



AWS SAFETY AND HEALTH FACT SHEET BUNDLE FOR WELDING EDUCATION

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

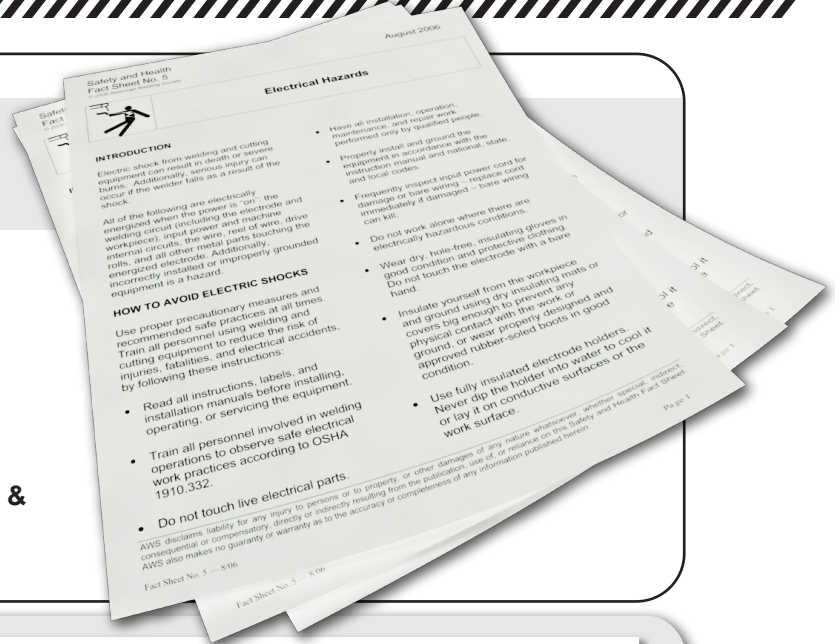
Fact Sheet 1: Fumes and Gases

Fact Sheet 5: Electrical Hazards

Fact Sheet 6: Fire and Explosion Prevention

Fact Sheet 33: Personal Protective Equipment (PPE) for Welding & Cutting

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:

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Fumes and Gases

INTRODUCTION

Many welding, cutting, and allied processes produce fumes and gases, which may be harmful to your health.

DEFINITION

- Fumes are solid particles which originate from welding consumables, the base metal, and any coatings present on the base metal.
- In addition to shielding gases that may be used, gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment.
- Acquaint yourself with the effects of these fumes and gases by reading the Material Safety Data Sheets (MSDSs) for all materials used (consumables, base metals, coatings, and cleaners).
- For help, consult a recognized specialist in Industrial Hygiene or Environmental Services.
- The amount and composition of these fumes and gases depend upon the composition of the filler metal and base material, welding process, current level, arc length, and other factors.

POSSIBLE EFFECTS OF OVER-EXPOSURE

- Depending on material involved ranges from irritation of eyes, skin, and respiratory system to more severe complications.
- Effects may occur immediately or at some later time.
- Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fume fever.
- The possibility of more serious health effects exists when highly toxic materials are involved. For example, manganese overexposure can affect the central nervous system resulting in impaired speech and movement.
- In confined spaces the gases might displace breathing air and cause asphyxiation.

HOW TO AVOID OVEREXPOSURE

- Keep your head out of the fumes.
- Do not breathe the fumes.
- Use enough ventilation or exhaust at the arc, or both, to keep fumes and

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gases from your breathing zone and general area.

- In some cases, natural air movement provides enough ventilation and fresh air
- Where ventilation is questionable, use air sampling to determine the need for corrective measures.
- Whenever the following materials are identified as other than trace constituents in welding, brazing, or cutting operations, and unless breathing zone sampling under the most adverse conditions has established that the level of hazardous constituents is below the allowable limits specified by the authority having jurisdiction, special ventilation precautions shall be taken: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Nickel, Ozone, Selenium, Silver, Vanadium. See section 5.5, Special Ventilation Concerns, ANSI Z49.1:2005, *Safety in Welding, Cutting, and Allied Processes*.
- Use mechanical ventilation to improve air quality.
- If engineering controls are not feasible, use an approved respirator.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Fumes from welding or cutting and oxygen depletion can alter air quality causing injury or death. Be sure the breathing air is safe.

- Follow OSHA guidelines for permissible exposure limits (PELs) for various fumes.
- Follow the American Conference of Governmental Industrial Hygienists recommendations for threshold limit values (TLVs) for fumes and gases.
- Have a recognized specialist in Industrial Hygiene or Environmental Services check the operation and air quality and make recommendations for the specific welding or cutting situation.

INFORMATION SOURCES

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, 732 North Capital Street NW, Washington, DC 20401 (telephone: 800-321-6742; Web site: www.osha.gov).

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).

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

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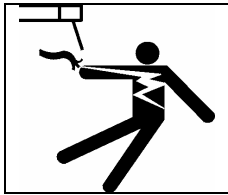
Mine Safety and Health Administration (MSHA). *Code of Federal Regulations*, Title 30 Mineral Resources, Parts 1 to 199, available from the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401; telephone: 202-693-9400; Web site: www.msha.gov.

American National Standards Institute (ANSI). *Safety 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.

For specific information, refer to the applicable Material Safety Data Sheet (MSDS) available from the manufacturer, distributor, or supplier.

TLV is a registered trademark of the ACGIH.

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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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- Do not touch electrode holders connected to two welding machines at the same time since double open-circuit voltage can be present.
- Do not allow the electrode holder or electrode to come in contact with any other person or any grounded object.
- Do not use worn, damaged, undersized, or poorly spliced cables, welding gun cables, or torch cables. Make sure all connections are tight, clean, and dry.
- Do not wrap cables carrying electric current around any part of your body.
- When required by ANSI Z49.1 or other codes, ground the workpiece to a good electrical earth ground. The work lead is not a ground lead. Do not use the work lead as a ground lead. Use a separate connection to ground the workpiece to earth.
- Do not touch an energized electrode while you are in contact with the work circuit.

When using auxiliary power from welding generators, it is recommended that you use a circuit protected by a ground fault circuit interrupter (GFCI) such as receptacles in boxes, extension cords, and the like. Use of an assured grounding system is also acceptable and is equivalent to use of a GFCI protected circuit. (see AWS Safety and Health Fact Sheet No. 29, Grounding of Portable and Vehicle Mounted Welding Generators, for information about assured grounding systems).

Additional safety precautions are required when welding is performed under any of the following electrically hazardous conditions: in damp locations or while wearing wet clothing; on metal floors, gratings, scaffolds, or other metal structures; in cramped positions such as sitting, kneeling, or lying; or when there is a high risk of unavoidable or accidental contact with the workpiece or ground. Where these conditions are present, use one of the following types of equipment presented in order of preference: (1) a semiautomatic DC constant voltage metal electrode (wire) welder, (2) a DC manual covered electrode (stick) welder, or (3) an AC welder with reduced open-circuit voltage. In most situations, use of a DC, constant voltage wire welder is recommended. And, do not work alone!

- Wear a safety harness to prevent falling if working above floor level.
- Turn off all equipment when not in use. Disconnect the power to equipment that will be left unattended or out of service.

Disconnect the input power or stop the engine before installing or servicing the equipment. Lock the input disconnect switch in the “open” (Off) position, or remove the fuses, so that power cannot be turned on accidentally. Follow lockout/tagout procedures (see AWS Safety and Health Fact Sheet No. 18, Lockout/Tagout).

- Use only well maintained equipment. Frequently inspect welding equipment and repair or replace all damaged parts before further use.

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- Keep all covers and panels securely in place.

WEARERS OF PACEMAKERS

The technology of heart pacemakers and other electronic devices changes frequently and this may change the way these devices are affected by other electrical devices including welding equipment. Wearers of pacemakers or other electronic devices vital to life should be instructed to check with their doctor and with the device manufacturer to determine if any hazard exists when near welding or cutting operations. See AWS Fact Sheet No. 16, Pacemakers and Welding, for additional information about pacemakers and welding.

PROCEDURES FOR ELECTRIC SHOCK

- Turn off the electric power.
- Use nonconducting material, such as dry wood, to free the victim from contact with live parts or wires.
- If the victim is not breathing, call for emergency services. Administer cardiopulmonary resuscitation (CPR) immediately after breaking contact with the electrical source. Continue CPR until breathing starts or until help arrives.
- Where an automatic electronic defibrillator (AED) is available, use according to instructions.
- Treat an electrical burn as a thermal burn by applying clean, cold (iced) compresses. Prevent contamination, and cover with a clean, dry dressing.

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 1910.1 to 1910.1450, 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

National Fire Protection Association (NFPA). *National Electric Code* (NFPA 70), available from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101; telephone: 800-344-3555; Web site: www.nfpa.org.

National Fire Protection Association (NFPA). *Standard for Fire Prevention During Welding, Cutting and Other Hot Work* (NFPA 51B), available from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101; telephone: 800-344-3555; Web site: www.nfpa.org.

National Fire Protection Association (NFPA). *Standard for Electrical Safety Requirements for Employee Workplaces* (NFPA 70E), available from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101; telephone: 800-344-3555; Web site: www.nfpa.org.

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations*

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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 Welding Society (AWS). *Safety
and Health Fact Sheets*, published by the
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INTRODUCTION

Welding, cutting, and allied processes produce molten metal, sparks, slag, and hot work surfaces. These can cause fire or explosion if precautionary measures are not followed.

NATURE OF THE HAZARD

Flying sparks are the main cause of fires and explosions in welding and cutting. Sparks can travel up to 35 feet (10.7 meters) from the work area. Sparks and molten metal can travel greater distances when falling. Sparks can pass through or become lodged in cracks, clothing, pipe holes, and other small openings in floors, walls, or partitions.

Typical combustible materials inside buildings include: wood, paper, rags, clothing, plastics, chemicals, flammable liquids and gases, and dusts. Parts of buildings such as floors, partitions, and roofs may also be combustible.

Typical combustible materials outside buildings include dry leaves, grass, and brush.

Welding and cutting can cause explosions in spaces containing flammable gases, vapors, liquids, or dusts. Special precautions are needed for any work on containers (see AWS F4.1).

HOW TO AVOID THE HAZARD

- Develop adequate procedures, and use proper equipment to do the job safely.
- When Required obtain a Hot-Work Permit (See NFPA 51B).
- Remove combustible materials for a minimum radius of 35 feet (10.7 meters) around the work area or move the work to a location well away from combustible materials.
- If relocation is not possible, protect combustibles with covers made of fire-resistant material.
- If possible, enclose the work area with portable, fire-resistant screens.
- Cover or block all openings, such as doorways, windows, cracks, or other openings with fire resistant material.
- Do not weld on or cut material having a combustible coating or internal structure, such as in walls or ceilings, without an appropriate method for eliminating the hazard.
- When needed, have a qualified firewatcher in the work area during and for at least 30 minutes after the job is finished.

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- After welding or cutting, make a thorough examination of the area for evidence of fire. Remember that easily visible smoke or flame may not be present for some time after the fire has started.
- Do not dispose of hot slag in containers holding combustible material.
- Keep appropriate fire extinguishing equipment nearby, and know how to use it.
- Make sure all electrical equipment and wiring are installed properly and have recommended circuit protection.
- Do not overload or improperly size input conductors and/or weld output conductors to avoid equipment and building fire hazards.
- Connect the work cable to the work as close to the welding area as practical.
- Do not weld or cut in atmospheres containing reactive, toxic, or flammable gases, vapors, liquids, or dust.
- Do not apply heat to a workpiece covered by an unknown substance or coating that can produce flammable, toxic, or reactive vapors when heated.
- Do not apply heat to a container that has held an unknown substance or a combustible material unless container is made or declared safe. (see AWS F4.1).
- Provide adequate ventilation in work areas to prevent accumulation of flammable gases, vapors, or dusts.

SUMMARY

Remember that sparks can travel up to a radius of 35 feet (10.7 meters) from the work and pass through or become lodged in all kinds of openings and cause fires where least expected. Recognize that sparks can travel well beyond the 35 foot (10.7 meters) radius when falling or during plasma arc cutting and air carbon arc cutting or gouging. Remove combustible materials and prevent flammable gases, vapors, and dusts from accumulating in the work area to reduce the possibility of a fire or explosion. Always have appropriate fire extinguishing equipment nearby, and know how to use it.

Fires and explosions can be prevented by being aware of your surroundings, minimizing the combustibles in them, and taking the appropriate protective precautions.

INFORMATION SOURCES

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes*, Z49.1, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126. Phone 800-443-9353; Web site: www.aws.org.

National Fire Protection Association (NFPA), *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, NFPA 51B, available from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts USA 02269-9101. Phone: 617-770-3000; Web site: www.nfpa.org.

Occupational Safety and Health Administration (OSHA). *Code of Federal*

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Regulations, Title 29 Labor, Chapter XVII, Parts 1901.1 to 1910.1450, available from Superintendent of Documents, U.S. Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954. Phone: 866-512-1800; Web site: www.osha.gov.

American Welding Society (AWS). *Safe Practices for the Preparation for Welding and Cutting of Containers or Piping*, AWS F4.1, available from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126. Phone: 800-443-9353; Web site: www.aws.org.

American Welding Society (AWS). *Fire Safety in Welding and Cutting*, Pamphlet, available from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126. Phone: 800-443-9353; Web site: www.aws.org.

Mine Safety and Health Administration (MSHA). *Code of Federal Regulations*, Title 30 Mineral Resources, Parts 1-199, available from Superintendent of Documents, U.S. Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954. Phone: 866-512-1800; Web site: www.msha.gov.

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Personal Protective Equipment (PPE) for Welding and Cutting

INTRODUCTION

Like other jobs or careers, welders must wear suitable protective equipment. In general, Personal Protective Equipment (PPE) must protect against hazards such as burns, sparks, spatter, electric shock, and radiation. The use of PPE is a good safe practice and may be required by regulatory agencies. For example, OSHA requires the use of PPE when engineering and administrative controls are not feasible or effective.

NATURE OF THE HAZARD

Welding and cutting can produce hazards such as sparks, spatter, radiation (infrared, ultraviolet, and blue light), slag, heat, hot metal, fumes and gases, and even electric shock. Since these hazards may cause burns, injury, or death, it is important to wear proper PPE at all times.

EYE AND FACE PROTECTION

- Wear a helmet with filter lens and cover plate that complies with ANSI Z87.1 for protection from radiant energy, flying sparks, and spatter.
- According to ANSI Z49.1 and OSHA 29 CFR 1910.252, "Helmets and hand shields shall protect the face, forehead, neck, and ears to a vertical line in back of the ears, from the direct radiant energy from the arc and from direct weld spatter."

- Helmets shall be made of material that complies with ANSI Z49.1.
- Filter lenses and cover plates must meet the tests prescribed in ANSI Z87.1.
- Wear approved safety glasses with side shields (or goggles) under your helmet.
- The safety glasses with side shields (or goggles) are used to protect against flying metal, slag chips, grinding fragments, wire wheel bristles, and similar hazards, which can ricochet under the helmet.
- Choose a filter lens shade according to the Lens Shade Selector Chart in ANSI Z49.1.
- Consult AWS Fact Sheet 31, *Eye and Face Protection for Welding and Cutting Operations*.

HEAD AND EAR PROTECTION

- Wear a fire-resistant welder's cap or other head covering under your helmet. It will protect your head and hair from flying sparks, spatter, burns, and radiation.
- When working out of position, such as overhead, wear approved ear-plugs or muffs. They prevent sparks, spatter, and hot metal from entering your ears and causing burns.
- If loud noise is present, wear approved earplugs or muffs to protect your hearing and prevent hearing loss.

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FOOT PROTECTION

- Select boots that meet the requirements of ASTM F2412 and ASTM F2413 (or the older ANSI Z41 which has been withdrawn). Look for a compliance mark inside your boot.
- Wear leather, steel-toed, high-topped boots in good condition. They will help protect your feet and ankles from injury.
- In heavy spark or slag areas, use fire-resistant boot protectors or leather spats strapped around your pant legs and boot tops to prevent injury and burns.
- Do not wear pants with cuffs. Wear the bottoms of your pants over the tops of your boots to keep out sparks and flying metal. Do not tuck pant legs into your boots.

HAND PROTECTION

- Always wear dry, hole-free, insulated welding gloves in good condition. They will help protect your hands from burns, sparks, heat, cuts, scratches, and electric shock.
- ANSI Z49.1 requires all welders to wear protective flame-resistant gloves, such as leather welder's gloves. They should provide the heat resistance and general hand protection needed for welding.

BODY PROTECTION

- Wear oil-free protective clothing made of wool or heavy cotton. Heavier materials work best. They are harder to ignite and resist wear and damage.
- Choose clothing that allows freedom of movement and covers all areas of exposed skin. Wear long sleeved shirts (no t-shirts), and button the cuffs, pockets, and collar. They will protect your arms and neck from radiation

exposure and skin burns (caused by ultraviolet radiation from the arc).

- Wear heavy, durable, long pants (no shorts) without cuffs that overlap the tops of your boots.
- Keep clothing dry. Change it when needed (this reduces the possibility of electric shock).
- Be aware that any cuffs or open pockets can catch flying sparks and start on fire easily. Unroll cuffs and button pockets to prevent spark entry.
- Keep clothing clean (free of oil, grease, or solvents which may catch fire and burn easily). Keep it in good repair (no holes, tears, or frayed edges). Always follow the manufacturer's directions for their use, care, and maintenance.
- Remove all flammables and matches and cigarette lighters from your pockets.
- Do not wear synthetic (man-made) fabrics because they may burn easily, melt, stick to your skin, and cause serious burns.
- Wear leather aprons, leggings, capes and sleeves as needed for the application. Leather protects better than most materials.

Read ANSI Z49.1. It gives a full explanation of the protective clothing needed when welding or cutting. In brief, Z49.1 states that "Clothing shall provide sufficient coverage, and be made of suitable materials, to minimize skin burns caused by sparks, spatter, or radiation." Full details are in the document.

RESPIRATORY PROTECTIVE EQUIPMENT

For information on respirators, see ANSI Z49.1. Also see OSHA and NIOSH regulations.

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SUMMARY

Protect all areas of your body from injury during welding or cutting by wearing the proper protective clothing and equipment. Do not weld or cut unless wearing the necessary PPE as specified in this Fact Sheet and in ANSI Z49.1.

INFORMATION SOURCES

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes*, Z49.1, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (phone: 800-443-9353, website: www.aws.org).

American National Standards Institute (ANSI). *Practice for Occupational and Educational Eye and Face Protection*, Z87.1, available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations*, Title 29 Labor, Parts 1910 and 1915, 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).

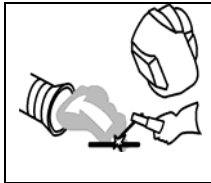
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American Welding Society (AWS). Safety and Health Fact Sheet No. 31, *Eye and Face Protection for Welding and Cutting Operations*, available from American

Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (phone: 800-443-9353, website: www.aws.org).

ASTM International Standards, F2412, *Test Methods for Foot Protection*, and F2413, *Specification for Performance Requirements for Protective Footwear*, available from ASTM International, 100 Bar Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2559 (telephone: 610-832-9585; website: www.astm.org). (Note: F2412 and F2413 have replaced the former ANSI Z41 standard, which has now been withdrawn.)

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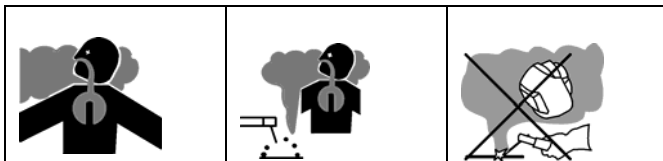


Ventilation for Welding and Cutting

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.

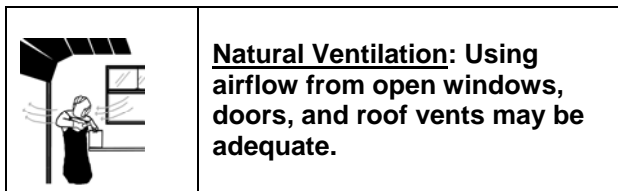
Use ventilation to control the fumes and gases produced from cutting and welding. Adequate ventilation keeps exposures to airborne contaminants below allowable limits. Have a technically qualified person evaluate the exposure to determine if the ventilation is adequate. Wear an approved respirator when 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.



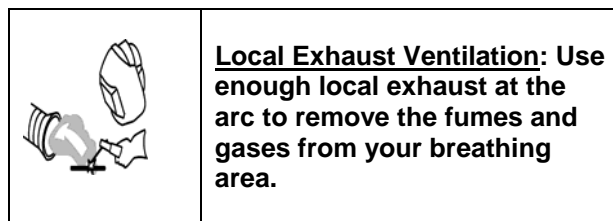
Mechanical Ventilation – is the movement of air through a workplace by a mechanical device such as a fan. Mechanical Ventilation is reliable. It can be more effective than natural ventilation. Local exhaust, local forced air, and general ventilation are examples of mechanical ventilation.

Local exhaust ventilation 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.



Local forced air ventilation 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.

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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

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 1910.1 to 1910.1450, 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.

National Fire Protection Association (NFPA). *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work* (NFPA 51B), available from National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, telephone: 800-344-3555, web site: www.nfpa.org.

American Conference of Governmental Industrial Hygienists (ACGIH), *Industrial Ventilation – A Manual of Recommended Practice* 21st edition, published by the ACGIH, 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211-4438; telephone , 513-742-2020; web site: www.acgih.org.

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