Description

Process schematic

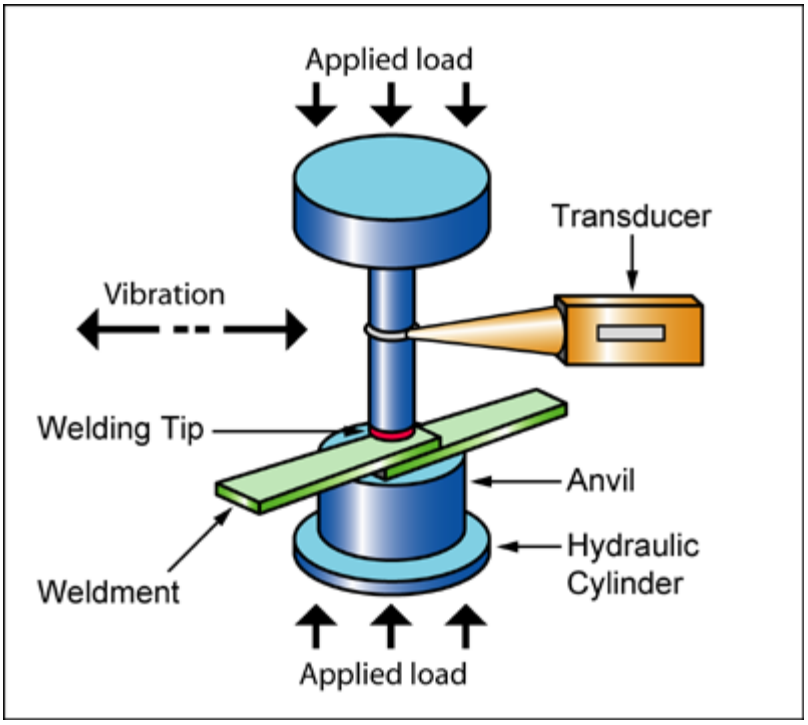

Figure caption

Ultrasonic welding can be applied to both polymers and metals

The process

If you want to weld using ultrasound, you need an ultrasonic generator, a converter (transducer), a booster and a welding tool, bizarrely called a sonotrode. The generator for ULTRASONIC WELDING converts 50 Hz mains voltage into a 20 kHz signal. The converter uses the reverse piezoelectric effect to transform the 20 kHz AC signal into mechanical oscillations. The booster and the sonotrode transmit this to the weld zone in such a way to create an oscillating displacement of 10 to 30 microns. A static pressure of 2-15 MPa is applied across the surfaces to be joined and the power switched on to make them slide, heat, roughen and bond.

Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓
Polymers - thermoplastics	✓

Function compatibility

Electrically conductive	✓
Thermally conductive	✓
Watertight/airtight	✓
Demountable	✗

Joint geometry compatibility

Lap	✓
Butt	✓

Tee	✓

Load compatibility

Tension	✓
Compression	✓
Shear	✓
Bending	✓
Torsion	✓
Peeling	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	medium
Labor intensity	low

Physical and quality attributes

Range of section thickness	0.2	-	3	mm
Unequal thicknesses	✓			
Processing temperature	6.85	-	76.9	°C

Process characteristics

Discrete	✓

Supporting information

Design guidelines

Ultrasonic welding produces fast, strong, clean and reliable welds in both polymers and metals. For polymers, the process is principally used for thermoplastic film and sheet. It can join similar materials of differing thickness, applying either spot or seam welds. Most metals can also be ultrasonically welded. There is some increase in temperature at the sliding surface, but it is always well below the melting temperature of the material. Instead, it appears that the rapid reversal of stress breaks up surface films and contaminants, and local plasticity, coupled with some diffusion, creates the bond. The process requires a low energy input compared with welding, brazing or soldering; it also offers short process times (e.g. 3 seconds per weld) and relatively low temperatures, minimizing damage to the material adjacent to the weld.

Technical notes

Ultrasonic welding is generally limited to the joining of thin materials - sheet, film or wire - or the attachment of thin sheet to heavier structural members. The maximum thickness, for metals, is about 1mm. The process is particularly useful for joining dissimilar metals. Because the temperatures are low and no arcing or current flow is involved, the process can be applied to sensitive electronic components. Joint shear strengths up to 20MPa are possible.

Typical uses

Polymers: the process is widely used in the automotive, appliance, medical, textile and toy industry. Typical assemblies include sealed tail light assemblies with clear lenses and opaque bodies, double-layer insulated drinking cups, decorative multi-color name plate panels and toys. Metals: spot or line welding of thin sheet, joining of dissimilar metal in bimetallics, microcircuit electrical contacts, encapsulating explosives or chemicals.

The economics

Ultrasonic welding is fast and clean. Up to 1000 pieces an hour can be

The environment

The process has enviable environmental credentials. It is totally clean - no fumes no chemicals, no electrical or other hazards. The input energy is almost entirely transmitted to the joint, giving energy efficiency far exceeding that of thermal processes, without radiation or excessive heat.

Links

MaterialUniverse

Reference