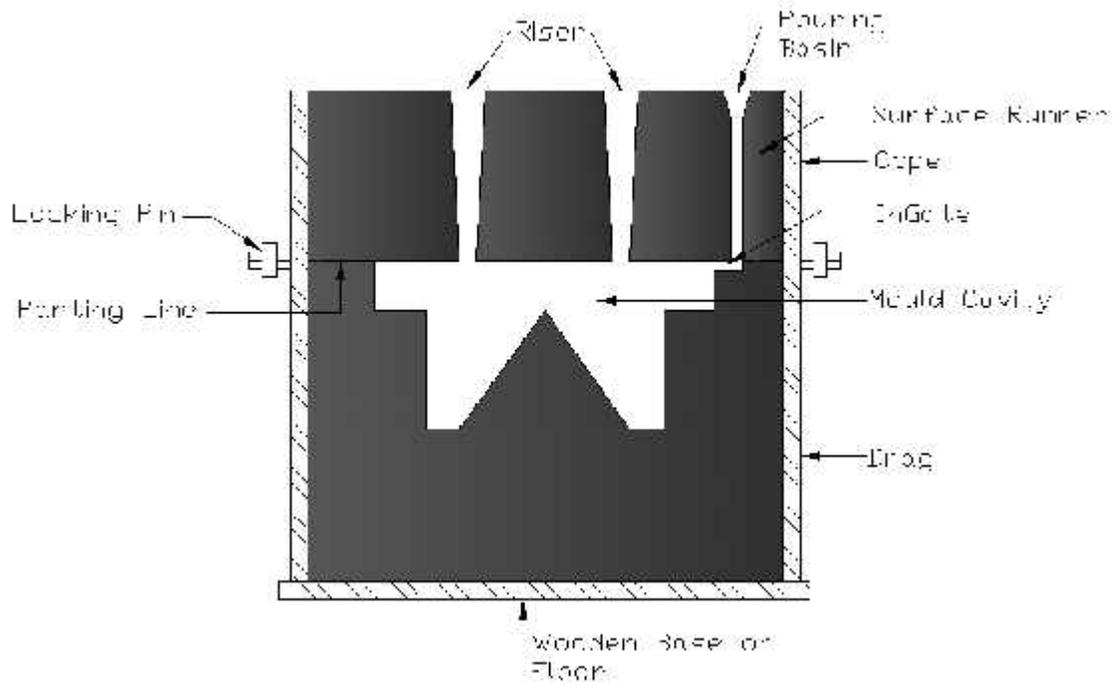
Procedure:

1. Select a moulding box suitable for then pattern provided. It should be large enough to allow some space around the pattern for ramming of sand.
2. Place the drag part of the moulding box upside down on the floor and place the lower part of the pattern in the center of the drag. The drag is then filled and rammed properly with well – prepared green sand. The excess sand is then cut off to bring it in level with the edges of the drug with the help of a strike of bar. Then drag is turned downside up along with lower half pattern in it and sprinkle small amount of parting sand over the top surface to avoid sticking. Now turn the drag up side down with lower half of the pattern in it.
3. Place the cope over the drag in its proper position in alignment with locking pins. Then assemble top part of the pattern in it.
4. Sprinkle parting sand over the surface of the drag and the pattern.
5. Place the runner and riser in position and fill the cope with green sand and ram it properly. Cut off excess sand to bring it in level with the edges of the cope.
6. Remove the runner and riser to from the pour basin.
7. Using a venting wire perform the venting operation. It is done to allow exit of gases and steam generated during pouring.
8. Remove the cope from the drag, and three after remove the pattern from cope and drag.
9. Repair the mould cavity for any small damage caused while removing the pattern; cavity should be free from any undesirable sand particles.
10. The cope and drag are then locked with locking pins. The mould is thus ready for pouring.
11. Melt the metal, and then pour the molten metal through pouring basin continuously till the riser is filled and allow it to solidify.
12. The solidified casting is then removed by breaking the mould and cleaned by removing adhering sand. The sand is recycled and reused.

Precautions

1. Ramming of filled sand should be proper and uniform through out surface of drug and cope.
2. Place the pattern in the drag properly.
3. Make the gate properly with broadening at the gate point.
4. The cope and drag should fit properly.
5. Take out the pattern carefully causing minimum damage.

6. Molten metal should be poured in to the mould cavity carefully, to avoid any accident.
7. The riser should be filled completely.
8. Do not touch casting immediately after from the sand mould.



Fitting Shop

Introduction

In Fitting shop unwanted material is removed with the help of hand tools. It is done for mating, repair and manufacturing purposes. Commonly used tools in fitting shops are hacksaw, files, chisels, etc.

Classification of Metals

Metals are classified into two categories:

1. **Ferrous Metals** – In ferrous metals the percentage of iron is very high. Some other materials like carbon, sulfur, nickel, etc are also mixed into ferrous metals to change the properties. They are magnetic in nature. Some ferrous metals are discussed as under.
 - i) **Steel** – Steel is a mixture of iron and carbon.
 - Low Carbon Steel – Carbon content 0.08 to 0.25%.
 - Medium Carbon Steel - Carbon content 0.25 to 0.55%.
 - High Carbon Steel - Carbon content 0.55 to 0.8%.
 - Tool Steel - Carbon content 0.8 to 1.5%.
 - ii) **Alloy Steel** – Alloy steel is made by combining some percentage of additional elements like nickel, phosphorous, silicon, chromium, molybdenum in the plain carbon steel to give strength, hardness, resistance to corrosion properties.
 - iii) **Cast Iron** – Iron containing carbon more than 2% is known as cast iron. It is hard and brittle material, used in machine beds, heavy parts of machines.
 - iv) **Wrought Iron** – It is almost pure iron containing 99.9% of iron. It is ductile and soft.
 - v) **High speed Steels** – The composition of high speed steel is 18% tungsten, 4% chromium, 1% vanadium and 0.7% carbon, used for making cutting tools.
 - vi) **Spring Steel** – It contains 0.5 to 0.6% carbon, used for making springs.
2. **Non Ferrous Metals** - The metals which contain no quantity of iron are known as non ferrous metals, copper, aluminum, brass, bronze, tin ,lead are common non ferrous metals.
 - i). **Copper:** Reddish brown color, soft, ductile, high electrical and thermal conductivity.
 - ii). **Brass:** Alloy of copper and zinc, soft and ductile.
 - iii). **Bronze:** Alloy of tin and copper, wear resistance material.
 - iv). **Aluminum:** Soft metal, white in color, light in weight, good electrical conductivity.
 - v). **Gun metal:** Alloy of copper, tin and zinc, used in making casting.

Tools Used In Fitting Shop

1. Clamping Tools: Clamping tools are used for holding the job firmly during various fitting operations.

- i). **Bench vice:** It is a common tool for holding the jobs. It consists of cast iron body and iron jaws .The jaws are opened up to required length, job is placed in the jaws and is fully tightened with handle.
- ii). **Leg vice:** It is stronger than bench vice and used for heavy work.
- iii). **Hand vice:** It is used to grip very small objects.
- iv). **Pin vice:** Pin vice is used to hold wire or small diameter rods.
- v). **Pipe vice:** It is used to hold pipes. It grips the pipe at four places and is fixed on bench or can be grouted.

2. Measuring and Marking Tools

- i). **Try Square:** It is used for checking square ness of two surfaces. It consists of a blade made up of steel which is attached to base at 90°.

- ii). **Bevel Protector:** It consists of a steel dial divided into 360° divisions.
- iii). **Combination Set** – Multipurpose instrument can be used as a protector, a level, a meter, a center square and a Try square.
- iv). **Centre Square** – It is used to find the centre of the round jobs.
- v). **Scriber and Surface Gauge** – It is used for marking of lines parallel to a surface. Scriber mounted on a vertical bar is called surface gauge.
- vi). **Dot Punch** – It is used for marking dotted lines. Angle of punching end is 60°.
- vii). **Centre Punch** – It is like a dot punch used to mark the centre of hole before drilling. Angle of punch end is 90°.
- viii). **Surface Plate** – Surface plate is used for testing the flatness, trueness of surfaces, its upper face is planed to form a very smooth surface.
- ix). **Angle Plate** – It consists of cast iron in which two ribs of metal are standing at right angle to each other, used for holding and supporting the jobs.
- x). **‘V’ Block** – It is used for supporting as well as marking of round jobs.
- xi). **Steel Rules** – It is made up of stainless steel and marked in inches or millimeters, available in various sizes ½ ft to 3 ft.
- xii). **Vernier Caliper** – It is a precision instrument used for measuring lengths and diameters. Minimum dimension that can be expressed on vernier caliper is known as least count which is usually 0.001 or 0.02 mm.
- xiii). **Micrometer** – It is used for measuring diameters or thickness of any Job. The graduation on micrometers is available in inches as well as in millimeters.
- xiv). **Dial Indicator** – A round gauge in which a pointer moves over a graduated scale. The movement is magnified through links. It is used to check the run out or ovality of Jobs.
- xv). **Dividers** – Dividers have two legs having sharp feet. It is used for marking arcs, dividing a line or transferring the dimensions.
- xvi). **Calipers:** it is generally used to measure the inside or outside diameters. There are four types of calipers.
 - a) Outside calipers
 - b) Inside calipers
 - c) Spring calipers
 - d) Odd leg calipers

Gauges

- i). **Depth Gauge:** It is used to measure the depth of a hole. The beam is graduated in inches or millimeters.
- ii). **Feelers Gauge:** It is used to check the gap between two mating parts. It consists of a number of metal leaves of different thickness marked on the leaves.
- iii). **Radius Gauge:** It is used to check the radius of outer and inner surfaces. Every leave has different radius.
- iv). **Vertical Height Gauge:** It is used to measure the height of work pieces.
- v). **Thread Gauge:** It is used to check the pitch of the threads. It consists of a number of leaves, pitch of the threads marked on each leaves.
- vi). **Wire Gauge:** It is used to check the diameter of wires and thickness of sheets.

Cutting Tools

These tools are used to remove the materials

1. **Hacksaw** – It is used of cutting of flats, rods etc. The blade of hacksaw is made up of high carbon steel and frame is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The teeth of hacksaw blades are generally forward cut. There are two types of hacksaw frames, fixed frames and adjustable frame.

The material to be cut with hacksaw is clamped in a vice. The hacksaw should be moved perfectly straight and horizontal.

2. **Files** – It is used to remove material by rubbing it on the metal. Classification of files.
 - i) **Size** – The length of file vary from 4 inch to 14 inch.
 - ii) **Shape** – The shapes available are flat, square, round, half-round, triangular etc.
 - iii) **Cuts** – Single and Double Cut.
 - iv) **Grade** –
 - Rough - 20 Teeth per inch
 - Bastard - 30 Teeth per inch
 - Second Cut - 40 Teeth per inch
 - Smooth – 50-60 Teeth per inch
 - Dead Smooth - 100 Teeth per inchRough and Bastard files are used for rough cutting, smooth and dead smooth files are used for finishing work. Files should be used in perfect horizontal position. Pressure should be applied on the forward stroke only. Work is held in a vice.
3. **Chisels** – They are used for chipping away the material from the work piece. Commonly used forms of chisels are flat, cross cut, half round, and diamond point chisels. Flat chisel is used for chipping a large surface. Cross cut chisel is used for groover. Half round chisel is used to cut oil-grooves. Diamond point chisel is used for chipping plates.

Striking Tools

Hammers are the only tools used for striking in fitting shop like chipping, fitting, punching etc. Main types of hammer

- Ball Pean Hammer
- Straight Pean Hammer
- Cross Pean Hammer

Miscellaneous Tools

Drill – It is used for making round holes. Twist drill is most commonly used for making holes.

Reamer – It is used to finish the drilled hole to accurate size.

Taps – It is used for making internal threads. Tap is held by the tap holder, normally it comes in a set of three, taper Tap, Intermediate Tap, Plug Tap.

Die – It is used for cutting external threads. It is held in a die stock, the handle is rotated by hand and job is held firmly in a vice.

Bench Working Processes

1. **Marking** – Measurement is performed on the job by measuring instrument and marking is done by scriber.
2. **Chipping** – Material is removed with the help of chisels.
3. **Sawing** – This operation is required to cut the metal in different sizes and shapes by hacksaw.
4. **Filing** – This operation is performed with the help of files, pressure should be exerted in the forward stroke and backward stroke is ideal.
5. **Scrapping** – This is done for reducing more accurate finish that obtained by filing.
6. **Drilling** – This is done to produce holes with the help of drills. It is done on a drilling machine and job is held in a machine vice. Drill is fixed on the drilling machine,
7. **Tapping** – This is done to cutting the internal threads with the help of tap and tap holder.
8. **Dieing** – This is done to cut the external threads by the help of die and die holder.

Job No.-1

AIM: To carry different types of fitting operations like checking, marking, punching, cutting filing etc. on a job of size 50*60 mm MS flat.

Tools & Equipment Used: File, Hacksaw, bench vice, Twist drill, drilling machine, surface plate, angle plate, marking gauge, Vernier clippers, Try square

Material Required: Mild steel flat 50*62*6 mm

Drawing: See diagram

Procedure:

1. Check the tools and equipments required to ensure that the required tools are in good working condition.
2. Do marking on the MS Flat using scale and cut the piece with the help of hacksaw.
3. Do filing operation on the job piece with proper method of filing and make two sides at a right angle.
4. Do marking operation with the marking tools and cut a chamfer cut 10*10 mm and square cut of 15*15 mm by using hacksaw.
5. Do drilling operation with the pillar electric drilling machine and do the tapping operation.
6. Do finishing operation with smooth file.

Precaution:

1. Grip the job in the bench vice properly.
2. Always move the hacksaw in perfect and straight horizontal position.
3. The blade should be tight to avoid breaking.
4. The teeth should be protected from excessive wearing.
5. Tapping should be at right angle
6. Keep your hands away from the drilling machine

To make a square fitting job

