# PLASTICS WELDING

**Plastics welding** is the process of joining two pieces of Thermoplastics at heated state and under a pressure as a result of cross-linking of their polymermolecules. The work pieces are fused together with or without filler material. The joint forms when the parts are cooled below the Glass Transition Temperature (foramorphous polymers) or below the melting temperature (for crystalline polymers).

Thermosets (thermosetting resines) in cured condition cannot be welded, since cross-linking of their molecules has completed.

Plastics welding processes:

- ⊡ **Hot Gas Welding**
- ⊡ **Hot Plate Welding**
- ⊡ **Ultrasonic Welding**
- ⊡ **Spin Welding**
- ⊡ **Vibration Welding**

## Hot Gas Welding

**Hot Gas Welding** is a plastics welding process, utilizing heat of hot gas stream. The gas (usually air) is heated by electric heating elements mounted within the welding gun. The torch (welding gun) directs the heated gas toward the work piece surfaces and a rod of filler material. The edges of the joined parts and the filler rod material are fused together and pressed. The polymer molecules are cross-linked when the work pieces cool down, forming a strong joint.

Hot Gas Welding is manually operated process requiring high level of the operator skill. Some polymers (e.g. Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE)) oxidize at incresed temperature therefore they are welded by hot Nitrogen.

Applications of Hot Gas Welding:

- ⊡ Containers;
- ⊡ Tanks for storage chemicals;
- ⊡ Ventilation ducting;
- ⊡ Tubes;
- ⊡ Repair works.

## Hot Plate Welding

**Hot Plate Welding** is a plastics welding process, utilizing heat of hot plate placed between the surfaces to be joined. The work pieces, pressed to the plate, heat up and soften. After a predetermined time the plate is removed, the parts are brought to the contact, pressed and fused together. Their polymer molecules are cross-linked when the work pieces cool down, forming a strong joint.

Hot plates are made mainly of Aluminum alloys. A hot plate is equipped with an electric heating elements and a thermocouple providing temperature control of the plate surface.

Applications of Hot Plate Welding:

- ⊡ Components of domestic electric devices (dishwashers, washing mashines, vacuum cleaners);
- ⊡ Pipes;
- ⊡ Automotive components (lights, fuel tanks, reservoirs, batteries).

Advantages of Hot Plate Welding:

- ⊡ Easily automated;
- ⊡ High quality tight joints;
- ⊡ Large and comples parts may be welded;
- ⊡ Hot plate provides conforming the joined surfaces.

Disadvantages of Hot Plate Welding:

- ⊡ Long welding cycle: up to 20 sec. for small parts and up to 30 min. for large parts;
- ⊡ Relatively large amount of flash (excess material) forms.

## Ultrasonic Welding

**Ultrasonic Welding** is a plastics welding process, in which two work pieces are bonded as a result of a pressure exerted to the welded parts combined with application of high frequency acoustic vibration (ultrasonic).
Ultrasonic vibration transmitted by a metal tool (horn, sonotrode) causes oscillating flexing of the material and friction between the parts, which results in a closer contact between the two surfaces with simultaneous local heating of the contact area. The plastic melts in the contact area, the polymer molecules are cross-linked, forming a strong joint.

Ultrasonic Welding cycle takes about 1 sec. The frequency of acoustic vibrations is in the range 20 to 70 kHz (commonly 20-40 kHz). The ampltude of the acoustic vibrations is about 0.002” (0.05 mm).
Thickness of the welded parts is limited by the power of the ultrasonic generator.

Ultrasonic Welding is used mainly for processing amorphous polymers (Polysterene (PS), Acrylonitrile-Butadiene-Styrene (ABS))

Applications of Ultrasonic Welding:

- ⊡ Medical equipment (filters, face mask, valves, cardiometry reservoir);
- ⊡ Automotive components (glove boxes doors, filters, valves, airflow sensors);
- ⊡ Appliance (vacuum cleaner, steam iron, dishwasher components);
- ⊡ Electrical equipment (switches, terminal blocks,connectors);
- ⊡ Electronic and computer components;
- ⊡ Toys.

Advantages of Ultrasonic Welding:

- ⊡ Short welding cycle;
- ⊡ Easily automated and controllable;
- ⊡ Small amount of flash forms;
- ⊡ Low energy consumption;

Disadvantages of Ultrasonic Welding:

- ⊡ Only small and thin parts may be welded;
- ⊡ Tool design is required.

## Spin Welding

**Spin Welding** is a plastics welding process, in which two cylindrical parts are brought in contact by a friction pressure when one of them rotates. Friction between the parts results in heating their ends. After a predetermined time the rotation stops and the molten regions of the work pieces are fused together under an axial pressure applied until the joint is cooled down.

Spin Welding is similar to Friction Welding (FRW).

Spin Welding is used for manufacturing aerosol bottles, floats and other circular parts.

Advantages of Spin Welding:

- ⊡ Reproducibility;
- ⊡ Large parts may be welded;
- ⊡ High quality weld;
- ⊡ Oxidizing polymers may be welded.

Disadvantages of Spin Welding:

- ⊡ At least one of the parts to be welded should have a circular symmetry;
- ⊡ Minimum rigidity required.

# Vibration Welding

**Vibration Welding** is plastics welding process, in which two work pieces are vibrated at certain frequency and ampltude. The parts rubb each other under a pressure causing a friction between their surfaces, which generates heat. The heat results in melting polymer in the joint region. The work pieces are fused together and after a predetermined time the vibration stops. The polymer molecules are cross-linked when the work pieces cool down, forming a strong joint.

Vibration Welding cycle is very short (milliseconds). The frequency of acoustic vibrations is in the range 100 to 500 Hz (commonly 100-240 Hz). The ampltude of the vibrations is about 0.02-0.2” (0.5-5 mm).

Most polymers (amorphous, semicrystalline and crystalline) produced various fabrication methods (Thermoforming, Extrusion, Injection molding, Blow molding,Compression molding, Transfer molding) may be welded by Vibration Welding.

Vibration Welding is used in automotive and domestic appliance industries.

Advantages of Vibration Welding:

- ⊡ Oxidizing polymers may be welded;
- ⊡ Easily automated;
- ⊡ High productivity;
- ⊡ Large and complex parts may be welded.

Disadvantages of Vibration Welding:

- ⊡ Relatively expensive equipment;
- ⊡ Minimum rigidity required.

Source : http://www.substech.com/dokuwiki/doku.php?id=plastics_welding