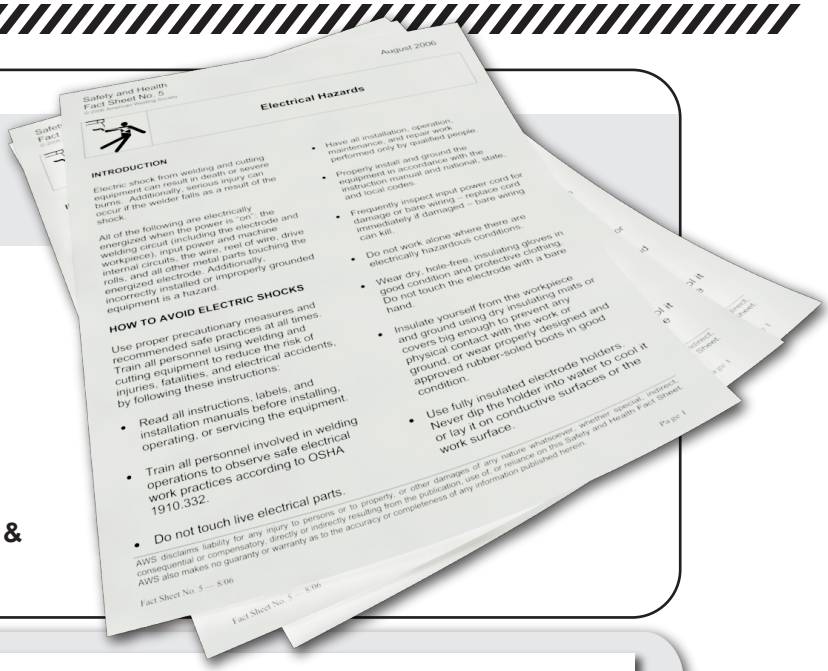
AWS SAFETY AND HEALTH FACT SHEET BUNDLE

FOR UTILITIES

Includes the following concise and helpful fact sheets from the American Welding Society's Committee on Safety and Health


Safety and Health Fact Sheet No. 5
August 2006
Electrical Hazards
INTRODUCTION
Electric shock from welding and cutting equipment can result in death or severe burns. Additionally, serious injury can occur if the welder falls as a result of the shock.
All of the following are electrically energized when the power is "on": the welding circuit (including the electrode and workpiece), input power and machine internal circuits, the wire, reel of wire, drive rolls, and all other metal parts touching the energized electrode. Additionally, incorrectly installed or improperly grounded equipment is a hazard.
HOW TO AVOID ELECTRIC SHOCKS
Use proper precautionary measures and recommended safe practices at all times. Train all personnel using welding and cutting equipment to reduce the risk of injuries, fatalities, and electrical accidents, by following these instructions:
- Read all instructions, labels, and installation manuals before installing, operating, or servicing the equipment.
- Train all personnel involved in welding operations to observe safe electrical work practices according to OSHA 1910.332.
- Do not touch live electrical parts.
- Have all installation, operation, maintenance, and repair work performed only by qualified people.
- Properly install and ground the equipment in accordance with the instruction manual and national, state, and local codes.
- Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.
- Do not work alone where there are electrically hazardous conditions.
- Wear dry, hole-free, insulating gloves in good condition and protective clothing. Do not touch the electrode with a bare hand.
- Insulate yourself from the workpiece and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground, or wear properly designed and approved rubber-soled boots in good condition.
- Use fully insulated electrode holders. Never dip the holder into water to cool it or lay it on conductive surfaces or the work surface.
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Fact Sheet 4: Chromium and Nickel in Welding Fume

Fact Sheet 11: Confined Spaces

Fact Sheet 18: Lockout/Tagout

Fact Sheet 29: Grounding of Portable and Vehicle Mounted Welding Generators

Fact Sheet 36: Ventilation for Welding & Cutting

The following safety fact sheets and the complete 66-page ANSI Z49.1 Safety in Welding, Cutting, and Allied Processes are available for free download at ***www.aws.org/safety***:

1: Fumes and Gases
2: Radiation
3: Noise
4: Chromium and Nickel in Welding Fume
5: Electrical Hazards
6: Fire and Explosion Prevention
7: Burn Protection
8: Mechanical Hazards
9: Tripping and Falling
10: Falling Objects
11: Confined Spaces
12: Contact Lens Wear
13: Ergonomics in the Welding Environment
14: Graphic Symbols for Precautionary Labels
15: Style Guidelines for Safety and Health Documents
16: Pacemakers and Welding
17: Electric and Magnetic Fields (EMF)
18: Lockout/Tagout
19: Laser Welding and Cutting Safety
20: Thermal Spraying Safety
21: Resistance Spot Welding
22: Cadmium Exposure from Welding & Allied Processes
23: California Proposition 65
24: Fluxes for Arc Welding and Brazing: Safe Handling and Use
25: Metal Fume Fever
26: Arc Viewing Distance
27: Thoriated Tungsten Electrodes
28: Oxyfuel Safety: Check Valves and Flashback Arrestors
29: Grounding of Portable and Vehicle Mounted Welding Generators
30: Cylinders: Safe Storage, Handling, and Use
31: Eye and Face Protection for Welding and Cutting Operations
33: Personal Protective Equipment (PPE) for Welding & Cutting
34: Coated Steels: Welding and Cutting Safety Concerns
36: Ventilation for Welding & Cutting
37: Selecting Gloves for Welding & Cutting
Z49.1: Safety in Welding, Cutting, and Allied Processes

American Welding Society®

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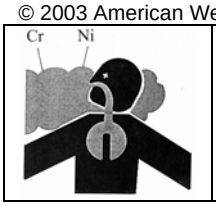


Chromium and Nickel in Welding Fume

INTRODUCTION

The fume from welding processes may contain compounds of chromium, including hexavalent chromium, and of nickel. The composition of the base metals, the welding materials used, and the welding processes affect the specific compounds and concentrations found in the welding fume.

IMMEDIATE EFFECTS OF OVER-EXPOSURE TO FUMES CONTAINING CHROMIUM AND NICKEL

- Similar to the effects produced by fumes from other metals.
- Cause symptoms such as nausea, headaches, dizziness, and respiratory irritation.
- Some persons may develop a sensitivity to chromium or nickel which can result in dermatitis or skin rash.

CHRONIC (LONG TERM) EFFECTS OF EXPOSURE TO FUMES CONTAINING CHROMIUM AND NICKEL

- Definite effects are not yet determined
- Conclusions from the National Institute for Occupational Safety and Health (NIOSH): some forms of hexavalent chromium and nickel and their inorganic compounds should be considered occupational carcinogens (cancer-causing agents).
- NIOSH Criteria Documents 76–129 and 77–164 (listed below) contain these conclusions based on data from the chromate producing industry and from nickel ore-refining processes.
- Conclusions from the International Agency for Research on Cancer (IARC): (1) there is limited evidence in humans for the carcinogenicity of welding fumes and gases, and (2) there is inadequate evidence in experimental animals for the carcinogenicity of welding fumes.

OVERALL EVALUATION

- Welding fumes are possibly carcinogenic to humans (Group 2B).
- No determination has yet been made concerning the health effects on welders or users of chromium- or nickel-containing alloys.
- Nevertheless, give consideration to the NIOSH and IARC conclusions.

HOW TO PROTECT AGAINST OVER-EXPOSURE

- Do not breathe fumes and gases. Keep your head out of the fumes.
- Use enough ventilation or exhaust at the arc or both to keep fumes and gases from your breathing zone and general area.

- If ventilation is questionable, use air sampling to determine the need for corrective measures.

- Keep exposure as low as possible.

INFORMATION SOURCES

National Institute for Occupational Safety and Health (NIOSH). *Criteria for a Recommended Standard: Occupational Exposure to Chromium (VI),* NIOSH Publication No. 76-129. Cincinnati, OH (telephone: 800-356-4674; web site: http://www.cdc.gov/niosh/homepage.html).

National Institute for Occupational Safety and Health (NIOSH). *Criteria for a Recommended Standard: Occupational Exposure to Inorganic Nickel,* NIOSH Publication No. 77-164. Cincinnati, OH (telephone: 800-356-4674; web site: http://www.cdc.gov/niosh/homepage.html).

American Welding Society (AWS). *Fumes and Gases in the Welding Environment,* published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; Web site: www.aws.org.

American Conference of Governmental Industrial Hygienists (ACGIH). *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634 (telephone: 513-742-2020; web site: www.acgih.org).

Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations,* Title 29 Labor, Parts 1910.1 to 1910.1450, available from the U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (telephone: 800-321-6742; web site: www.osha.gov).

American Conference of Governmental Industrial Hygienists (ACGIH). *Documentation of the Threshold Limit Values and Biological Exposure Indices,* available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634 (telephone: 513-742-2020; web site: www.acgih.org).

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Chromium, Nickel, and Welding, Vol. 49 (1990), Oxford University Press, New York, NY 10016 (telephone: 212-726-6000; web site: www.oup-usa.org).

The following references include the specific precautionary methods used to protect against exposure to fumes and gases:

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes* (ANSI Z49.1), published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; Web site: www.aws.org.

National Institute for Occupational Safety and Health (NIOSH). *Safety and Health in Arc Welding and Gas Welding and Cutting,* NIOSH Publication No. 78-138. Cincinnati,OH (telephone: 800-356-4674; web site: http://www.cdc.gov/niosh).

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations,* Title 30 Mineral Resources, Parts 1 to 199, available from the U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (telephone: 202-693-9400; web site: www.msha.gov).

Safety and Health
Fact Sheet No. 11 September 2009

Hot Work in Confined Spaces

NATURE OF THE HAZARD

Many different places require welding, cutting, and other hot work. Some of these places lack room and become "confined spaces." Confined spaces have the following characteristics:

- Limited space, entry, or exit.
- Poor ventilation – lack of safe breathing air and possible buildup of hazardous gases, fumes, and particles.

EXAMPLES OF CONFINED SPACES

Small rooms	Process vessels
Pits	Tunnels
Vats	Furnaces
Storage tanks	Pipelines
Sewers	Silos
Degreasers	Boilers
Reactor vessels	Utility vaults
Compartments of ships	Ventilation ducts
Unventilated room areas	Conveyers

REASONS FOR DEATHS AND SERIOUS INJURIES FROM HOT WORK IN CONFINED SPACES

- Fire
- Electric shock
- Exposure to hazardous air contaminants
- Explosion
- Asphyxiation

ACTIONS REQUIRED BEFORE APPROVING HOT WORK IN A CONFINED SPACE

- Determine if special training or a permit is required to enter the space.
- Open all covers and secure them from closing.
- Test atmosphere for:
  (1) suitable oxygen content
  (2) combustibles or reactives
  (3) toxics

  Note: The testing requires special equipment and training.
- Isolate lines by capping or double blocking and bleeding. Keep vents open and valves leak-free.
- Lock out/tagout all systems not required during hot work.
- Provide means for readily turning off power, gas, and other supplies from outside the confined space.
- Protect or remove any hazardous materials or materials which may become hazardous when exposed to hot work.

REQUIRED ACTIONS DURING HOT WORK IN A CONFINED SPACE

- Continuously ventilate and monitor air to ensure fumes and gases do not exceed safe exposure limits.

- 29 CFR 1910.252(c) and 1926.353(c) require the use of local exhaust ventilation or supplied air respiratory protection when hot work is performed in a confined space where there is a potential for exposure to fluorine compounds (fluxes and rod coatings), zinc, lead, cadmium, or mercury. When beryllium is present, use both local exhaust and a supplied-air respirator.

- 29 CFR 1926.353(c) requires the use of local exhaust ventilation or supplied air respiratory protection when hot work is performed in a confined space where there is a potential for exposure to chromium or when Gas Metal Arc Welding is performed on stainless steel.

- Use NIOSH/MSHA (National Institute for Occupational Safety and Health/Mine Safety and Health Administration) approved breathing device when required by code.

- Keep unnecessary persons and equipment out of, and away from, the confined space.

- Do not allow equipment to block exit or rescue efforts.

- Place as much equipment as possible outside the confined space.

- Do not enter a confined space unless a watchperson, properly equipped and trained for rescue, is outside. Maintain continuous communications with the worker inside.

- When possible, provide means for readily turning off power, gases, and fuel from inside the confined space, even if outside turn-off means are provided.

INFORMATION SOURCES

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes* (ANSI Z49.1), published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; web site: www.aws.org.

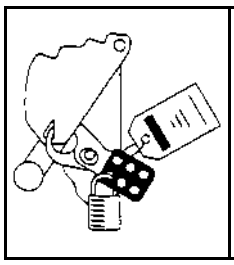
Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations,* Title 29 Labor, Parts 1910 and 1926, available from the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401; telephone: 800-321-6742; web site: www.osha.gov.

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations* Title 30 Mineral Resources, Parts 1 to 199, available from the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401; telephone: 202-693-9400; web site: www.msha.gov.

American National Standards Institute (ANSI). *Safety Requirements for Confined Spaces* (ANSI Z117.1), available from ANSI, 25 West 43rd Street, New York, NY 10036; telephone: 212-642-4900; web site: www.ansi.org.

National Institute for Occupational Safety and Health (NIOSH) Respirator Rule. *Code of Federal Regulations,* Title 42 Public Health, Part 84, available from the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401; telephone: 800-356-4674; web site: www.cdc.gov/niosh.

March 1997



LOCKOUT/TAGOUT

INTRODUCTION

Sometimes work must be performed on equipment, pipelines, and machinery that may contain moving parts, pressurized gases or liquids, electrical energy, or other hazards. Contact with any of these may result in injury or death.

DEFINITIONS

“Lockout” means to install a locking device that keeps the switch, valve, or other mechanism from being turned on or opened. “Tagout” means to put a tag on the locking device. The tag indicates DANGER or WARNING, along with a brief message. It has a place to put the date and person’s name who lockedout the equipment so that he or she may be easily found or notified.

STEPS TO FOLLOW

- Train employees in the purpose and methods of lockout/tagout.
- Inform the job supervisor about the proposed work, and obtain permission to lockout and tagout the equipment.
- Shut down the equipment.
- Place locks and tags on the switches and valves to prevent their use.

  Note: If more than one person is performing work on the equipment, it is recommended that they have their own locks and tags on the lockout point.

- Have the operator try to start the equipment or open the valves. If the equipment and valves are not operable, proceed to the next step. If they are operable, check where the locks should be placed or, if needed, place additional locks to ensure that equipment or valves are not operable. Check the equipment or valves for operation again.

- Start the work. If the employees' shift ends before the work is completed, they must remove their locks and the next shift's employees must install their locks before continuing the work and before the previous shift's locks are removed.

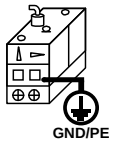
- When the work is completed, ensure that all employees are clear before removing the locks and tags, energizing equipment, or opening valves.

INFORMATION SOURCES

Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations*, Title 29 Labor, Chapter XVII, Parts 1901.1 to 1910.1450, Order No. 869-019-00111-5, available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations*, Parts 1-199, available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

For specific information on recommended lockout points for equipment, machinery, and valves, contact the manufacturer.



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 (O) 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.

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.

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.

- 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, published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; Web site: www.aws.org.

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).

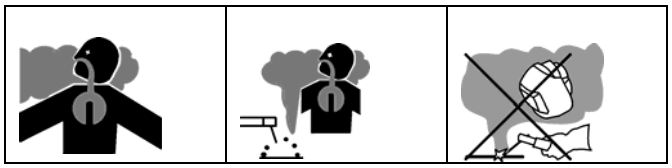
American Welding Society (AWS).*Welding Terms and Definitions*, A3.0, published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; Web site: www.aws.org.

Ventilation for Welding and Cutting

INTRODUCTION

Ventilation is used to control overexposures to the fumes and gases during welding and cutting. Adequate ventilation will keep the fumes and gases from the welder's breathing zone.

NOTE: This safety and health fact sheet does not address ventilation in confined spaces. Also, the term "welding" includes "cutting."



NATURE OF THE HAZARD— THE FUME PLUME

The heat of the arc or flame creates fumes and gases (fume plume). Fumes contain respirable particles. Gases include the shielding gas, and combustion products. The heat from the arc or flame causes the fume plume to rise.

Fumes contain hazardous substances. Overexposure to them may cause acute (short term) or chronic (long term) health effects. Fumes and gases may be produced at toxic levels and they can displace oxygen in the air causing asphyxiation. Overexposure to welding fumes and gases can cause dizziness, illness, and even unconsciousness and death.

HOW TO AVOID THE HAZARD — VENTILATION

Keep your head out of the fumes. Reposition the work, your head, or both to keep from breathing the fumes.

Use ventilation to control the fumes and gases produced from cutting and welding. Adequate ventilation keeps exposures to airborne contaminants below allowable limits. Have a technically qualified person evaluate the exposure to determine if the ventilation is adequate. Wear an approved respirator when ventilation is not adequate or practical.

Adequate ventilation depends on:

- Size and shape of the workplace
- Number and type of operations
- Contents of the fume plume
- Position of the worker's and welder's head
- Type and effectiveness of the ventilation

Adequate ventilation can be obtained through natural or mechanical means or both.

Natural Ventilation – is the movement of air through a workplace by natural forces. Roof vents, open doors and windows provide natural ventilation. The size and layout of the area/building can affect the amount of airflow in the welding area. Natural ventilation can be acceptable for welding operations if the contaminants are kept below the allowable limits.

	**<u>Natural Ventilation</u>: Using airflow from open windows, doors, and roof vents may be adequate.**

Mechanical Ventilation – is the movement of air through a workplace by a mechanical device such as a fan. Mechanical Ventilation is reliable. It can be more effective than natural ventilation. Local exhaust, local forced air, and general ventilation are examples of mechanical ventilation.

<u>Local exhaust ventilation</u> systems include a capture device, ducting and a fan. The capture devices remove fumes and gases at their source. Fixed or moveable capture devices are placed near or around the work. They can keep contaminants below allowable limits.

One or more of the following capture devices are recommended:

- Vacuum nozzle at the arc
- Fume Hoods
- Gun mounted fume extractor

Some systems filter the airflow before exhausting it. Properly filtered airflow may be recirculated.

	**<u>Local Exhaust Ventilation</u>: Use enough local exhaust at the arc to remove the fumes and gases from your breathing area.**

<u>Local forced air ventilation</u> is a local air moving system. A fan moves fresh air horizontally across the welder's face. A wall fan is an example of Local Forced Air Ventilation.

When using localized ventilation, remember:

- Locate the hood as close as possible to the work.
- Position the hood to draw the plume away from the breathing zone.
- Curtains may be used to direct airflow.
- Some toxic materials or chemicals may require increased airflows.
- Velocities above 100 feet per minute at the arc or flame may disturb the process or shielding gas.
- The capture device can depend on the type of job.

SUMMARY

Adequate ventilation removes the fumes and gases from the welder's breathing zone and general area. It prevents overexposure to contaminants. Approved respirators may be required when ventilation is not adequate.

To minimize worker overexposure to fumes and gases:

- Keep your head out of the fumes, and do not breathe the fumes.
- Reposition the work and your head to avoid the fumes.
- Choose the correct ventilation method(s) for the specific operation.
- Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.
- Understand what is in the fumes.
- Have a technically qualified person sample your breathing air and make recommendations.
- Keep hazardous air contaminants below allowable limits.
- Wear the proper respirator when necessary.

INFORMATION SOURCES

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