Advantages are initial cost is vey less when compared to other furnaces, simple design, less floor area, maintenance is easy, it can be operated continuously for many hours.

WELDING

Welding: The process of joining similar metals by the application of heat is called "Welding".

Welding can be obtained with or without application of pressure and with or without addition of filler metal which is known as 'electrode'.

Classification of welding process: 1. Fusion welding 2. Plastic welding.

Fusion welding: The metal at the joint is heated to a molten state and then it is allowed to solidify. Pressure is not applied during the process and hence it is called "non pressure welding". Filler material is required for this welding.

Plastic welding: The metal parts are heated to a plastic state and are pressed together to make the joint. It is called as "pressure welding". No filler material is required.

TYPES OF WELDING: Thermit welding

Fusion welding ---- Arc welding ------Submerged,Plasma,Automic hydrogen,MIG, Metal, Carbon,Electro slagWELDING

Gas welding ------ Oxyacetylene, Oxyhydrogen

Plastic welding ------Explosive welding

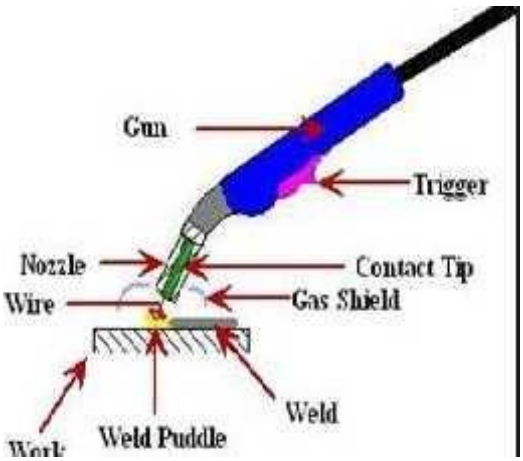
Ultrasonic welding

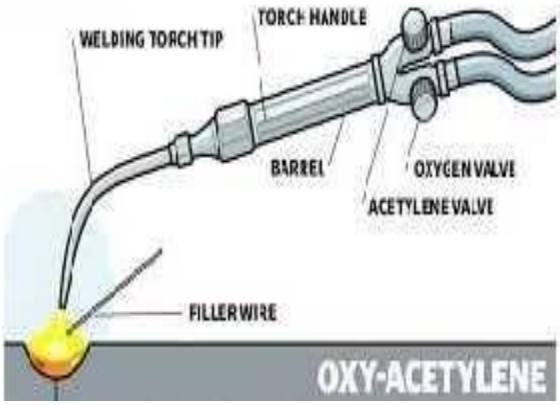
Electric resistance—Butt, Spot, Seam,

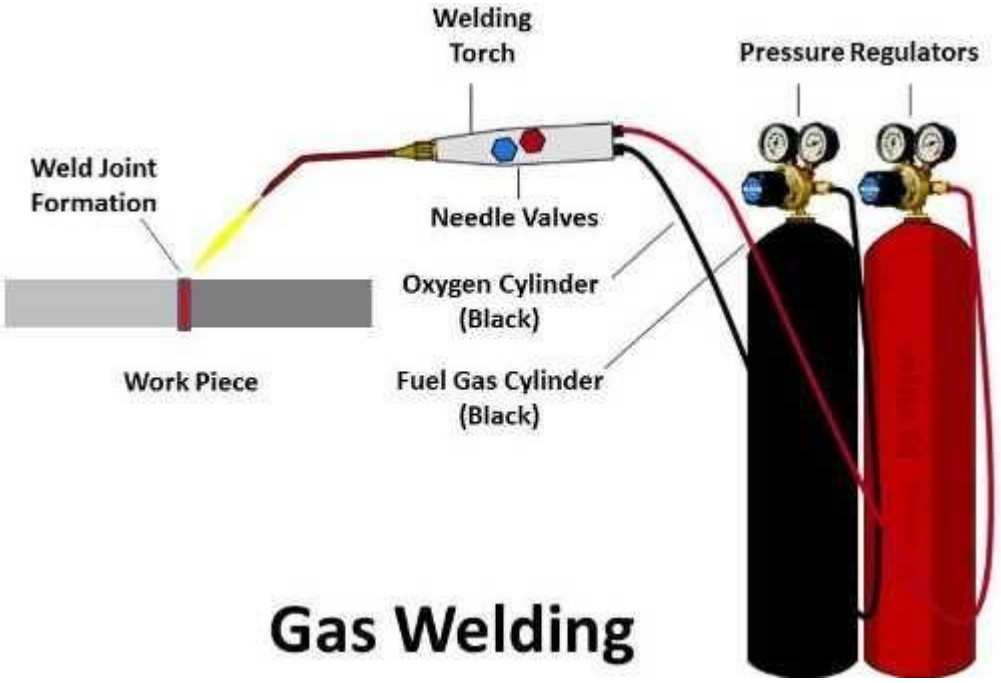
Projection,Percusion

Friction welding

Forge welding







GAS WELDING: 1.Oxy – acetylene welding 2) Oxy – hydrogen welding 3) Air – hydrogen

Oxy acetylene Welding: The edges of the metal to welded are melted by using a gas flame. No pressure is applied. The flame is produced at the tip of the welding torch. The welding heat is obtained by a mixture of oxygen and combustible gas. The gases are mixed in the required proportion in a welding torch which provides control for the welding flame.

The gases used are acetylene, hydrogen, propane and butane. Common gas is oxy acetylene. The flame only melts the metal and additional metal to the weld is supplied by filler rod. A flux is used during welding to prevent oxidation and to

remove impurities. Metal 2 mm to 50 mm thick are welded. The temperature of the flame is about 3200 ^{o}C. There are two types of oxy acetylene systems, one is High pressure and the other is Low pressure system.

Oxy Hydrogen Welding: Similar to OA welding process. The oxygen and hydrogen gases are mixed with the required proportions for producing heat. It was once used extensively to weld low temperature metals like Al, Lead and Magnesium. Presently this process is not used.

Air Hydrogen Welding: Similar to OA welding process. Air is used instead of oxygen. The air is taken from the atmosphere is compressed in a compressor and mixed with acetylene to the required proportion in the torch. The temperature is low and used in welding of lead.

GAS WELDING EQUIPMENTS:

1) Gas cylinders: Oxygen in Black colour, Acetylene in maroon colour.
2) Pressure regulators: Each cylinder is fitted with pressure regulator. It is used to control the working pressure of the gases. Oxygen 0.7 to 2.8 kg/cm^2 Ace 0.07 to 1.03 kg/cm^2
3) Pressure gauges: Each cylinder is fitted with two pressure gauges. One is for cylinder pressure and the other one is working pressure pressure for welding.
4) Hoses: Each cylinder is connected to the torch through two long hoses. It should be flexible, strong, and light. Oxygen is fitted with black colour and Ace in red colour.
5) Welding torch: Oxygen and ace enters the torch through the hose is separate passage. Both the gases are mixed in the mixing chamber of the torch. When it is ignited a flame will be produced at the tip of the torch called nozzle. Two control valves are used to control the quantity of oxygen and ace to adjust the flame.The nozzles are made of copper and available in different sizes depending upon the type of metal to be welded.
6) Goggles: It is used the protect eyes from the flame heat, ultraviolet and infrared rays.
7) Welding gloves: It is used to protect hand from the injury by heat and metal splashes.
8) Spark lighter: It is an igniter to start the burning of the oxy ace gases.
9) Wire brush: It is used to clean the weld joint before and after welding'

FLAME CHARACTERISTICS:

It is important to control the flame to suit the welding conditions by supply of oxy and ace . Three types of flames are 1) Neutral flame 2) Carburising flame 3) Oxidising.

1. Neutral flame: It is obtained by supplying equal quantity of oxy and ace. It has two zones. One is sharp bright inner cone and the other is bluish outer

cone. The inner cone develops heat to melt the metal. The maximum temperature of neutral flame is obtained at the inner cone is 3200°C. The outer cone protects the molten metal from oxidation reaction. It is used for welding steel, cast iron, copper, aluminium etc.

2. Carburising flame: It is also called reducing flame. It is obtained by supplying more acetylene than oxygen. It has three zones. a) Sharp inner cone b) whiter intermediate cone called feather cone c) Bluish outer cone. The flame is used for welding very low carbon steel, non-ferrous materials.
3. Oxidising flame: It is obtained by supplying more oxygen than acetylene. It has two zones. a) smaller inner cone b) outer cone. It is used for welding brass and bronze.

GAS WELDING TECHNIQUE:

In gas welding the speed and quality of the welding can be improved by proper selection of torch size, filler material, method of moving the torch, angle at which the torch is held. Two techniques are used. 1) Leftward or forward welding 2) Rightward or backward welding.

1. Leftward or forward welding: The torch moves from right to left. The torch is held on right hand and the welding rod is held on left hand. The torch angle 60 to 70^0 and welding rod at 30 to 40^0. It allows the preheating of the plate immediately ahead of the molten pool. It is suitable for welding m s plates up to 5 mm thick.
2. Rightward or backward welding: The torch moves from left to right. The torch is held at angle 40 to 50° and welding rod at 30 to 40°. Better shielding. It is suitable for welding ms plate more than 5 mm.

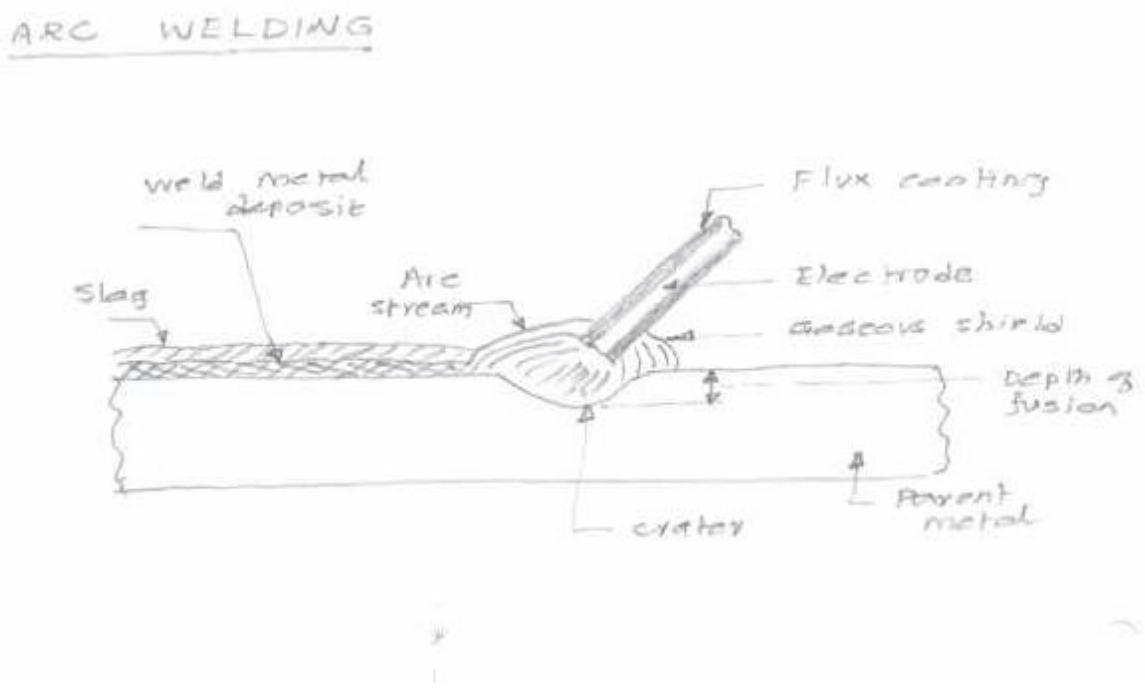
FILLER RODS FOR GAS WELDING:

Filler rods/welding rods used in gas welding to supply additional metal to make the joint. It is metal rod made of the same material as parent material. The diameter of the filler rod is depending upon the thickness of the metal to be weld. d = t / 2 + 1. Filler rods are coated with copper to prevent oxidation of the molten metal.

ADVANTAGES AND LIMITATIONS OF GAS WELDING:

Advantages: 1) Temperature of the flames can be easily controlled. 2) Filler metal deposits can be controlled easily 3) All types of metals can be welded 4) Cost of the equipment is less 5) It can be used in factory or in the field 6) Maintenance cost is less.

Limitations: 1) It is not suitable for joining thick plates 2) It is slow process 3) Strength of weld is not so good as arc welding 4) Handling and storing needs more care.



ARC WELDING:

The heat is developed by an electric arc. The arc is produced between and electrode and the work. It is a process of joining two metals by melting their edges by an electric arc. The electrical energy is converted to heat energy. The gap between the electrode and the work is 3mm. The current is passed through the workpiece and the electrode to produce an electric arc. The workpiece is melted by the arc. The electrode is also melted and hence both the workpieces becomes a single piece without applying any external pressure. The temperature of the arc is 5000 to 6000 ^{o} C. A transformer or generator is used for supplying the current. The depth to which the metal is melted and deposited is called Depth of fusion. To obtain better depth of fusion the electrode is kept at 70^{o} inclination to vertical.

Electrodes used in arc welding are generally coated with a flux. The flux is used to prevent the reaction of the molten metal with the atmospheric air. It removes the impurities from the molten metal and forms a slag. The distance between the tip of the electrode and bottom of the arc crater is called “arc length”

ARC WELDING EQUIPMENTS:

The equipments used in arc welding are 1) Welding generator DC or Transformer AC 2) Electorde 3) Electrode holder 4) Two cables, one for work

and other for electrode 5) Gloves 6) Protective shield 7) Apron 8) Wire brush 9) Chipping hammer 10) Safety goggles.

In the electric arc welding both DC and AC are used for producing arc. In DC machines and DC generators are driven by an electric motor of an IC engine. In AC welding machine transformers which are used for stepping down the main supply voltage. 220/440 V Normal welding requires 20 to 90 Volts.

COMPARISION OF ARC WELDING AND GAS WELDING:

Arc welding	Gas welding
Heat is produced by electric arc	Heat is produced by the gas flame
The arc temperature is about 4000^{o}C	The flame temperature is about 3200^{o}C
Filler rod is used as electrode	Filler rod is introduced separately
It is suitable for medium and thick work	It is suitable for thin work
Arc weld joints have very high strength	Gas weld joints do not have much

METAL INERT GAS WELDING (MIG WELDING)

The process is also called as " gas metal arc welding (GMAW). The arc is produced between a consumable metal electrode and the work piece. During welding the arc and welding zone are surrounded by an inert gas. Argon or Helium is used as the inert gas. The surrounded air protects the weld from atmosphere. The electrode is fed continuously through welding head because during the welding the electrode is melted by arc and deposited over the work piece. Either DC Generator or AC Transformer is used. The current ranges from 100 to 400 A depending upon the diameter of the wire. It is used for welding aluminium, ss, nickel and magnesium w/o defects

Advantages: a) No flux is required b) High welding speed c) Possible to weld ferrous and non-ferrous metals d) Greater efficiency e) Produces high quality weld f) Cheaper process.

TUNGSTEN INERT GAS WELDING (TIG WELDING)

In TIG welding the electric are is produced between a non consumable tungsten electrode and the work piece. An electrode holder in which the non consumable tungsten electrode is fixed when the arc is produced. By supplying the electric power between the electrode and the work piece, the inert gas from the cylinder passes through the nozzle of the welding head around the electrode. The inert gas surrounds the arc and protects the weld from atmospheric effects and defects free joints are made. The process is also called Gas Tungsten Arc Welding

(GTAN). An electrode used in this process is tungsten. The process is used for welding steel, cast iron, aluminium, ss, Nickel based alloys having thickness less than 6 mm.

Advantages: No flux is required, High welding speed, both ferrous and non ferrous metals can be welded, High quality welding, No cleaning is required.

SOLDERING: Soldering is a process of joining two metal parts with a third metal. The third metal has a very low melting point. It is known as Solder. It is used as a filler rod. Most of the solders are alloys of tin and lead. They melt at a temp of about 215^{o}C. The work pieces are not melted. Electrically heated soldering irons are available.

The two sheets are properly cleaned to remove oil, grease, oxides and dirt. This is done by chemical cleaning, filing, or by emery cloth. Two sheets are positioned. A flux is applied using a brush. The flux prevents oxidation. The flux used is in the form of liquid or paste. The flux used are zinc chloride and hydrochloric acid. The soldering iron is heated to proper temp. It is dipped in the flux and then rubbed on the solder. This is known as tinning of the tip.

Applications: Used in electrical appliances, computers, automobile radiators.

BRAZING: It is the process of joining two similar or dissimilar metals by using a fusible alloy called “spelter”. Spelter is a harder filler rod. Its melting temp is about 600^{o}C. This is below the melting point of the work materials. The most commonly used spelters are copper alloys and silver alloys. For brazing ferrous metals copper alloys made of copper, zinc and tin are used. Silver alloys made of silver and copper are used for any metals.

The metal parts are thoroughly cleaned. The parts are assembled with a gap between them so that the filler material may flow inside the joint. Now the flux (borax powder) in the paste form (mixed with water) is applied over the joint, this is done before heating the parts. Then the parts are heated below their melting point. The heating may be done in a furnace or by oxy-acetylene flame. The flux melts and flows in the gap between the surfaces. When the spelter is applied to the joint it gets melted. It flows in the gap between the work piece and solidifies. Thus a hard brazed joint is formed.

Types: a) Dip brazing b) Torch brazing c) Furnace brazing d) Electrical brazing.

Dip brazing: Parts are dipped in molten filler material. The molten metal fills the gap and makes the joint. This method is used for small components.

Torch brazing: In this method oxy-acetylene torch is used to heat the metals. Spelter metal melts and fills the gap. It is very widely used in assembly and repair works.

Furnace brazing: In this method the parts kept in a furnace and heated up.

Electrical brazing: Electrically heated up by induction heating method. It is used for joining carbide tips on tool holders, automobile radiators and heat exchangers.

Advantages: a) Dissimilar metals which cannot be welded in other processes can be brazed b) Very thin sheets can be easily joined c) Plates of different thickness can be brazed d) No finishing operation is required for good brazing d) Less distortion

Comparisionof Soldering and Brazing:

Soldering	Brazing
Filler material is known as solder	Filler material known as spelter
Low melting point alloys used	High melting point alloys used
Alloys of tin and lead are used	Copper and silver base alloys used
Strength of the joint is relatively low	Relatively high strength
Fluxes are Zinc chloride and hcl acid	Flux is borax powder
Mostly used for elec connections, tins and cans	Joining of dissimilar metals,

LATHE

Introduction:

Lathe is a machine tool, which is used to remove metal from work piece for required shape and size. This is done by holding the work piece firmly on the machine and turning it against the cutting tool, which will remove metal from the work in the form of chips.

Center lathe:

This lathe is the most important member of lathe family and most widely used. This lathe is also known as engine lathe. The basic parts of center lathe are bed, headstock, tailstock, and carriages, cross slide, compound rest, tool post and apron.