Workshop Practice : Welding
Job 1 :- To join the two thick plate (5 mm)
Material :- M.S Plate

A. Some Common Welding Terminologies :-

a) Root :- Point at which two pieces to be joined nearest.
b) Toe :- Junction between the weld face and base metal.
c) Base metal :- The metal is to be joined on which edge preparation is done.
d) Peretration :- Depth form the top surface upto which base metal combines with the weld metal.
e) Puddle :- The portion of weld joint that is in molten combination while welding continues.
f) Bead :- Metal added in the joint during a single pass
g) Weld pass :- A single movement of the electrode or torch along the length depositing some molten metal.
h) Weld face :- Exposed surface of the weld bead.
i) Leg :- Width of the connection between filter metal and base metal.
j) Throat :- Smallest length of the filter metal ; i.e; length of filter material on the plane of failure.
k) Reinforcement :- Depth of the weld bead over the theoretically assumed profile.
l) HAZ :- Portion of the base material where mechanical properties are affected because of heating.

m) Crater :- In case of arc welding depression in the metal pool at the point where arc strikes base metal.

n) Tack weld :- A small weld used to hold the workpiece temporarily during actual welding.

B. AC Welding Set-Up :-

A digital AC welding set-up generally has following voltage - current characteristic equation :-

$$V = V_0 C + K \cdot I$$

where, V = voltage across the arc corresponding to current I.

V_{oc} = Open circuit voltage or max voltage for no current flow, usually 80 V.

C. Different types of joints depending on relative placement of the parts to be joined :-

Butt Joint, Lap joint, Corner joint, TEE joint, Edge joint.

D. Different types of Welding depending on position :-

Flat, overhead, vertical, horizontal.

E. Different types of edge preperation & Symbolic representation:

In case of higher plate thickness (generally more than 5 mm) to facilitate good penetration edges of

the parts to be joined are required to be prepared seperately before joining.

Straight or square, Single - V, Single - U, Single - Bevel, Single - J, Fillet, Double - V, Double - U, Double - Bevel, Double - J.

E. Different types of movement of electrode w.r.t arc :-

Forehand Welding - Electrode is moved in the direction of the arc.

Backhand welding - Electrode is moved opposite to the direction of the arc. It gives better penetration and generally used for thick materials.

G. Weld penetration affected by polarity :-

Almost 70% heat is liberated near the positive electrode or anode. So, for DCEN penetration is maximum and is generally used for high thickness material or high thermal conductivity material. DCEP is used mainly with the objective of minimizing heat affected zone in the base material. AC welding provides just intermediate characteristic of this two type.

1. Job Informations :-

Material - mild steel.
Plate thickness - 5 mm
Length of Pass - 50 mm
Type of Joint - Butt Joint
Type of edge - Square or Straight
Power Source Type - AC
Voltage -
Current -
Welding Position - Flat
Welding Pass - Backhand
Types of welding electrode - MMAW (Manual Metal Arc Welding) or SMAW (Shielded Metal Arc welding).
Electrode - Coated

2. Steps to be followed :-

i) Set the metal plates to be joined in the fixture keeping 1.5 to 3 mm root opening.

ii) Turn the power on establish the current flow between the electrode and the workpiece. Move the electrode so that it will scratch the work metal. and establish a current flow. The normal distance by which the electrode is seperated form the work-metal is same as the electrode diameter. After initiating the arc

bought the electrode back to the start point of the weld.

iii) After initiating the stable arc length move the electrode along the weld length. Speed of this forward motion is guided by the metal deposition rate.

iv) Intense heat of the arc melts the electrode also. So, to maintain a constant arc gap a downward motion is also given to the electrode. Downward movement must not be too high so that electrode sticks into metal and also must not be too small so that the arc is extinguished.

v) While moving along the length, electrode is given a sidewise weaving movement also to maintain a constant bead width. This sidewise weaving movement is given generally at a distance of 1.5 mm.

vi) At the end of welding extinguish the arc gradually so that current is reduced gradually and arc crater is also completely filled.

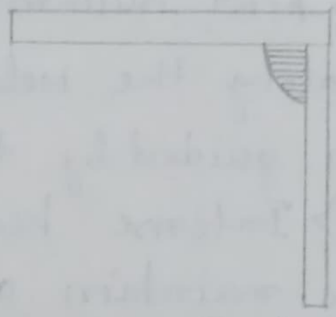
vii) Before starting of the next pass break the brittle slag coating with the help of chipping hammer and clear the area with a wire brush.

3. Answer following questions :-

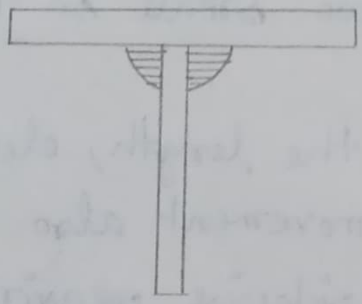
i) What is welding and how welding is classified ?

⇒ Welding is a process of joining similar metals by

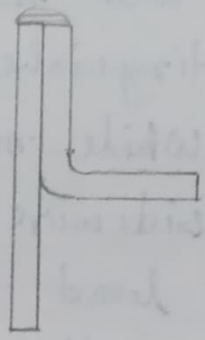
Butt Joint



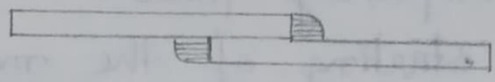
Corner Joint



TEE Joint



Edge Joint



Lap Joint

Different Types of joints depending on relative placement of the parts to be joined

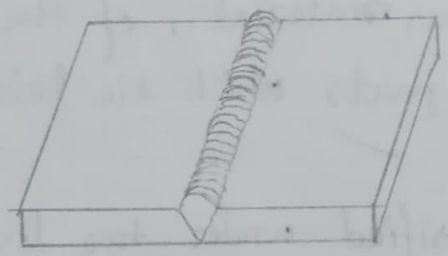
application of heat with or without application of pressure and addition of filler material. The result is a continuity of homogeneous material, of the compostics and characteristics of two parts which are being joined together.

•• Welding can be classified under two broad heading

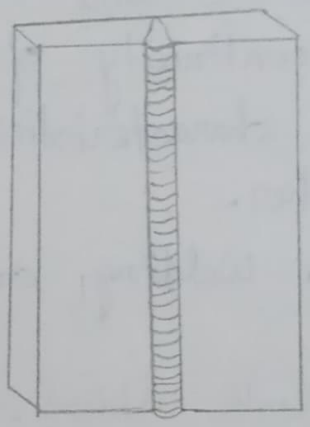
1. Plastic Welding :- The pieces of metal to be fixed are heated to a plastic stand and then forced together by external pressure. This procedure is used in forge welding resistance welding, thermit welding.
2. Fusion Welding :- The material at joint is heated to a molten state and allowed to solidify. This is used in gas welding, arc welding etc.

Welding Process :-

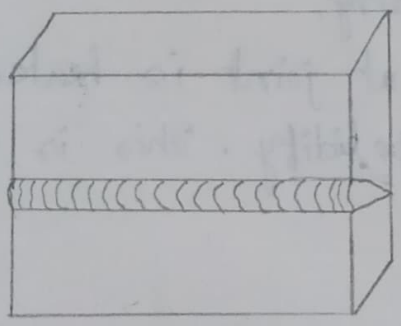
1. Solid State Welding :- a) Forge Welding, b) Friction Welding, c) Diffusion Welding, d) Explosive Welding, e) Ultrasonic Welding.
2. Fusion Welding :- a) Metal arc welding, b) Carbon arc welding, c) Tungsten arc welding, d) Resistance spot welding, e) Resistance steam welding, f) Resistance Butt welding, g) Gas welding, h) electro slag welding, i) laser beam welding, j) electron beam welding.



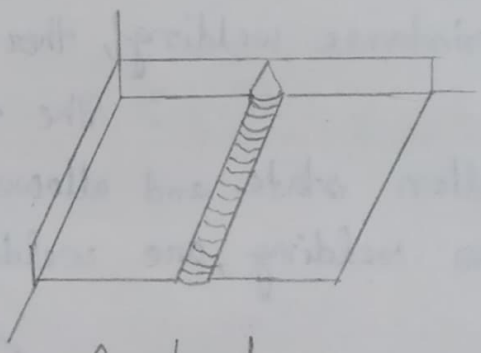
Flat



Vertical



Horizontal



Overhead

Different types of welding depending on position

ii) Write a short note about arc welding.

⇒ Electric arc welding is one of the most versatile joining process and is extensively used all over the world. One of the attractive features of arc welding is ease of use and high production rate that can be achieved economically. Arc welding is a fusion welding process where joining is obtained by heat produced by electric arc. In arc welding process when consumable electrodes are used. It also acts as filler material which is consumed continuously and deposited into the joint to make the weld, when non-consumable electrodes are used along with seperated filler metal rods.

iii) Define the arc and explain the arc structure.

⇒ An arc is an electric discharge between two electrodes which takes place through an electrically conducting hot ionised gas known as plasma. The arc column is generated between an anode which is the positive pole of DC power supply and the cathode, the negative pole. When these two conductors of an electric circuit are brought together and seperated for a small distance such that the current continues to flow through a path of ionised particles called plasma, an electric arc is formed.

iv) What are the equipments used in arc welding?

⇒ The equipments used in arc welding as follows - 1) Welding torch, 2) Welding tip, 3) Pressure Regulator, 4) Hose and hose fittings, 5) Gas cylinder, 6) Alternating current machine, 7) Direct current machine.

v) Write the function of electrode in arc welding.

⇒ Initially, the contact is made between two conduction of electricity anode and cathode to create an electric current. When the flow of current is established they are seperated by small distance and arc is formed. Actually arc is sustained electric discharge through the ionised gas column between two electrodes.

vi) Specify and classify the electrode used in arc welding.

⇒ The electrodes used for providing heat arc of two types -

1. Consumable electrodes :- Welding using a consumable electrode is most common methode nowadays. There electrode is consumed continuously and acts on filler material. The melting temperature of consumable electrode is below the themperature of arc. Since the electrode continuously melts the function of providing a filler metal and heat are both butt into a single electrode. The consumable electrode must be continuously moved towards the workpiece to maintain a stable arc and satisfactory welding conditions.

2. Non-Consumable Electrode :- When non-consumable electrodes are used, seperate filler metal rods are used. We may say that in case of welding processes using non-cosumable electrodes heat source and filler metal deposition can be seperately controlled for all processes using non-consumable electrodes it is better to connect the electrode to the negative terminal to pup the heat losses minimum. However, in case of welding aluminium and magnesium it is preferable to use AC power supply.

vii) Why the coated electrode is used in arc welding?

⇒ Coated electrode is used in arc welding for the following reasons :-

1) Coating on the electrode provides a gas shielding around the arc to eliminate the formation of undesirable oxides and nitride, which would otherwise form by reacting with atmospheric oxygen and nitrogen.

2) Coating forms a slog while being lighter than molten metal floats on the top of weld pool and protects the it against the surroundings air during weld bead solidification. It also helps metal to cool slowly, preventing the formation of brittle weld.

3) Elements for stabilisation of arc are added to these coatings.

4) Alloy elements can also be added through these coatings to improve the strength and physical properties of weld metal.

viii) Classify power sources availble for welding. What is duty cycle of a power source?

⇒ The power sources availble for welding are as follows :-

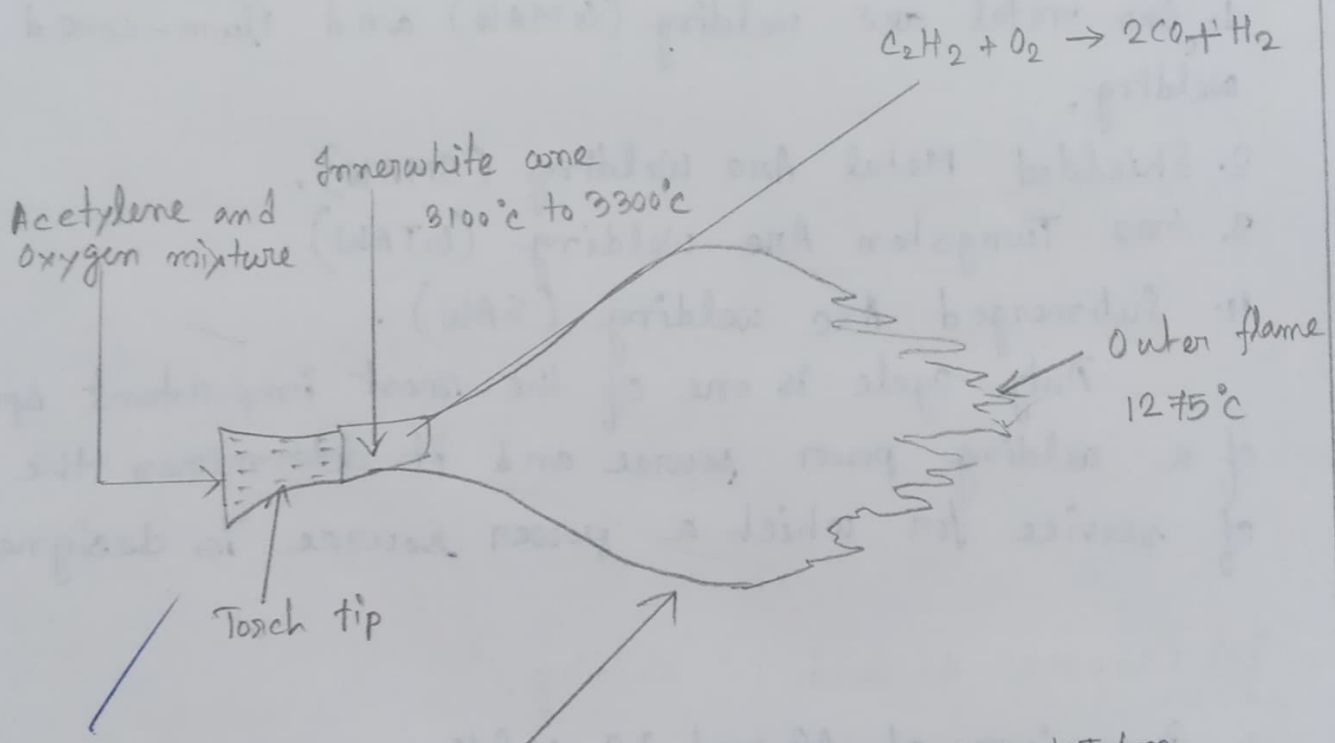
1. Gas metal arc welding (GMAW) and Flum-cored Arc welding.
2. Shielded Metal Arc Welding (SMAW).
3. Gas Tungsten Arc Welding (GTAW).
4. Submerged Arc welding (SAW).

Duty cycle is one of the most important specification of a welding power source and it determines the type of service for which a power source is designed.

ix) Compare AC and DC Welding.

⇒ Comparison of AC and DC Welding.

	Direct Current (Convertor)	Alternating Current (Transformer)
1. No load voltage	low (higher safety)	Frequently too high, upto over (≠ 0V).
2. No load requirements	very high	low (advantages).
3. Efficiency	Low, can sequently highest of electrical energy.	High.



(a) Neutral flame

	Direct Current (converter)	Alternating Current (Transformer)
4. Prime cost	Two or three times compared to that of transformer.	Low.
5. Electrodes	Non-coated and this cheap electrodes can be used.	Only coated that is expensive electrodes can be used.
6. Protected rod	Normal.	Considerably higher because of phase factor cos ϕ. Additional welding condenser required.

x) Write short note about gas welding.

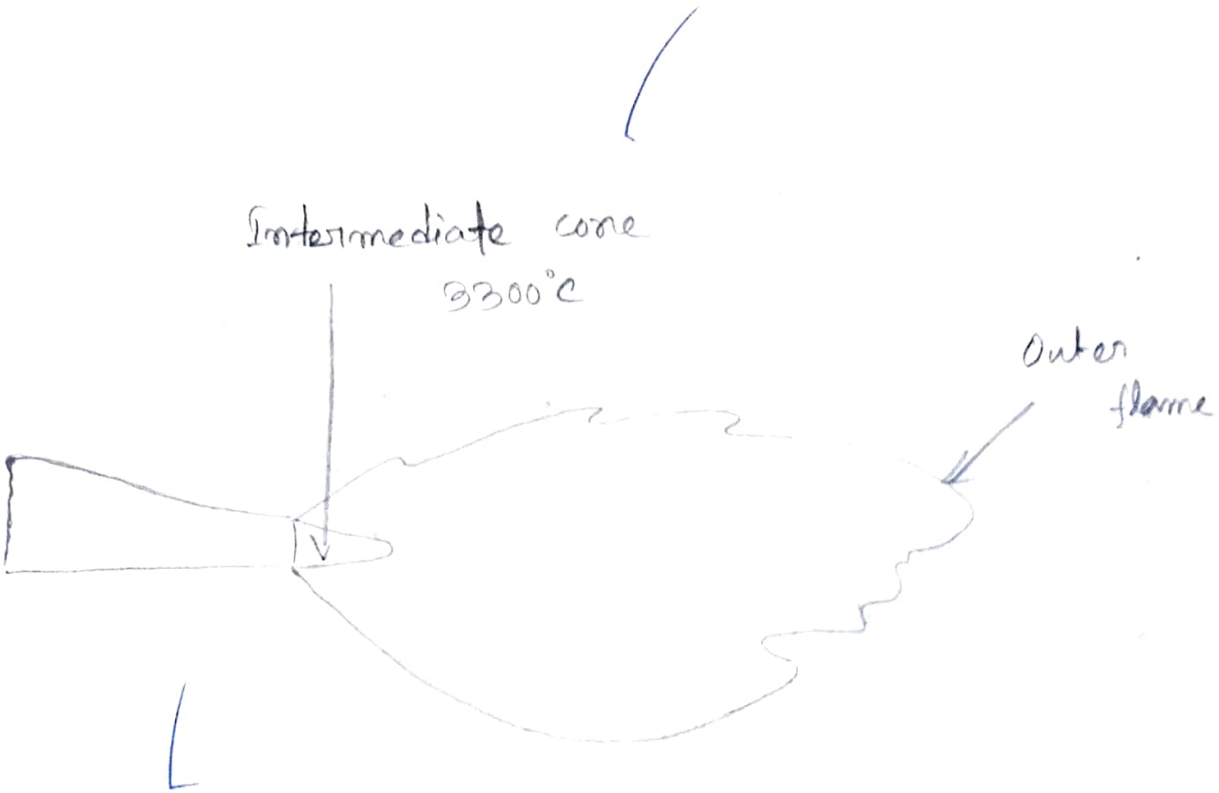
⇒ Gas welding obtains the heat for welding by the combustion of a fuel gas. The process is fusion welding process where the joint is completely melted and no pressure is used. Filler metal may or may not be used. The fuel gas most widely used in acytelyne when mixed with oxygen acytelene burns to produce temperature at the range of 3100°c.

xi) Describe different types of flames used in gas welding.

⇒ Different types of flames used in gas welding are as follows :-

1. Neutral flame : Certain amount of oxygen is required for the complete combustion of acytelene. In neutral

(b) Carburising flame or reducing flame



(c) Oxidizing Flame

flame all the acytelene is completely burned and thus all the available heat in the acytelene is released. The flame has two short definitions. Most of the acytelene welding is done with use of neutral flame. It is used for welding cast iron, aluminium, copper and stainless steel.

2. Reducing or carborising flame :- When the amount of oxygen is provided less than that theoretically required for complete combustion of fuel then reducing flame is obtained. Reducing flame is similar to neutral flame with the addition of third phase in between inner white cone and outer blue flame. It is known as intermediate flame feather. The length of feather is an indication of excess acytelene present. This unburnt carbon present goes to the weld metal pool and causs the steel to become extremely hard and brittle. It is used for oxygen free copper alloys, high carbon steel cast irons, high speed steels and cemented carbides.

3. Oxidising flame :- When the amount of oxygen is in excess then oxidizing flame is obtained. It is similar to neutral flame with exception that inner white cone is some what shorter and giving rise to higher tip temperatures. It is used in most of the applications since metal is badly oxidized. However, it is useful for welding some non-ferrous alloy such as copper based and zinc base alloys

Some alloys of iron such as cast iron and manganese steel are also better welded by oxidizing flame.

xii) Write the equipments used in gas welding.

⇒ Equipments used in gas welding are as follows :-
1) Welding torch, 2) Welding tip or noggle, 3) Pressure regulator, 4) Hose and hose fittings, 5) Gas cylinder.

xiii) Discuss about the welding defects.

⇒ During welding process if proper care is not taken, the following defects may arise -

1) Incomplete fusion :- It results from poor joint preperations, incorrect welding perimeter like welding current.

2) Oxides and slog inclusion :- Oxides should be removed because they tend to get entrapped in the solidifying metal. Fluxes are after used to remove oxides.

3) Poor Penetration :- It results from too lifting heat input. It may be also caused because of the incorrect edge penetration and may lead to cracping.

4) Porosity :- It results from oily, wet or dirty base metal and insufficient gas shielding. It is also caused by the presence of gases such as hydrogen, oxygen and nitrogen which get enterapped during solidification.

5) Cracking :-

(a) Hot Cracking :- It is influenced by the sulphur and carbon of mild steel weld metals.

(b) Cold Cracking :- It occurs at room temperature after the weld to be completely cooled and can be seen in heat effected zone.

Unit-II