Description

Image



Image caption

(1) A Miller spot welder © Triddle at Wikimedia Commons [Public domain] (2) Spot Welding 24 © Alex Wiebe at Wikimedia Commons (CC BY 2.0) (3) Hyundai RM15, concept for automobile space-frame © Spielvogel at Wikimedia Commons [Public domain]

The process

The tungsten filament of a light bulb is heated, by resistance, to about 2000 C. That is more than enough to melt most metals. RESISTANCE WELDING relies on localizing the electric current I (and thus the "I-squared R" heating) where heating is desired: at the interface. In RESISTANCE SPOT WELDING, the overlapping sheets are pressed between water cooled electrodes. The current-pulse generates heat; the cooled electrodes chill the surfaces, localizing the heat in the interface between the sheets where the metal melts and welds. PROJECTION SPOT WELDING uses an additional trick - a pre-formed pimple on the face of the joint - to confine the current path and further localize the heating; a clever idea, because it extends the use of the method to forgings, castings and machined components and makes it faster because several welds can be made at the same time. In SEAM RESISTANCE WELDING the electrodes are water-cooled wheels, between which overlapping sheets are rolled to give a seam weld.

Process schematic

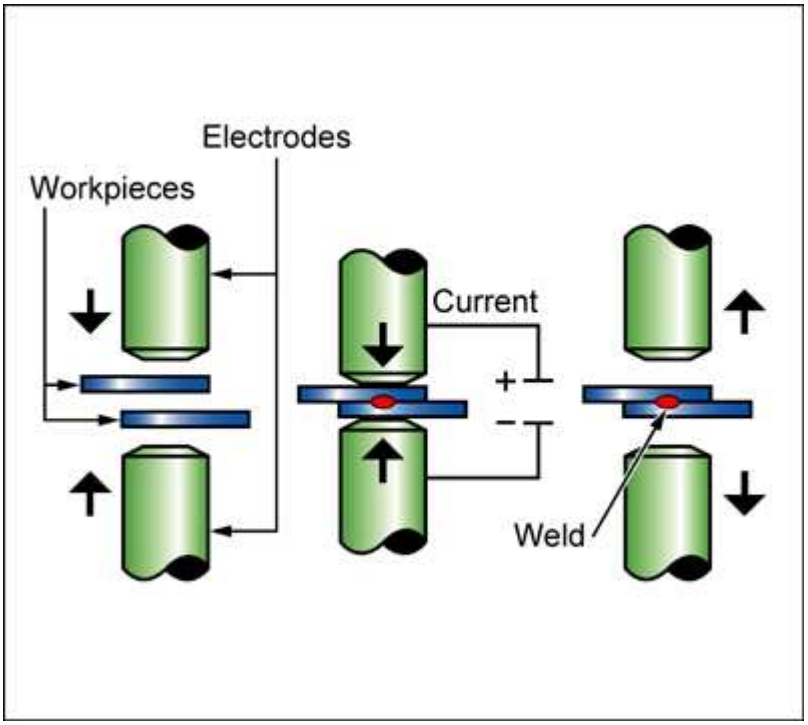

Figure caption

Resistance welding

Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓

Function compatibility

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

Joint geometry compatibility

Lap	✓
Sleeve	✓
Tee	✓

Load compatibility

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

Economic compatibility

Relative tooling cost	medium
Relative equipment cost	medium
Labor intensity	low

Physical and quality attributes

Range of section thickness	9.84	-	315	mil
Unequal thicknesses	✓			
Processing temperature	1.11e3	-	2.78e3	°F

Process characteristics

Discrete	✓
Continuous	✓

Supporting information

Design guidelines

Resistance welding has many advantages over rivets or screw fasteners: it is faster, easily automated, requires no drilling or punching, and no fluxes or fillers; and it gives products that are lighter. Joint design must allow for access to electrodes.

Technical notes

Resistance welding is commonly used for steels of all grades, aluminum, magnesium, brass and cast iron. Electrodes are made of low resistance copper alloys and are hollow to allow water-cooling. Resistance spot welding rates are typically 12-180 welds/minute; projection spot welding rates are greater.

Typical uses

The really big-time users of resistance welding are the automobile and domestic appliance industries. In aircraft structures it is used for assembling doors, fuselage stringers, outer skins, decking, ribs and seat frames. The electronics industry makes extensive use of miniaturized spot welding for assembling circuitry. Seam resistance welding is used for water or gas-tight assemblies: fuel tanks for vehicles, ductwork, drums and cans.

The economics

The capital cost of equipment is medium; high if automated. But the process is fast, reliable, lends itself to automation, and requires no post-weld treatments.

The environment

The heat and the flash of welding require normal precautions - face-shield, goggles - but otherwise the environmental burden is minimal.

Links

MaterialUniverse

Reference