Resistance welding process makes use of the electrical resistance for generating heat required for melting the workpiece. It is generally used for joining thin plates and structures. It has different variants such as Seam welding, Projection welding and Spot welding.

**Distinct advantages of Resistance Welding over other welding processes:**

There are a number of distinct advantages that account for wide use of the resistance welding processes, particularly in mass production. These advantages include:

- They are very rapid in operation.
- The equipment can be fully automated.
- They conserve materials as no filler material, shielding gas or flux is required.
- Skilled operators are not required.
- Dissimilar metals can be easily joined.
- A high degree of reliability and reproducibility can be achieved.

**Resistance Welding has some limitations, the principal ones being:**

- The equipment has a high initial cost.
- There are limitations to the type of joints that can be made (mostly suitable for lap joints).
- Skilled maintenance persons are required to service the control equipment.
- Some materials require special surface preparations prior to welding.

**Resistance Seam Welding:**

The seam consists of a series of overlapping spot welds. These are made by two distinct processes. In one case, the weld is made between overlapping sheets of metal (Fig. 4.2.1 & Fig.
4.2.2) and the process is used to produce liquid or gas tight sheet metal vessels, such as gasoline tanks, automobile mufflers and heat exchangers.

As the metal passes between the electrodes, timed pulses of current pass through it to form the overlapping welds. The timing of the welds and the movement of the works is controlled to assure that the welds overlap and the workpiece do not get too hot. The welding current is usually higher than the conventional spot welding. In order to compensate for the short circuit of the adjacent welds, external cooling of the work by air or water is often employed. In a variation process, a continuous seam is produced by passing a continuous current through the rotating electrodes. The typical welding speed is about 60 in/ min for thin sheets. Some variants of resistance seam welding which are in use are illustrated in Fig. 4.2.3.
The second type of resistance seam welding is used to make butt welds between thicker metal plate. In this process, the electrical resistance of the abutting metal is used to generate heat and a high frequency current (up to 450 kHz) is employed to restrict the flow of current to the surfaces
to be joined and to their intermediate surroundings. The most extensively used resistance butt welding is in the manufacturing of pipes and tubes and simple structural shapes which can be produced from plates.

**Applications:**

- Materials from 0.13 mm thickness to more than 19 mm thickness can be welded up to 82 meter /min.
- The combination of high frequency current and high welding speed produces a very narrow heat affected zone.
- Almost all types of materials can be welded, including dissimilar metals and high conductivity metals, such as aluminium and copper.

**Projection Welding:**

**Principles:** A dimple is embossed into one of the workpieces at the locations where the weld is desired as shown in the Figs. 4.2.4 & 4.2.5. The work-pieces are then placed between large area electrodes. Pressure and current are applied as in the spot welding process. Since the current must flow through the points of contact, namely the dimples, the heating is concentrated where the weld is desired. As the metal heats and becomes plastic, pressure causes the dimple to flatten and form a weld. Since the projections are press formed, they can often be produced during other blanking and forming operations with virtually no additional cost.

![Fig. 4.2.4 Projection welded joints and variants](image-url)
Advantages:

- Dimples and projections can be made in almost any shapes such as round, oval or circular in order to produce the welds of shapes to suit various design purposes.
- Several dimples can be incorporated into the sheet and multiple welds can be made at a given time.
- A conventional spot welding machine can be changed into a projection welding machine by changing the size and shape of the electrode.
- Projection welding leaves no indentation mark on the free surface, a distinct advantage over spot welding when good appearance is required (Fig. 4.2.6).
Applications:

- Several joints can be made with multiple spots as per required applications.
- Nuts, bolts can be attached to other metal parts by projection welding. Contact is made at a projection that has been machined or forged onto the bolt or nut, current is applied and the pieces are pressed together to form a weld.
- It is an attractive means of mass production. Multiple welds can be made with additional strength thereby improving the short comings of a conventional spot welding where one spot is made at a time.

Resistance Spot Welding:

The individual welds are produced by momentary application of pressure and resistance into the workpiece. The workpieces are held together under pressure between the anvil faces. The machine is started which applies current and the resistance is generated at the point of contact. Spot weld between sheets are roughly elliptical in shape at the interface. They can be overlapped to produce an essentially continuous weld joint.