

WELDING

Welding is a process of joining similar metals by application of heat with or without application of pressure and addition of filler material. The results is a continuity of homogeneous material, of the composition and characteristics of two parts which are being joined together.

Types of Welding

There are two main types of welding they are :

1. Plastic (Pressure) welding
2. Fusion (Non-Pressure) welding

Types of Welding

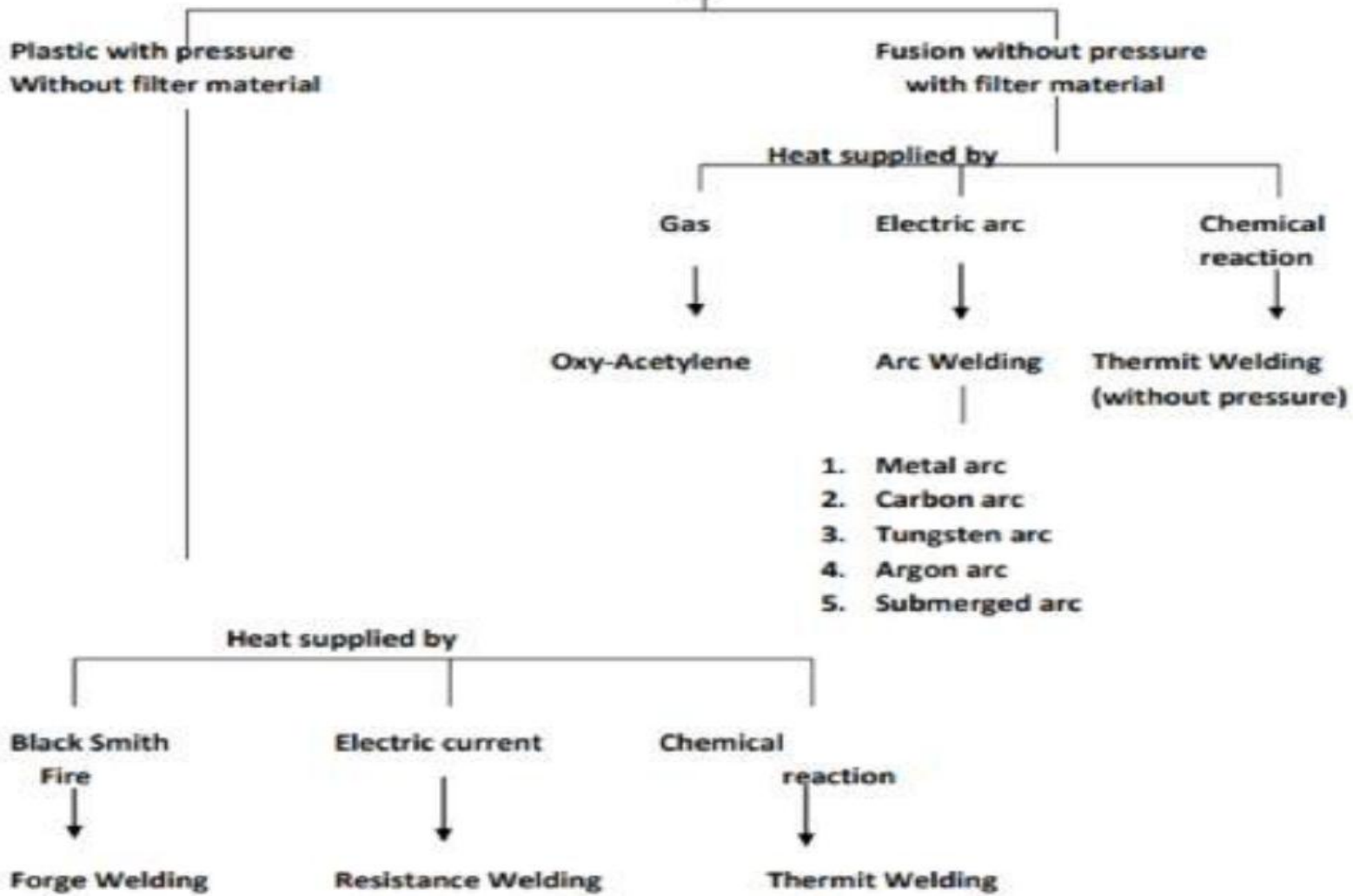
There are two main types of welding they are :

1. Plastic (Pressure) welding
2. Fusion (Non-Pressure) welding

In the plastic welding or pressure welding, the pieces of metal to be joined are heated to a plastic state and then forced together by external pressure. This procedure is used in forge welding, resistance welding, "thermit" welding, and gas welding, in which pressure is required.

In the fusion welding or nonpressure welding, the material at the joint is heated to a molten state and allowed to solidify. This includes gas welding, arc welding "thermit" welding, etc.

Welding Process



Arc welding is metal jointing process, where the joint is produced by heating the work piece with a electric arc set up between an electrode and the work piece. The electrical energy is converted is into heat in the arc, which attains a temperature around 5500°C, The electrode itself melts and supplies the necessary filler material.

Arc Welding Electrodes

The 2 types of electrodes are used in Arc welding.

1. Consumable electrode
2. Non-consumable electrode

Consumable electrodes melts along with the work piece and fills in the joint.

When non-consumable electrodes are used, an additional filler material is used, the advantage using non-consumable electrode is the metal deposited by a filler rod can be controlled which is not possible in consumable electrode.

FLUXES

An electrode has metal core surrounded by flux coating. Flux coating is made up of ferrous alloys. The functions of flux coating are

1. It produces a gas which provides a shield around the arc to protect it from atmosphere.
2. It forms slag by mixing with impurities of the molten metal and, thus, refines the metal.
3. The slag, being lighter, floats over the surface of the molten metal and on solidification forms a thin layer over the weldment, which helps in gradual and uniform cooling of weld and prevents its oxidation during cooling.

FLUXES

4. In some cases, it also carries necessary alloying elements which are added to the molten metal.
5. It promotes conduction of electric current across the arc and helps in stabilizing the arc.
6. It also helps in controlling the bead shape by providing necessary materials for this purpose.

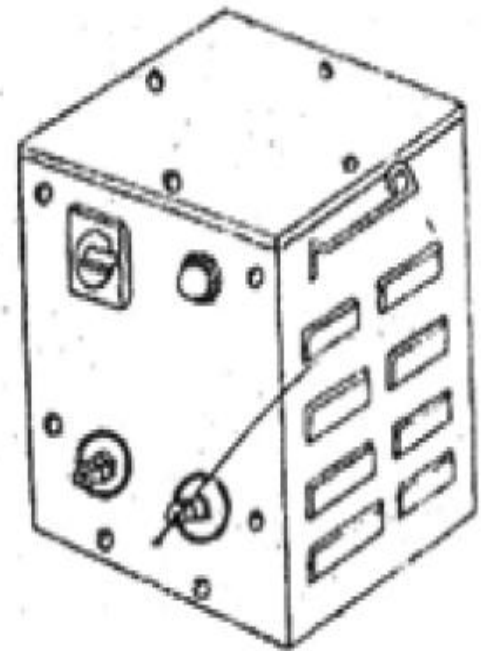
Equipments used in Arc Welding

The most commonly used equipment for arc welding consists of

1. AC or DC machine (transformer or generator)
2. Electrode
3. Electrode holder,
4. Cables, cable connectors
5. Earthing clamps
6. Safety goggles
7. Welding helmet
8. Hand gloves
9. Aprons
10. Chipping hammer
11. Wire brush etc.,

1. Transformer :

The function of a transformer is to generate a low voltage (10 to 50 V), and high amperage (50 A to 300 A) Electric Current. The current may be alternating current or direct current. Transformer converts Electrical energy into heat Energy which is required for the welding process.



2. Electrode Holder

The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light strong and easy to handle and should not become hot while in operation.

Figure 2 shows one type of electrode holder. The jaws of the holder are insulated, offering protection from electric shock.

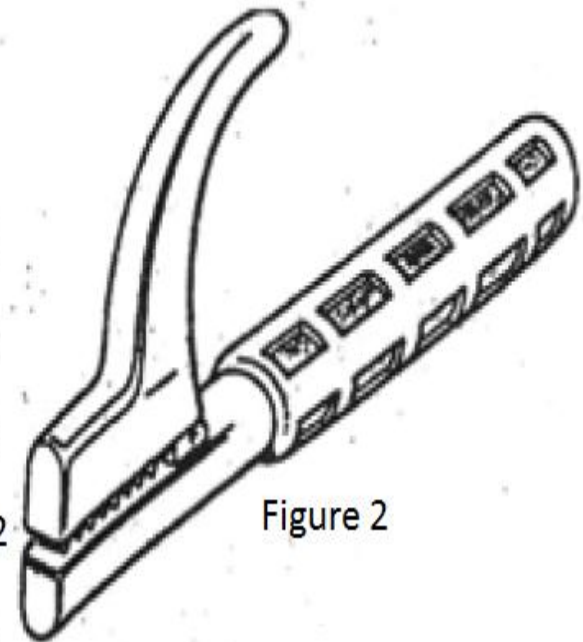


Figure 2

Figure 2

3. Electrode

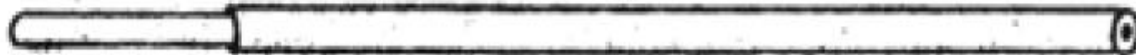


Figure 3

Welding rod as shown in fig. (3) is one of the electrode which acts as a filler material i.e., when the arc produced at the tip of electrode during welding process, the electrode itself melts and fills the gap between two base metals

Electrodes commonly used are of two types

- (i) Coated electrodes
- (ii) Bare electrode

Coated electrodes carry a core of bare metallic coated wire provided with a flux coating wire provide with a flux coating or covering on the outside surface.

Mild steel is the most commonly used material for core wire.

The common ingredients of a flux which help in slag formation and metal refining are asbestos, mica, silica, fluorspar, stealite etc.,

Bare electrodes is one which does not have any coating. Bare electrodes are cheaper, but welds produced through these are of poor quality. It is used in inert gas metal arc welding (MIG).

4. Ground (earthing) Clamp

It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit as shown in fig. (4). It should be strong and durable, and give low resistance connection.

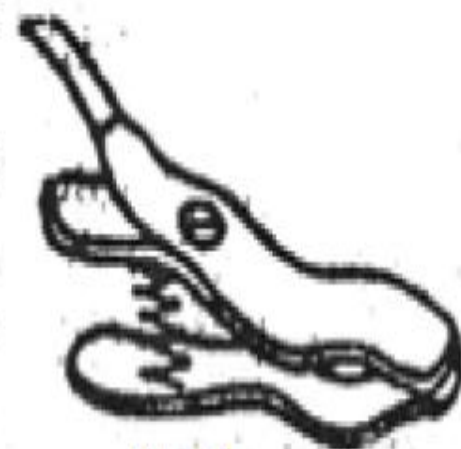


Fig. 4

5.Face or head shields

A face shields provide better protection and allow the welder the free use of both hands. It is mainly used to protect the eyes and face from the rays of the arc and from the spatter or flying particles of hot metal. It is available either in hand or helmet type as shown in fig. (5).

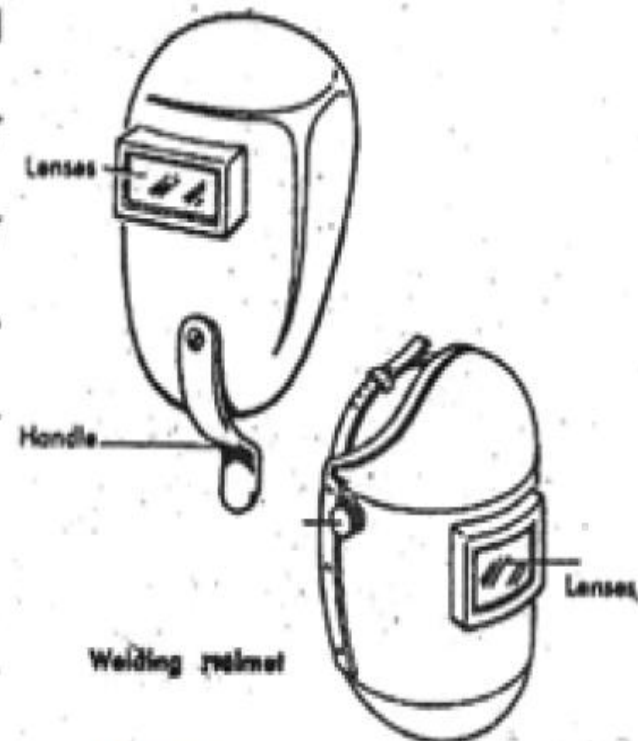


Figure 5

6. Goggles

Goggles with coloured glasses are used to protect the eyes from glare and flying bits of hot metal as shown in fig. (6).

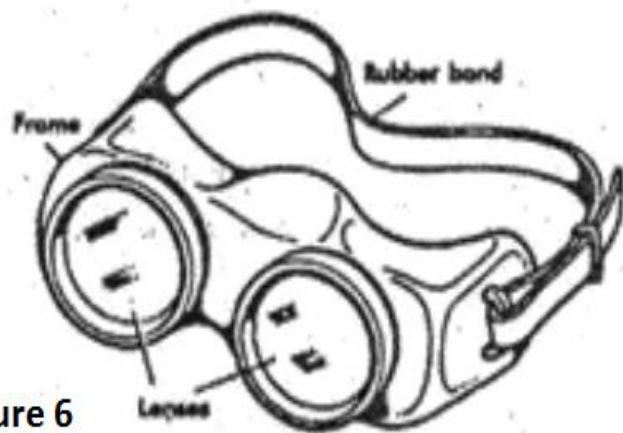


Figure 6

Welding goggles

Chipping hammer

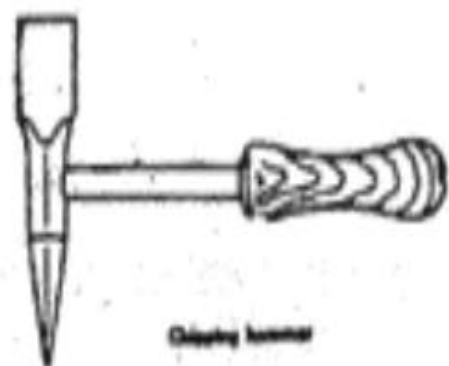


Fig. 7

Chipping hammers as shown in fig. (7) is used for removing or chipping off the slag that forms on welded surface. A chipping hammer has two striking ends, one end of the head is sharpened like a cold chisel and the other flat end that turns parallel to the handle.

8 Wire brush

Wire brush as shown in fig. (8) is used after chipping. For further cleaning of the welded surface. The bristles are made from steel or stainless steel.

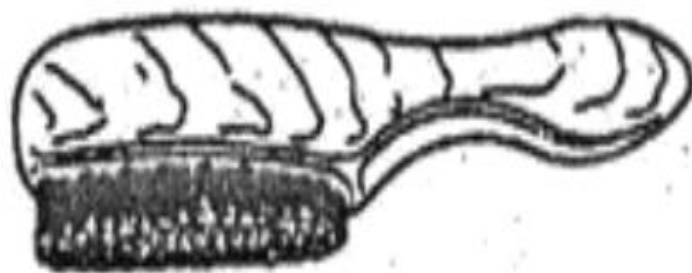


Figure 8

Comparison between A.C. and D.C arc welding

Following is the comparison between A.C. and D.C arc welding

Use of A.C in arc welding	Use of D.C in arc welding
1. AN A.C. welding transformer is cheaper and simpler in operation	A.D.C. generator set is costlier and more cumbersome in operation.
2. Maintenance of an A.C transformer is easier and more economical since it has no moving parts	A.D.C. generator carries many moving parts and its maintenance cost is higher
3. It is less suitable for use at low current with small dia. Electrodes	It is better suited for use at low amperages with small dia. Electrodes
4. Except in case of iron powder electrodes, maintenance of a Small arc is difficult	Maintenance of short arc is easier with D.C.
5. It is preferred for welding at very large distances from the power supply, because voltage drop in long leads is much less as compared to	In D.C. the voltage drop is relatively higher and therefore, only short cables are used, prohibiting its use for welding at long distances from power supply D.C
6. Striking of arc, particularly with electrodes is relatively difficult	In D.C it is easier to strike an arc, even with thin electrodes.
7. Bare electrodes cannot be used in A.C. Only specifically designed coated electrodes with coverings containing stabilizers can be used.	Both bare and coated electrodes can be used.

Preparation of the work before welding :-

Before welding, the work pieces must be thoroughly cleaned of rust, scale and other foreign materials. Thin pieces of metal are generally weld without beveling the edges. However thick work pieces should be bevelled to ensure adequate penetration and fusion of all parts of the weld. But, in either case, the parts to be welded must be separated slightly to allow better penetration of the weld.

Advantages of welding

- 1) A properly made weld can be stronger than the part on which it is used.
- 2) It is a permanent joint.
- 3) The equipment is inexpensive.
- 4) The joint produced by welding is as strong as base metal.
- 5) No patterns are used as in castings.
- 6) The equipment can be portable.
- 7) The process allows considerable freedom in design.

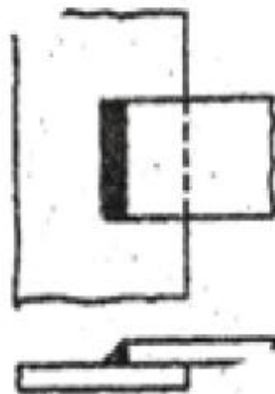
Disadvantages of welding

- 1) A good welding job requires skilled operator.
- 2) Fixtures are often needed to hold parts in position for welding.
- 3) Each part of weldment must be cut to size and shape before it can be welded.
- 4) Presence of residual stresses and distortion in the welded joints.

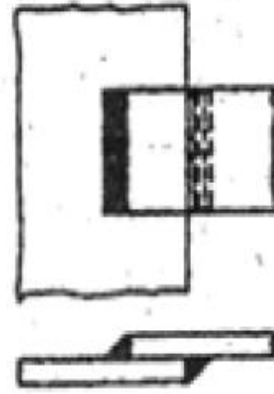
Types of welded joints

The relative positions of the two work pieces being joined determine the type of joint. The following are the give basic types of joints commonly used in fusion welding are :

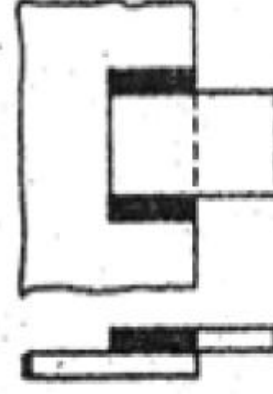
1. Lap joint
2. Butt joint
3. Corner joint
4. T-joint
5. Edge joint



Single transverse



Double transverse



Parallel lap joint

Common defects in welding

1. Cracks
2. Porosity
3. Poor fusion
4. Inclusions
5. Undercut

Safe welding practices

- 1) Never look at the arc with naked eye. The arc can burn your eyes severely.

Therefore always use a face or head shield or goggles, while welding.

- 2) Always wear the safety hand gloves apron and shoes.
- 3) Ensure proper insulation of the cables and check for openings.