

### ELECTRIC ARC WELDING

- The electric arc welding process makes use of the **heat produced by the electric arc** to fusion weld metallic pieces.
- This is one of the most widely used welding process, mainly because of the ease of use and high production rates that can be achieved economically.

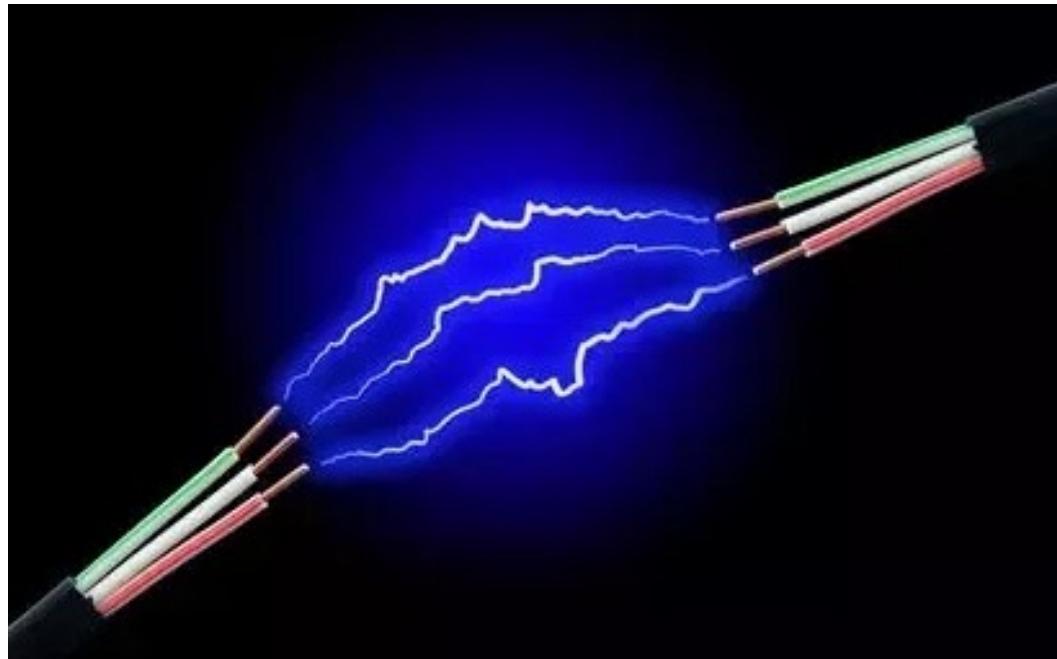
### Principle of Arc

- An arc is generated between two conductors of electricity, cathode and anode, when they are touched to establish the flow of current and then separated by a small distance.
- An arc is a sustained electric discharge through the ionised gas column called plasma between the two electrodes.

# MECHANICAL ENGINEERING SCIENCE

## JOINING PROCESSES

- It is generally believed that electrons liberated from the cathode move towards the anode and are accelerated in their movement. When they strike the anode at high velocity, large amount of heat is generated.
- A temperature of the order of  $6000^{\circ}\text{C}$  is generated at the anode.



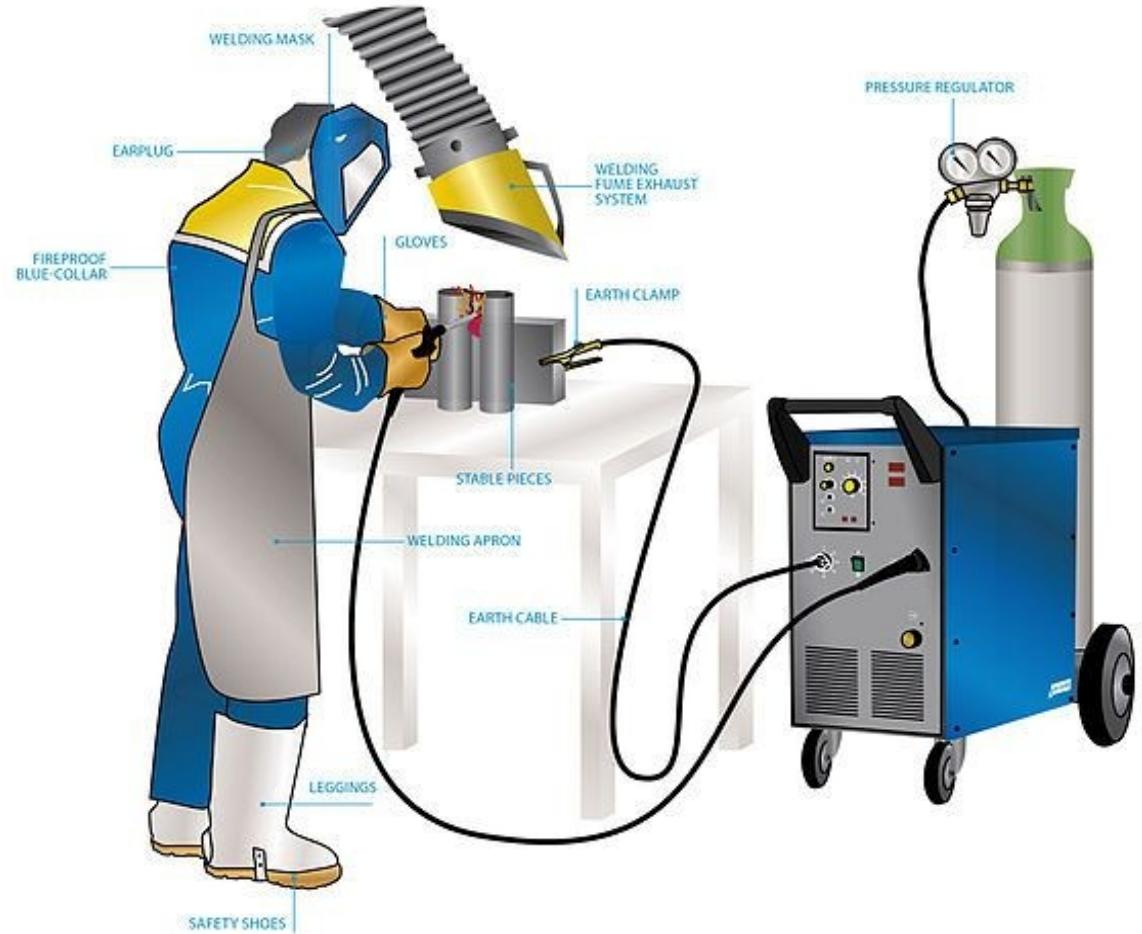
# MECHANICAL ENGINEERING SCIENCE

## JOINING PROCESSES

### ARC WELDING EQUIPMENT

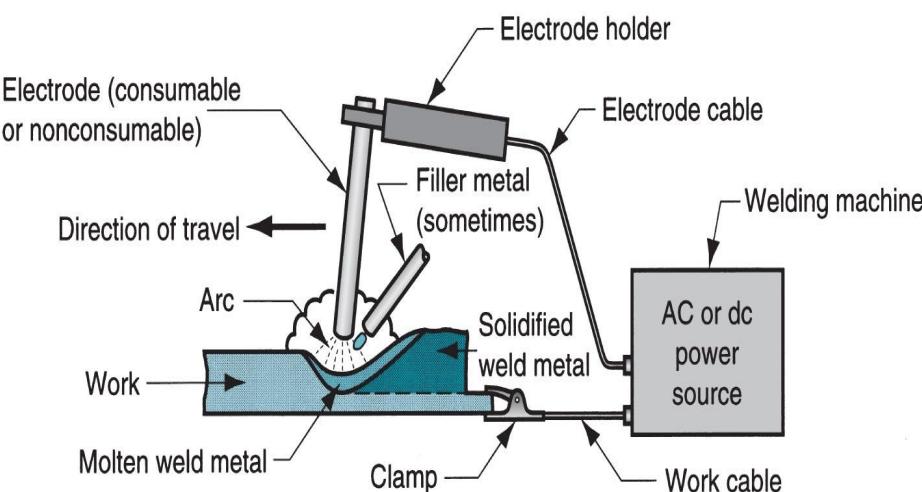
- AC or DC machine
- Electrode and electrode holder
- Chipping hammer
- Earthing clamps
- Wire brush
- Helmet
- Safety goggles, Hand gloves, etc.

Correct and safe electric welding station



### ARC WELDING PROCEDURE

- In operation, an arc is struck by touching the tip of the electrode on the workpiece and instantaneously the electrode is separated by a small distance of 2 – 4 mm such that the arc still remains between the electrode and the workpiece.
- The high heat at the tip of the arc melts the workpiece metal forming a small molten metal pool. At the same time, the tip of the electrode also melts.
- The molten metal of the electrode is transferred into the molten metal of the workpiece in the form of globules of molten metal.
- The deposited metal fills the joint and bonds the joint to form a single piece of metal.
- The electrode is moved along the surface to be welded to complete the joint.



### ELECTRODES

- The electrodes used for providing heat input in arc welding are of two types, **the consumable and the nonconsumable electrodes**.
- When the arc is obtained with a **consumable electrode**, the **weld metal under the arc melts as also the tip of the electrode**. The molten metal from the electrode and that obtained from the base metal gets intimately mixed under the arc and provides the necessary joint after solidification.
- Consumable electrodes are made of various materials depending on the purpose and chemical composition of the metals to be welded. Thus, they may be made of steel, cast iron, copper, brass, bronze or aluminium.
- It is also possible to use **non-consumable electrodes** made of carbon, graphite or tungsten. The carbon and graphite electrodes are used only in DC welding, whereas tungsten electrodes are used for both AC and DC welding. The filler metal required has to be deposited through a **separate filler rod**.

### ELECTRODES

- A consumable electrode, used in welding, can be either **bare or coated**. The coated electrode also called stick electrode, is used for the manual arc welding process.
- The coating on the electrodes serves a number of purposes –
  - 1) The coatings give off inert gases such as carbon dioxide under the arc heat, which **shields** the molten metal pool and protects it from the atmospheric oxygen, hydrogen and nitrogen pick up thus, reducing contamination of the weld metal.
  - 2) The coatings provide flux to the molten metal pool, which mixed with the oxides and other impurities present in the puddle, forms a **slag**. The slag being lighter, floats on the top of the puddle and protects it against the surrounding air during the weld bead solidification. The slag covering also helps the metal to cool slowly preventing the formation of a brittle weld. When the weld is sufficiently cooled, the slag can be removed exposing the shiny weld underneath.

### ELECTRODES

- 3) Some elements that are required for stabilisation of the arc are also added in these coatings. The coatings are different for AC welding and DC welding.
- 4) Special alloying elements can be introduced through these coatings to improve the strength and physical properties of the weld metal.
- 5) The coatings also contain materials which can control the slag to be viscous or fluid. Viscous slag would be useful for making welds in vertical position to cover the metal puddle for a longer time.

