AWS SAFETY AND HEALTH FACT SHEET BUNDLE

FOR THE MINING INDUSTRY

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

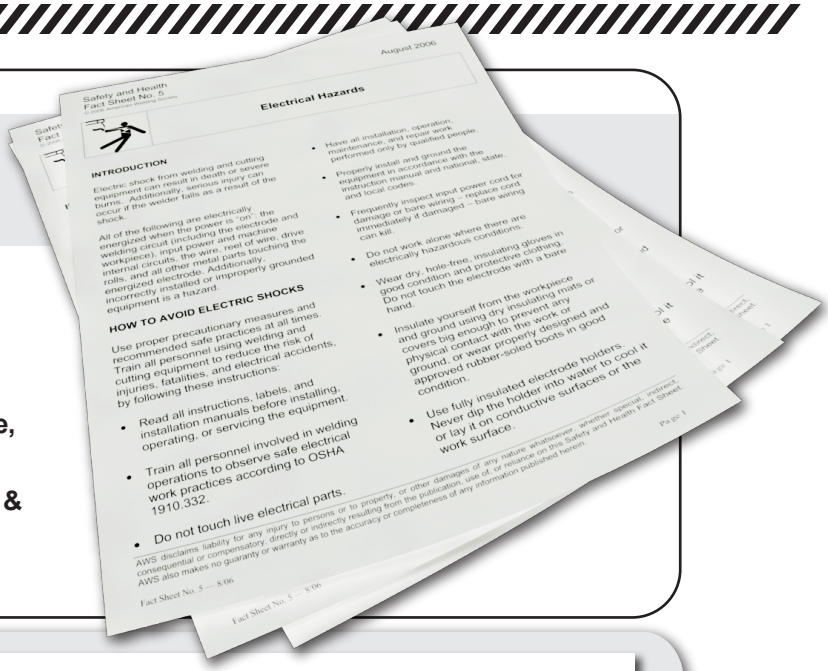
Fact Sheet 3: Noise

Fact Sheet 5: Electrical Hazards

Fact Sheet 11: Confined Spaces

Fact Sheet 30: Cylinders: Safe Storage, Handling, and Use

Fact Sheet 36: Ventilation for Welding & Cutting


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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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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Noise

INTRODUCTION

In welding, cutting, and allied operations, noise may result from the process, the power source, or other equipment. Air carbon arc cutting and plasma arc cutting are examples of processes which are frequently noisy. Engine-driven generators may also be quite noisy. Excessive noise is a known health hazard.

DEFINITION

Scientifically, noise is composed of several frequencies and involves random changes in frequency or amplitude. Sound waves are produced when the air is mechanically disturbed. Sound is measured by its frequency (pitch-high or low) and intensity (loudness). Practically, noise is unwanted or unpleasant sound. It can get in the way of the sounds we would rather hear and often need to hear for safety reasons.

EFFECTS OF OVEREXPOSURE TO NOISE

- Loss of hearing that may be either full or partial and either temporary or permanent.
- Hearing loss may be a temporary threshold shift from which the ears may recover if removed from the noise source.
- The time required to develop permanent hearing loss depends on individual susceptibility, noise level, and exposure duration.
- There is evidence that excessive noise affects other bodily functions and behavior as well.

HOW TO PROTECT AGAINST NOISE

- Reduce the intensity of the source.
- Shield the source where practical.
- Use engineering control methods, such as room acoustics, to control noise.
- If engineering methods fail to reduce noise to acceptable levels, wear approved personal protective devices such as ear muffs or ear plugs appropriate for the situation.
- Follow OSHA regulations which require a Hearing Conservation Program if noise levels reach 85 dB on an 8-hour, Time Weighted Average (TWA) basis.
- If noise level is questionable, have a certified safety specialist or Industrial Hygienist take measurements and make recommendations.

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, 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). *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).

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).

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.

- 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.

- 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 exits 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 SOUCES

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*

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

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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

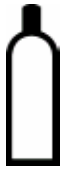
American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes* (ANSI Z49.1), published by the American Welding Society, 550 NW LeJeune Road, Miami, FL 33126; telephone 800-443-9353; web site: www.aws.org.

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.



Cylinders: Safe Storage, Handling, and Use

INTRODUCTION

To use compressed gas cylinders safely, it is important that they are stored properly, handled correctly, used with the correct equipment, and that the properties of the gases they contain are fully understood.

OVERVIEW OF CYLINDER PHYSICAL HAZARDS

Physical Damage: Cylinders, with their high internal pressure [up to 2,500 pounds per square inch gauge (psig)], are very hazardous when exposed to damage from falling over or tipping, heat, electric circuits, motion, or vibration – anything that can cause a weakness or crack in the cylinder wall or shell. Such damage can cause the cylinder to rupture and explode sending sharp metal pieces, like shrapnel, blasting through the area.

Valve Hazard: The CGA (in Pamphlet V-1) has established a 0.300 inch (7.62 mm) maximum valve inlet diameter as a requirement to minimize the propulsion effect in case the valve is severed. This standard has the exception of valves used in liquefied gas services and fire control systems. Special design requirements and unique applications such as fire control systems, which require a “high blow down flow”, may dictate greater diameters. The actual outcome of a broken off valve depends on the design and pressure of the valve and cylinder. If the valve is broken off and the valve inlet opening meets the Compressed Gas Association (CGA) requirements, the cylinder will rapidly release all its gas (which could be a health and/or flammability concern), cause a whistling sound, and possibly spin uncontrollably. If the valve inlet opening is different from the standard hole size used in most welding gases, such as those used for propane or butane and fire protection system cylinders, the cylinders may take off and become airborne. You can check this size matter by being sure the cylinder meets all V-1 requirements.

Tipping and Falling: The most common major hazard is having a cylinder tip over or fall on you or another nearby worker. Since cylinders are heavy and awkward to handle, they require special care and equipment in handling and securing so they don’t fall or tip over and cause injury.

Valve Leakage: Cylinder valves can leak, causing their contents to discharge. To minimize hazards from leaks, use proper ventilation and storage.

OVERVIEW OF CYLINDER CONTENTS HAZARDS

Read, understand, and follow the markings on the cylinder, the label(s) on the cylinder, and the material safety data sheet (MSDS). Each compressed gas cylinder has unique hazards based on contents. Some are filled with inert gases – especially those used in arc welding. Many gases are flammable, explosive, toxic, or a combin-

ation. Common compressed gases include acetylene, carbon dioxide, argon, hydrogen, nitrogen, air, propane, and oxygen.

HOW TO STORE CYLINDERS

- Store cylinders upright and secure them with a chain, strap, or cable to a stationary building support or to a proper cylinder cart to prevent them from tipping or falling.

- Completely close the valves, and keep the valve protection devices, such as caps or guards, securely in place.

- Store cylinders in a dry, well-ventilated area at least 20 feet from combustible materials. Do not keep cylinders in lockers. If they leak, a buildup of flammable or other types of gases can occur inside the locker.

- Mark the storage area with proper precautionary signs, such as flammable, oxidizer, or toxic.

- Place them in a location where they will not be subject to mechanical or physical damage, heat, or electrical circuits to prevent possible explosion or fire. Keep cylinders away from vehicle traffic.

- Store empty cylinders separate from full ones.

- Keep oxygen cylinders 20 feet away from fuel-gas cylinders, such as acetylene, or separate them with a non-combustible barrier (such as a wall) at least 5 feet high with a fire-resistance rating of at least one-half hour.

HOW TO TRANSPORT CYLINDERS

- Most accidents or injuries involving cylinders happen when moving or handling the gas cylinders.

- Use the right equipment, correct procedures, and sufficient number of persons to lift and move cylinders to avoid personal injury and cylinder damage.

- Wear protective footwear, safety glasses, and heavy gloves.

- Securely install the valve protection devices, such as caps or guards.

- Secure cylinders upright to a proper hand truck or cylinder cart designed for the purpose.

- Don't drag or roll them – use a properly designed cart or hand truck.

- When using a crane, be sure to use proper cradles, nets, boats, or special platforms designed for this purpose to prevent cylinders from falling.

- Prevent damage – handle carefully – avoid dropping or banging them.

- Do not lift by the protective cap/guard or use magnets or slings to lift or move them since valves may be damaged or sheared off.

HOW TO USE CYLINDERS

- Follow the instructions in the Compressed Gas Association (CGA) publication P-1, “Safe Handling of Compressed Gases in Cylinders.” (The phone number and web site of the CGA are located at the end of this sheet in the Information Sources Section.) Don't tamper with safety devices.

- Keep cylinders upright and away from heat, sparks, fire, physical damage, or electrical circuits to avoid rupture.

- Use in a well-ventilated area to avoid gas accumulation.

- Do not bring cylinders into a confined space to avoid inhaling the gas and possible suffocation from the accumulation of flammable, toxic, or reactive gases.

- Read, understand, and follow all cylinder markings and labels to avoid misuse.

- Before connecting a regulator, stand to one side, and momentarily open the valve and then close it immediately. This procedure, called “cracking” the valve, is done to clear the valve of dust or dirt that could enter the regulator.

- Open valves slowly by hand to avoid gauge damage. If a specific tool is required to open the valve, leave it in position so that the flow of gas can be stopped quickly in an emergency.

- Lift and move cylinders properly.

- Close the gas cylinder valves when not in use such as during breaks, lunch, or end-of-shift to avoid leaks.

- Avoid getting any oil or grease on the cylinders or regulators/gauges, particularly those containing oxygen, to avoid fire or explosion.

- Storage is not required for single cylinders of fuel gas and oxygen ready for use with regulators attached secured to a proper cart.

HOW TO MAINTAIN THEM

- Protect the markings on cylinders that identify the contents, and mark the full/empty status on cylinders (do not use color to identify contents). Mark all empty cylinders (some companies use "MT").

- Don't use the recessed top of the cylinder as a storage area for tools or material.

- If cylinders are leaking, isolate them outdoors and away from sparks or heat. Call your gas supplier to send qualified people to take care of the problem – don’t try any repairs yourself. Tag leaking cylinders.

- Never mix gases in a cylinder or try to refill a cylinder – always contact your gas supplier.

SUMMARY

Even though high-pressure, compressed gas cylinders are near or part of most welding and cutting operations, they are used safely everyday by many people throughout the world. To prevent injury, always store, handle, use, and maintain them properly. Treat them with the respect they deserve.

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 and 1919.332, 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).

Compressed Gas Association (CGA). *Safe Handling of Compressed Gases in Cylinders*, CGA Pamphlet P-1 (and V-1), from Compressed Gas Association, 1735 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102 (telephone: 703-412-0900, web site: www.cganet. com).

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; website: www.nfpa.org).

Barlen, Bill. "The Significance of the Zero Point Three Hundred Hole." Specialty Gas Report, Vol. 6, No. 2, Second Quarter 2003. (Web site: www.specgasreport.com).

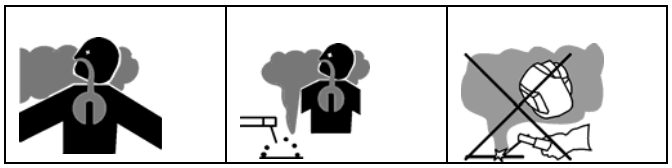
Barlen, Bill. "Follow-up on the Linde Hole. Plus, Where Did the Three Pounds Go?" Specialty Gas Report, Vol. 6, No. 3, Third Quarter 2003. (www.specgasreport.com).

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

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.

American Welding Society (AWS). *Ventilation Guide for Weld Fume* (AWS F3.2), 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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Occupational Safety and Health Administration (OSHA). *OSHA Technical Manual* (OTM), Section III Health Hazards, Chapter 3 Ventilation Investigation, available from OSHA, Room N3655, 200 Constitution Ave., N.W., Washington, DC 20210; telephone: 202-693-2095; web site: http://www.osha.gov.