



# The Professional's Advisor on **Resistance Welding**



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## Basic Safety Precautions

**Burn Protection.** Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting, and allied processes. These can cause burns if precautionary measures are not used. Workers should wear protective clothing made of fire-resistant material. Pant cuffs, open pockets, or other places on clothing that can catch and retain molten metal or sparks should not be worn. High-top shoes or leather leggings and fire-resistant gloves should be worn. Pant legs should be worn over the outside of high-top shoes. Helmets or hand shields that provide protection for the face, neck, and ears, and a head covering to protect the head should be used. In addition, appropriate eye protection should be used.

**Electrical Hazards.** Electric shock can kill. However, it can be avoided. Live electrical parts should not be touched. The manufacturer's instructions and recommended safe practices should be read and understood. Faulty installation, improper grounding, and incorrect operation and maintenance of electrical equipment are all sources of danger.

All electrical equipment and the workpiece should be grounded. The workpiece lead is not a ground lead. It is used only to complete the welding circuit.

A separate connection is required to ground the workpiece. The workpiece should not be mistaken for a ground connection.

**Fumes and Gases.** Many welding, cutting, and allied processes produce fumes and gases which may be harmful to health. Avoid breathing the air in the fume plume directly above the arc. Do not weld in a confined area without a ventilation system. Use point-of-welding fume removal when welding galvanized steel, zinc, lead, cadmium, chromium, manganese, brass, or bronze. Do not weld on piping or containers that have held hazardous materials unless the containers have been inerted properly.

**Compressed Gas Cylinders.** Keep caps on cylinders when not in use. Make sure that gas cylinders are chained to a wall or other structural support. Do not weld on cylinders.

**Radiation.** Arc welding may produce ultraviolet, infrared, or light radiation. Always wear protective clothing and eye protection to protect the skin and eyes from radiation. Shield others from light radiation from your welding operation.

AWS also recommends a personal copy of "Arc Welding Safely," "Fire Safety in Welding and Cutting," and "Safety in Welding, Cutting, and Allied Processes."

## Chapter 1—Definitions

### Resistance Welding

*Acceptable weld*—A weld that meets all the requirements and the acceptance criteria prescribed by the welding specifications.

*Contact resistance*—Resistance to the flow of electric current between two workpieces or an electrode and a workpiece.

*Cool time*—The time interval between successive heat times in multiple-impulse welding or in the making of seam welds. (See Figures 1 and 2.)

*Electrode force*—The force applied to the electrodes in making spot, seam or projection welds by resistance welding.

*Electrode indentation*—The depression formed on the surface of workpieces by electrodes.

*Electrode pickup*—Contamination of the electrode tips or wheel faces by the base metal or its coating during spot, seam, or projection welding.

*Electrode skid*—The sliding of a resistance welding electrode along the surface of the workpiece when making spot, seam, or projection welds.

*Faying surface*—The mating surface of a member that is in contact with or in close proximity to another member to which it is to be joined.

*Follow-up*—The ability of the moveable electrode to maintain proper electrode force and contact with the workpiece as metal movement occurs, especially in projection welding.

*Forge-delay time*—The time elapsing between a preselected point in the welding cycle and the initiation of the forge force. (See Figure 1.)

*Forge force*—A compressive force applied to the weld after the heating portion of the welding cycle is essentially complete.

*Heat-affected zone (HAZ)*—The portion of the base metal whose mechanical properties or microstructure have been altered by the heat of welding. It should be noted that with resistance welding processes the HAZ is usually much narrower than with arc welding processes, but the metallurgical characteristics are the same.

*High-strength low-alloy steel (HSLA)*—A general term for low-carbon steel having higher yield strength than standard low yield strength, low-carbon steels. It can be furnished as either a hot or cold rolled product.

*High-strength steels (HSS)*—A general group of steels with greater tensile and yield strengths than low strength, low-carbon steel. *NOTE:* I-F steels are low-carbon steels with improved formability having less than 0.02 percent carbon (C) with niobium (Nb) or titanium (Ti) additions.

*Impulse*—A group of pulses occurring on a regular frequency separated only by an inter-pulse time. (See Figures 1 and 2.)

*Indentation*—In a spot, seam, or projection weld, the depression on the exterior surface of the workpieces.

*Indirect welding*—A resistance welding secondary variation in which the welding current flows through the workpieces in locations away from, as well as at, the welds for resistance spot, seam, or projection welding. (See Figure 3.)