

Workshop Technology

[Metal Joining]

Metal Joining



Metal Joining

Introduction

Metal joining is defined as joining of two metal parts either temporarily or permanently with or without the application of heat or pressure.

Classification

- **Permanent**
 - Soldering
 - Brazing
 - Welding
 - Riveting
- **Semi-permanent**
 - Adhesive bonding
 - Bolting/screwing
 - Crimping
 - Shrink fitting



Metal Joining

Soldering

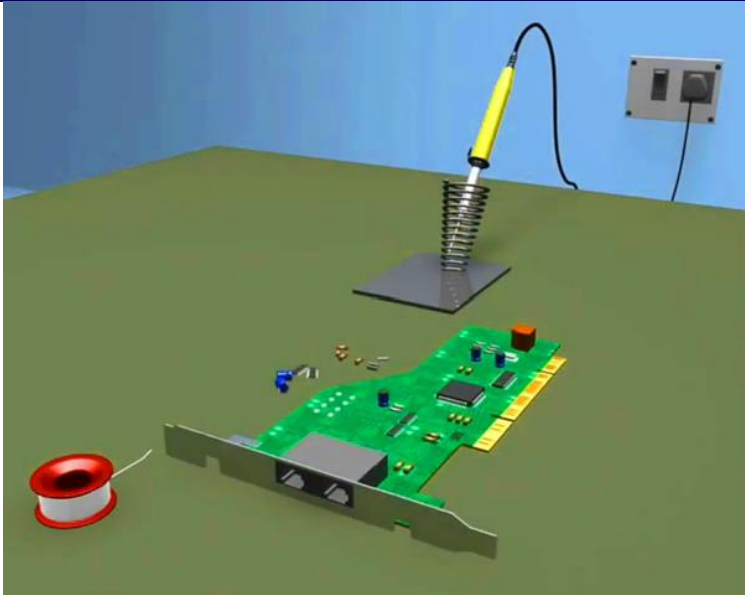
Soldering is metal joining process in which the filler metal or alloy is heated to a temperature below 450 C.

Only filler metal melts and deposits fusing the workpiece.

Extensively used in electronics and jewelry industry.



Metal Joining



Metal Joining

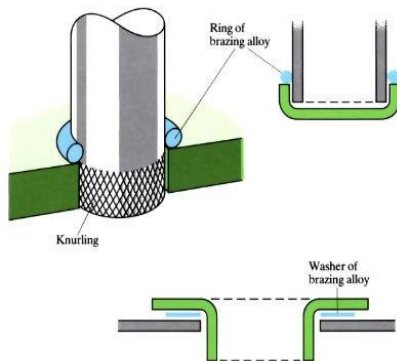
Brazing

Brazing is metal joining process in which the filler metal or alloy is heated to a temperature above melting point.

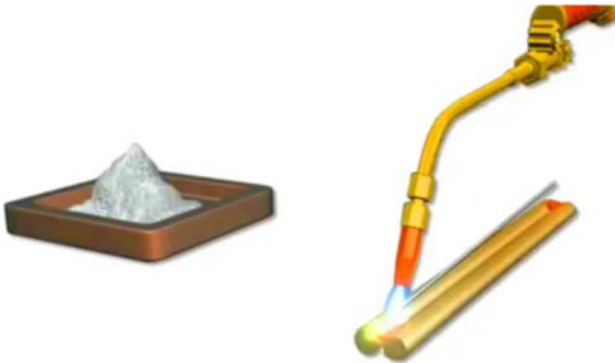
Only filler metal melts and deposits fusing the workpiece.

Workpiece doesn't melt. Base metal is heated and filler metal is distributed between two close fitting parts by capillary action.

Filler metals: Aluminum-silicon, Copper, Brass, nickel alloy, etc.



BRAZING



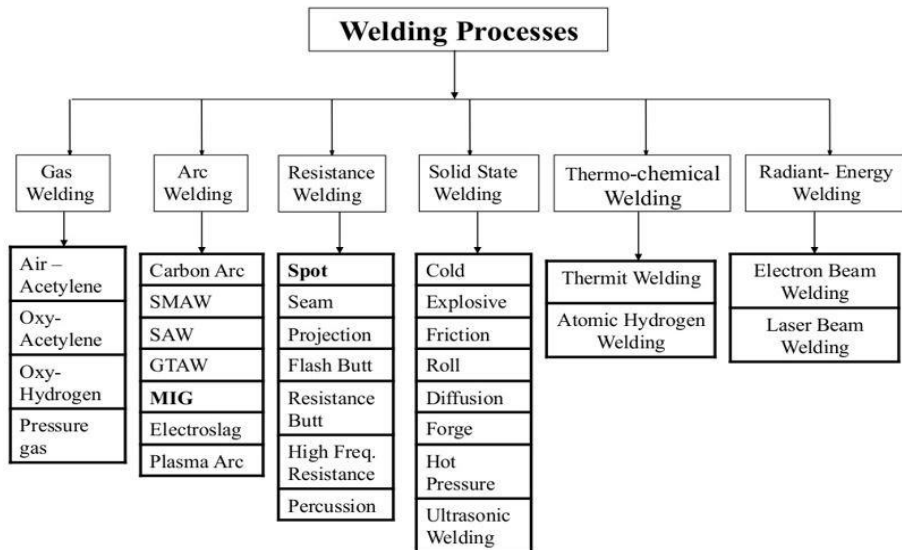
Metal Joining

Welding

Welding is a process of permanently joining metal/alloys by fusion with heat and with or without pressure. The welding process involves applying heat to the workpiece. The heat should be such that the work piece should melt, i.e. the temperature at which welding is done, should be more than the melting point of the work piece to be welded.



Classification of welding



Welding

Basic requirements

- Two metal (work pieces) should be either in contact with each other or closely placed.
- The weld surfaces should be free from oxides, paint, oil, dirt, grease, etc.
- Energy source, electrode and filler metal rod/wire
- Shielding



Welding

Gas welding

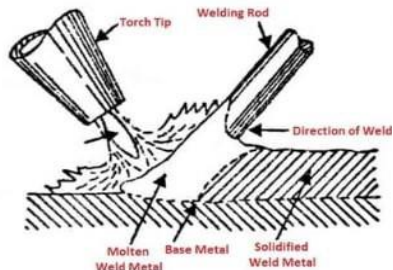
Gas welding is fusion welding process. It join metals, using heat of combustion of oxygen/air and fuel gas mixture. The intense heat thus produced melts and fuses together the edges of the parts to be welded, generally with the addition of a filler metal.

Application

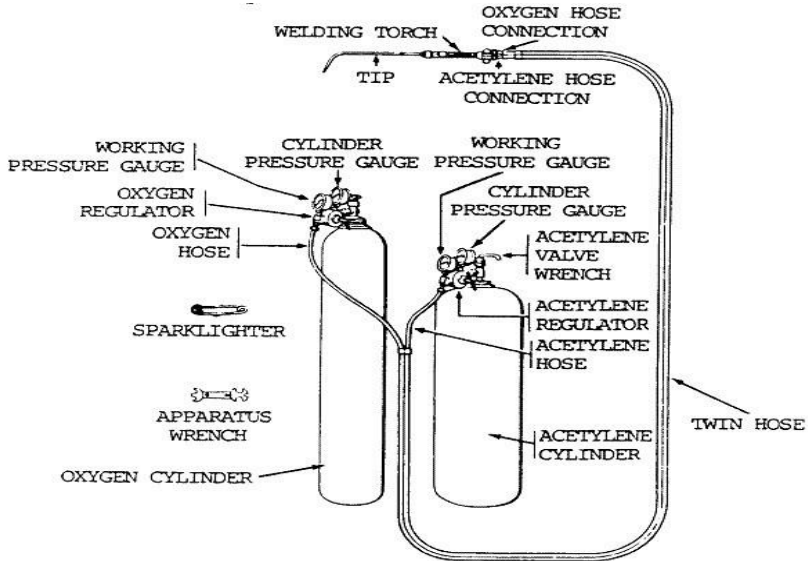
Joining thin metals

For joining most ferrous and non-ferrous metal.

In automotive and aircraft industries.



Gas welding



Welding

Arc welding

Arc welding is a process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals.

Metal arc welding

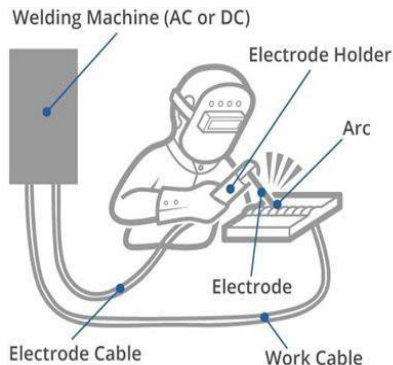
Metal inert gas (MIG) welding

Tungsten inert gas (TIG) welding

Plasma arc welding

Submerged arc welding

Electro-slag welding



Welding

Shielded metal arc welding(SMAW)

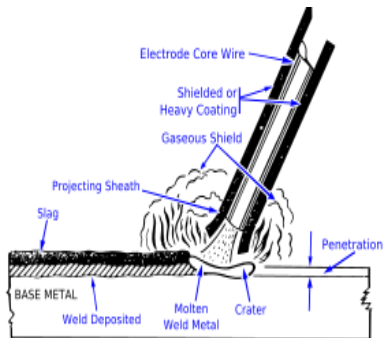
The metals are melted and joined by heating them with an arc between a consumable coated electrode and workpiece.

Electrode supplies the filler materials.
Electrode - core metal wire with an outer coating, Flux

The flux assists in creating and stabilizing the arc and it provides shielding

Flux removes impurities from molten metal in the form of **slag**.

Slag gets deposited over the weld metal, protects from rapid cooling.



Welding

Metal inert gas (MIG) welding

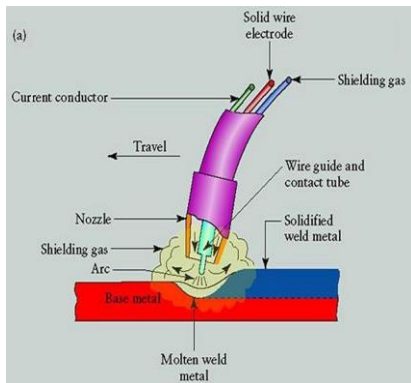
The electric arc is produced between a consumable metal wire electrode and the workpiece

During welding, the arc and welding zone are surrounded by an inert gas - argon, helium, carbondioxide

Consumable metal wire electrode - same chemical composition of base metal

Thick plates can be welded

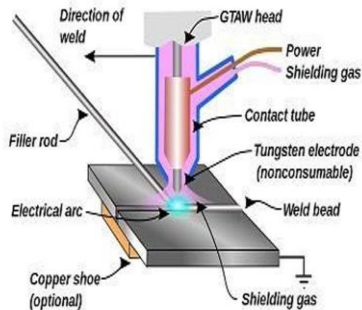
Carbon steel, stainless steel, aluminum



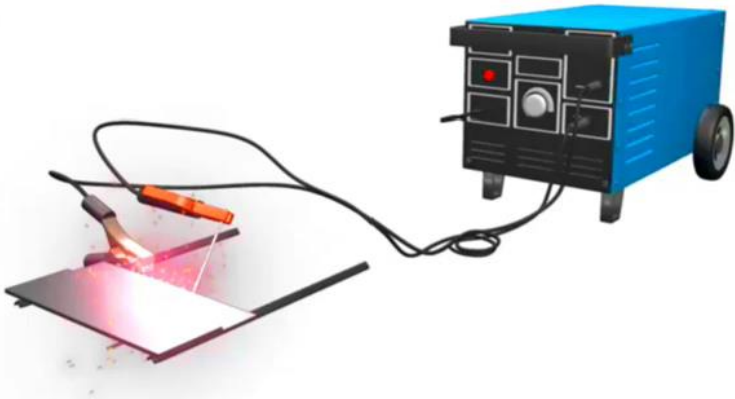
Welding

Tungsten inert gas (TIG) welding

The electric arc is produced between a non-consumable and the workpiece. The inert gas from the cylinder is passed through the nozzle of the welding head around the electrode. A filler rod may or may not be used. If a filler rod is used, it should be the same composition as the base metal. Electrode - Tungsten - high melting point, it will not melt during welding. Used in thin parts and sheet metal. Widely used in automotive industry.



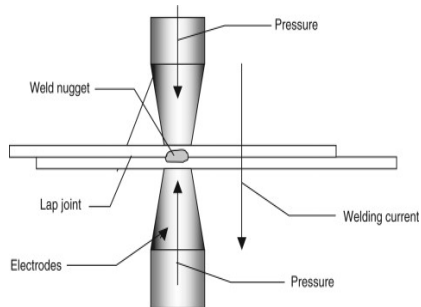
PRINCIPLE OF ARC WELDING



Welding

Resistance welding

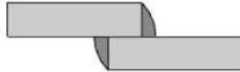
Resistance welding is a group of welding processes where fusion is produced by the heat obtained from flow of electric current in a circuit of which the work is part and by application of pressure. Pressure creates friction and the heat thus produced leads to fusion. No filler metal is used.



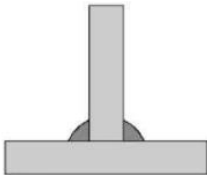
Types of welding joints



Butt Joint



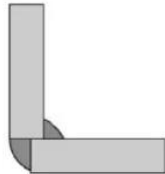
Lap Joint



Tee Joint



Edge Joint



Corner Joint

Riveting



THANK YOU !