SHEET-METAL SHOP

Exercise No. - 1

Aim:- To prepare a open box as per dimensions.

Tools Required:-

1. Shears
2. Stakes
3. Mallet and sheet metal Hammers
4. Marking Tools and Measuring Tools
5. Sheet metal Machines

Material

24 Gauge Galvanized Iron Sheet.

Description of Tools

Marking and Measuring Tools

Steel Rule

It is particularly useful in measuring and laying out small size of work.

Striking Tools

Hammer

To suit the different types of

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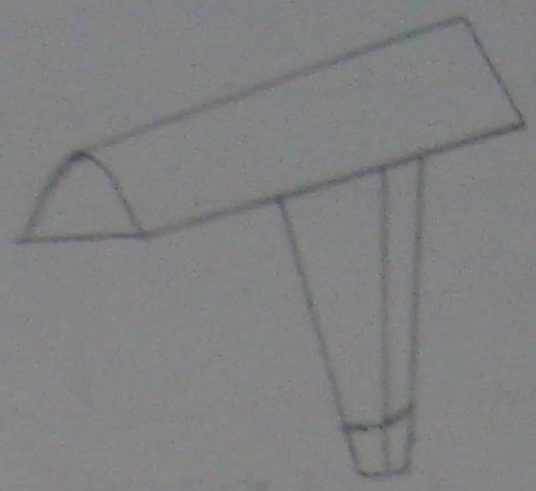
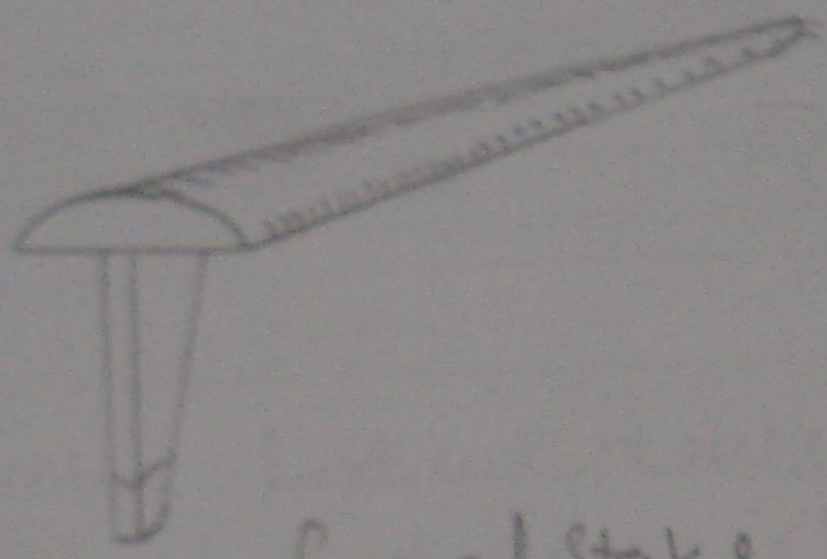
Pick Iron



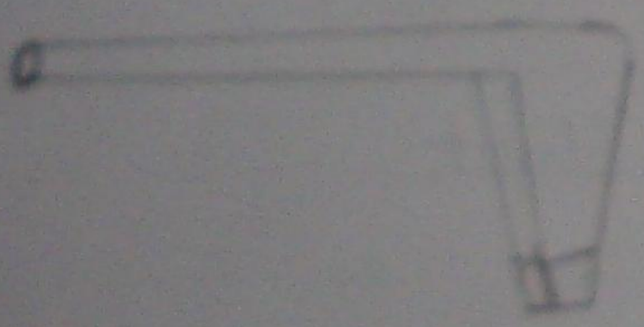
Hatched Stake

Half-moon Stake

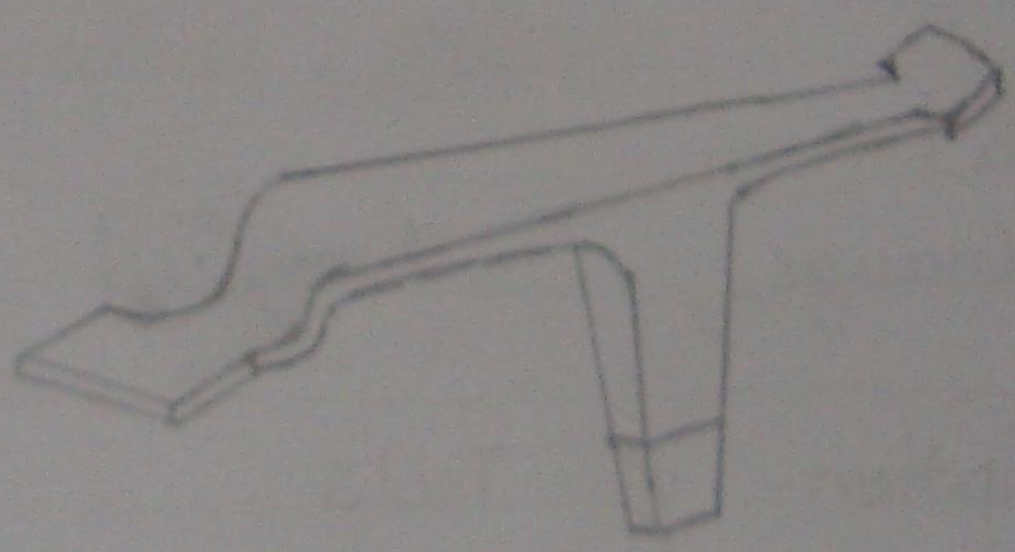


funnel Stake

Conver Stake



Pipe Stake



Horse Type Stake

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work on tin sheet, various sizes and shapes of hammers are used. They are made to have square or round heads to suit for striking or hammering the corners and round surfaces respectively. For avoiding the damage of sheet, soft faced hammers are frequently used.

Mallet:
This is also used for striking purpose and made of hard rubber, lead, copper or mostly of hard wood.

Holding Supporting and forming Tools

Stakes:
Stakes are used for seaming, bending or forming operations. They actually work as supporting tools as well as forming tools.

Punches:
These are also made by hardened steel. Punches are used for marking out work and to locate the centre in a permanent manner. Punches may be divided in two types:

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(a) Prick punch or Dot punch
(b) Centre Punch

Prick punch is used to make small marks and to make this prick punch marks larger, we have to use centre punch. Centre of the hole that is to be drilled is marked by centre punch.

Cutting Tools

Chisels

These are generally used for chipping and cutting operations and are made of high carbon steel. for steel metal work, the flat and round nose chisels are widely used.

Snip or Shears

These are made of high carbon steel and used for cutting thin or soft metallic sheets. There are so many types of snip but straight and curved or bent types of snip are commonly used in practice.

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Shearing Machine

It is used to cut or shear the sheet in many ways. The selection of particular method depends upon the size and shape of the parts required and the numbers needed.

As shown in figure, it is a simply hand operated machine. It consists of a base which can be fixed easily in any position as desired, two blades of high carbon steel arranged in the machine. The fixed blade is rigidly fixed with the frame. The movable blade is operated by means of the hand levers.

Pliers

These are used for holding and forming the various shapes and patterns. In general, flat nose and round nose pliers are widely used.

River Set

This a hardened steel tool with a hollow part at one end. It is

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Heat to shape the end of a rivet into a round and smooth head.

Procedure:-

1. Make the development as per dimensions with allowances.
2. Cut the sheet by using shears / shearing machine with reference of development.
3. Notching the ends / corners of sheet by using shears / notching machine.
4. Folding / Bending by using bending machines / mallets and stakes.
5. Making the Joints (Hems, Seams, Rivets etc) as per shape required.

Dimensions:-

Box height → 50mm
width → 60mm
Hem → 5mm extra for bottom
Corner joint → 5mm one side extra
10mm other side extra
bottom → 60×60 square mm
10mm from bottom
Total dimensions → 255×70 mm

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Safety Precautions in Sheet Metal Shop

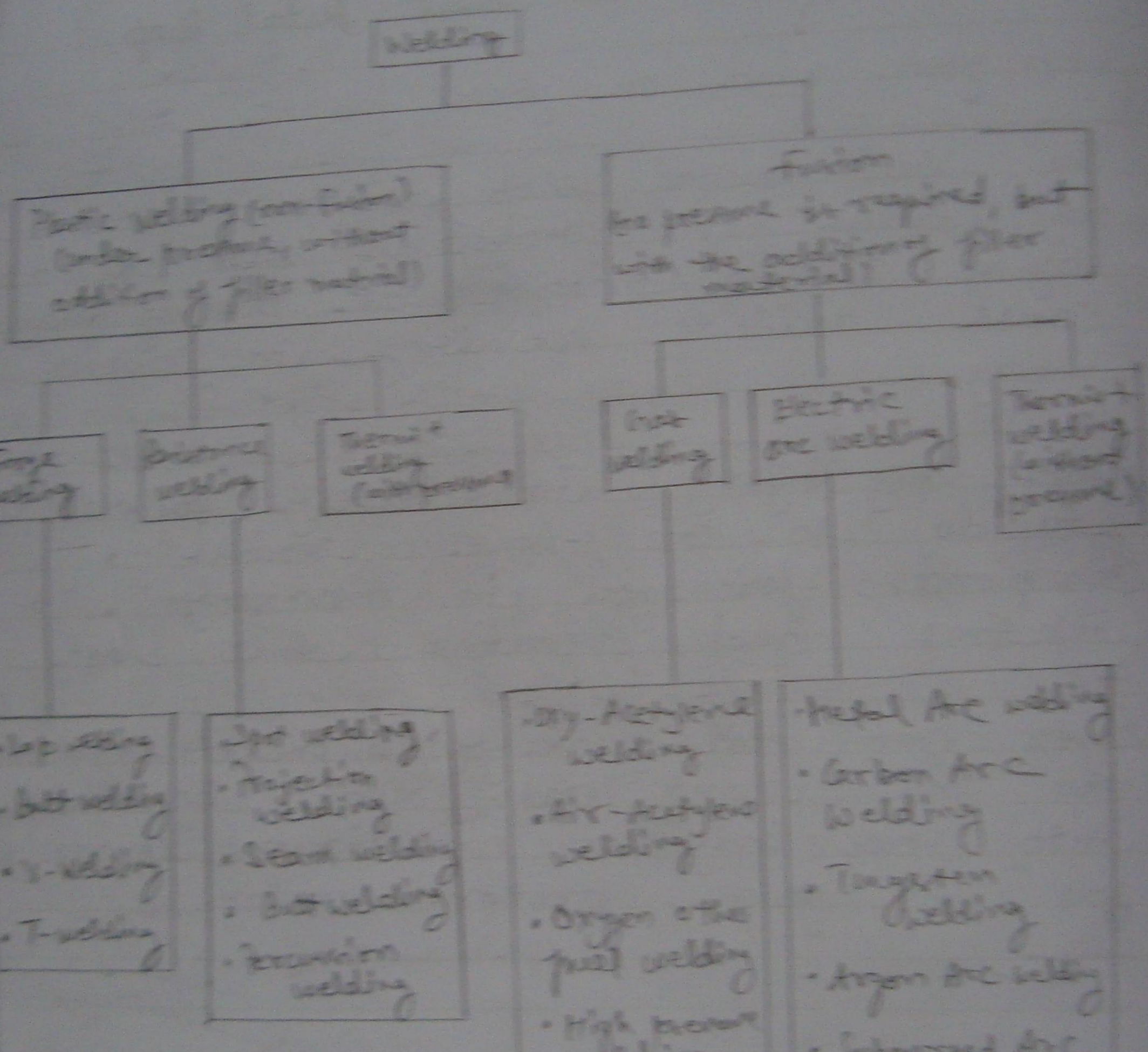
1. Keep your mind on your job

2. The sheet metal shop is no place to play! Careless or thoughtless acts such as playing running, tripping or pushing may cause accidents resulting in serious injury.

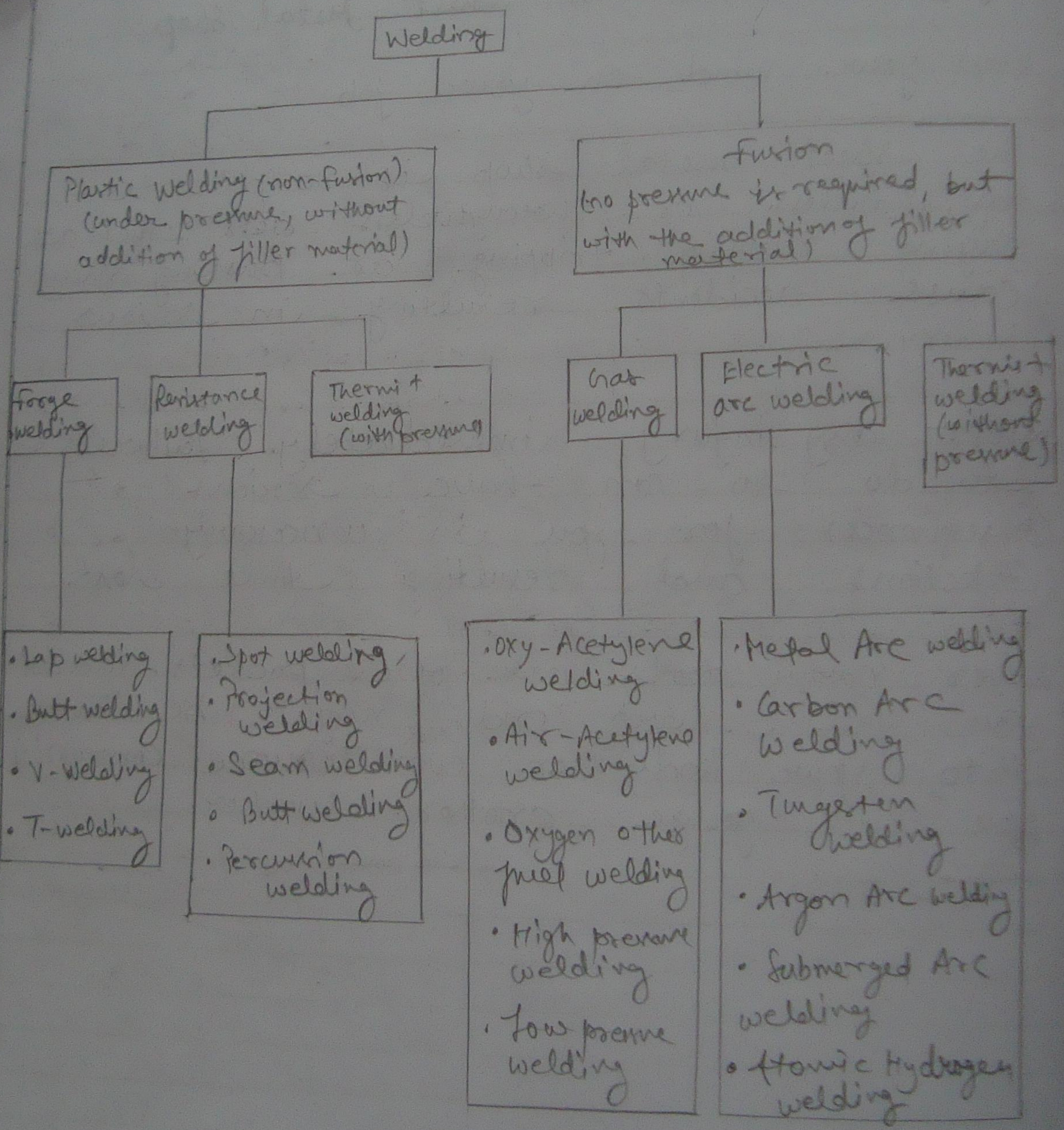
3. Report any injury immediately failure to do so can have serious consequences for you in unnecessary injections and resulting time lost.

4. Never carry tools in your pockets. Should you fall, sharp ends might be driven into your body or even more commonly you will gouge another worker.

Types of welding :-



Typer of Welding! -



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Welding

Introduction

Welding is a process of joining similar metals by application of heat with or without application of pressure and addition of filler material.

The filler material has similar composition and melting point temperature as the base metal. It is used to fill gap between the joint surfaces.

→ Plastic welding

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

→ Forge welding

The work pieces 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

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pressing together.

Resistance Welding

In resistance welding, a heavy electric current is passed through the metals to be joined to the plastic condition. The parts are quickly superimposed and worked into a complete union by hand or power hammering or by pressing together.

Thermit welding

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

Gas welding

Gas welding is a pressure in which the required heat to melt the surfaces is supplied by a high temperature flame obtained by a mixture of two gases.

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Oxy-acetylene Welding

In oxy-acetylene welding oxygen and acetylene are the two gases used for producing flame. The oxygen is mainly used for the combustion intensity.

The oxygen and acetylene is obtained under high pressure in cylinders which are fitted with pressure regulators. Each cylinder is connected to the blowpipe by flexible hoses. The oxygen cylinders are painted black and acetylene cylinders are painted maroon.

When acetylene is mixed with oxygen in correct proportions in the welding torch, ignition is taking place. The flame resulting at the tip of the torch is sufficiently hot to melt and join the parent metal. The flame temperature is about 3200°C. The filler metal rod is generally added to the molten metal pool to built up the seam for greater strength.

Types of flames

1. Neutral flames (oxygen, acetylene in equal proportions)

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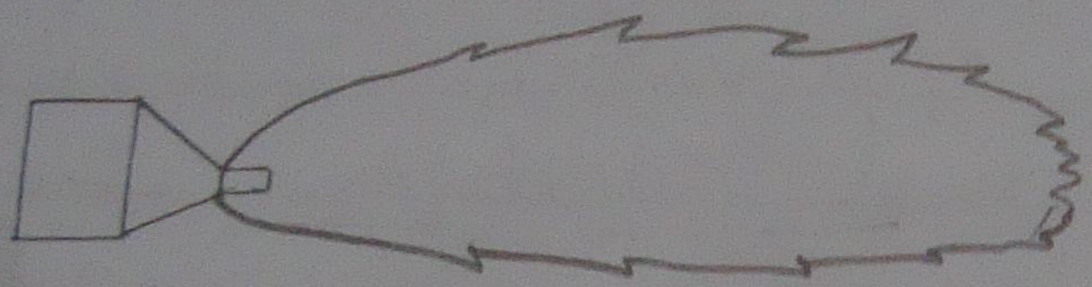
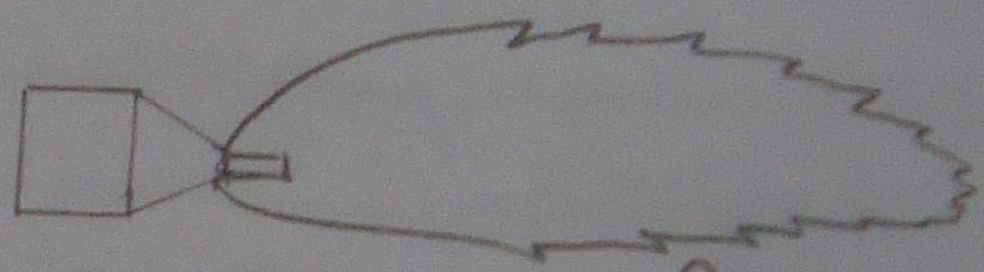
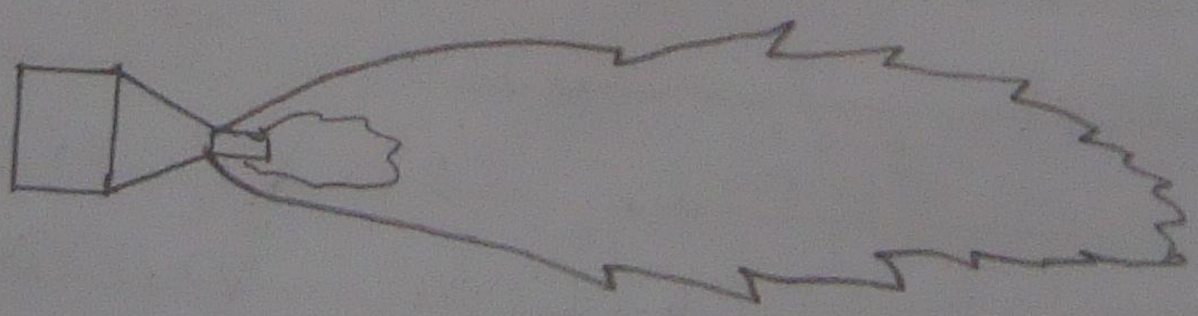
Type of flame



Neutral flame



Oxidising flame



Reducing flame

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2. oxidising flame (excess of oxygen)
3. Reducing flame (excess of acetylene).

Neutral flame

- A neutral flame is produced when approximately equal volumes of oxygen and acetylene are mixed in the welding torch and burnt at the torch tip.
- The temperature of the neutral flame is of the order of about 3260°C.
- The flame has inner cone which is light blue in colour.
- The neutral flame is used for the welding of mild steel, copper, aluminium, cast iron etc.

Oxidising flame

- If the volume of the oxygen supplied to the neutral flame is increased then resulting flame will be oxidising flame.
- The temperature of oxidising flame is of the order of about 3482°C.
- Normally the outer flame envelope is much shorter. It has very small white inner cone.
- This flame is used to weld copper.

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base metals, zinc - base metals.

Reducing flame [Carburizing flame]

- If the volume of the oxygen supplied to the neutral flame is reduced, the resulting flame will be a carburizing or reducing flame (i.e. rich in acetylene).
- In this case, flame is recognised by acetylene feather which exists between the inner core and outer envelope. The outer flame envelope is longer than that of the neutral flame and is usually much brighter in colour.
- It has an appropriate temperature of 3038°C.
- In this type, flames are used to weld the high - carbon steel, non-ferrous alloys, zinc - bearing alloys.

Welding Techniques

i) Leftward technique or forehand welding method.
ii) Rightward technique or Backhand welding method.

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i) Leftward Technique
- Welding is done in a right to left direction.
- ~~Rightward tech~~
- In this process, the welding flame is directed away from the finished weld (i.e) the flame follows the completed bead and the filler rod.
- Suitable for upto 3mm thick sheets and for other general purpose applications.

Advantages
i) The flame is pointed in the direction of welding and it preheats the edges of joints.
ii) Good control and a neat appearance are characteristics are enjoyed in the leftward technique.

ii) Rightward Technique
- In this welding process, the welding is done in a left to right direction.
- The filler rod follows the welding torch and the flame.
- Suitable for large size jobs.

Advantages
i) As the flame is always directed towards the solidified weld, it results in annealing effect and better

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mechanical properties are obtained.
(ii) Very little agitation is produced because torch moves in a straight line.

Shutting off the plant

At the end of the work, shut off the plant as mentioned below
Step 1: close the acetylene cylinder valve.
Step 2: Open the blow pipe acetylene valve and release all pressure.
Step 3: Release the acetylene regulator pressure by adjusting screw.
Step 4: Close the blow pipe acetylene valve.
Step 5: Repeat the above four steps for shutting off oxygen cylinder also.

filler Metal

It is the material that is added to the weld pool to assist in filling the gap. filler metal forms an integral part of the weld. The filler metal is usually available in rod form. These rods are called filler rods.

fluxes

During the welding, if the metal

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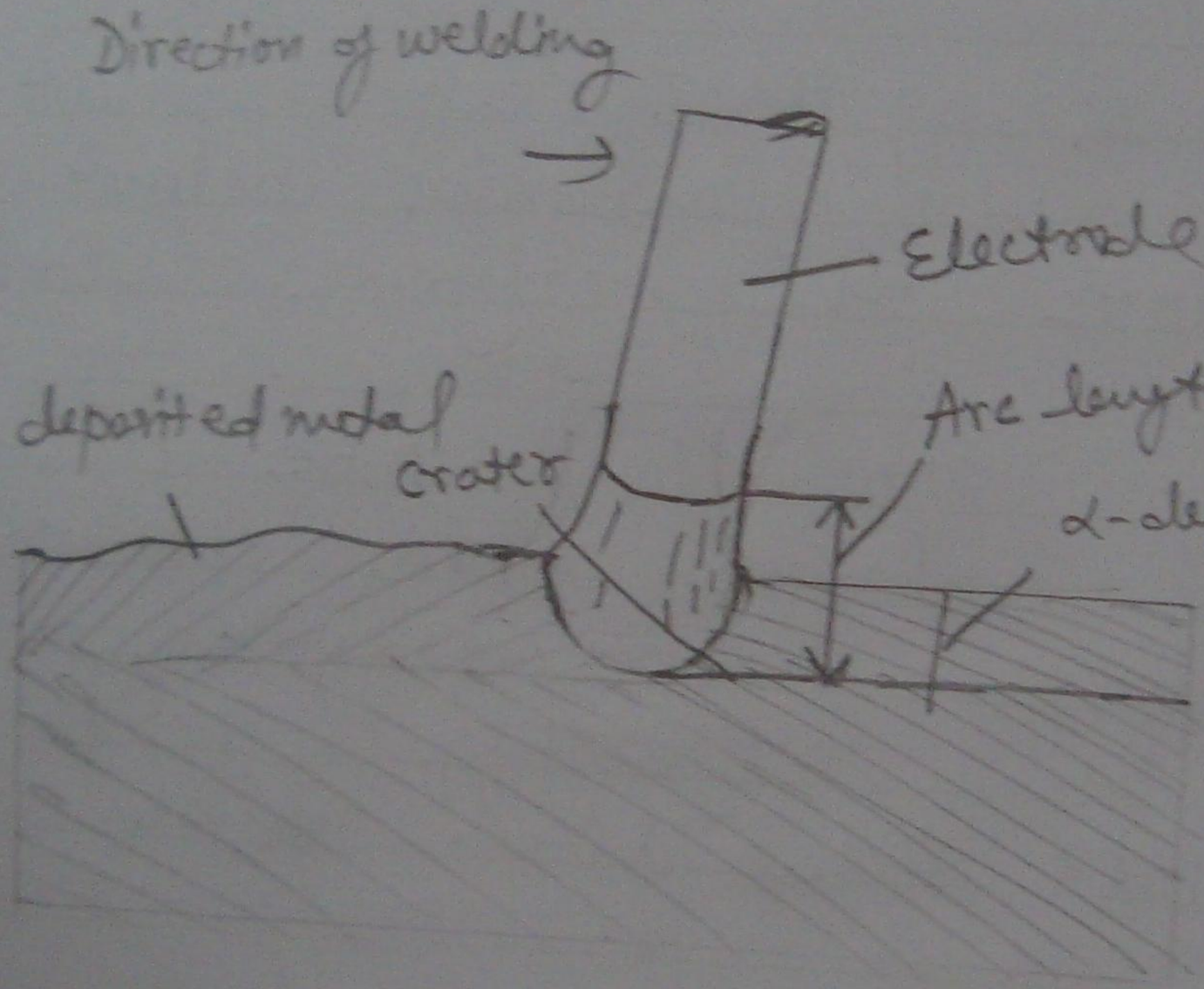

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is heated in air, oxygen in the air combines with the metal to form oxides which result in poor quality, low strength welds or in some cases may even make welding impossible. In order to avoid this problems, a flux is added during the welding. This flux prevents oxidation by preventing oxygen from contacting the weld zone.

ARC Welding

Arc welding is the most extensively employed method of joining metal parts. Here the source of heat is an electric arc.

Principle of Arc welding

Prinicple of operation

The heat required for joining the metals is obtained from an electric arc. The electric motor generator or transformer sets are used to supply high electric current and the electrodes are used to produce the necessary arc. The electrode serves as the filler rod and arc melts the surfaces so that the metals to be joined are fused together.

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The transformer type welding machine produces AC current. It takes power directly from power supply and to produce high current and low voltage to the welding. It is less expensive.

Electrodes

filler rods used in arc welding are called as electrodes. The electrodes are made of metallic wire called core wire. It is coated uniformly with a protective coating called flux while fusing an electrode. about 20mm of length is left bare at on end for holding it using electric holder. It is used to transmit full current from electrode holder to the front end of the electrode coating. The size or diameter of the core wire will depend upon the amount of weld metal to be deposited and on the type of joint.

Electrode Holder

- It is a device used for mechanically holding the electrode and conducting current to it.
- Electrode holder should be light, to minimize fatigue incurred by the

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welder.

- Jaws are made to hold the bare end of the electrode in either a vertical or an angular position.

Welding Cables

- Two cables are needed for welding purpose. One is used to connect the power source to electrode another cable is connected to ground.
- The cables are well insulated with rubber.

Applications of Arc welding

(i) Today, almost all the commonly employed metals and their alloys can be welded by the arc welding process.

(ii) Shielded metal arc welding is used both as a fabrication process and for maintenance and repair jobs.

(iii) The process finds application in
(a) air receiver tanks, boiler and pressure vessels & fabrications.
(b) Ship building

(iv) Arc welding is used in building and bridge construction.

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Foundary Shop

Introduction:-

Producing components by casting has been used since the earliest days of civilisation. Lot of shapes and sizes can be prepared in a casting of a component, a cavity of desired shape is to be produced in which the molten metal is to be poured mould is the cavity of the required shape made in moulding sand or other material.

Pattern:-

Pattern is the model used to get required casting. It is used to provide the mould cavity in sand.

Foundary:-

The place where moulding and casting are alone is known as foundary.

Moulding sand or Green sand:-

It is a mixture of sand and additives such as water, bentorite, incornet, sodium

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silicate etc. used in create mould cavity.

Component required for moulding :-

(1) Moulding sand (Green sand)
(2) Moulding boxes
(3) Patterns
(4) Moulding tools

flow proces diagram for production of castings significance of gettling
The casting are obtained from the moulds are not fit for immediate use or for work in the machine shop as they carry unwanted metal attached in the form of gates, risers etc. sand particle also stend to the surface of the casting. The casting are therefore sent to the gettling section where the necessary projections are cutt-off. The adhering sand removed and the entire surface made clean and uniform by sand blasting proces.

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Moulding sand
Composition:-
It is a special type of sand used for making mould. Moulding sand has three constituents. They are
(i) Sand (ii) Binder (iii) Additive

Sand:-
It has silica, clay and mixture. Silica is the main constituents of sand. Silica has 80 to 90 percent silicon dioxide silicon gives refractories to the sand.

Clay:-
Clay is another constituent of sand. Clay gives more bonding strength to the sand. Generally, sand have 5 to 20% clay. Moisture is the water added to the sand. It gives the bonding action. In general 2 to 8% water is added to the sand.

Binders:-
Binder is added to the moulding sand to bring the property

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of cohesiveness, the binder binds the sand grains together and brings strength.

There are three type of binders.
(a) clay type binders - Bentonite
(b) Organic binders - Resins
(c) Inorganic binders - Sodium silicate.

Additive:-
By adding an additive, properties like strength, refractoriness and permeability can be increased.
Eg - seaweed, wood flour, straw etc.

Properties of Moulding sand:-
A good moulding sand must have the following properties:-

(i) Porosity or Permeability
It is the property of moulding sand by which the sand allows the steam and gases to pass through it. When molten metal is poured into the ~~root~~ mould, steam and gas will be formed. If the gases are not removed, casting defects such as blow holes will occur. This property by which moulding sand allows other gases to go

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outside it called porosity or permeability.

(ii) Particity:-

This is the property by which the moulding sand gets the shape of the pattern and retains the shape. Only due to this property the moulding sand gets the shape of the pattern in the mould.

(iii) Adhesiveness:

This is the property by which the sand particle stick or adhere to another body. The moulding sand sticks to the side of the moulding boxes by this property. The moulding sand doesnot fall out of the box because of adhesiveness.

(iv) Cohesiveness:-

It is the property by which the sand particles stick together. It is called strength of sand. Because of this property, mould remains strong and doesnot breaks when molten metal is poured.

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Pattern

A pattern is the replica of the desired casting, used to produce a mould cavity into which liquid metal is poured. When pattern packed in a suitable material produces a cavity called the mould. This cavity when filled with molten metal produces the desired casting.

The following pattern materials are widely used,

(i) Wood and wood products.
(ii) Metal and Alloys
(iii) Plastics and Rubbers
(iv) Plasters and waxes

Pattern allowances

The various pattern allowances are ~~mu~~ mentioned below:-

(i) Shrinkage or contraction allowance.
(ii) Machining or finishing allowance
(iii) Draft or Taper allowance
(iv) Distribution Allowance
(v) Shake or rapping allowance.

Pattern Types:-

One piece (solid) pattern:-
- Smallest type of pattern

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- As the name suggests the pattern is made from one piece and does not contain loose pieces or joints
- It is inexpensive.
- It is used for making a few large simple castings.
- One piece pattern is usually made up of wood or metal depending upon the quantity of castings to be produced.

Split pattern:-

- Patterns of intricate castings cannot be made in one piece because of the inherent difficulties associated with the moulding operations. Such patterns are then made as split or two piece pattern.
- The upper and the lower parts of the split pattern are accomodated in the cope and drag portions of the mould respectively.
- Taps and water stop-cocks are produced with the help of split pattern.

Loose piece pattern:-

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- Certain patterns cannot be withdrawn once they are embedded in the moulding sand, such patterns are usually made with one or more loose pieces facilitating their removal from the moulding box and are known as loose piece patterns.
- Loose parts or pieces remain attached with the main body of the pattern with the help of dowel pins.

Core:

It is a sand mall used to make cavity or holes in a casting. The shape of the core is similar to the required hole in the casting. Core is made by core sand in core boxes.

Core print:-

It is the projection pattern. It forms a seat formed by the core print.

Core Box:-

A core box is a pattern made of either wood or metal, into which sand

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it packed to form the core. Wooden boxes are commonly used for making a core box but metal are used when cores are to be used in large number.

Core Making Procedure -

Core Making is done in the following steps -

1) moulding a green sand core
2) Baking
3) finishing
4) Coating

Moulding Boxes :-

Moulding box is also called Moulding flask. It is a frame or box of wood or metal. Wood is cheaper and boxes can be made quickly. Wood wears out quickly. It is destroyed by contact with hot metal. Metal boxes in steel Cast iron, and aluminium alloys are used in mass production. Moulding Boxes are used for making sand moulds. Moulding flasks may have two or more parts, the main type of flask are :-

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a) Snap flask
b) Tight or Box flask
The name of the boxes are
(i) Cope (Top box)
(ii) Cheek (Middle box)
(iii) Drag (Bottom box)

Moulding Tools:-

1. Shovel:- Shovel is a big tool used for mixing and transporting moulding sand. It is also used for cutting the moulding sand from the sand bit to the moulding box. It has a broad metal blade with long wooden handle.

2. Riddle:-
Riddle is a metal sieve used for removing foreign materials such as stone, nail etc from the moulding sand.

3. Trowel:-
Trowel is a metal blade usually rectangular and has round or square end used for smoothing the surface of mould. It is also used to repair the damaged portion of mould.

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4. Stick :-
Stick is a double ended tool used for repairing and finishing moulds.

5. Lifter :-
It is used to lift the openings of deep moulds. It is also used to repair broken surfaces of mould. It is made of various width and length.

6. Strike off bar :-
It is made of wood. It has a straight edge. It is used to remove excessive sand from the mould after ramming.

7. Bellows :-
Bellows are used to blow off loose sand particles from the mould and pattern.

8. Gate cutter :-
It is used for cutting gates and runners in the mould.

9. Draw spike :- It is a pointed steel with a loop at one end. It is

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used to remove the pattern from the mould.

5. Vent rod' –
The rod used for making vent holes in the sand mould so that the molten gases released during pouring of molten metals, can easily escape from mould.

Advantages of Sand Casting:-
1. Use is widespread, technology well developed.
2. Materials are inexpensive, capable of holding detail and resist deformation when heated.
3. Process is suitable for both ferrous and non-ferrous metal castings.
4. Handles a more diverse range of products than any other casting method.
5. Produces both small protection casting and large castings of up to 1 tonne.
6. Can achieve ~~both~~ very close tolerances if uniform composition is achieved.
7. Mould preparation time is relatively short in comparison to many other process.

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8. The relative simplicity of the process makes it ideally suited to mechanism.
9. High levels of sand reuse are achievable.

Limitation of sand casting:-
1. Typically limited to one or a small number of moulds per box.
2. Sand : metal ratio is relatively high.
3. High level of waste is typically generated, particularly sand, baghouse dust and spent shot.

Safty precautions for foundry:-
1. Always wear glover, shoes, apron.
2. Dont lift the moulding box by yourself.
3. Local exhaust ventilation should be provided in the sand mixing place.
4. While melting the metal wear informed goggles, face shield, long - sleeve wool shirt, insulated leggings, apron etc.
5. Water should not be added more, specified proportion should be maintained because more moisture flashes out the molten metal while pouring.

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JOB-1

Aim:- To make the mould of a ~~pulley~~ grooved pulley.

Material supplies:-
Moulding sand, parting sand, facing sand, pattern, Moulding boxes etc.

Tools Required:-
1. Shovel 2. Sieve 3. Trowel
4. Rammers 5. Sprue pin 6. Strike off bar
7. Lifter 8. Gate cutter 9. Runner
10. Riser 11. Vent Rod 12. Draw spike
13. Bellow

Sequence of operations:-
1. Sand preparation
2. Core preparation
3. Placing the pattern on the moulding board.
4. Ramming of drag.
5. Placing runner and riser
6. Ramming of Cope
7. Removal of pattern, runner, riser
8. Gate cutting.

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Procedure:-

1. The grooved pully pattern is placed on the moulding board.
2. A suitable core is prepared and placed in the hole of the circular pully pattern.
3. Clay washing is done ~~trip~~ inside the drag surface.
4. Parting sand is applied over the pattern.
5. Box is filled with moulding sand.
6. Excess sand is removed using the strike off bar.
7. The drag is turned upside down.
8. The cope is placed on the cope during clay wash.
9. The runner and the cope box is assembled over the drag box.

Result:-

Thus the grooved pulley mould is prepared and ready for casting.