

Welding

Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material.

Advantages and Limitation of Welding as a Fabrication Technique

Welding is mainly used for the production of comparatively simple shape components. It is the process of joining the metallic components with or without application of heat, pressure and filler metal. Application of welding in fabrication offers many advantages, however; it suffers from few limitations also. Some of the advantage and limitations are given below.

Advantages of welding are enlisted below:

1. Permanent joint is produced, which becomes an integral part of work piece.
2. Joints can be stronger than the base metal if good quality filler metal is used.
3. Economical method of joining.
4. It is not restricted to the factory environment.

Disadvantages of welding are enlisted also below:

1. Labour cost is high as only skilled welder can produce sound and quality weld joint.
2. It produces a permanent joint which in turn creates the problem in disassembling if of sub component required.
3. Hazardous fumes and vapours are generated during welding. This demands proper ventilation of welding area.
4. Weld joint itself is considered as a discontinuity owing to variation in its structure, composition and mechanical properties; therefore welding is not commonly recommended for critical application where there is a danger of life.

Applications of welding

- ✓ The welding is widely used for fabrication of pressure vessels, bridges, building structures, aircraft and space crafts, railway coaches and general applications besides shipbuilding, automobile, electrical, electronic and defense industries, laying of pipe lines and railway tracks and nuclear installations.

Specific components need welding for fabrication includes

- ✓ Transport tankers for transporting oil, water, milk etc.
- ✓ Welding of tubes and pipes, chains, LPG cylinders and other items.
- ✓ Fabrication of Steel furniture, gates, doors and door frames, and body
- ✓ Manufacturing white goods such as refrigerators, washing machines, microwave ovens and many other items of general applications.

Welding processes can be classified on the basis of following technological criteria:

➤ **welding with or without filler material**

○ **without filler material**

- ✓ Laser beam welding
- ✓ Electron beam welding
- ✓ Resistance welding,
- ✓ Friction stir welding

○ **With filler material**

- ✓ Metal inert gas welding: (with filler)
- ✓ Submerged arc welding: (with filler)
- ✓ Flux cored arc welding: (with filler)
- ✓ Electro gas/slag welding: (with filler)

○ **May or may not use of filler material**

- ✓ Plasma arc welding
- ✓ Gas tungsten arc welding
- ✓ Gas welding

➤ **Source of energy for welding**

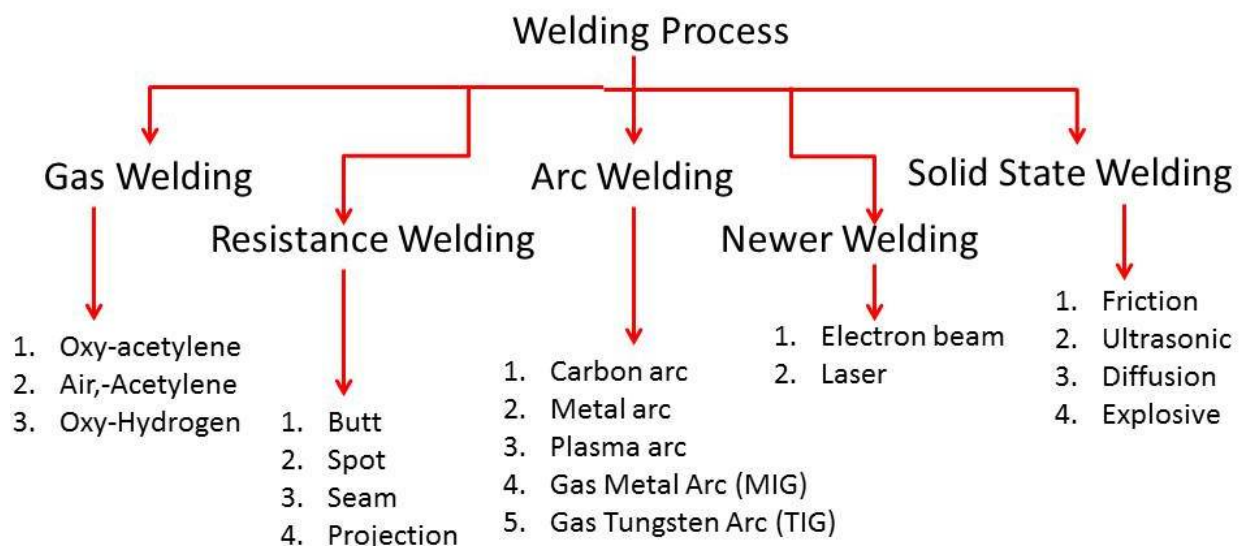
- ✓ Chemical energy: Gas welding, explosive welding, thermite welding
- ✓ Mechanical energy: Friction welding, ultrasonic welding
- ✓ Electrical energy: Arc welding, resistance welding
- ✓ Radiation energy: Laser beam welding, electron beam welding

➤ **Arc and non-arc welding**

○ **Arc based welding processes**

- ✓ Shielded Metal Arc Welding: Arc between base metal and covered electrode
- ✓ Gas Tungsten Arc Welding: Arc between base metal and tungsten electrode
- ✓ Plasma Arc Welding: Arc between base metal and tungsten electrode
- ✓ Gas Metal Arc Welding: Arc between base metal and consumable electrode

- ✓ Flux Cored Arc Welding: Arc between base metal and consumable electrode
- ✓ Submerged Arc Welding: Arc between base metal and consumable electrode
- **Non-arc based welding processes**
 - ✓ Resistance welding processes: uses electric resistance heating
 - ✓ Gas welding: uses heat from exothermic chemical reactions
 - ✓ **Thermit welding**: uses heat from exothermic chemical reactions
 - ✓ **Ultrasonic welding**: uses both pressure and frictional heat
 - ✓ **Diffusion welding**: uses electric resistance/induction heating to facilitate diffusion
 - ✓ Explosive welding: involves pressure
- **Fusion and pressure welding**
 - **Pressure welding**
 - ✓ Resistance welding processes (spot, seam, projection, flash butt, arc stud welding)
 - ✓ Ultrasonic welding
 - ✓ Diffusion welding
 - ✓ Explosive welding
 - **Fusion welding process**
 - ✓ Gas Welding
 - ✓ Shielded Metal Arc Welding
 - ✓ Gas Metal Arc Welding
 - ✓ Gas Tungsten Arc Welding
 - ✓ Submerged Arc Welding
 - ✓ Electro Slag/Electro Gas Welding

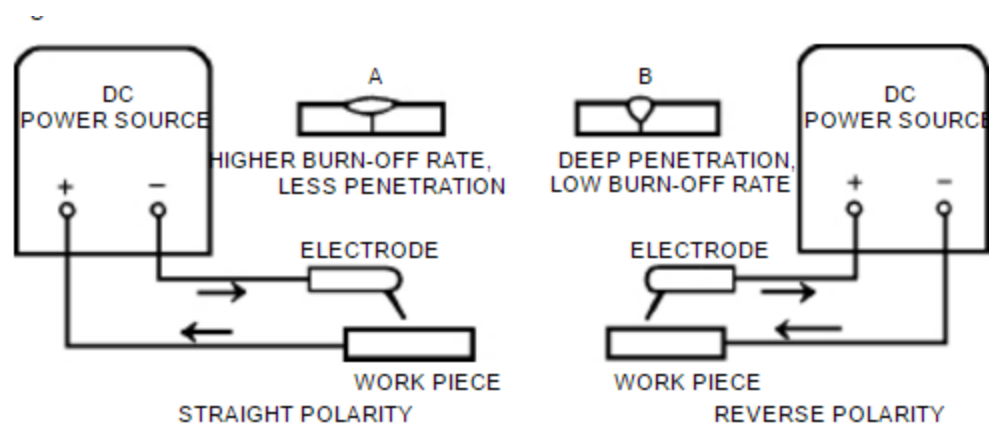


Straight polarity: DC EN

- ✓ Here electrode is negative and work piece is positive and the circuit is between the two.
- ✓ So the electrons move from electrode to work piece with high velocity.
- ✓ the high velocity electrons hits the work piece with high kinetic energy and this high KE is transformed to heat energy during which the arc is produced because of plasma formation.
- ✓ So heat energy is created and generated at the work piece surface and transfers to surrounding i.e electrode and the other forces like magnetic and electric will restrict the heat to transfer in other directions.
- ✓ Finally in DC EN; 2/3 of heat will be at the work piece and 1/3 will be at the electrode.
- ✓ so more heat is concentrated on the work piece results in more penetration and less weld width.

Reverse polarity: DC EP

- ✓ Here the whole scenario is opposite, electrons move from work piece to electrode resulting in 2/3 heat at electrode and 1/3 at work piece.
- ✓ So resulting in less penetration and more weld width.



Alternating Current - (A.C.)

- ✓ AC offers moderate level of penetration.
- ✓ In case of AC, current flow direction reverses in every cycle (number of cycles per second depends on the frequency of supply). Now, in arc welding, base metals are connected with one terminal and the electrode is connected with other terminal.

- ✓ For AC supply, both polarities occur one after another in every cycle for a number of times (equals to frequency of supply).
- ✓ **AC or Reversing Polarity** in one half of cycle base plate is positive and electrode is negative; and in next half of the cycle base plate is negative and electrode is positive. This repeats in every cycle.

