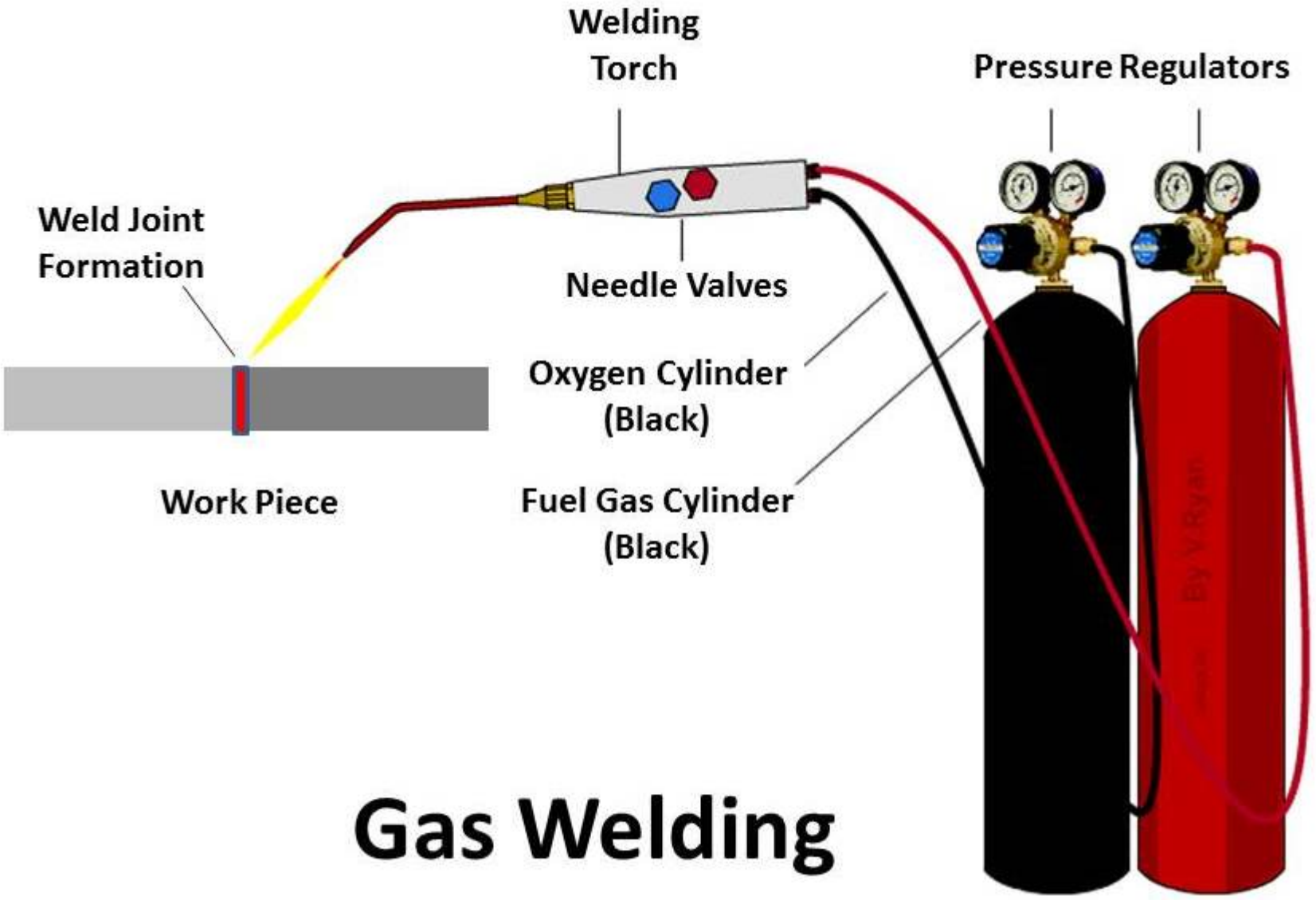
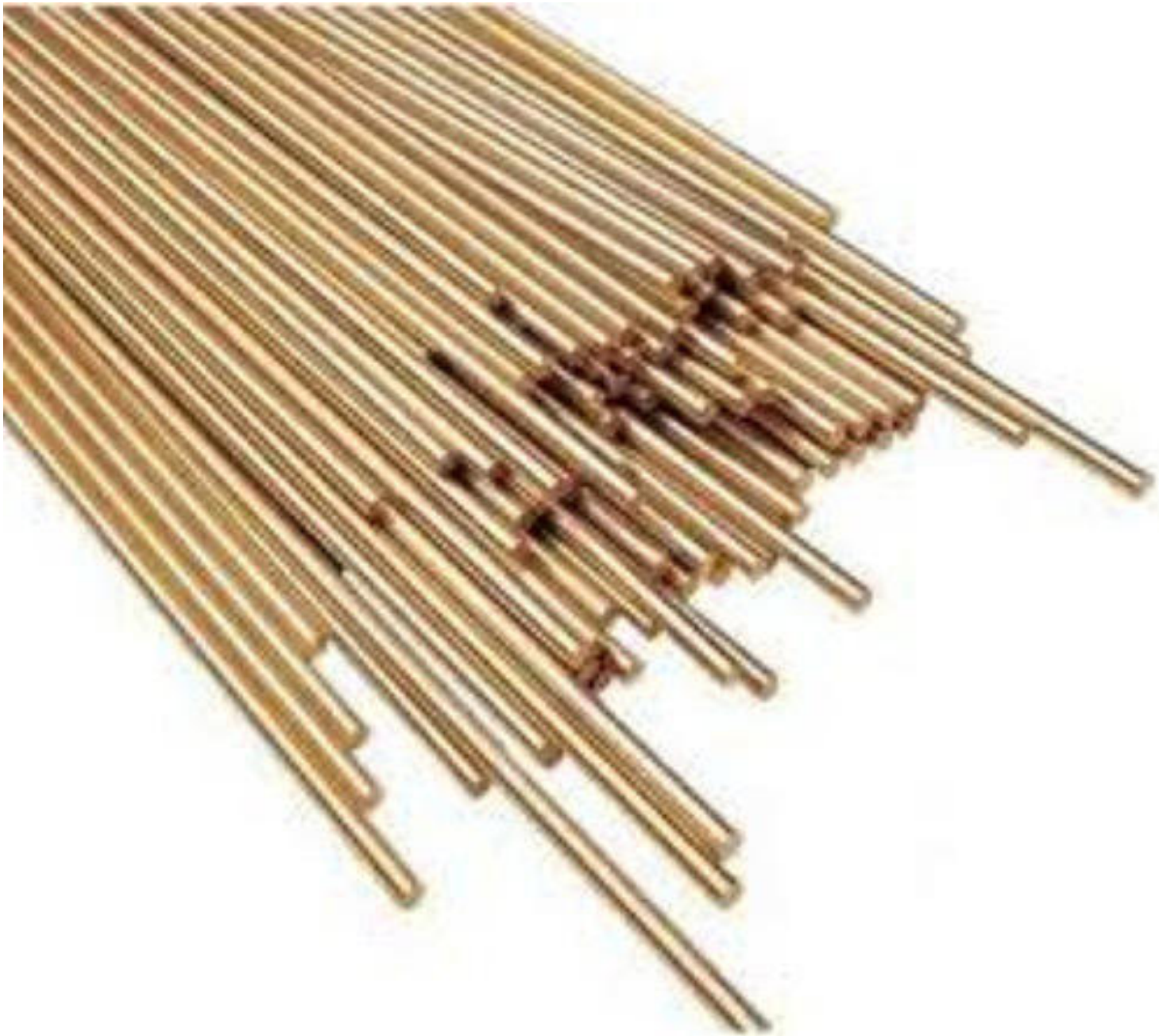
# WELDING


Welding
Torch
Pressure Regulators
Weld Joint
Formation
Needle Valves
Oxygen Cylinder
(Black)
Work Piece
Fuel Gas Cylinder
(Black)

# Gas Welding

- For producing acetylene, the reaction of calcium carbide ($CaC_2$) with water ($H_2O$) is used, whereas acetylene and lime ($Ca(OH)_2$) is generated.
- an acetylene/oxygen flame produce a temperature of 3,500 ℃



# Oxyfuel Gas Welding

- Welding process that uses fuel gas combined with oxygen to produce flame
- This flame heat melts the metals at the joint
- Acetylene fuel is used in gas welding process

Primary combustion process

$$C_2H_2 + O_2 \longrightarrow 2CO + H_2 + heat$$

- This reaction dissociates into carbon monoxide and hydrogen.

Secondary combustion process

$$2CO + H_2 + 1.5\ O_2 \qquad 2CO_2 + H_2O + heat$$

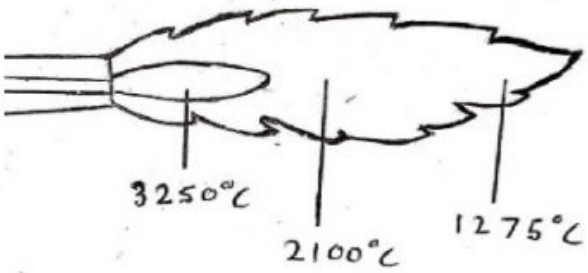
# Welding Flame Types

Carburizing Flame

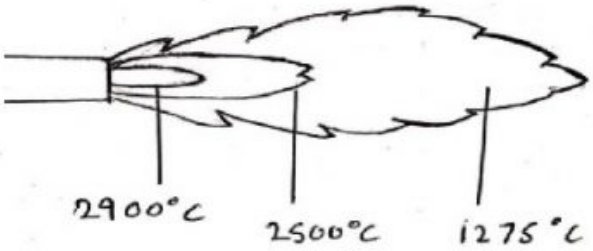
Neutral Flame

Oxidizing Flame

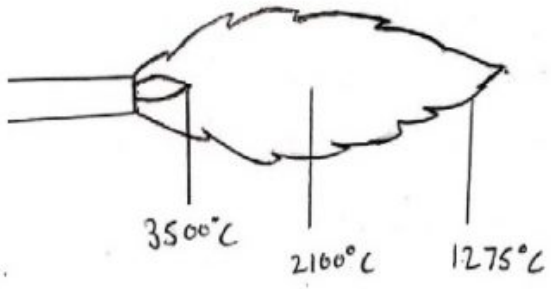
# DIFFERENT TYPES OF WELDING FLAMES




**Neutral or Balanced Flame**




**Reducing or Carburizing Flame**




**Oxidizing Flame**

# GAS CUTTING

- **Gas welding is the process in which a gas flame is used to raise the temperature of the metals to be joined.**

- **The metals are heated up to melting. The metal flows and on cooling it solidifies.**

- **A filler metal may be added to the flowing molten metal to fill up cavity made during the end preparation.**

- **Welding is a fabrication process where two or more parts are fused together by means of heat.**

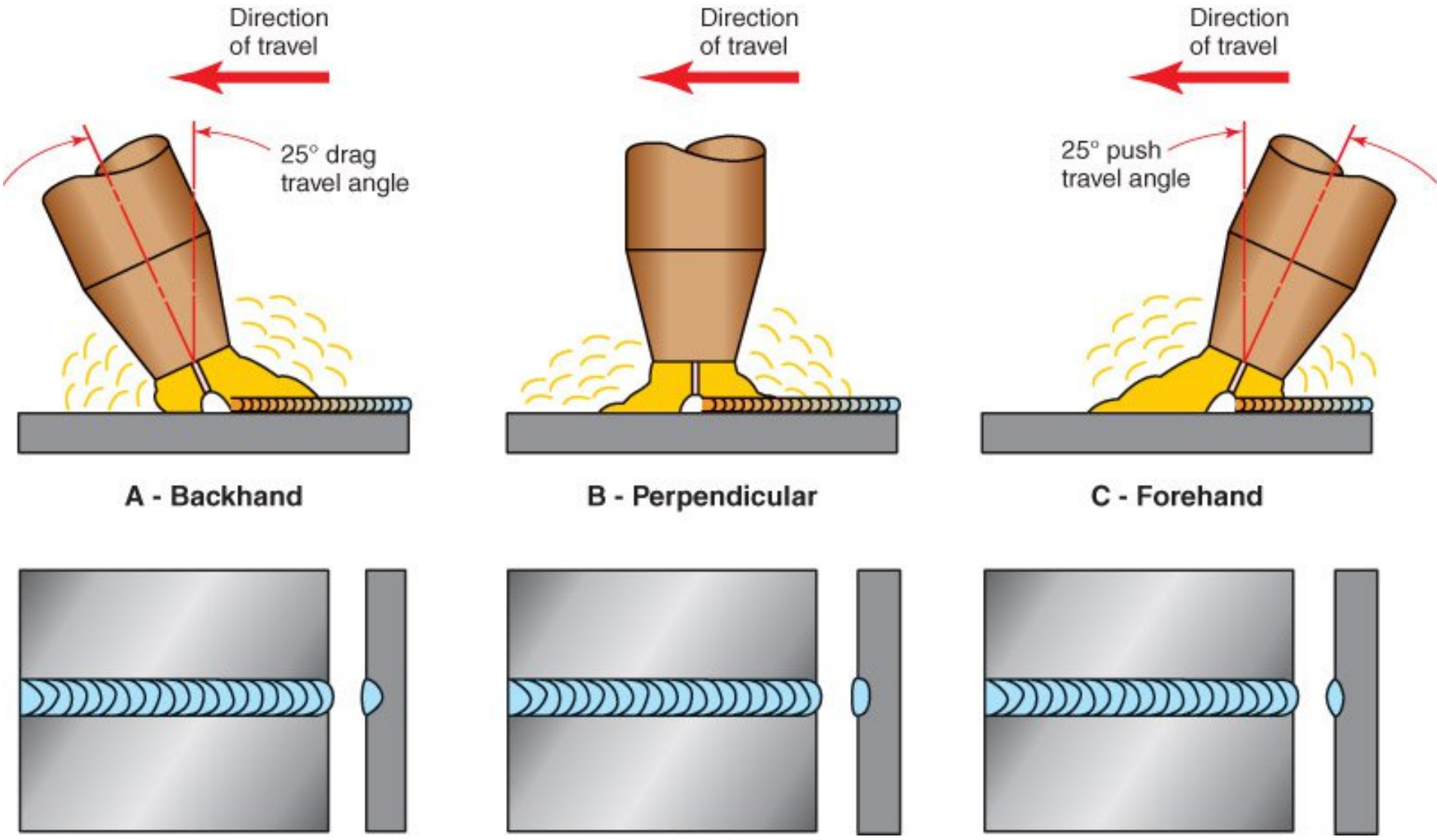
- **The completed welded joint may be called as a weldment.**

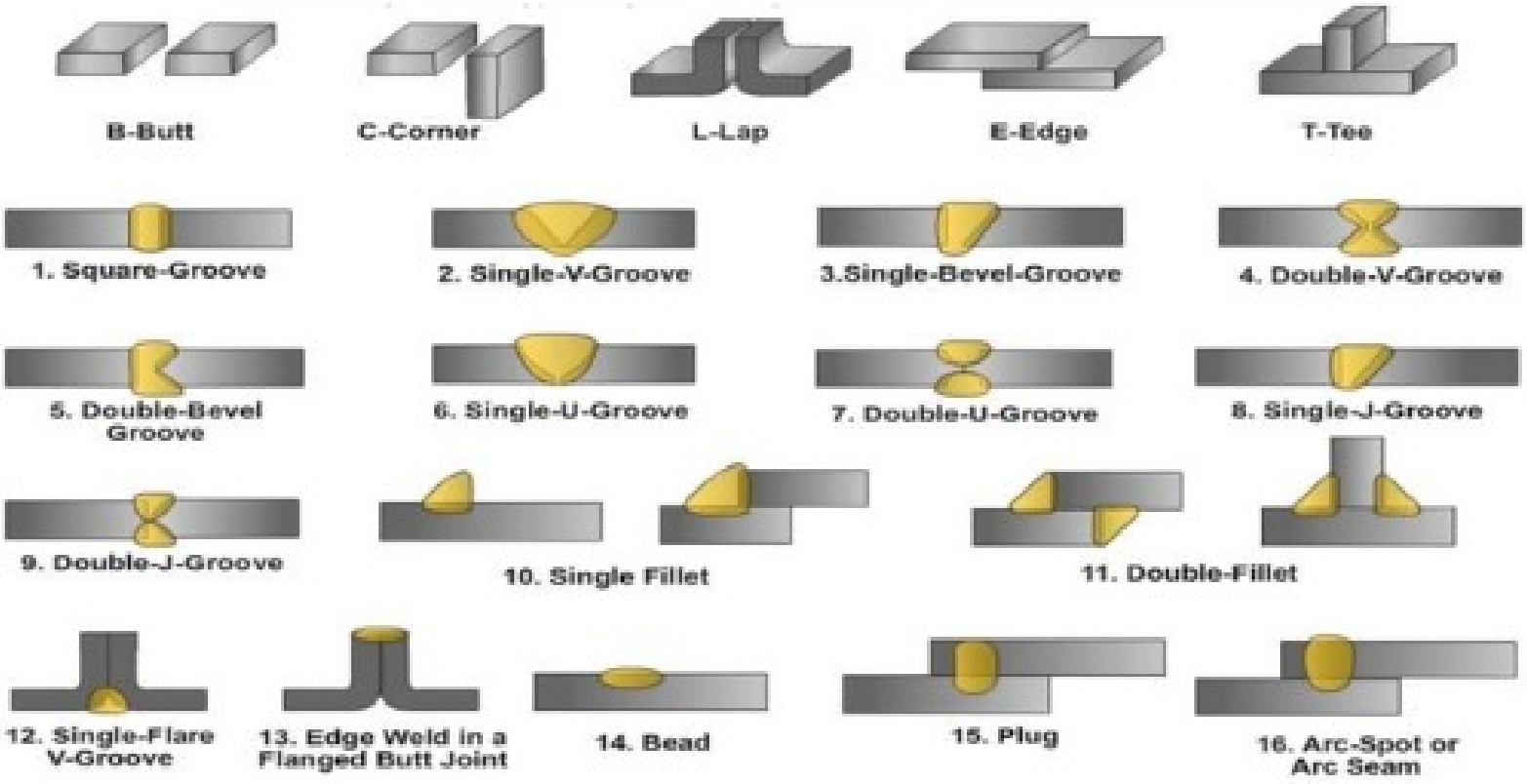
- **Applications of gas welding include welding of hot water pipes, gas bottles, nuclear heat exchangers and boilers.**

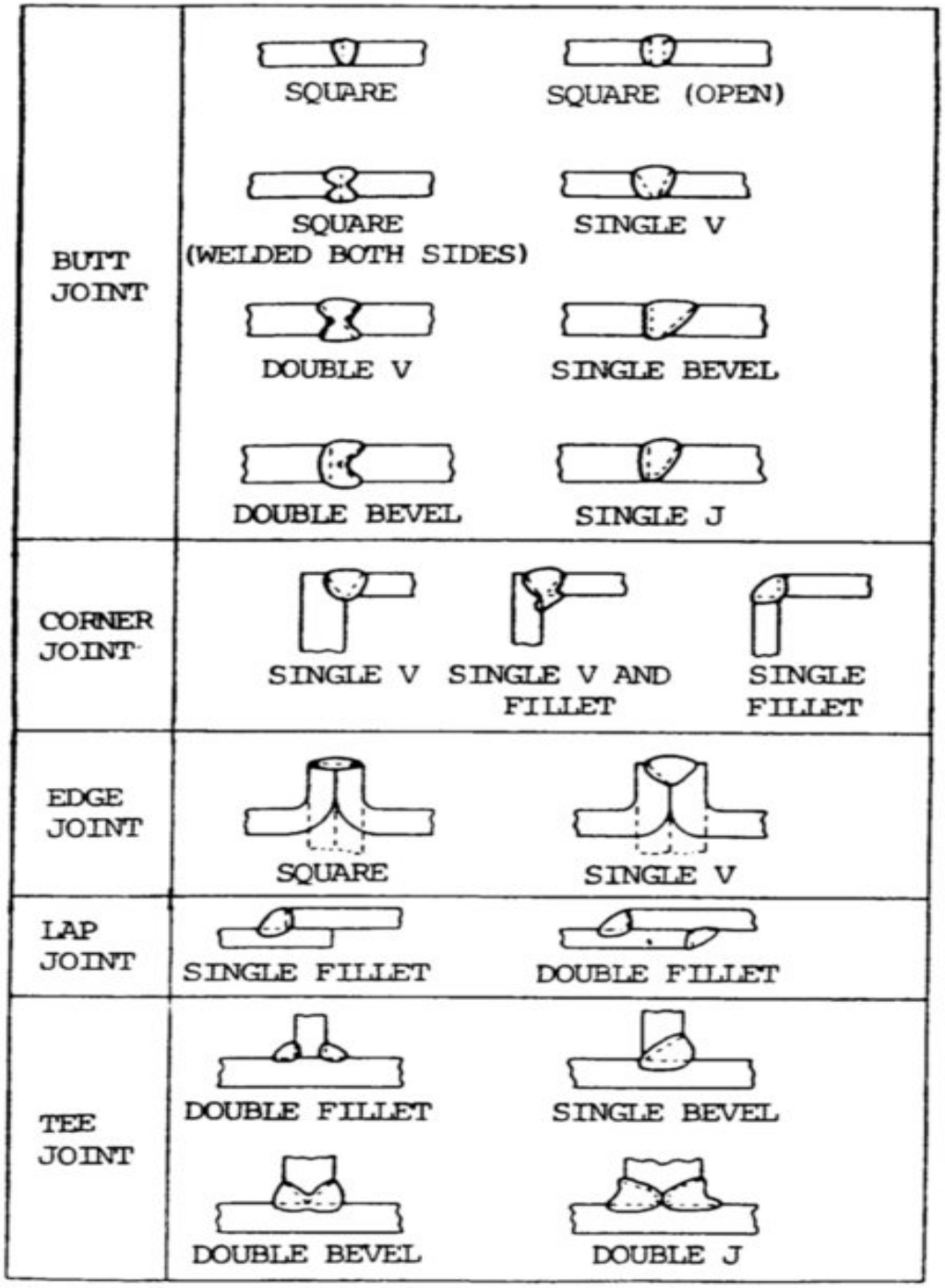
- **Slow heating and cooling can avoid the risk of hardening.**

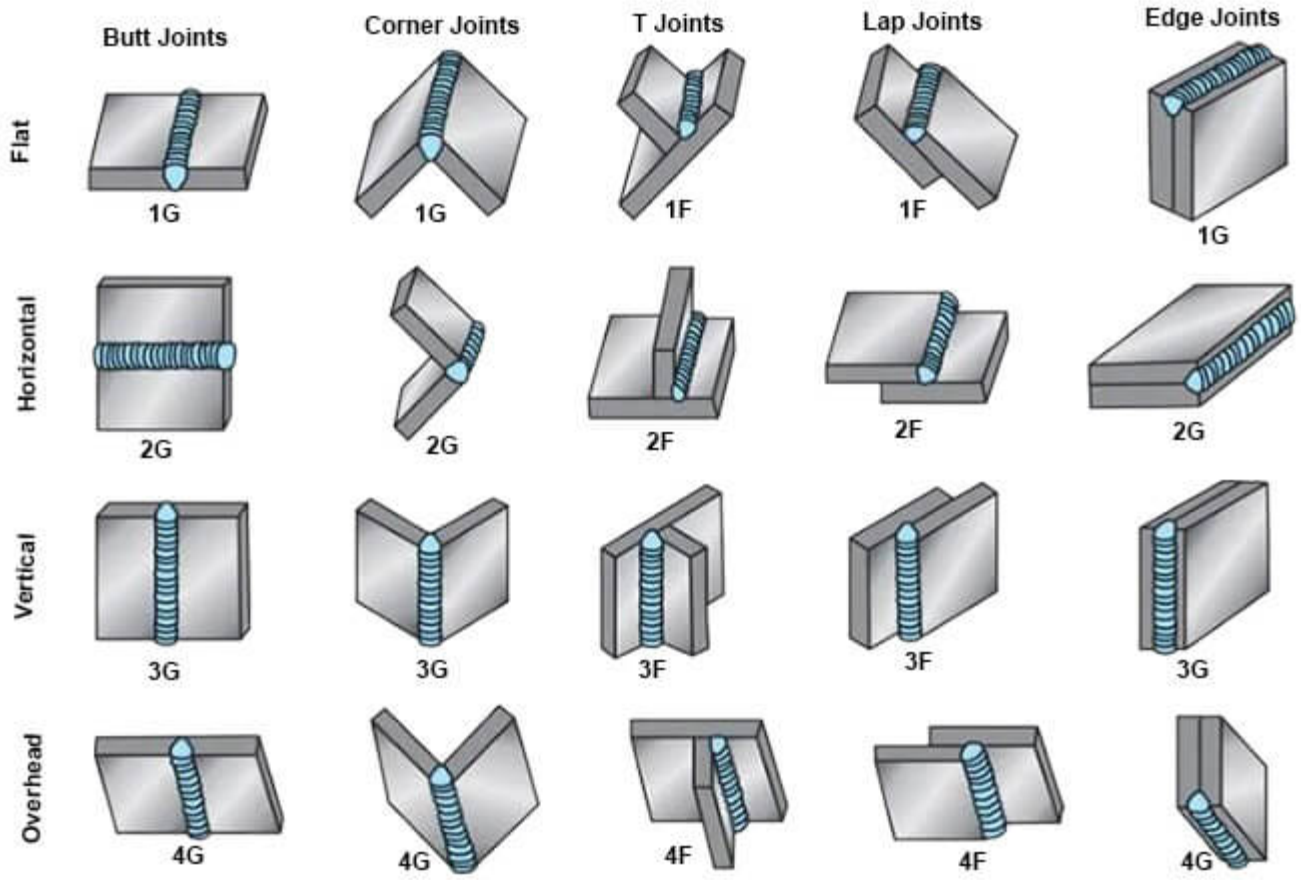
- **Oxyacetylene welding, commonly referred to as gas welding, which relies on combustion of oxygen and acetylene.**

- **When mixed together in correct proportions within a torch a relatively hot flame is produced with a temperature of about 3,200 deg. C.**


Direction of travel
25° drag travel angle
A - Backhand
Direction of travel
B - Perpendicular
Direction of travel
25° push travel angle
C - Forehand


B-Butt
C-Corner
L-Lap
E-Edge
T-Tee
1. Square-Groove
2. Single-V-Groove
3.Single-Bevel-Groove
4. Double-V-Groove
5. Double-Bevel Groove
6. Single-U-Groove
7. Double-U-Groove
8. Single-J-Groove
9. Double-J-Groove
10. Single Fillet
11. Double-Fillet
12. Single-Flare V-Groove
13. Edge Weld in a Flanged Butt Joint
14. Bead
15. Plug
16. Arc-Spot or Arc Seam

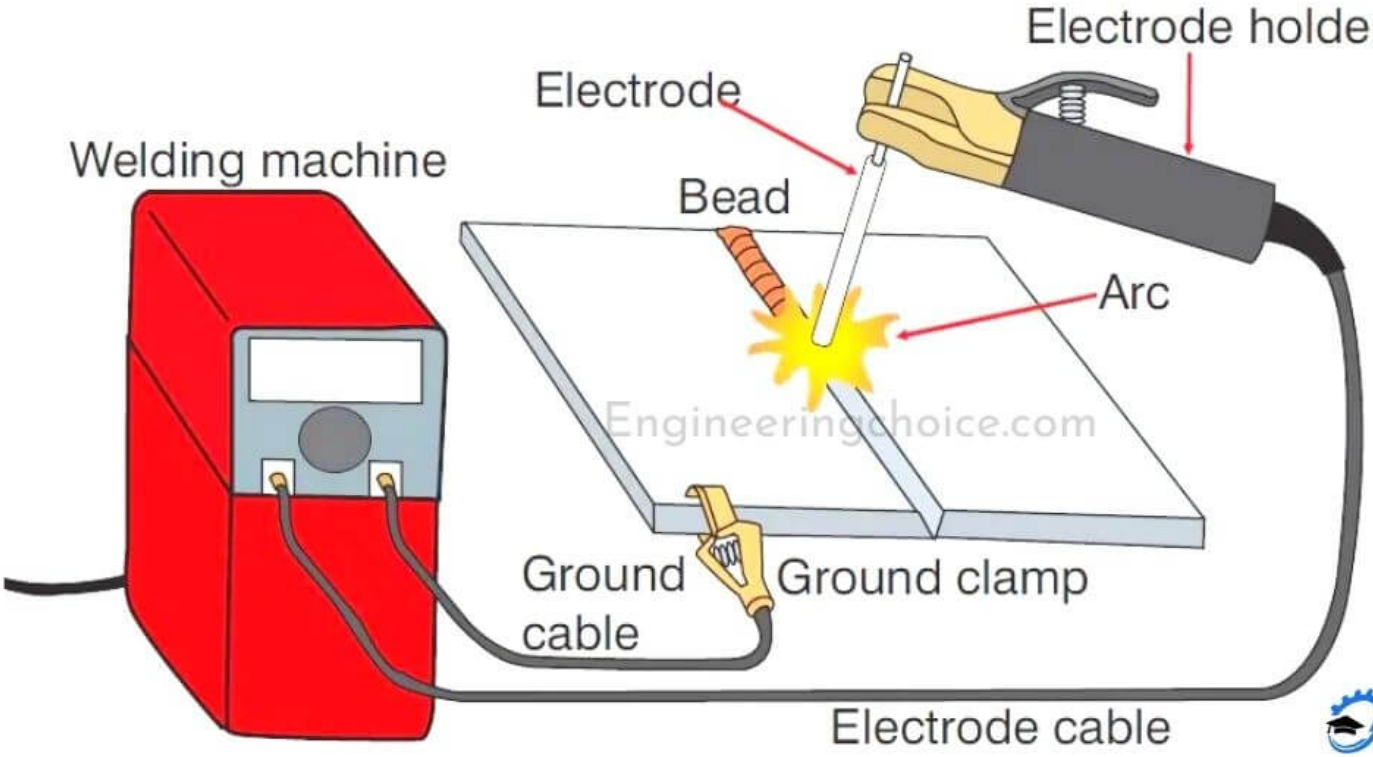

BUTT JOINT
SQUARE
SQUARE (OPEN)
SQUARE (WELDED BOTH SIDES)
SINGLE V
DOUBLE V
SINGLE BEVEL
DOUBLE BEVEL
SINGLE J
CORNER JOINT
SINGLE V
SINGLE V AND FILLET
SINGLE FILLET
EDGE JOINT
SQUARE
SINGLE V
LAP JOINT
SINGLE FILLET
DOUBLE FILLET
TEE JOINT
DOUBLE FILLET
SINGLE BEVEL
DOUBLE BEVEL
DOUBLE J


Butt Joints
Corner Joints
T Joints
Lap Joints
Edge Joints
Flat
Horizontal
Vertical
Overhead
1G
1G
1F
1F
1G
2G
2G
2F
2F
2G
3G
3G
3F
3F
3G
4G
4G
4F
4F
4G

# WELDING

# ARC WELDING

Arc welding is a welding 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.




ENGINEERING Choice

- **Both AC and DC can be used in the arc welding.**

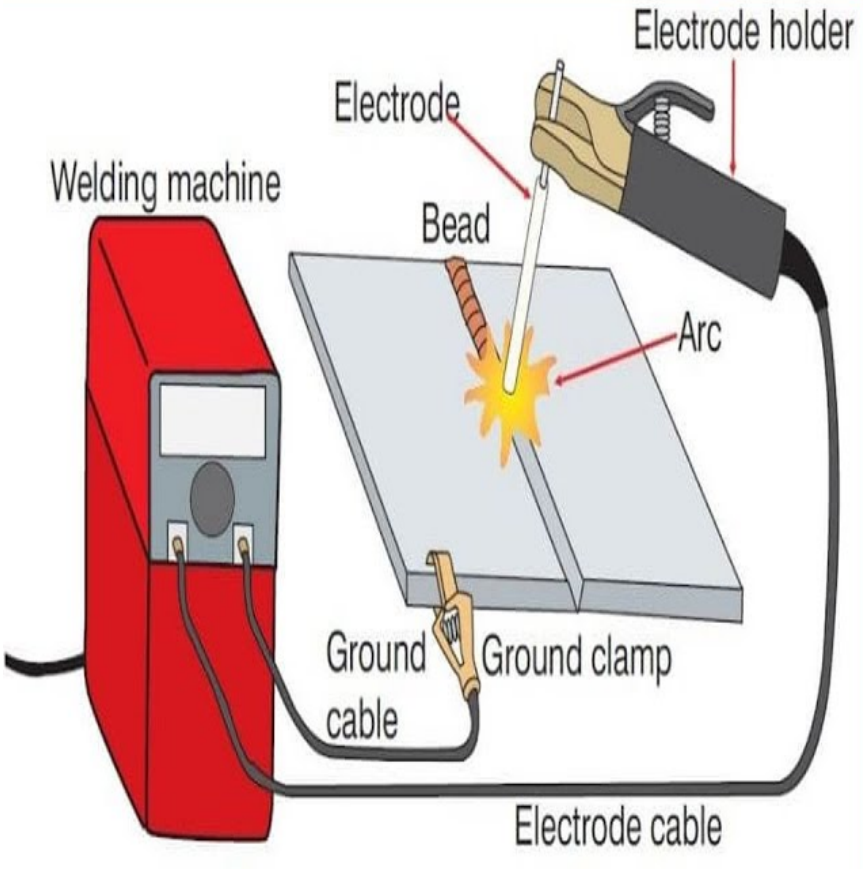
- **Usually, 70 – 100 V on AC supply**

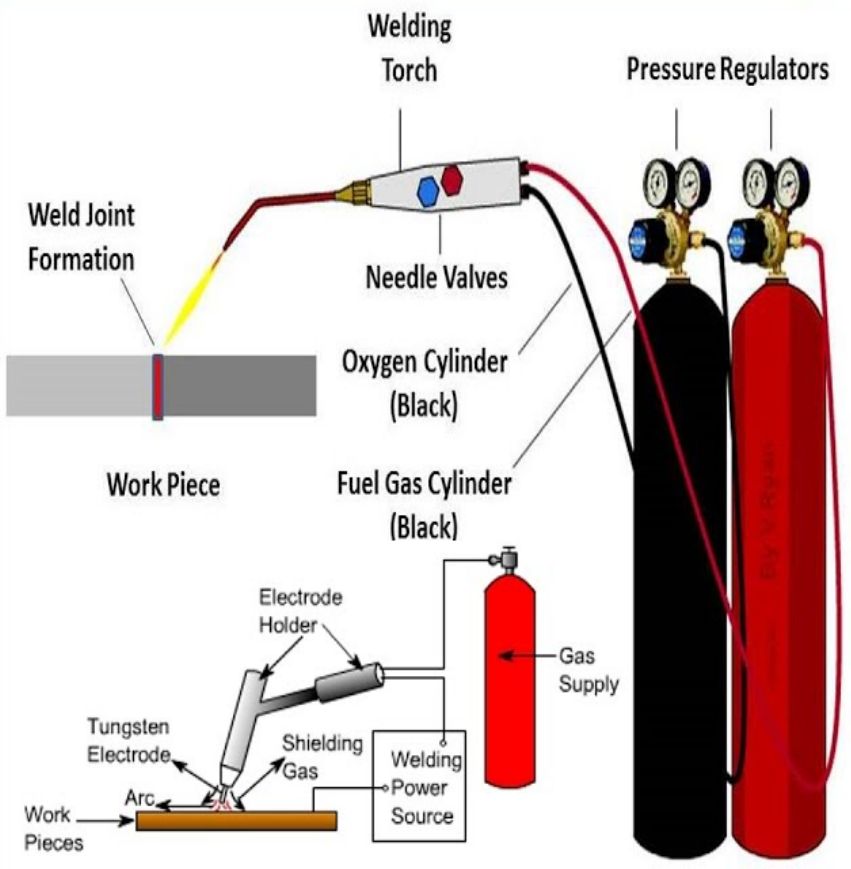
- **50 – 60 V on DC system is sufficient to strike the arc in the air gap between the electrodes.**

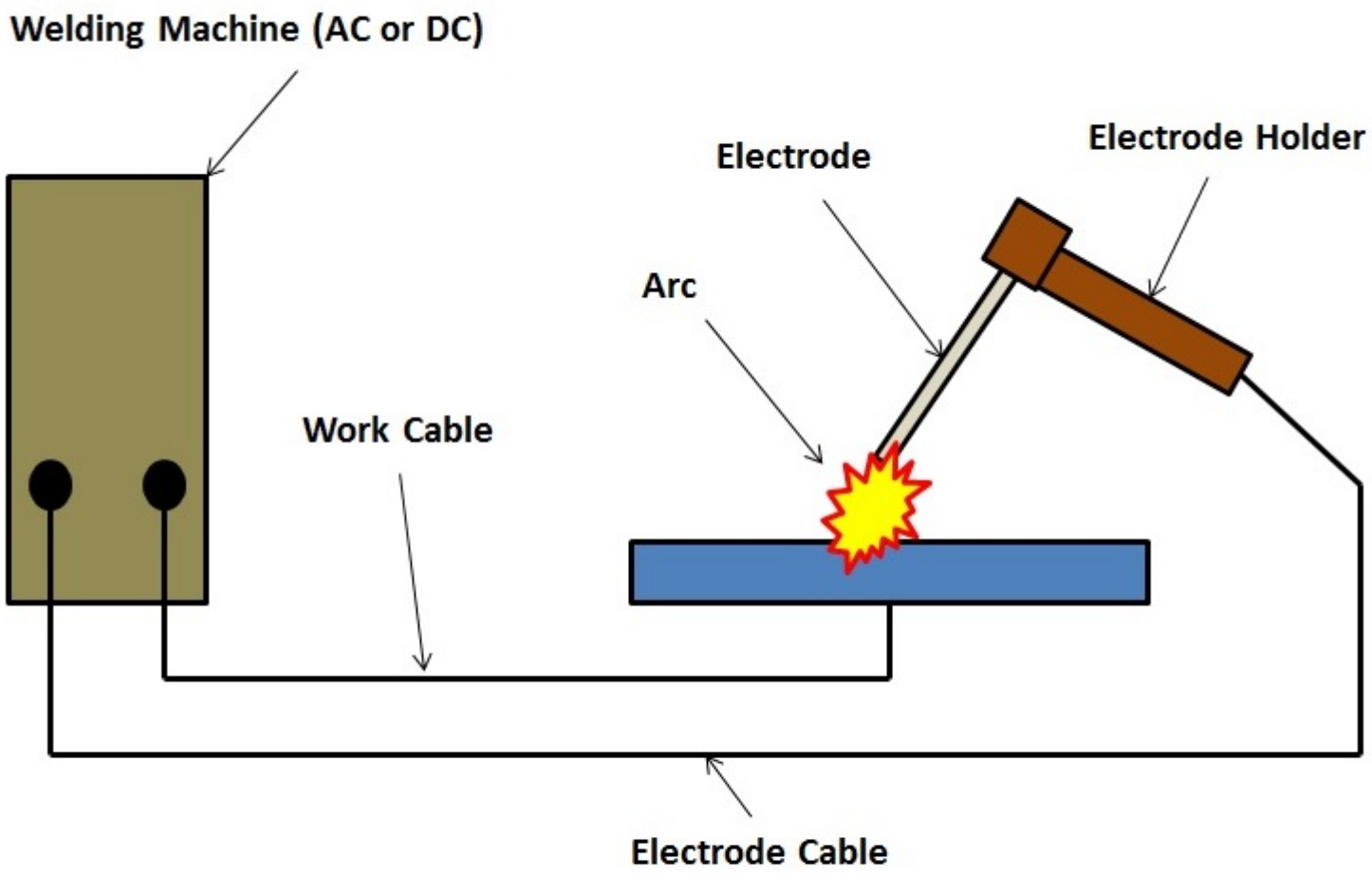
- **Once the arc is struck, 20 – 40 V is only required to maintain it.**

- **The temperature of the arc is about 5,000℃ to 20,000℃.**
- **The melting temperature of iron is about 1,500℃.**
- **Consequently, the base material and electrode are heated to a high temperature and fuse together.**

# Arc Welding Vs Gas Welding





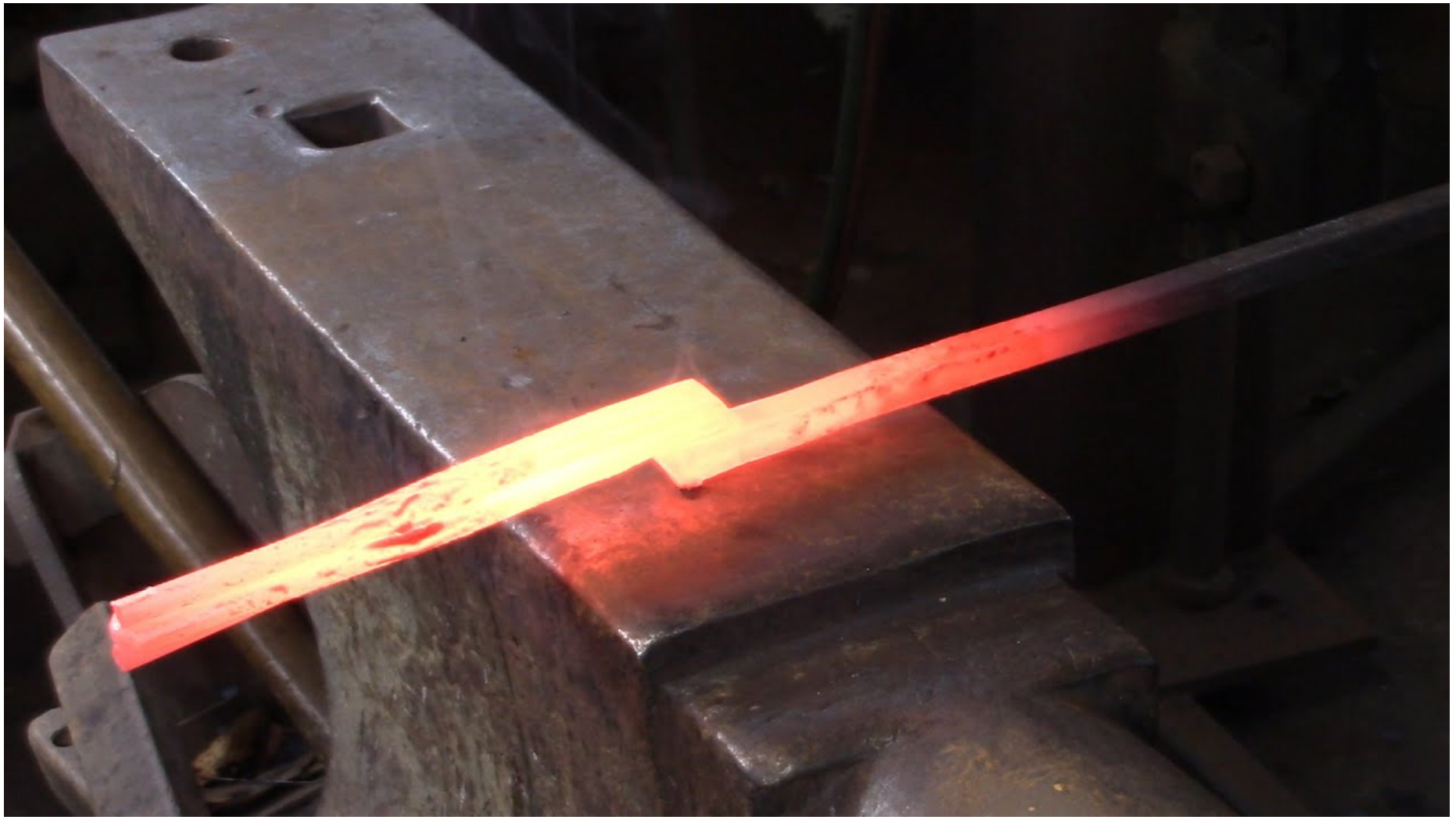

# Basic Arc Welding Circuit Diagram

# FORGE WELDING

- Forge welding is a process used to join two pieces of metal together by heating them to a high temperature and then hammering them together
- Welding processes are commonly used across a range of industries including aerospace, automotive, energy and construction

# FORGE WELDING

# FORGE WELDING



- **Forge welding is one of the oldest methods of joining metals.**
- **Forge welding is an essential technique and an invaluable skill for a blacksmith.**
- **The process requires more training from its operators given greater complexity and control of the process**

✓**The diffusion bond of a forge weld is often stronger than a fusion weld (gas or arc weld) in which the metal is liquefied.**

✓**The high heat combined with pressure significantly increases the strength of the material.**

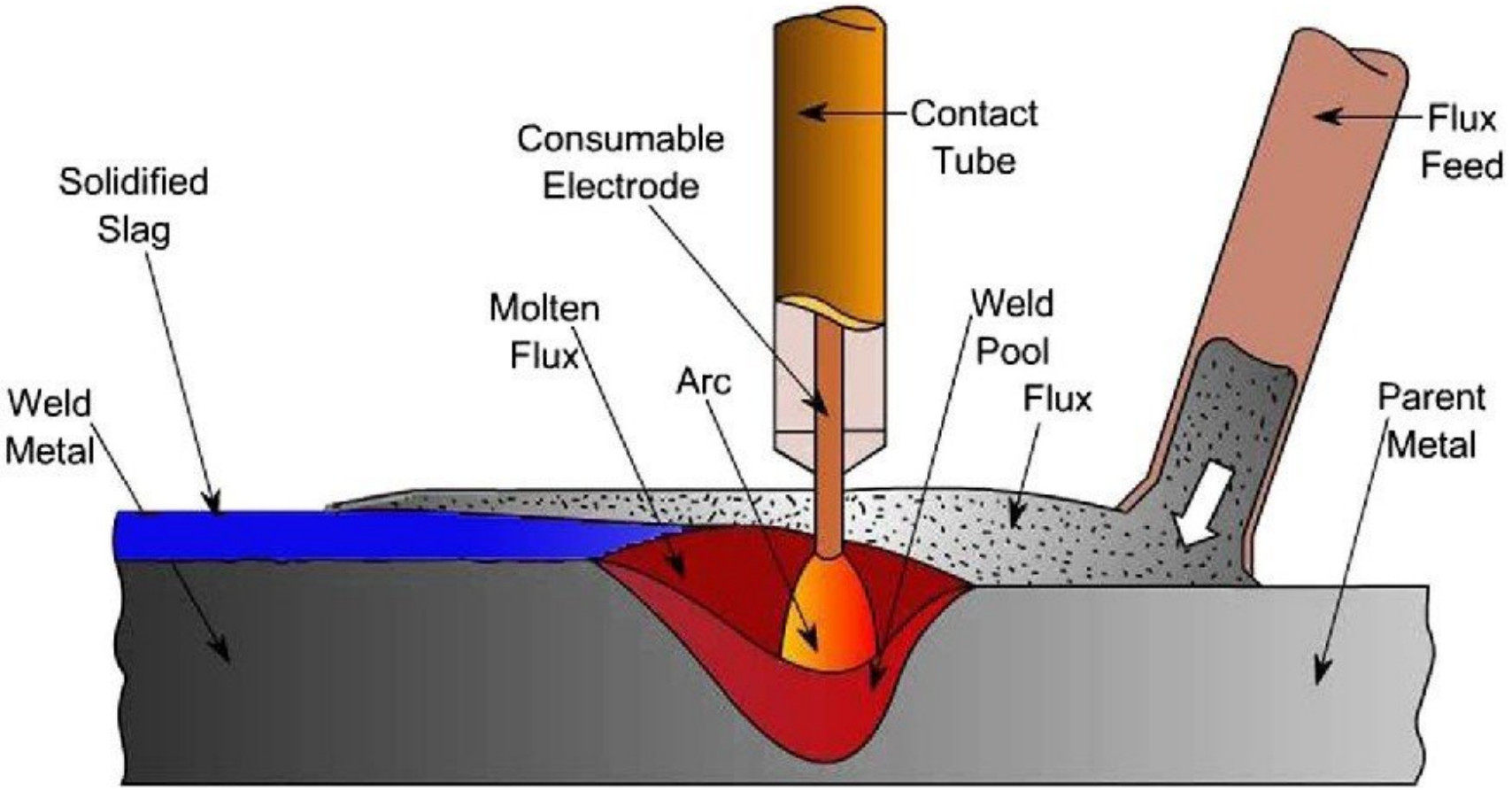
## APPLICATION OF FORGE WELDING

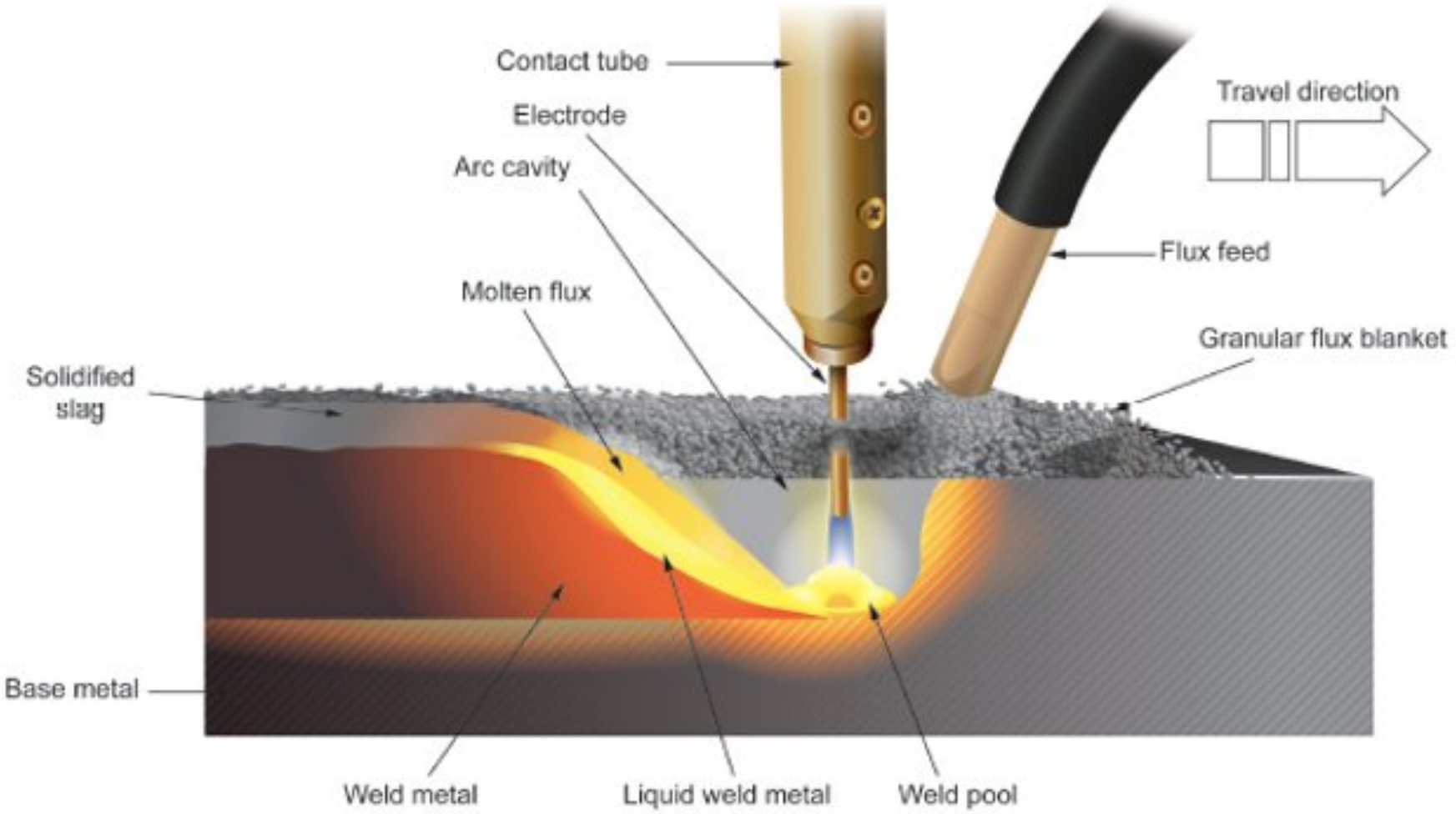
- **Forge welding has been used throughout its history for making most any items out of steel and iron.**
- **It has been used in everything from the manufacture of tools, farming implements, and cookware to the manufacture of fences, gates, and prison cells**

# SUBMERGED-ARC WELDING

❖Submerged-arc welding (SAW) is a common arc welding process that involves the formation of an arc between a continuously fed electrode and the workpiece.

❖The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux consisting of lime, silica, manganese oxide, calcium fluoride, and other compounds.


Solidified
Slag
Consumable
Electrode
Contact
Tube
Flux
Feed
Molten
Flux
Arc
Weld
Pool
Weld
Metal
Flux
Parent
Metal


Contact tube
Electrode
Arc cavity
Molten flux
Solidified slag
Base metal
Weld metal
Liquid weld metal
Weld pool
Travel direction
Flux feed
Granular flux blanket

## ADVANTAGES

- **Extremely high deposition rates.**
- **High quality, sound, uniform welds.**
- **High speed weld Little to no fumes, arc light, spatter.**
- **Suitable for indoor or outdoor applications.**

**DISADVANTAGES**

- ✓**Lower efficiency – more waste is generally produced during arc welding than many other types, which can increase project costs in some cases.**
- ✓**High skill level – operators of arc welding projects need a high level of skill and training, and not all professionals have this.**

## APPLICATIONS

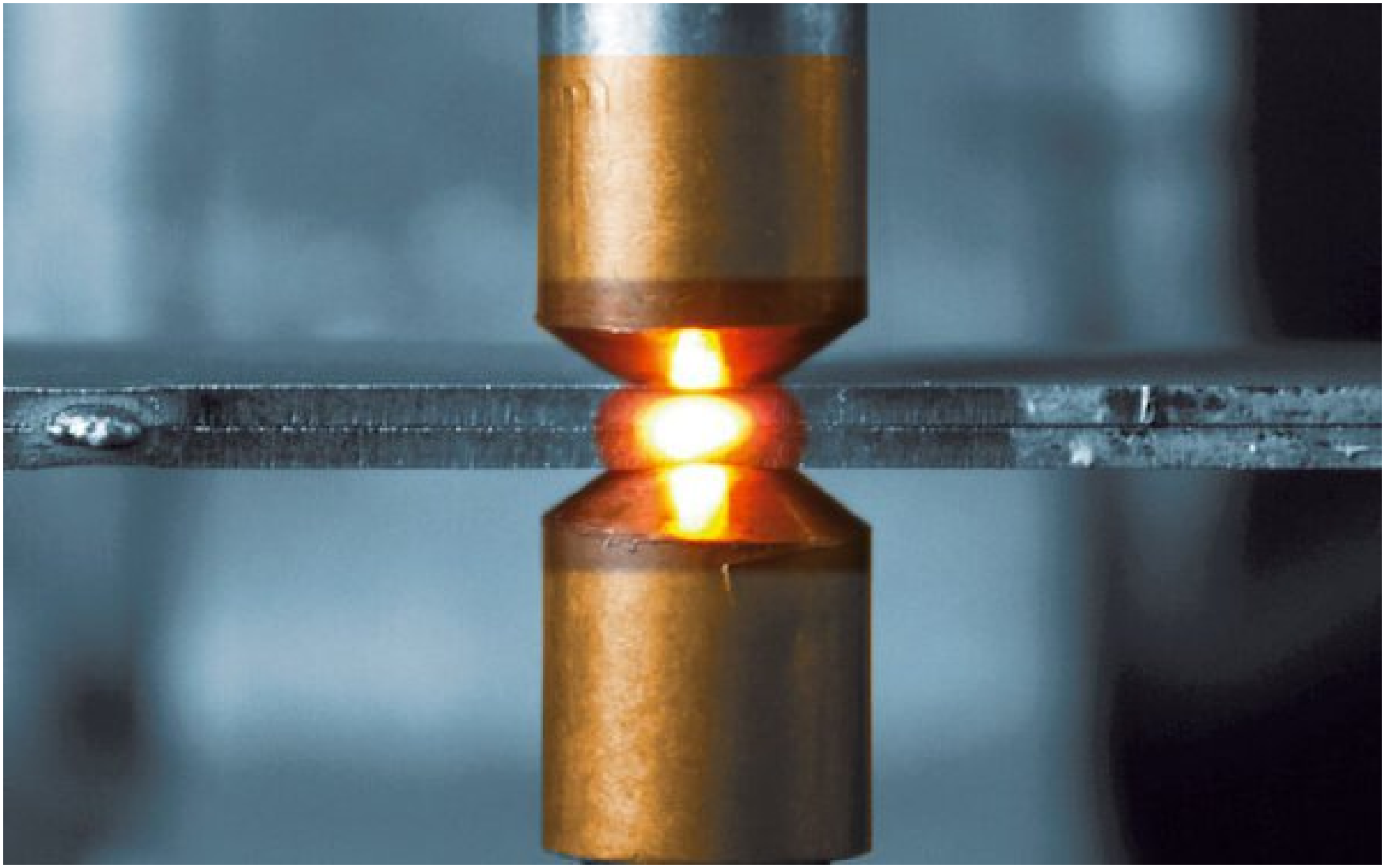
- ✓It is used for welding of low alloy steels.
- ✓It is also used for stainless steels and nickel based alloys.
- ✓It can also be used for surfacing applications such as wear-facing, corrosion overlay of steels, etc.

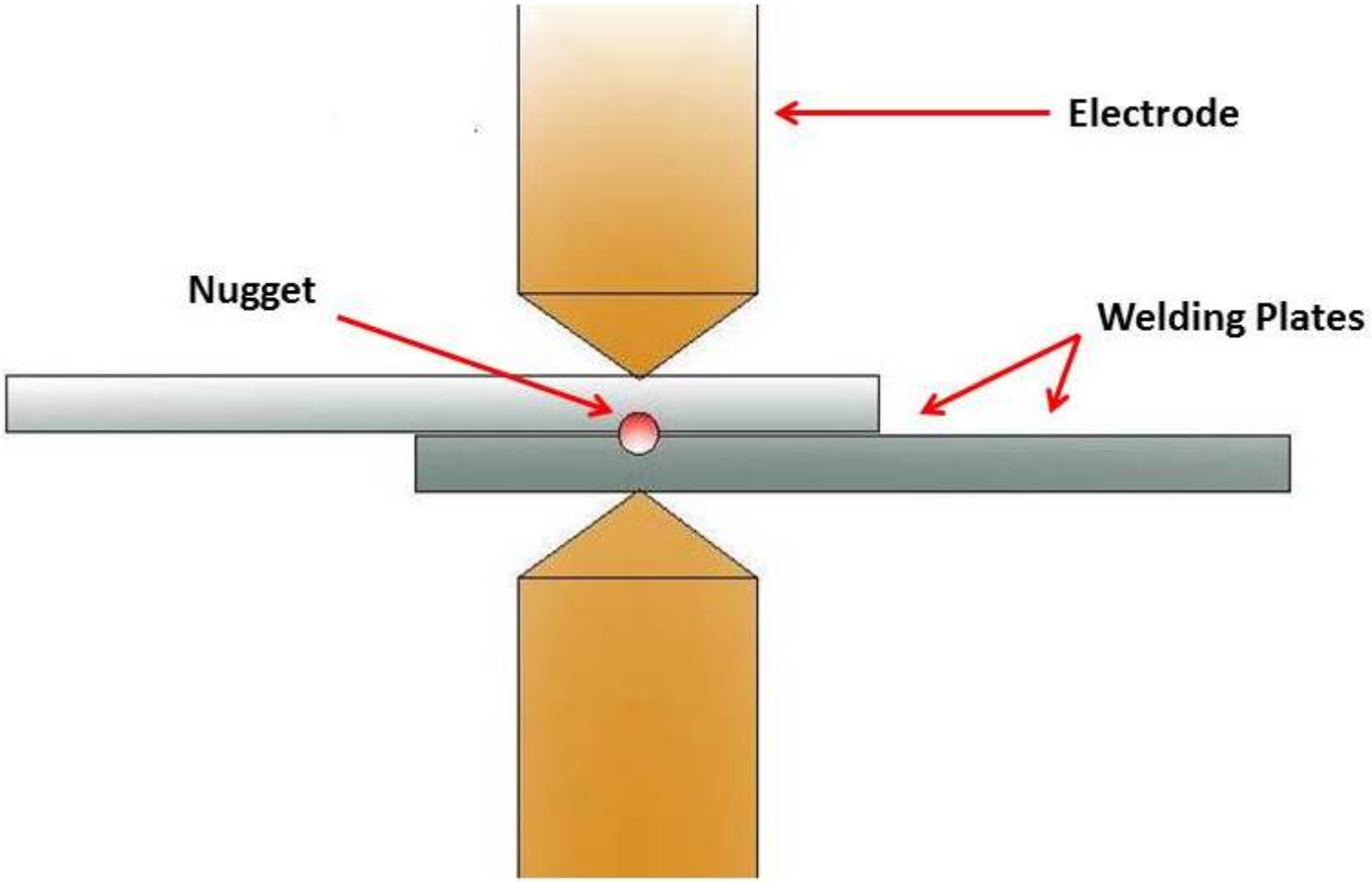
# SPOT WELDING

- **Spot welding is also known as resistance spot welding .**

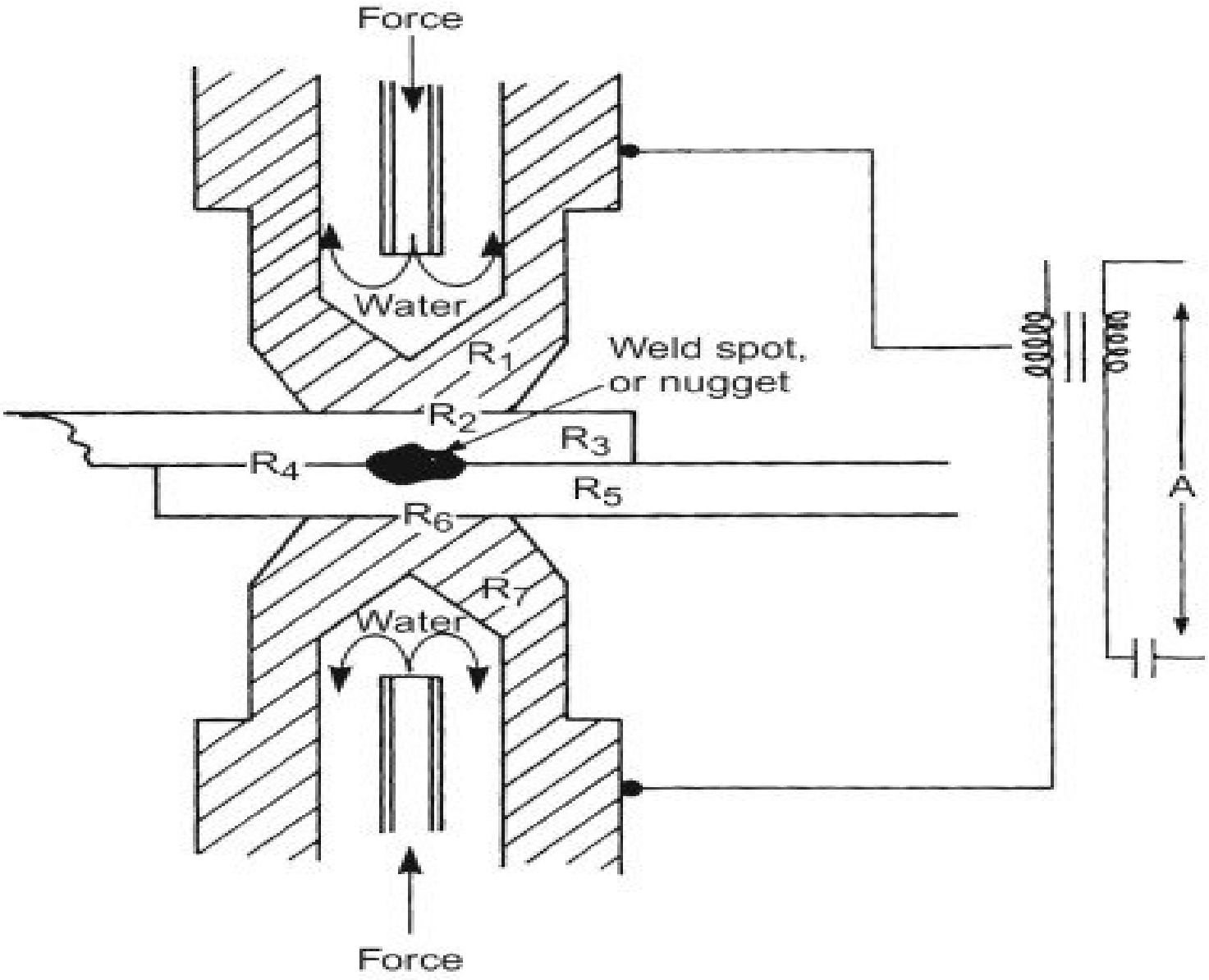
- **This welding process is used primarily for welding two or more metal sheets together by applying pressure and heat from an electric current to the weld area.**

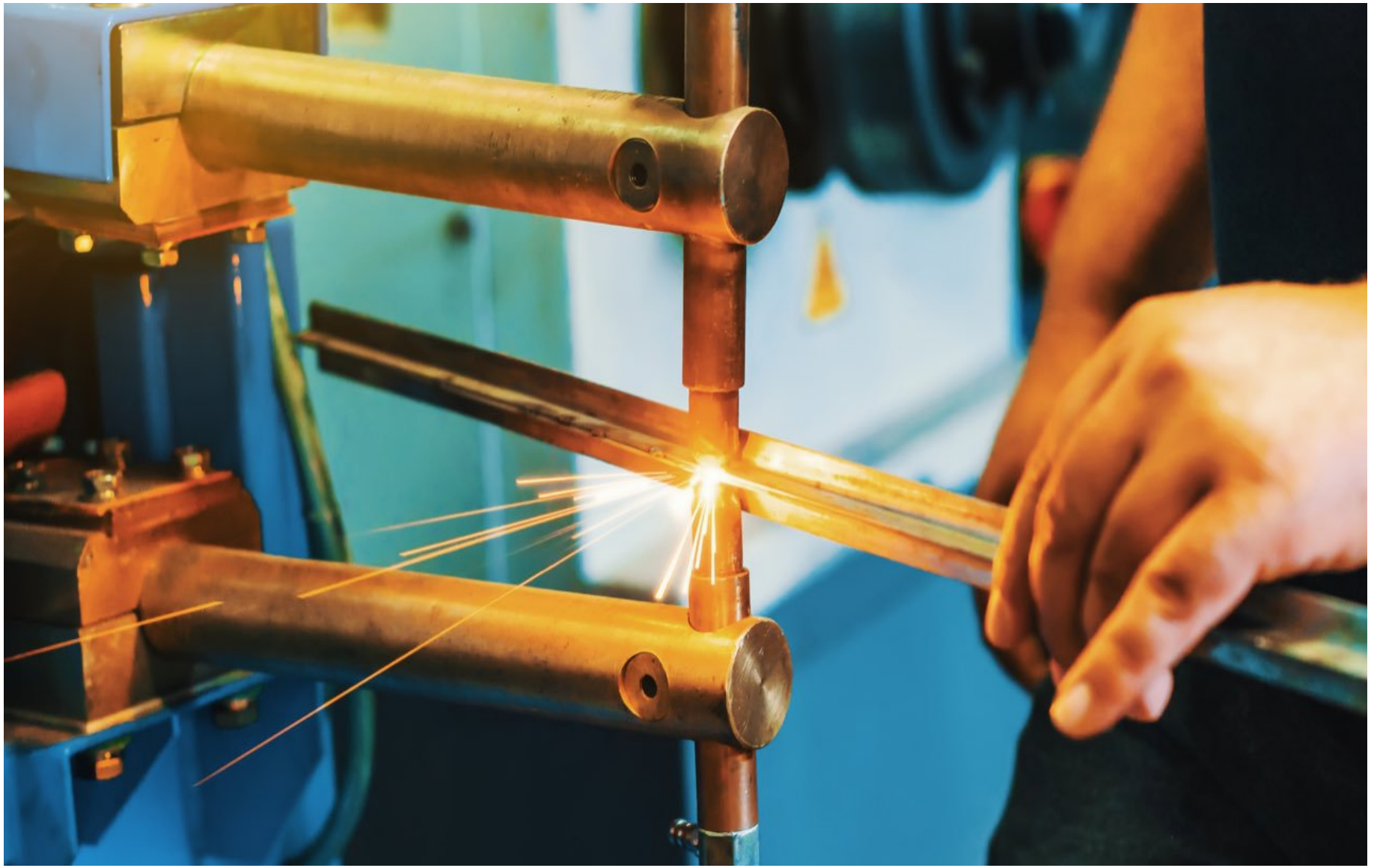
- **It's called spot welding because this welding method creates a tiny dot weld, that looks like a spot. The weld created between the copper electrodes is also sometimes called a nugget.**






# Spot Welding


Force
Water
R1
Weld spot,
or nugget
R2
R3
R4
R5
R6
R7
Water
Force
A



- **Electrodes seated in a weld head are brought to the surface of the parts to be joined and force (pressure) is applied.**

- **Current is applied through the electrodes to the workpiece to melt the material.**

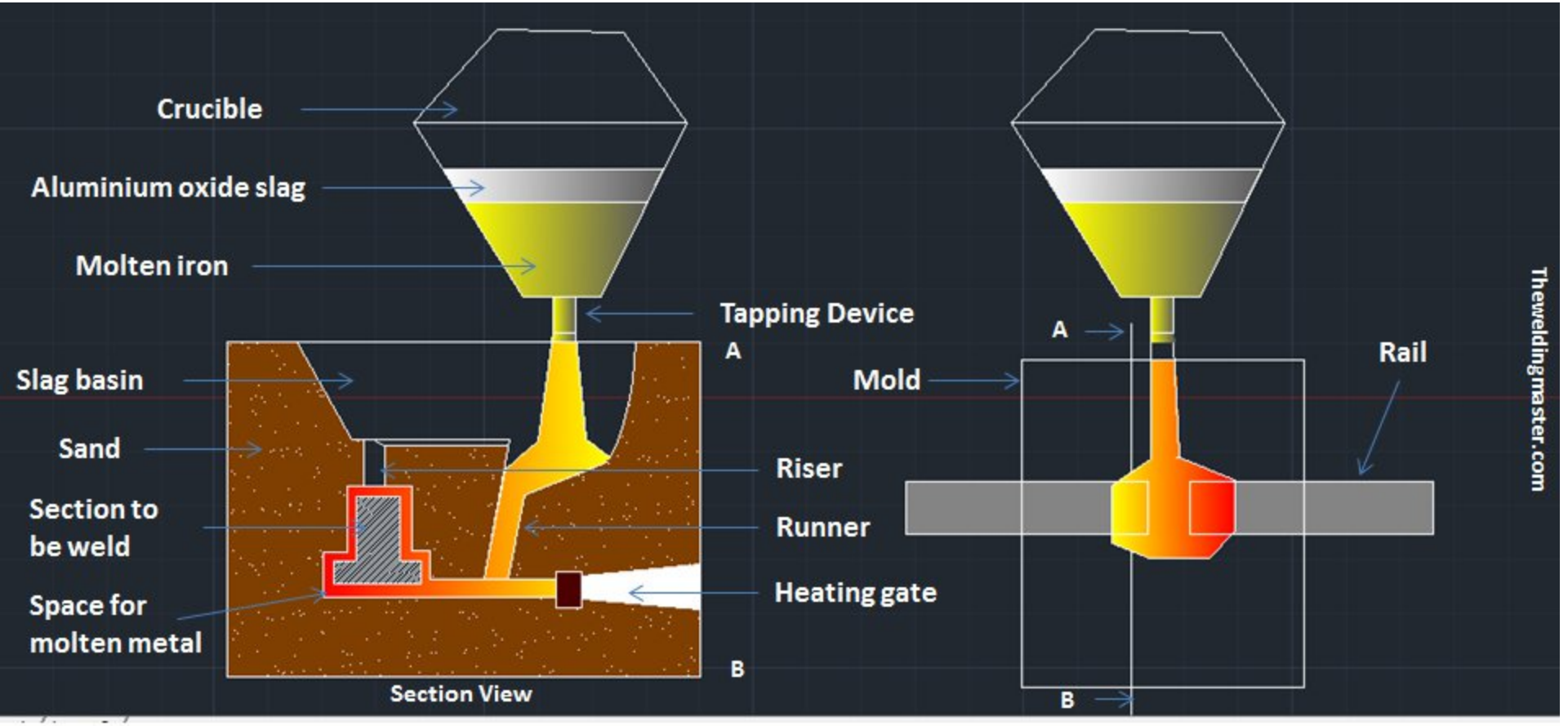
- **Current is removed but electrodes remain in place at force to allow the material to cool and solidify.**

# THERMIT WELDING

- **Thermit welding (TW) is a process that uses heat from an exothermic reaction to produce coalescence between metals.**

- **The name is derived from 'thermite' the generic name given to reactions between metal oxides and reducing agents.**

- **It is used to repair steel castings and forgings, for joining railroad rails, steel wires and steel pipes, for joining the large cast and forged parts**




Thermit Welding Process

- **Thermit welding is a process where heat generated from an exothermic chemical reaction.**

- **The chemical reaction occurs between aluminum powder and metal oxide.**

- **This reaction generates a molten metal that acts as filler metal joining the workpieces on solidification.**

Thermit Welding on Railway Track

✓**The process of igniting Aluminium and Ferric oxide is called thermite reaction.**

✓**This is an exothermic reaction.**

✓ **Iron obtained in this process is in molten state.**

✓ **$Fe_2O_3$ (s) + Al (s) →$Al_2O_3$ + 2 Fe(l) + Heat.**

✓ **The reaction is ignited by burning a magnesium ribbon**

❖**Aluminium has a high affinity for oxygen.**

❖ **It readily removes oxygen from oxides of less reactive metals so it is used in thermite welding.**

❖**The thermite mixture is a combination of finely powdered aluminum and iron oxide (also called ferric oxide) in a mass ratio of 1:3 respectively**

❖**Thermite process is exceptionally helpful for the welding of broken metal parts.**