American Welding Society
Safety and Health
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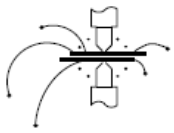

RESISTANCE WELDING

INTRODUCTION

Resistance Welding is a thermo-electric welding process where the weld is made by a combination of pressure and current. The process is a simple joining of metals by applying controlled pressure and passing current for a length of time through the metal area to be joined. There are several different forms of resistance welding (e.g., spot and seam, projection, butt, single-sided, bonding, cross wire, micro, flash, and upset welding) which differ primarily by the types and shapes of weld electrodes that are used to apply the pressure and conduct the current. The electrodes, typically manufactured from copper-based alloys due to superior conductive properties, are cooled by water flowing through cavities inside the electrode and the other conductive tooling of the resistance welding machine.

HOW THE PROCESS WORKS

Fundamentally, Resistance Welding occurs when current flows through the pieces of metal. As the metal heats, the applied force or pressure on the two pieces applied for a defined period of time joins the metals together to form a weldment. The resistance spot welding process uses copper electrode tips and pressure versus resistance seam welding that uses a wheel shaped electrode that rolls under pressure over the two metal surfaces to be joined. The physical metallurgy of the materials to be welded determines the application of the resistance welding process variables.

There are two categories of metals to be welded: “conductive” (such as aluminum, copper, gold and silver), and “resistive” (such as steel, nickel, Inconel, titanium, tungsten, and molybdenum) with a third, small, middle ground category occupied primarily by brass. In general, electrically conductive materials are also more thermally conductive and are softer.

The basic weld schedule for resistance welding is squeeze, heat, hold, off. The four critical parameters within the schedule include electrode force, squeeze time, weld pulse and hold time. As well, the weld schedule and parameters are influenced by the material. The power supply types include capacitor discharge (CD), Direct-Energy (AC), High Frequency Inverter (HFDC) and Transistor or Linear DC (DC). The four basic electrode configurations include Opposed (Direct) Welding, Step (Indirect) Welding, Series Welding and Seam Welding. The opposed (direct) welding configuration is the most common

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type of resistance welding as the current flows from one electrode directly across the weldment to the opposing electrode.

Key advantages of the resistance welding process include:

- Very short process time
- No consumables, such as brazing materials, shielding gas, solder, or welding rod/wire
- Operator safety because of low voltage and fume emission
- Clean and environmentally friendly
- A reliable electro-mechanical joint is formed

SAFETY HAZARDS

Resistance Welding is not an open- arc process. The weld is made inside or between the workpieces. Consequently, there are unique hazards to consider. Here are the major ones:

- Flying sparks can cause fire and explosion.
- Flying sparks and spatter can burn or injure eyes and skin.
- Electric shock from live electrical parts is a possible hazard.
- Hot metal and parts can cause burns.
- Moving electrode parts, such as tongs, tips, and linkages, can injure fingers and hands.
- Fumes from spot welding parts coated with cleaners, paints, or platings can be hazardous.

HOW TO AVOID THE HAZARDS

- Read and follow all labels and the equipment Owner's Manual before installing, operating, or servicing welding equipment.
- Read and follow Safety Data Sheets (SDSs) for metals, coatings, and cleaners.
- Wear safety goggles or a face shield and safety glasses. Wear long sleeved shirts made from non-melting material. Do not weld near flammables – move them away. Keep a fire extinguisher nearby and know how to use it.
- Wear dry insulated gloves. Install and ground unit according to electrical codes. Disconnect input power before servicing. Do not put hands between tips. Keep away from linkages and pinch points. Keep all guards and panels in place.
- Do not breathe the fumes. Use adequate ventilation.
- Do not touch hot workpiece, tips, or tongs with bare hands. Allow tongs and tips to cool before touching. Wear proper insulating gloves when handling hot work or parts is necessary.
- Ensure all equipment has been installed by qualified electricians with appropriate safety disconnecting switch or circuit breaker.
- Thermal protection switch provided for ignition tubes used in resistance welding

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- equipment.

- Guarding in place to mitigate activation of all automatic or air and hydraulic clamps including foot pedals/switches.

- Use electronic eye, two hand controls or protection similar to punch press operation as guarding for all press welding machine operations, where there is a possibility of the operator's fingers being under the point of operation.

- Grounding should be provided to the secondary of all welding transformers for multispot, projection and seam welding machines.

INFORMATION SOURCES

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes,* American National Standards Institute, <www.aws.org>.

ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection,* American National Standards Institute, <www.ansi.org>.

CSA W117.2, *Safety in Welding, Cutting and Allied Processes* (Standard W117.2), available from Canadian Standards Association, <www.csa.ca>.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting and Other Hot Work* (NFPA 51B)*,* National Fire Protection Association, <www.nfpa.org>.

NFPA 70, *National Electric Code* (NFPA 70)*,* available from National Fire Protection Association, <www.nfpa.org>.

OSHA, Title 29 Labor, Parts 1901.1 to 1910.1450, *Code of Federal Regulations*, Occupational Safety and Health Administration, <www.osha.org>.