UNIT V

MIG & GAS WELDING, SOLIDEING, BRAZING

Basic Civil and Mechanical Engineering

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GAS METAL ARC WELDING (GMAW) OR MIG (METAL INERT GAS WELDING)

- An arc welding process that uses an arc between a continuous filler metal electrode and the weld pool with shielding from an externally supplied gas and without the application of pressure

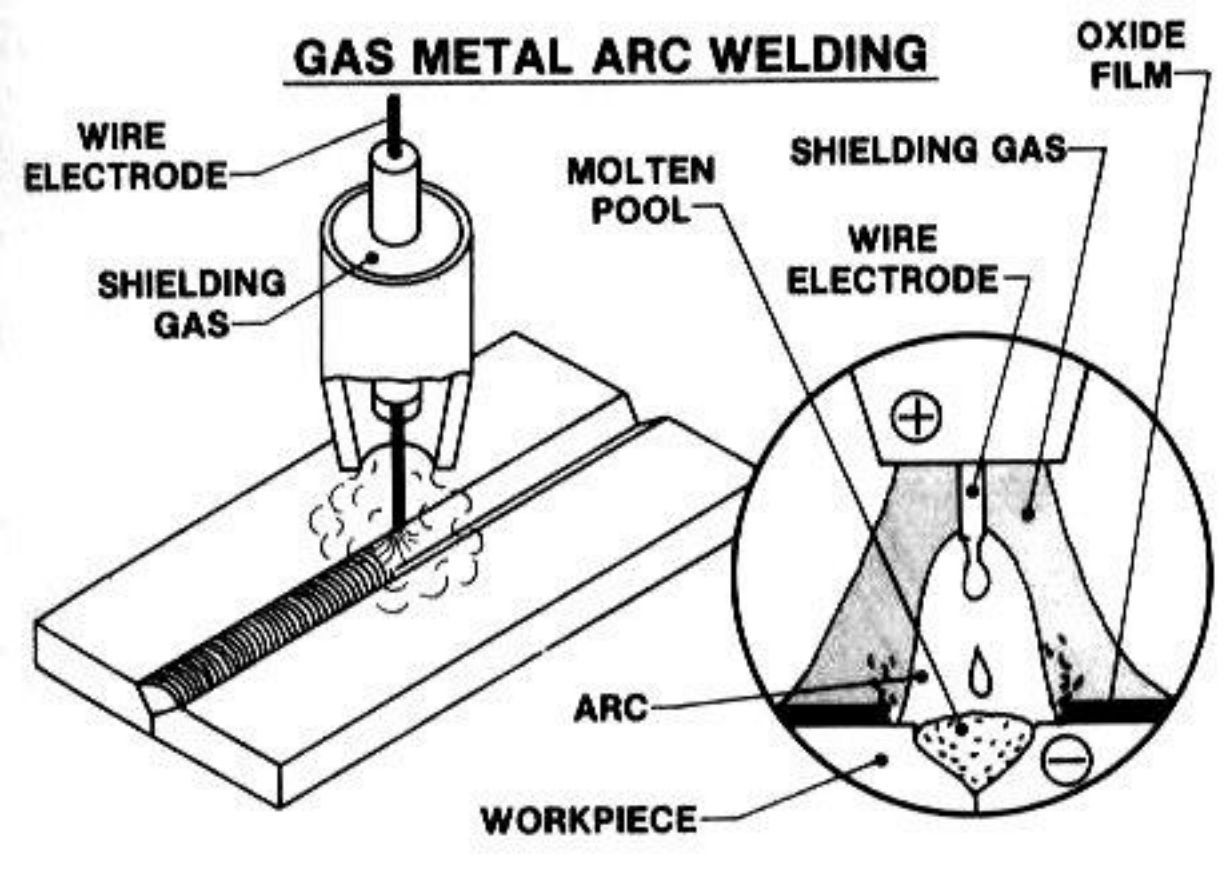
INTRODUCTION

- GMAW is defined as arc welding using a continuously fed consumable electrode and a shielding gas.
- Arc can be shielded by an active (Co2) or inert (Ar,He).
- If the inert gas is used then it is termed as MIG (Metal Inert Gas) and if shielding gas is active gas (like Co2 , mixture of Co2 +O2 or Co2+H2) GMAW is called as MAG (Metal Active Gas) welding.
- Produces high-quality welds
- Yields high productivity

PRINCIPLE OF OPERATION

- The gas metal arc welding uses the heat of an arc between a continuously fed consumable electrode and the work to be welded.
- The heat of the arc melt the surface of the base metal and the end of the electrode.
- The metal melted off the electrode is transferred across the arc to the molten pool.
- An envelope of gas fed through the nozzle provides shielding of molten pool, the arc, and surrounding area.

MIG (METAL INERT GAS WELDING)



ADVANTAGES

- ✓ High operating factor
- ✓ High deposition rates
- ✓ High utilization of filler metal
- ✓ Welding can be done in all positions
- ✓ Automation is possible
- ✓ No slag removal required, No slag inclusion
- ✓ High welding speeds
- ✓ High weld quality
- ✓ Less distortion of work piece

GMAW Vs SMAW

PROCESS	Heat	Shielding	Filler Material	Power Source
SMAW	Electric Arc	Inert Gas (Flux)	Stick Electrode	Constant Current
GMAW	Electric Arc	Inert Gas	Wire Electrode	Constant Voltage

GMAW can be used to weld the metal thickness from 0.13mm upward can be welded .

JOINT DESIGN

- Almost all joint designs are possible
- As similar that of SMAW process
- But, low groove angle (45^o instead of 60^o)
- Almost all metals and alloys
- Almost all thicknesses
- 0.13mm onwards

GMAW EQUIPMENT

- Three major elements are :

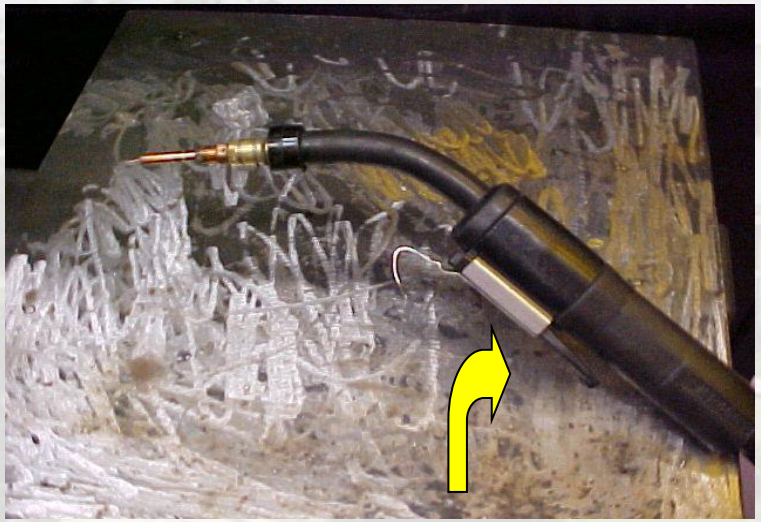
  1) Welding torch and accessories

  2) Welding control & Wire feed motor

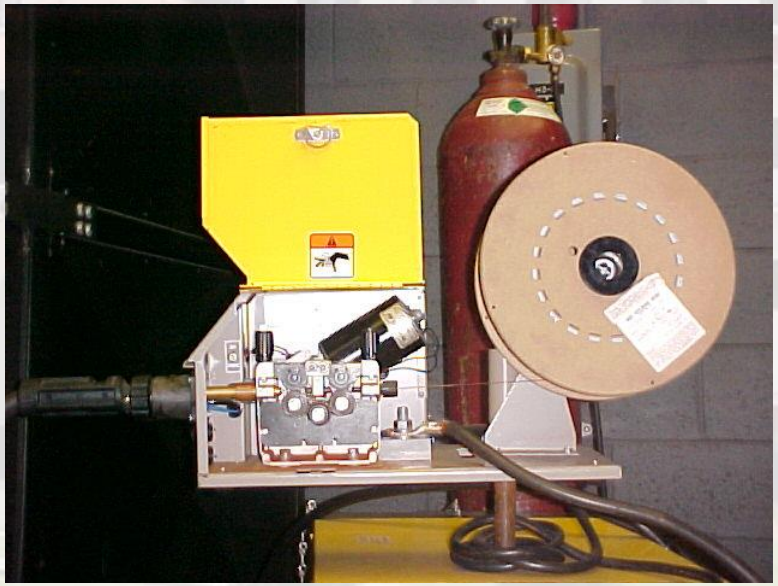
  3) Power Source

  4) Travel and guidance mechanism

- GMAW equipment can be used either manually or automatically



TRIGGER



WIRE CONTROL
&
WIRE FEED MOTOR

POWER SOURCE

SHIELDING GASES

- Purpose of shielding gas is the protect the weld area from the contaminants in the atmosphere
- Gas can be Inert, Reactive, or Mixtures of both
- Argon, Helium, and Carbon Dioxide are the main three gases used in GMAW

QUALITY OF WELD

- High quality welds obtained than compared with SMAW

➔ No flux melting required
➔ No / Low hydrogen process

- But it depends on,

➔ Electrode wire and its cleanliness,
➔ Joint cleanliness
➔ Purity of the shielding gases
➔ Position of welding & Welding procedure
➔ Presence of wind
➔ Skill of the welder

OXY-FUEL WELDING (OFW) OR GAS WELDING

- Oxy-fuel gas Welding (OFW) Is a group of welding processes that produces coalescence of workpiece by heating them with an oxy-fuel gas flame. The processes are used with or without the application of pressure, and with or without filler metal.

  Three major processes with in this group

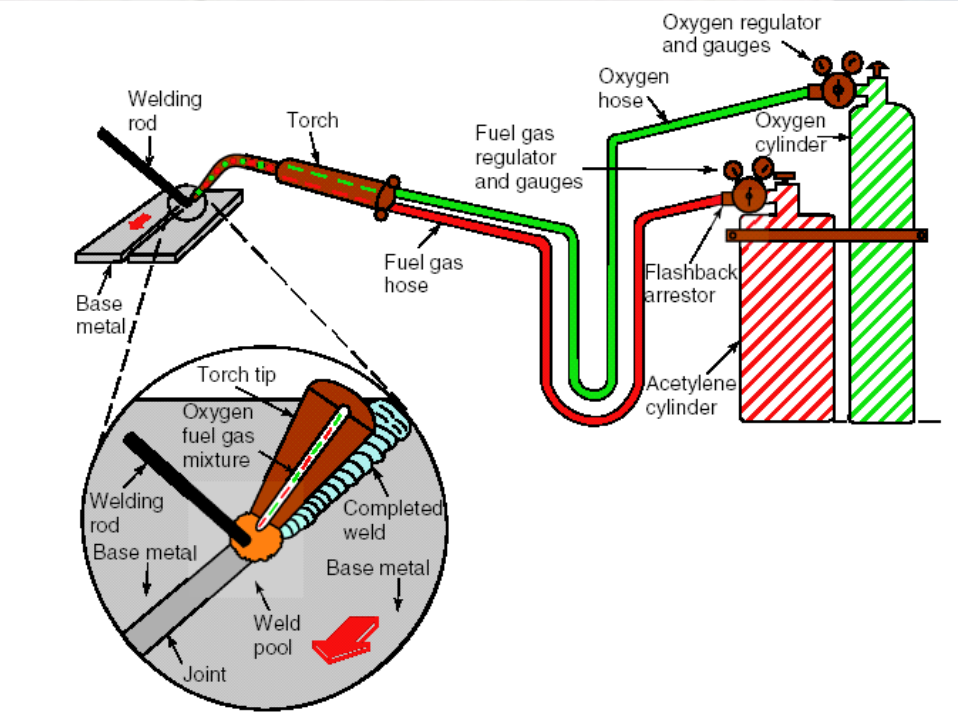
  1. oxyacetylene welding,
  2. oxy-hydrogen welding
  3. pressure gas welding

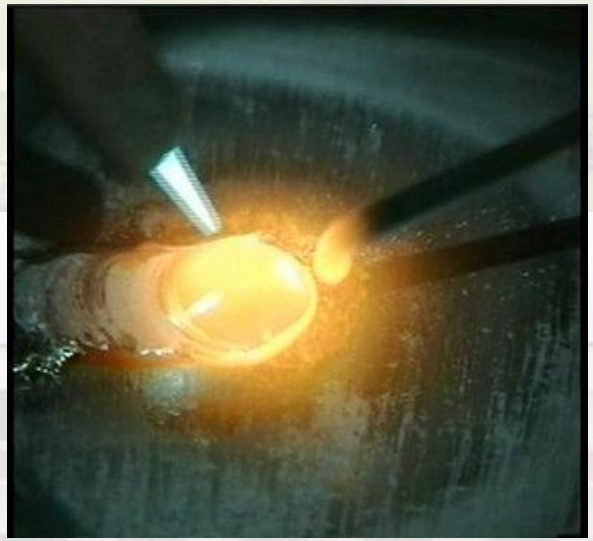
- Uses the hydrogen has the fuel gas → welding of Al
- PGW that produces a weld simultaneously over the entire faying surfaces. Pressure is applied and without filler metal.

OXY- ACETYLENE WELDING (OAW)

- ✓ The oxyacetylene welding process uses a combination of oxygen and acetylene (OAW) gas to provide a high temperature flame. Most popular process.
- ✓ High temperature flame is produced by combustion of acetylene with oxygen and directed by a torch.
- ✓ The intense heat of the flame 3,428˚C melts the surface of the base metal to form a molten pool.
- ✓ Filler metal can be added to fill gaps or grooves.

OXY- ACETYLENE WELDING (OAW)





OXY- ACETYLENE WELDING (OAW)

Advantages:

- It's easy to learn
- Cheaper than most other types of welding
- Portable than most other types of welding
- Can also be used for cutting of materials

Disadvantages:

- OA weld lines are much rougher
- OA welds have large heat affected zones

Materials Suitable for OA Welding:

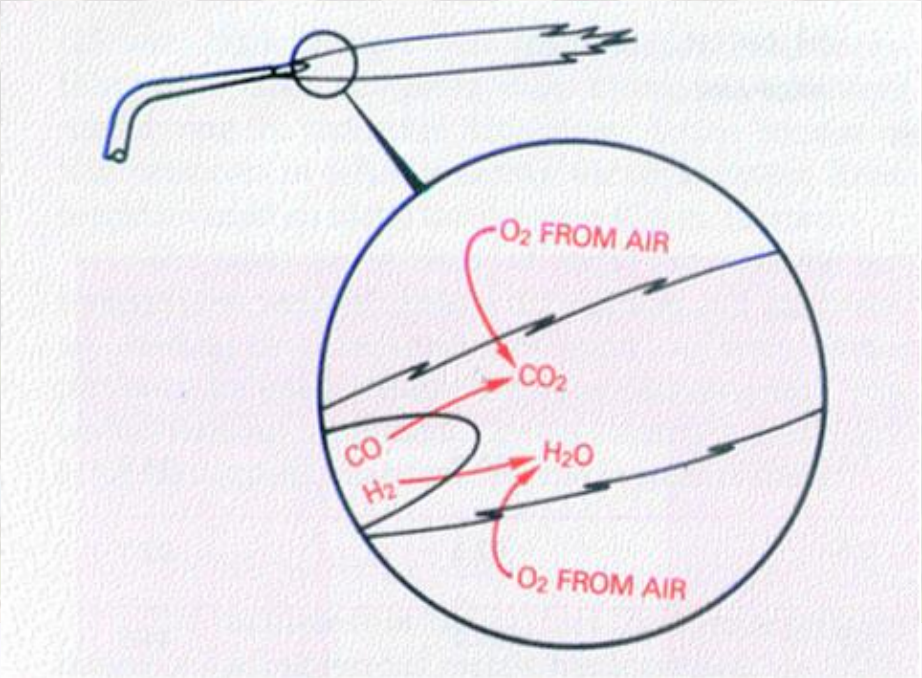
Most steels

Brass

OXY-ACETYLENE FLAME

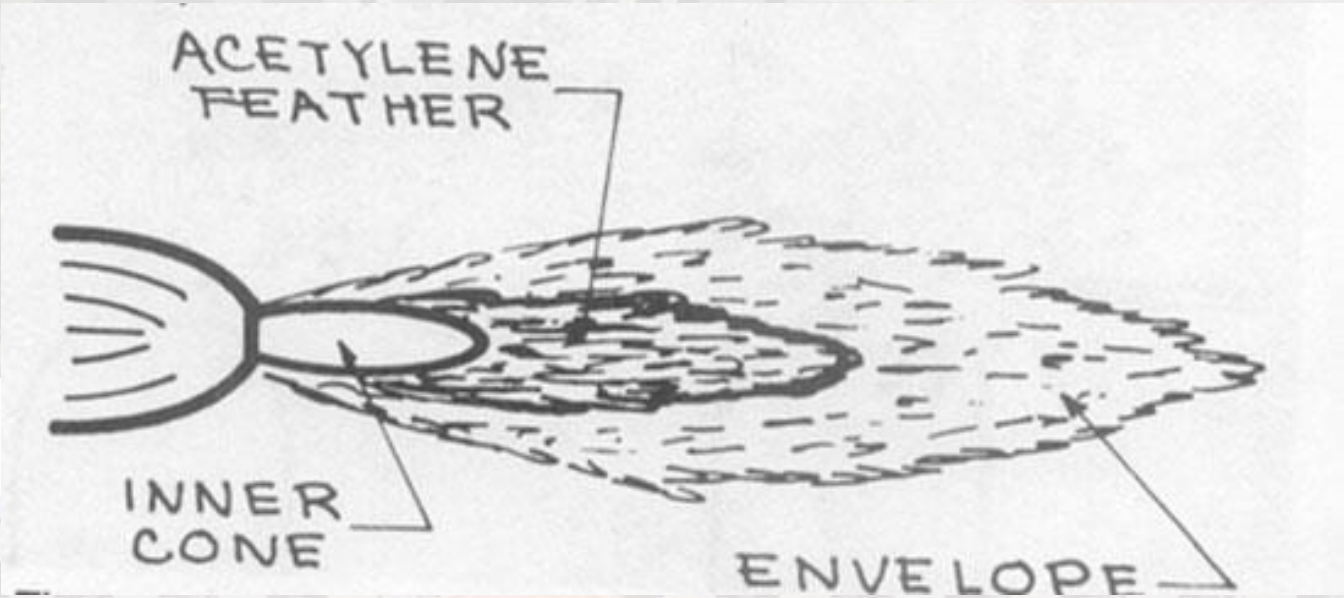
- Complete combustion of 1 volume of acetylene requires 2.5 volumes of oxygen

- Equal in torch, remainder from atmosphere



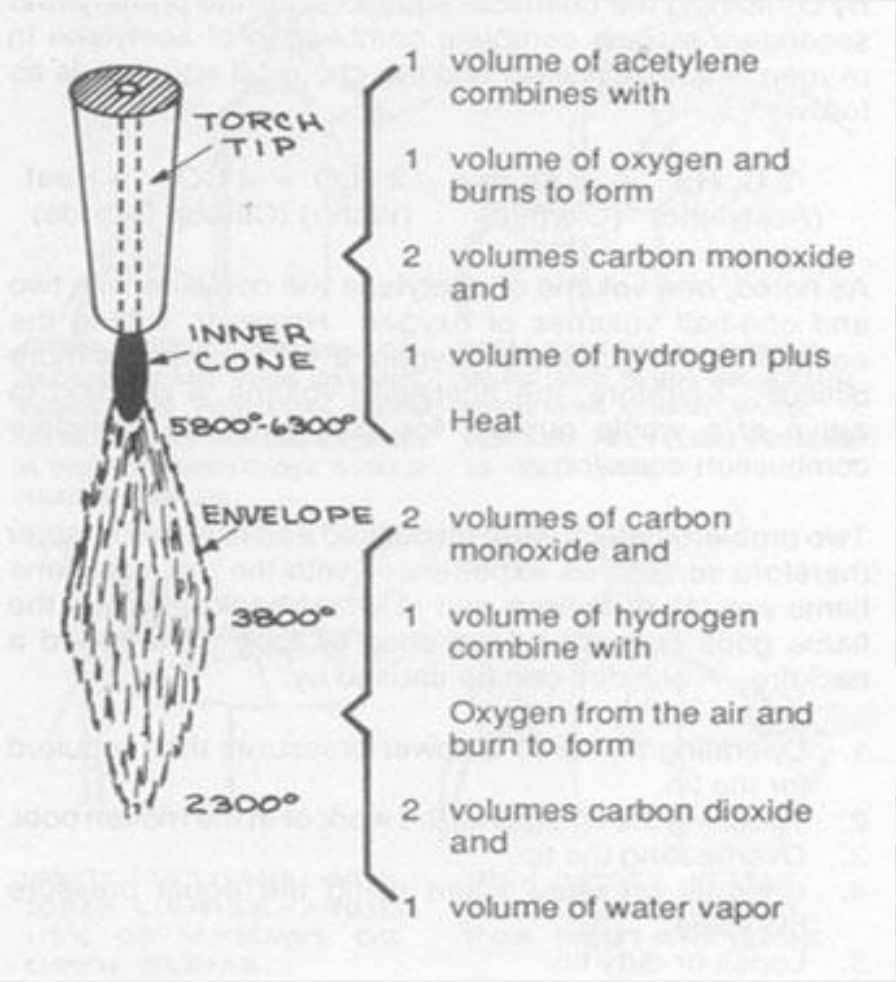
PARTS OF THE OXY-ACETYLENE FLAME

The Oxy-Acetylene Flame is not uniform throughout its length ,and combustion also different in different parts of the flame.



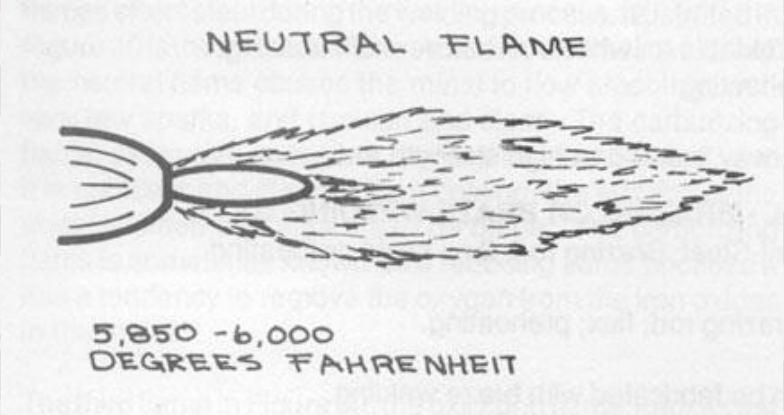
3 TYPES OF FLAME

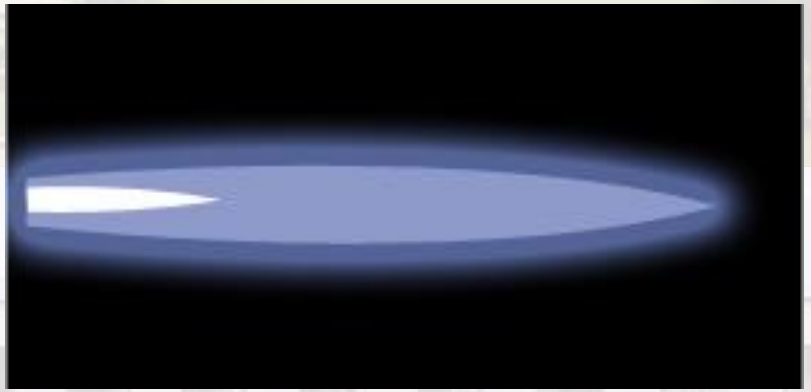
1. Neutral – balance of fuel gas and oxygen. (1:1)
2. Oxidizing – more oxygen than fuel gas
3. Carburizing or Acetylene flame – more fuel gas than oxygen.



NEUTRAL FLAME

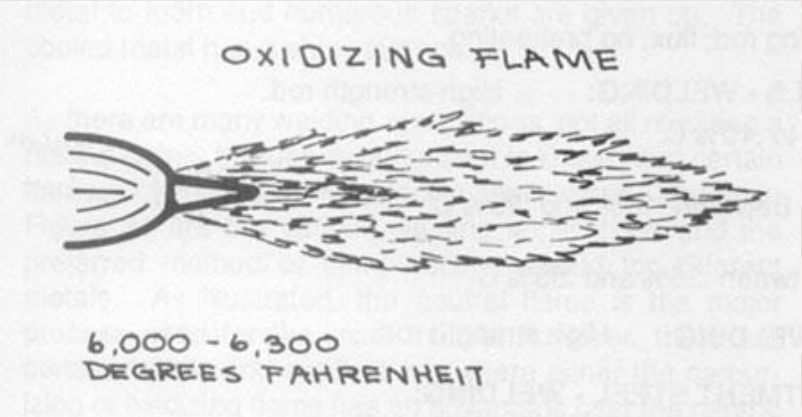
- Has only an inner cone and an envelope
- 3,315 ℃ at the end of the inner cone
- Inner cone has rounded blunt shape.
- Most welding procedures use the neutral flame.

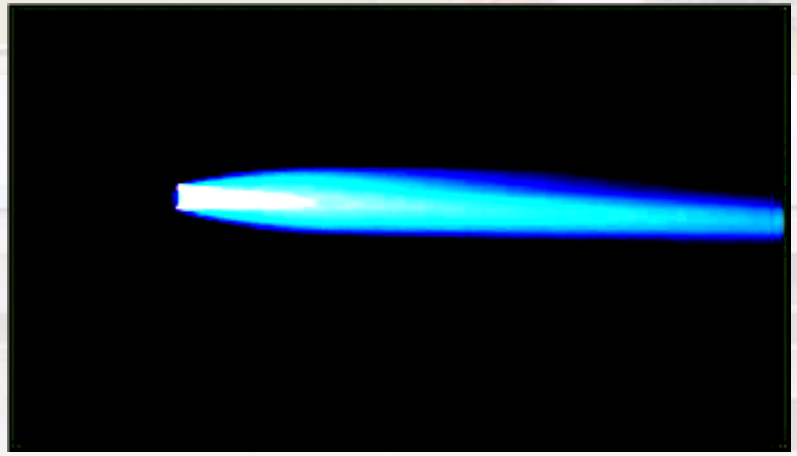




OXIDIZING FLAME

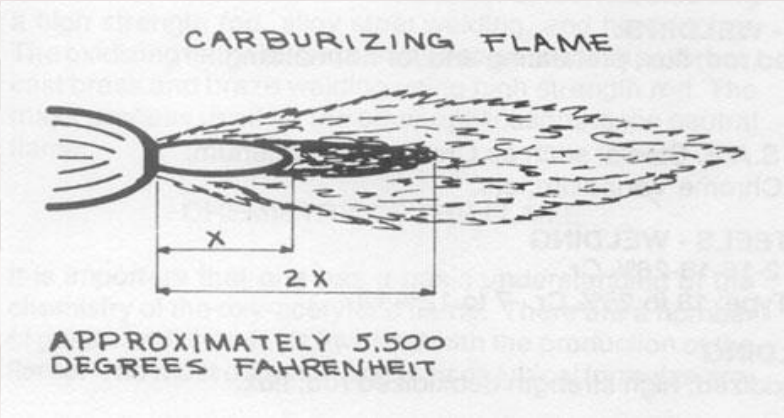
- ✖ Has only inner cone and envelope
- ✖ Inner cone is short and pointed or sharp
- ✖ Inner cone is very bright white 3482℃
- ✖ Has a roar or hissing sound
- ✖ This may tend to oxidize the weld metal and is used only for welding specific metals.





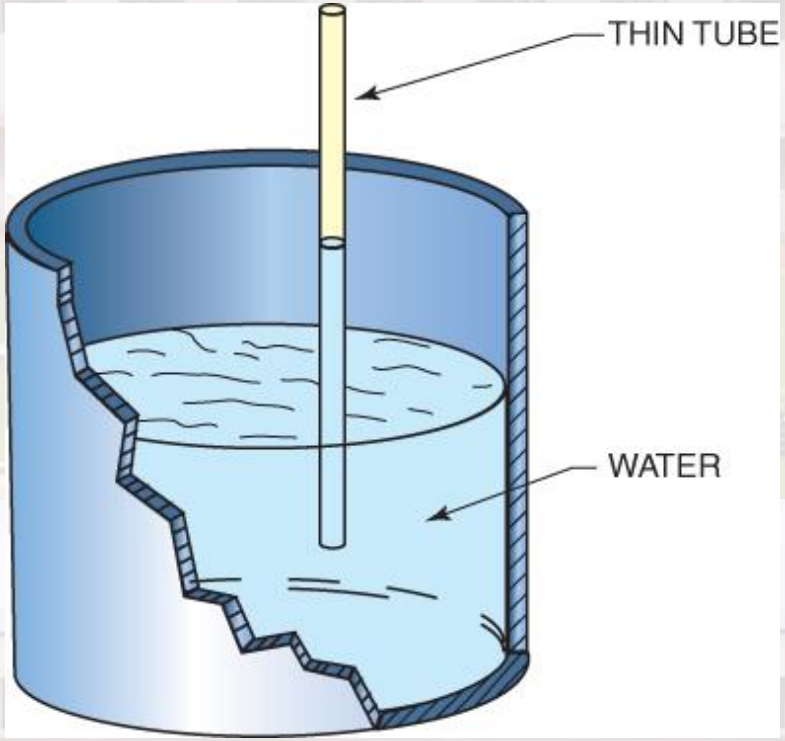
CARBURIZING FLAME

- This flame is characterized by three flame zones; the hot inner cone, a white-hot "acetylene feather", and the blue-colored outer cone.
- Flame includes the acetylene feather.
- If the acetylene feather is twice as long as the inner cone, it is known as a 2X flame, which is way of expressing excess acetylene.
- 3037 $^{\circ}C$
- Length of feather varies by the amount of acetylene.
- Carburizing Flame may add carbon to the weld metal.
- The reducing flame is the flame low in oxygen.



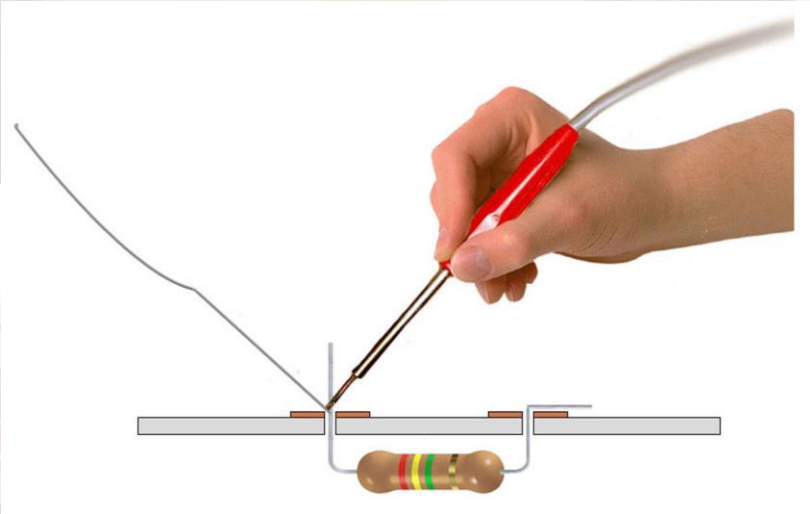
SOLDERING

- Soldering is a method of joining similar or dissimilar metals by means of filler metals whose liquidus temp is **below 450˚C.**
- Strength of the joint is limited by the strength of the filler metals.
- Not suitable for high temp services.
- In joint design the filler metals enters the joint by **CAPILLARY action**.
- Cleaning should be done periodically for the proper bonding



SOLDERING

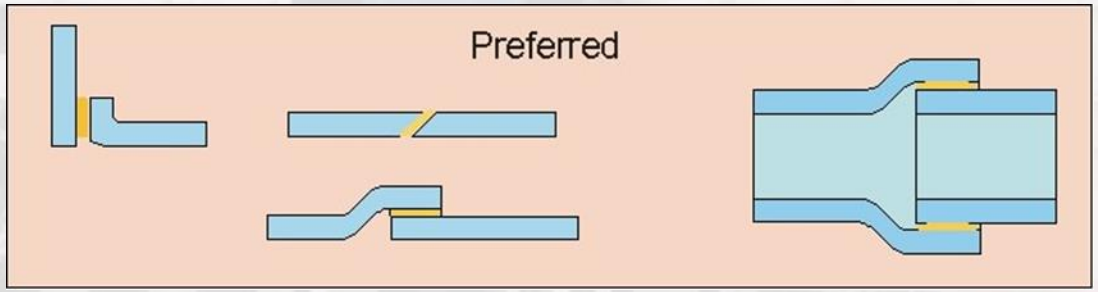
- Solders(Filler metal) commonly used is Tin, Lead, Au, Cd, Zn.
- Soldering iron is Copper rod.
- Power rating is 15 – 200W.
- Mostly used to weld electronic Components.



BRAZING

- A process that uses a metal alloy that melts above 450 ºC, but less than the melting point of the base metal.
- Brazing relies on capillary action to draw the filler metal into the joint or to keep it in the joint.
- The joint area is mechanically cleaned and fluxed
- The joint is assembled.
- A heat source is used to raise the temperature of the base metal above the melting of the filler metal (450˚C).
- The filler metal is added to the joint.
- The filler metal flows into the joint and adheres to the surfaces.
- The heat source is removed and the filler metal solidifies, bonding the surfaces together.

BRAZING JOINTS



- The tensile strength of brazing filler material is less than steel.
- The strength of the weld is increased if the joints are modified to increase the surface area.

SOLDERING VS. BRAZING

- Solders considerably weaker than brazes
- Some brazes approach strength of welds
- Brazing can hide the braze & color-match the workpiece
- Soldering under 450°C
- Brazing over 450°C
- Solders: Pb, Sn, Sb, Cd
- Braze Filler Metals:
  - Ag, Cu, Sn, Cd, Zn, Al, Ni, Si, P

ADVANTAGES AND DISADVANTAGES

❖ **Advantages of Soldering and Brazing**:

Low temperature

Permanently or temporarily joined

Dissimilar materials can be joined

Speed of joining

Less chance of damaging parts

Slow rate of heating and cooling

Parts of varying thicknesses can be joined

Easy realignment

❖ **Disadvantage**

- Service Temp

THANK YOU