

# 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.

Welding is used for making permanent joints.

It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

# Types

- **Plastic Welding or Pressure Welding**

The piece of metal to be joined are heated to a plastic state and forced together by external pressure

(Ex) Resistance welding

- **Fusion Welding or Non-Pressure Welding**

The material at the joint is heated to a molten state and allowed to solidify

(Ex) Gas welding, Arc welding

# Classification of welding processes

## **(i). Arc welding**

- Carbon arc
- Metal arc
- Metal inert gas
- Tungsten inert gas
- Plasma arc
- Submerged arc
- Electro-slag

## **(ii). Gas Welding**

- Oxy-acetylene
- Air-acetylene
- Oxy-hydrogen

## **(iii). Resistance Welding**

- Butt
- Spot
- Seam
- Projection
- Percussion

## **(iv) Thermit Welding**

## **(v) Solid State Welding**

- Friction
- Ultrasonic
- Diffusion
- Explosive

## **(vi) Newer Welding**

- Electron-beam
- Laser

## **(vii) Related Process**

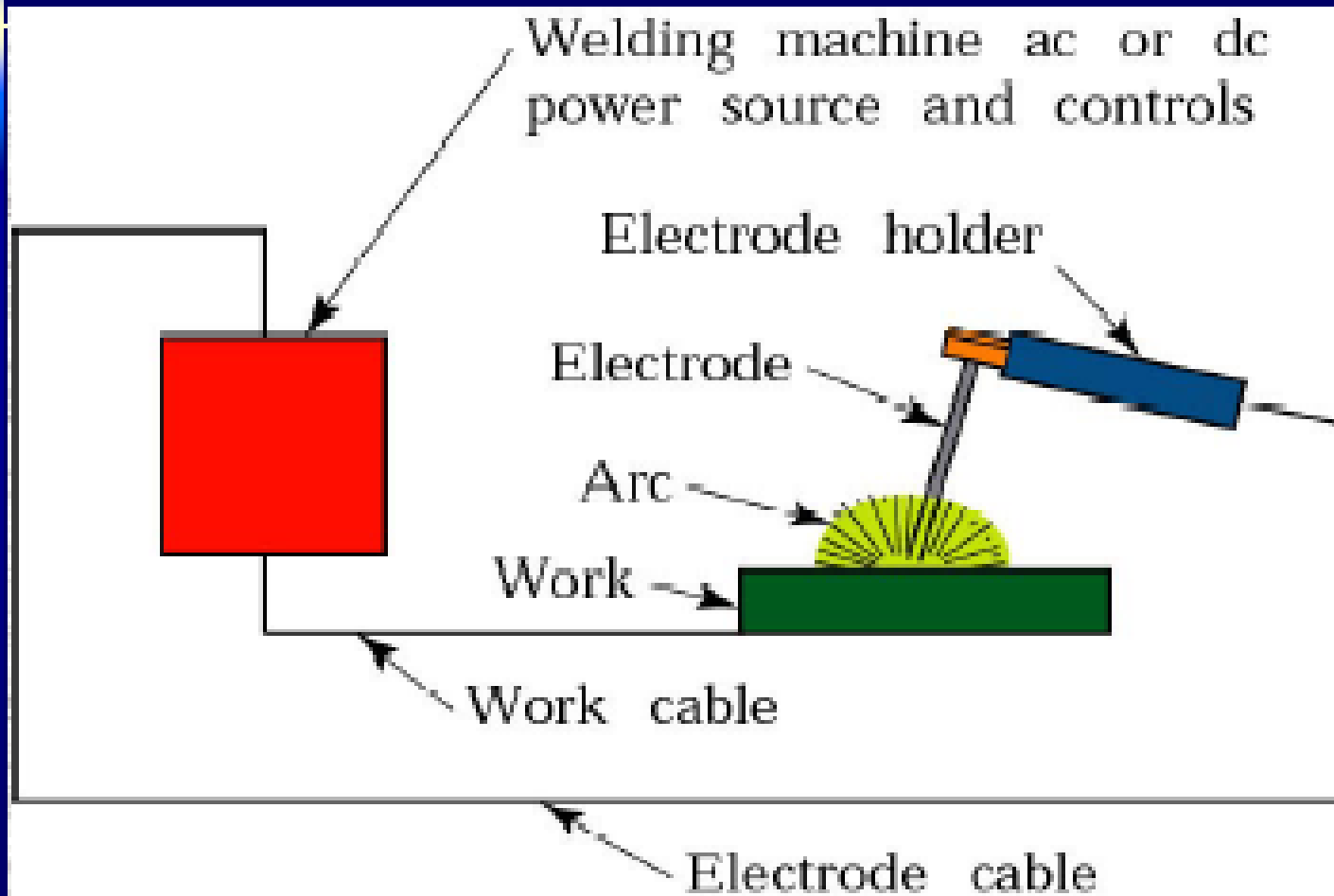
- Oxy-acetylene cutting
- Arc cutting
- Hard facing
- Brazing
- Soldering

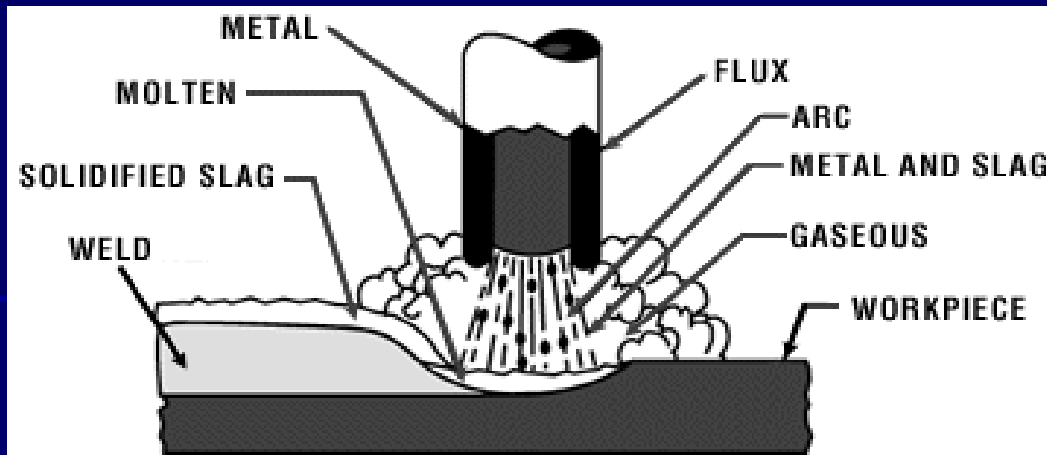
# Arc Welding

## Equipments:

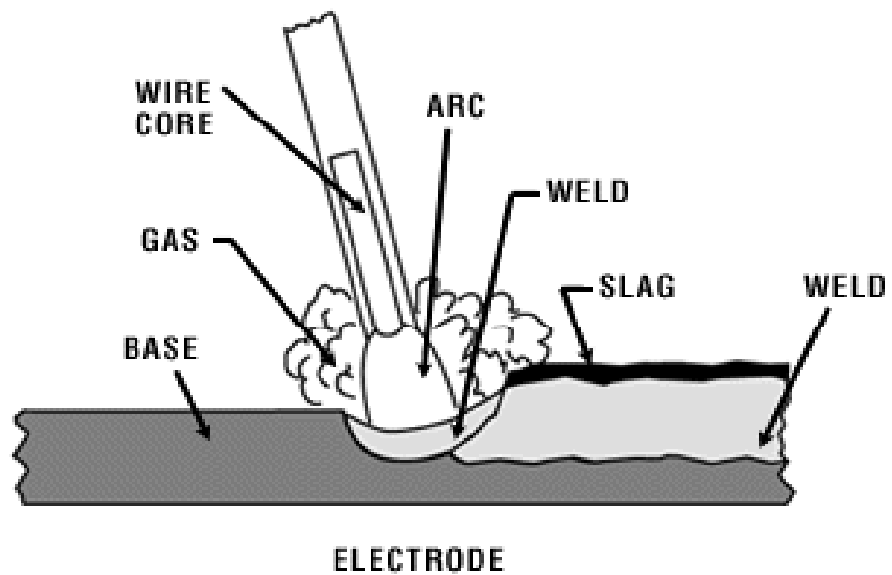
- A welding generator (D.C.) or Transformer (A.C.)
- Two cables- one for work and one for electrode
- Electrode holder
- Electrode
- Protective shield
- Gloves
- Wire brush
- Chipping hammer
- Goggles

# Arc Welding Equipments





**STICK WELDING PROCESS**



# Arc Welding



- Uses an electric arc to coalesce metals
- Arc welding is the most common method of welding metals
- Electricity travels from electrode to base metal to ground

# Arc Welding

## Advantages

- Most efficient way to join metals
- Lowest-cost joining method
- Affords lighter weight through better utilization of materials
- Joins all commercial metals
- Provides design flexibility

## Limitations

- Manually applied, therefore high labor cost.
- Need high energy causing danger
- Not convenient for disassembly.
- Defects are hard to detect at joints.



# Comparison of A.C. and D.C. arc welding

## Alternating Current (from Transformer)

- More efficiency
- Power consumption less
- Cost of equipment is less
- Higher voltage – hence not safe
- Not suitable for welding non ferrous metals
- Not preferred for welding thin sections
- Any terminal can be connected to the work or electrode

# Comparison of A.C. and D.C. arc welding

## Direct Current (from Generator)

- Less efficiency
- Power consumption more
- Cost of equipment is more
- Low voltage – safer operation
- suitable for both ferrous non ferrous metals
- preferred for welding thin sections
- Positive terminal connected to the work
- Negative terminal connected to the electrode

# GAS WELDING / OAW

- Sound weld is obtained by selecting proper size of flame, filler material and method of moving torch
- The temperature generated during the process is 33000c
- When the metal is fused, oxygen from the atmosphere and the torch combines with molten metal and forms oxides, results defective weld
- Fluxes are added to the welded metal to remove oxides
- Common fluxes used are made of sodium, potassium. Lithium and borax.
- Flux can be applied as paste, powder, liquid, solid coating or gas.

# GAS WELDING EQUIPMENT

## 1. Gas Cylinders

### Pressure

- Oxygen – 125 kg/cm<sup>2</sup>
- Acetylene – 16 kg/cm<sup>2</sup>

## 2. Regulators

- Working pressure of oxygen 1 kg/cm<sup>2</sup>
- Working pressure of acetylene 0.15 kg/cm<sup>2</sup>
- Working pressure varies depends upon the thickness of the work pieces welded.

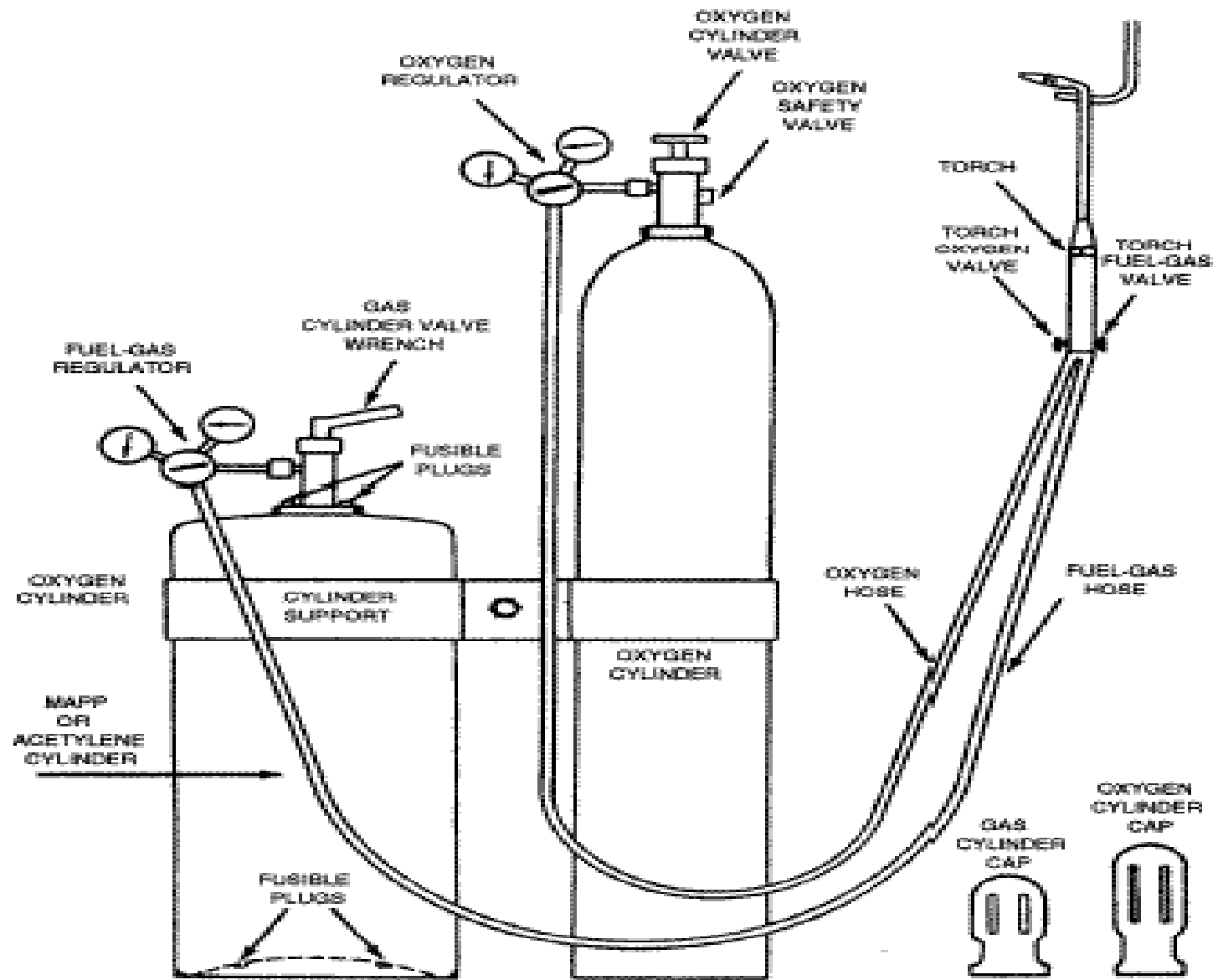
## 3. Pressure Gauges

## 4. Hoses

## 5. Welding torch

## 6. Check valve

## 7. Non return valve

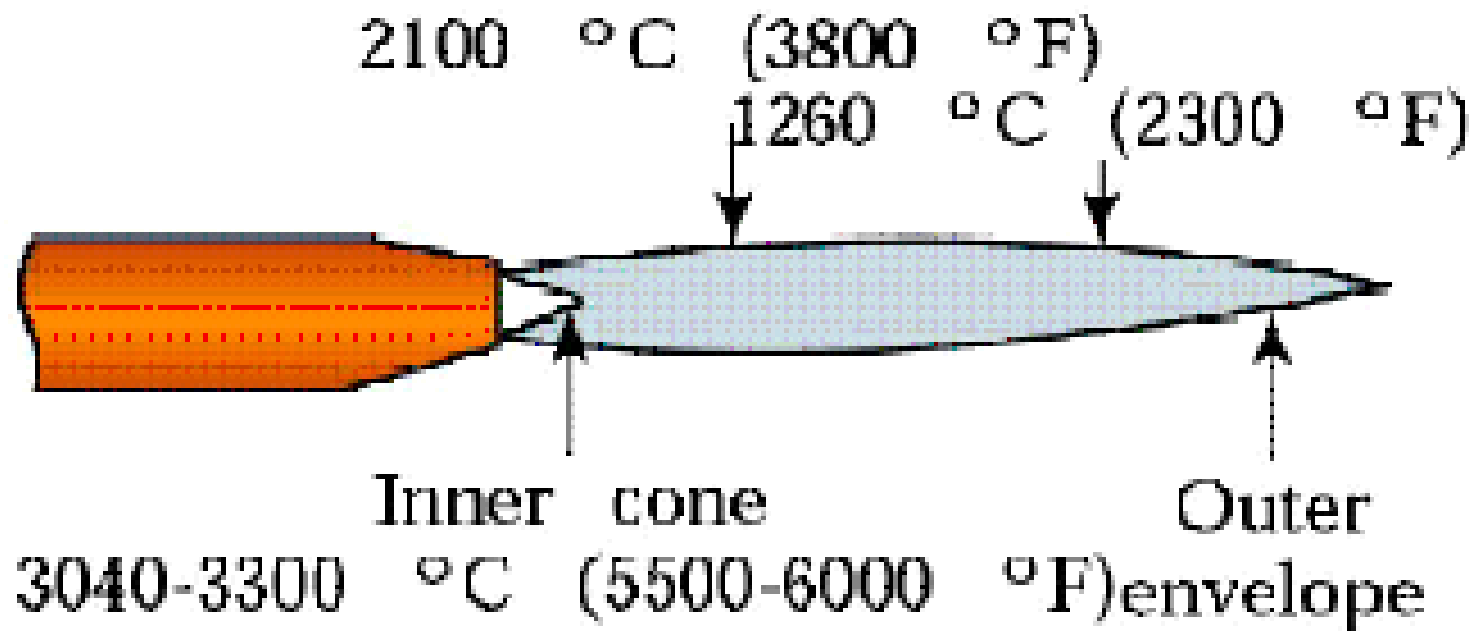


# TYPES OF FLAMES...

- Oxygen is turned on, flame immediately changes into a long white inner area (Feather) surrounded by a transparent blue envelope is called **Carburizing flame** (30000c)
- Addition of little more oxygen give a bright whitish cone surrounded by the transparent blue envelope is called **Neutral flame** (It has a balance of fuel gas and oxygen) (32000c)
- Used for welding steels, aluminium, copper and cast iron
- If more oxygen is added, the cone becomes darker and more pointed, while the envelope becomes shorter and more fierce is called **Oxidizing flame**
- Has the highest temperature about 34000c
- Used for welding brass and brazing operation

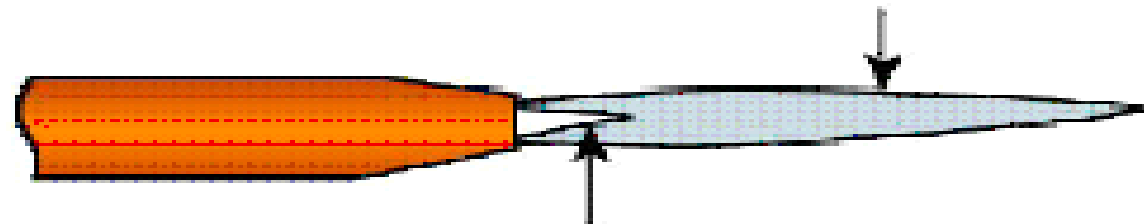
Three basic types of oxyacetylene flames used in oxyfuel-gas welding and cutting operations: (a) neutral flame; (b) oxidizing flame; (c) carburizing, or reducing flame.

(a) Neutral flame



(b) Oxidizing flame

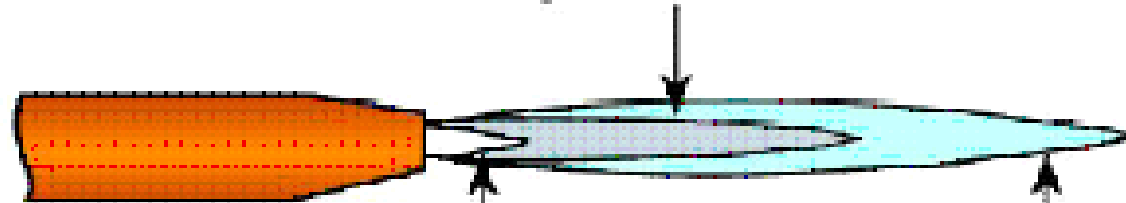
Outer envelope  
(small and narrow)



Inner cone  
(pointed)

(c) Carburizing (reducing) flame

Acetylene feather



Bright luminous  
inner cone

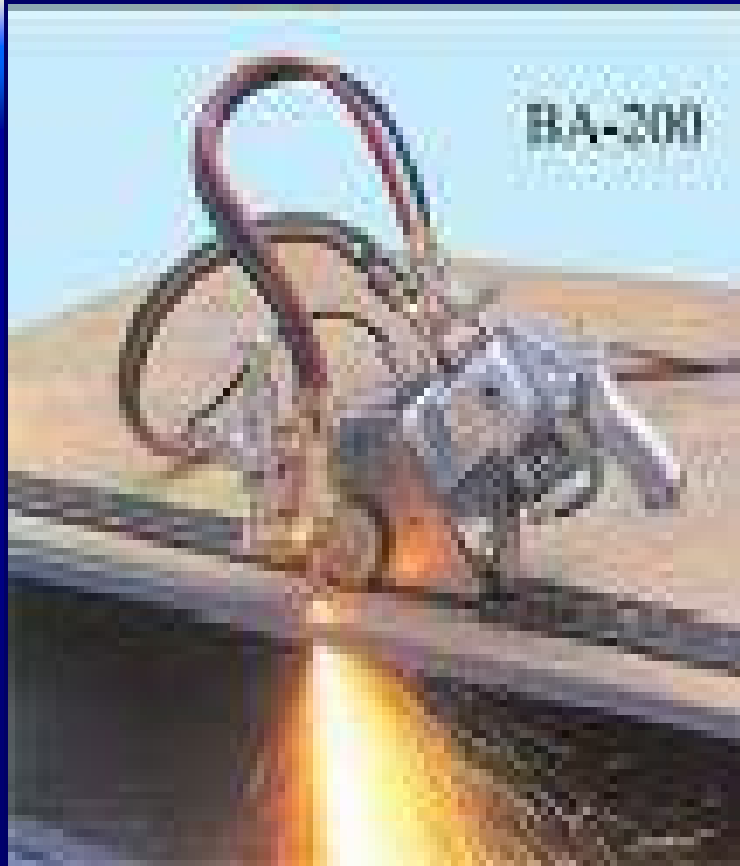
Blue envelope



# GAS CUTTING

- Ferrous metal is heated in to red hot condition and a jet of pure oxygen is projected onto the surface, which rapidly oxidizes
- Oxides having lower melting point than the metal, melt and are blown away by the force of the jet, to make a cut
- Fast and efficient method of cutting steel to a high degree of accuracy
- Torch is different from welding
- Cutting torch has preheat orifice and one central orifice for oxygen jet
- **PIERCING** and **GOUGING** are two important operations
- **Piercing**, used to cut a hole at the centre of the plate or away from the edge of the plate
- **Gouging**, to cut a groove into the steel surface

# Automatic and Manual Gas Cutting



# Brazing and Soldering

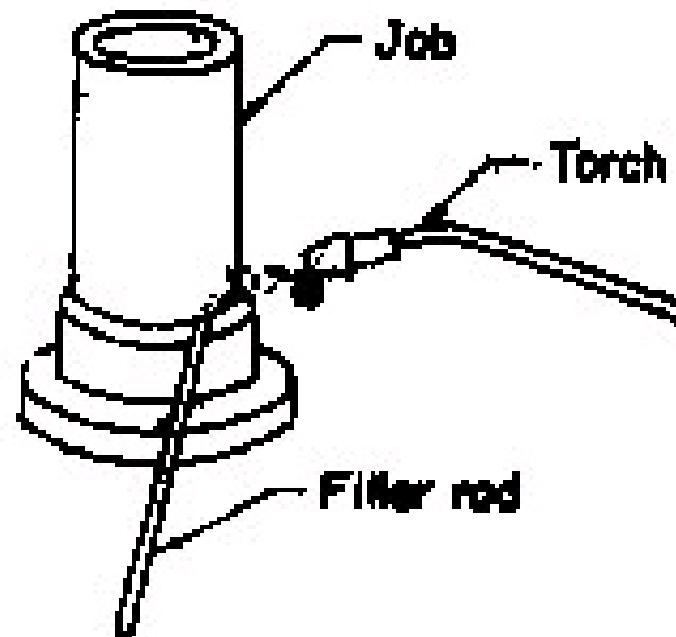
## ■ Brazing

It is a low temperature joining process. It is performed at temperatures above 840° F and it generally affords strengths comparable to those of the metal which it joins. It is low temperature in that it is done below the melting point of the base metal. It is achieved by diffusion without fusion (melting) of the base

### ■ **Brazing can be classified as**

1. Torch brazing
2. Dip brazing
3. Furnace brazing
4. Induction brazing

# Brazing



**BRAZING**

# Advantages

# & Disadvantages

## Advantages

- Dissimilar metals which cannot be welded can be joined by brazing
- Very thin metals can be joined
- Metals with different thickness can be joined easily
- In brazing thermal stresses are not produced in the work piece. Hence there is no distortion
- Using this process, carbides tips are brazed on the steel tool holders

## Disadvantages

- Brazed joints have lesser strength compared to welding
- Joint preparation cost is more
- Can be used for thin sheet metal sections

# Soldering

- It is a low temperature joining process. It is performed at temperatures below 840°F for joining.
- Soldering is used for,
  - Sealing, as in automotive radiators or tin cans
  - Electrical Connections
  - Joining thermally sensitive components
  - Joining dissimilar metals

