

CHAPTER IV. ASSEMBLY TECHNIQUES

IV.1. Introduction

When you want to produce or manufacture an object, you need to bring together all the elements that make it up. These elements can be composed of various materials and shapes, which may require the use of different assembly methods.

In the industrial sector, there are several assembly techniques that can be used to join the components of a product together: threaded fasteners, gluing, welding, riveting, and many others.

Material assembly is a process that allows several parts to be joined together to form a whole. The choice of assembly solution depends on:

- Cost
- Lifespan
- Maintainability
- Space requirements
- Aesthetics

IV.2. Types of assemblies

Each means of assembly can be defined by five criteria:

IV.2.1. Complete or partial assembly

- Complete assembly: No movement possible between the assembled parts;
- Partial assembly: Movement(s) possible between the assembled parts.

Examples:

- A piston in a cylinder constitutes a partial assembly;
- A cylinder head with an engine block constitutes a complete assembly.

IV.2.2. Removable or non-removable assembly

- **Removable assembly:** It is possible to remove the connection without damaging the connected parts or components.
- **Non-removable (permanent) assembly:** It is impossible to remove the connection without damaging the connected parts or components.

Examples:

- A cylinder head and engine block form a removable assembly.
- The welded components of a vehicle chassis form a permanent (non-removable) assembly.

IV.2.3. Elastic or rigid assembly

- **Elastic assembly:** Movement of one part causes deformation of an elastic element (spring, rubber);
- **Rigid assembly:** The assembly is not elastic in any direction of movement.
- **Examples:**
- A silent block contributes to the creation of an elastic assembly;
- An assembly using threaded elements (screw-nut) is rigid.

IV.2.4. Assembly by obstruction or adhesion

- **Assembly by obstruction:** An element obstructs movement between two parts
- **Assembly by adhesion:** The assembly is achieved by the phenomenon of adhesion due to friction between the parts.

Examples:

- A key creates an assembly by obstruction (it prevents rotation between a shaft and a hub);
- When two parts are tightly fitted together, the assembly is by adhesion.

IV.2.5. Direct or indirect assembly

- **Direct assembly:** The connected parts are in direct contact. There are no intermediate elements.
- **Indirect assembly:** The assembly requires one or more intermediate elements.

Examples:

- The assembly between a pulley and a shaft using a key is an indirect assembly.
- A ball bearing is part of an indirect assembly.

IV.3. Examples of assemblies

IV.3.1. Welding

Welding is an assembly process that permanently joins various metal components.

It refers to two techniques:

- Heterogeneous welding.
- Autogenous welding.



Figure 1. Welding

❖ Heterogeneous welding (brazing)

This involves introducing a liquid metal between the elements to be joined, which, after cooling, adheres strongly to both elements.

❖ Autogenous welding

Autogenous welding involves joining two elements of the same metal by local melting. There are many autogenous welding processes (commonly referred to as welding).

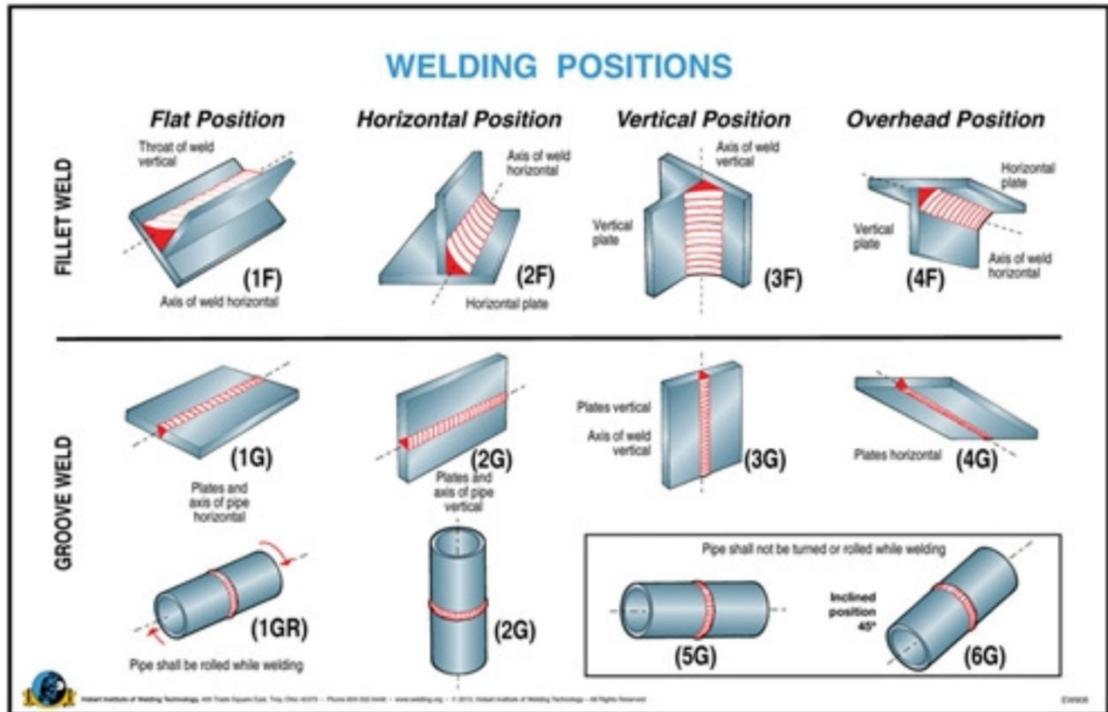


Figure 2. Welding Positions

The welding process

❖ Resistance welding:

The resistance welding process uses the Joule effect of a high-intensity electric current passing through the parts to be joined, which are brought into contact with each other.

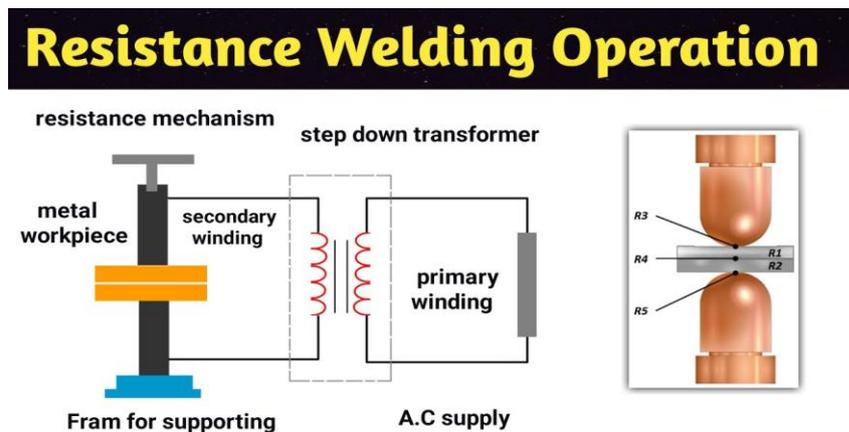


Figure 3. Resistance welding

❖ Tungsten inert gas welding

This type of welding uses a torch that generates the high temperatures required for welding metals.

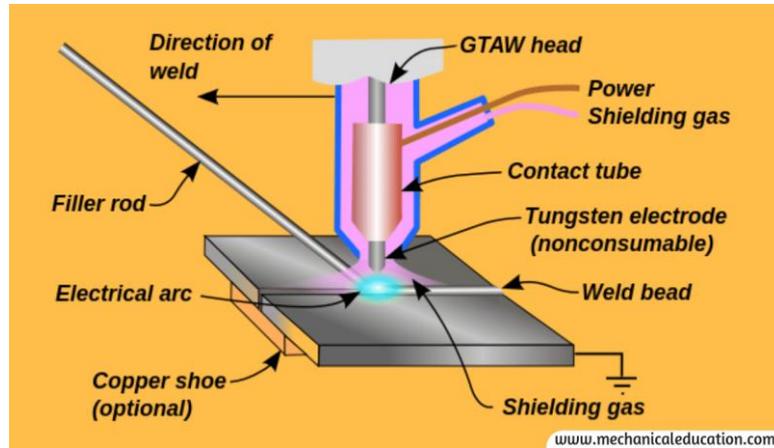


Figure 4. Tungsten inert gas welding

❖ Electric arc welding:

In electric arc welding, the energy required to melt the parts to be welded and to complete the assembly is obtained by means of an electric arc. This arc is generated between an electrode and the part to be welded.

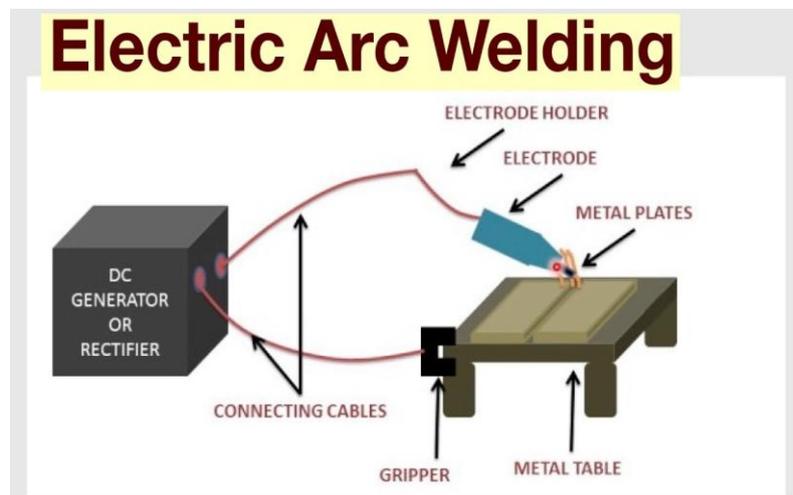


Figure 5. Electric circuit for arc welding.

IV.3.2. Riveting

A riveted assembly consists of joining a set of parts using rivets. The resulting connection is fixed and cannot be dismantled without damaging certain parts. A rivet consists of a cylindrical shaft, either solid or hollow, with a head of varying shape at one end (see figure). After being inserted into a pre-drilled hole, the other end is pushed back and forms the rivet joint.

Types of riveting

- ❖ Blind rivets are used in the assembly of thin sheet metal.
- ❖ Solid rivets are used for the assembly of thick sheet metal.



Figure 6. Type of Riveted assemblies

IV.3.3. Screwing and Bolting

Bolting is a method of mechanical assembly that can be dismantled. Bolts are used to create a continuous connection between elements or to ensure the complete transmission of forces from one part of a structure to another. A threaded assembly ensures pressure between parts in order to immobilize them in relation to each other, and often to ensure a seal.

Bolt = screw + nut

- ❖ **Screw:** a part consisting of a threaded rod over all or part of its length, with or without a head, but including a drive or locking device.
- ❖ **Nut:** a threaded part with a drive device, designed to be screwed on.
- ❖ **Bolt:** assembly consisting of a screw with a head and a nut, designed to provide a tight fit between the bearing surface of the head and that of the nut.
- ❖ **Stud:** a rod with threads at both ends, designed to provide a tight fit between the face of a part into which one end is permanently screwed and the bearing surface of a nut screwed onto the other end.

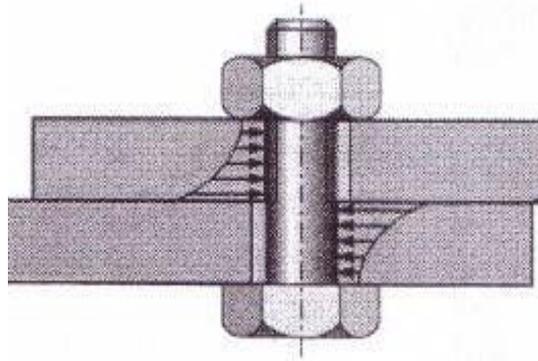


Figure 7. Removable mechanical assemblies (bolting).

IV.3.4. Keyed joints

A key is a component used to connect two parts in rotation. Forced keyed joints can be considered as obstacle connections. However, the stability of the assembly component forming the obstacle (key) is achieved by wedging, i.e. by adhesion.

- ❖ Keying is said to be transverse or longitudinal, depending on the position of the key.
- ❖ The 'complete' connection obtained is not capable of transmitting significant forces in all directions.

What is the keyed joint?

A keyed joint is a joint that consists of a key, a key seat (in the shaft), and a keyway (in the hub), where the key is used to transmit torque between the shaft and the machine part (flywheel, gearwheel, pulley, etc.) assembled on it.

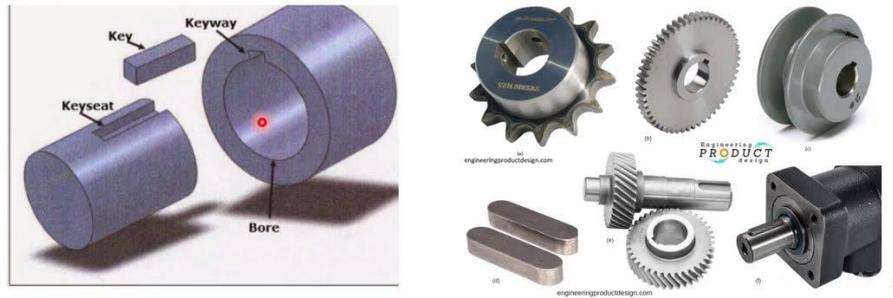


Figure 8. Keyed joints.