



Grounding of Portable and Vehicle Mounted Welding Generators

INTRODUCTION

Proper grounding and bonding of portable and vehicle mounted welding generators that also supply 115 or 230 volts AC auxiliary power is an on-going topic among welders. This Fact Sheet will help you determine the requirements for bonding and grounding welding generators. Additionally, it will give definitions and present necessary electrical concepts to clarify the requirements for bonding and grounding.

TERMS

Sources: ANSI Z49.1, hereafter termed Z49.1, AWS A3.0, and NEC--National Electrical Code, hereafter termed NEC. See Information Sources Section at end for details.

Bonding—The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Ground—The electrical potential of the earth's surface; a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Ground Connection—An electrical connection of the welding machine frame to the earth for safety.

Grounded—Connected to earth or to some conducting body that serves in place of the earth.

Grounded, effectively—Intentionally connected to earth through a ground connection of sufficiently low resistance and with adequate current-carrying capacity to prevent the buildup of voltage that may be hazardous to connected equipment or to persons.

Grounding—The process of bonding one or more conductive objects to the ground, so that all objects are at zero (0) electrical potential; also referred to as "earthing."

Grounding Conductor—A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes [ground rod(s) or metal water pipe].

Ground Rod—A metal rod, typically copper, not less than eight feet in length and 1/2 inch in diameter, driven into the earth such that at least eight feet of length is in contact with the soil, to function as a suitable connection point to earth. NOTE: Since different diameters are required for different rod materials and the driven length and number of rods used depends on the special soil conditions and applications, consult the NEC for the specific data for the correct ground rod and method of use for each particular situation.

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Hard Wired—Connected by separate conductors to a junction point or box—not to receptacles.

Metal Water Pipe—Typically an underground metal water pipe that supplies water to a building or premises or faucet /outlet and that is in contact with the earth for a specified distance. NOTE: Since the metal water pipe has several key requirements that must be met before it complies with regulations, consult the NEC for specific information before selecting any pipe for a ground connection.

Portable—Capable of being carried or moved about; designed for ready movement and use in field locations.

Separately Derived System--A premises wiring system whose power is derived from a battery, a solar photovoltaic system, or from a generator, transformer, or converter windings, and that has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Vehicle Mounted—Equipment installed in a truck, trailer, or similar wheeled vehicle.

Work—The workpiece or metal upon which the welder welds and is normally grounded independently of the welding leads to a good electrical ground unless a qualified person assures it is safe to work on an ungrounded workpiece.

Work Lead—The electric conductor between the source of arc welding current and the work. The work lead should not be referred to as the ground lead. It is preferable to connect the work lead directly to the work. Unless a separate grounding conductor is used (to connect the

workpiece to an earth ground), the work lead will not be grounded.

NATURE OF THE HAZARD

Some basics:

- When the generator is running, current can pass through a wire, a ladder, a hoist, your body, or any other conductor.
- If you become part of an electrical circuit, current can pass through your body causing a shock.

Why Grounding is Important: Grounding the frame of electrical equipment ensures the following:

- Generators are grounded to prevent the buildup of voltages that may result in undue hazards to persons or equipment.
- When no voltage difference exists between the grounded generator frame and earth, no electric current can flow. Therefore, the shock hazard is reduced.
- Since it is the flow of electric current through the human body that is hazardous, proper grounding is one of the best ways to prevent unintended electric shock.

If we don't ground the generator and should have, the results can be hazardous—here's why:

- If the auxiliary power circuit has a fault condition (such as a short caused by bare wires), and there is no safety ground connection to protect the user, the result can be an electric shock.
- Additionally, grounding helps prevent possible fire or explosion when fueling by reducing the chances for static electricity sparks from the fuel nozzle to the tank.

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CONDITIONS WHERE GROUNDING THE GENERATOR FRAME TO A METAL WATER PIPE OR GROUND ROD IS REQUIRED BY THE NEC:

1. The welding generator is not part of a separately derived system, **OR**
2. It has its neutral conductor solidly interconnected to a service-supplied system neutral, **OR**
3. It supplies auxiliary power output (115 volts AC / 230 volts AC) by means other than cord-and-plug connection through receptacles mounted on the generator, such as connections to internal terminals on the generator—hard wired (see equipment Owner's Manual for grounding instructions).

When **ANY** of these conditions are met, grounding is required.

CONDITIONS WHERE GROUNDING THE GENERATOR FRAME TO A METAL WATER PIPE OR GROUND ROD IS NOT REQUIRED BY THE NEC:

1. The welding generator has auxiliary power output (115 volts AC or 230 volts AC) and the generator receptacles have a ground pin outlet available for the equipment that plugs into the receptacle, **AND**
2. The generator is portable or mounted on a truck or trailer, **AND**
3. The auxiliary power is used by cord-and-plug-connection means through receptacles mounted on the generator, **AND**
4. The generator is mounted on a vehicle and the generator frame is bonded to the vehicle frame.

HOW TO AVOID THE HAZARDS

- Follow the manufacturer's recommended procedures for grounding the welding generator.

- Watch out for bed liners in trucks—securely connect the welding generator frame to the frame of the vehicle or trailer by a ground wire or bolted metal-to-metal contact.
- Bond the generator to the vehicle frame or earth.
- When grounding a generator sitting directly on the earth, use a driven ground rod to ensure the earth connection.
- Keep the fuel nozzle in contact with the tank when fueling to prevent static sparks and fire.

SUMMARY

- Proper grounding of the welding generator frame can help prevent electric shock.
- If your generator is in a truck or trailer, and you use power directly from the receptacles via plugs, connect (bond) the generator frame to the vehicle frame—be sure there is a good metal-to-metal connection.
- If you hard wire the generator auxiliary power to a project or building electrical system, then you must connect the generator frame to a driven ground rod or metal water pipe.
- **The decision is based on what you do with your auxiliary power:** If you just plug equipment into the receptacles, connection to the vehicle frame is fine. If you hard wire the auxiliary power into another electrical system, then you must connect the generator frame to a driven ground rod or metal water pipe.
- **Remember:** The objective is to keep the frame of the generator at zero (or earth) voltage.

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- In simplest terms, grounding the welding generator frame provides an electrical path to ground instead of a possible electrical shock hazard to the user.

INFORMATION SOURCES

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes*, Z49.1, available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5776 (phone: 800-854-7179, website: www.global.ihs.com).

Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations*, Title 29 Labor, Parts 1926.400, 1926.403, 1926.404, 1926.449, and 1910.302 available from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (phone: 800-321-6742, website: www.osha.gov).

National Fire Protection Association (NFPA). *National Electrical Code* (NFPA 70), available from National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101 (phone: 800-344-3555, website: www.nfpa.org).

Institute of Electrical and Electronic Engineers (IEEE), *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems*—Green Book, ISBN 1-5593-7141-2, Product Number SH14498-TBR Standard 142-1991, available from IEEE Publications Office, 10662 Los Vaqueros Circle, P.O. Box 3014, Los Alamitos, CA 90720-1264 (phone: 800-272-6657, website: www.ieee.org).

American Welding Society (AWS). *Welding Terms and Definitions*, A3.0, available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5776 (phone: 800-854-7179, website: www.global.ihs.com).