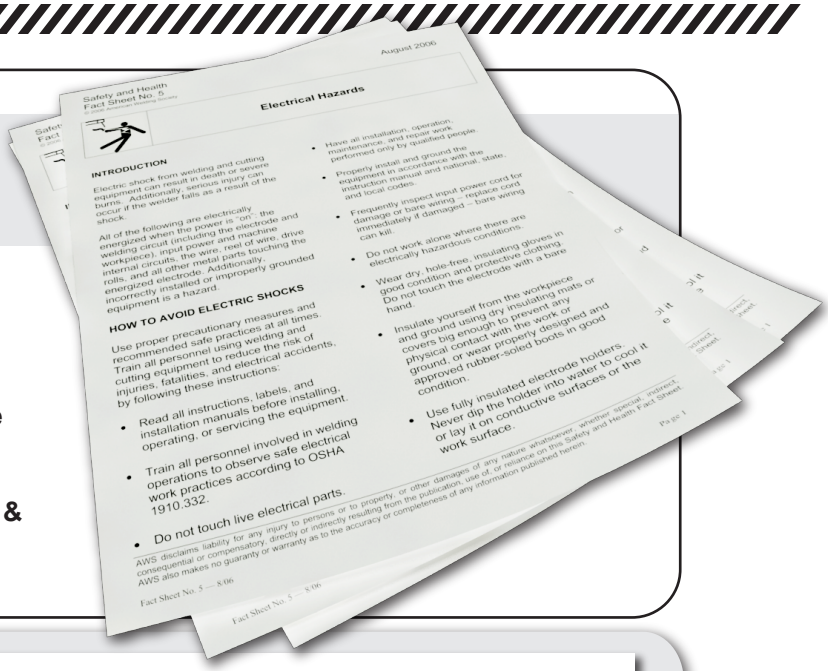
AWS SAFETY AND HEALTH FACT SHEET BUNDLE

FOR CHEMICAL INDUSTRY WELDING

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

Fact Sheet 4: Chromium and Nickel in Welding Fume
Fact Sheet 11: Confined Spaces
Fact Sheet 24: Fluxes for Arc Welding and Brazing: Safe Handling and Use
Fact Sheet 27: Thoriated Tungsten Electrodes
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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Page 1

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
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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

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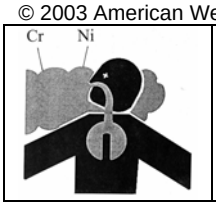

Chromium and Nickel in Welding Fume

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.

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- 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).

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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.

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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.

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FLUXES FOR ARC WELDING AND BRAZING: SAFE HANDLING AND USE

INTRODUCTION

Fluxes are used in various arc welding processes, such as Submerged–Arc Welding (SAW) and Electroslag Welding (ESW). Fluxes are also used in most brazing applications. Fluxes are available in various forms such as granules, powder, paste, or liquid. There are hazards when dealing with fluxes.

HAZARD OVERVIEW

The possible hazards associated with handling and using fluxes include the following:

- Inhaling toxic or corrosive flux dust
- Breathing welding fumes and gases
- Getting flux on the skin and in the eyes
- Swallowing toxic or corrosive flux or dust
- Breathing and swallowing flux particles during recovering and grinding.

The makeup and amount of these hazardous materials varies depending on the flux and the process. Individuals with pre-existing physical conditions, such as allergies or lung diseases, may react to levels below allowable exposure limits and have symptoms that normal, healthy adults do not experience.

ACUTE (SHORT TERM) EFFECTS OF OVEREXPOSURE

Overexposure to flux may cause the following symptoms:

- General overexposure may cause irritation, burning, and bleeding of the exposed tissue, headache, dizziness, and shortness of breath.
- Dust, fumes and gases may irritate the skin, eyes, and respiratory system.
- Toxic, corrosive, or oxygen–depleting gases can cause fluid in the lungs, suffication, and death.
- Fumes containing chromium or nickel compounds may irritate the skin and respiration tract and cause Metal Fume Fever (see Fact Sheet Number 25).
- Flux products containing both fluoride and hydrogen compounds may produce corrosive and toxic hydrofluoric acid which can cause irritation to skin, eyes, and the nose and throat.
- Swallowing or breathing barium oxide dust or fume can result in abdominal pain, vomiting, paralysis, and death.

CHRONIC (LONG TERM) EFFECTS OF OVEREXPOSURE

Long term overexposure to inhalable welding fumes may lead to their accumulation in the body. The effect is cumulative, depending on concentration and time of exposure. The accumulation, evident from x-ray examination, may or may not result in reduced lung function or disease. Smoking or other non-welding exposure to hazardous particules may cause or aggravate this type of lung accumulation condition. Chronic fluoride absorption can cause calcium loss from the bones and can discolor or spot the teeth. Prolonged exposure to manganese oxides may affect the central nervous system, causing tiredness, fatigue, sleepiness, muscular weakness, emotional disturbances, and uncontrolled movements while

walking (muscle spasms). Chronic overexposure to respirable crystalline silica may result in silicosis, a disabling lung disease, and also a suspected carcinogen to the lungs. Nickel and chromium VI compounds, when present, and when inhaled over long periods, are carcinogenic. Nickel fumes may also cause fibrous masses and fluid in the lungs.

OVERALL EVALUATION OF POTENTIAL HAZARDS

Fluxes are safe and useful when handled and used properly and when recommended safety procedures are followed. The major hazards to avoid are overexposure by breathing, swallowing, or inhaling the dust or fumes and gases, especially those containing respirable crystalline silica and fluorides. If the application recovers used flux, as is common in Submerged–Arc Welding (SAW), and then reuses or grinds the flux for reuse, overexposure to dust happens quickly if precautions are not taken.

Some submerged arc welding fluxes may contain very small quantities of naturally occurring radioactive material (NORM). Flux materials containing sufficiently low concentrations of NORM are not subject to federal radiation control regulations. These fluxes do not present an environmental or health hazard. Contact the flux manufacturer for further information.

HOW TO PROTECT AGAINST OVEREXPOSURE

- Wear proper hand, face, and body protection when handling or when otherwise exposed to fluxes and their dust, fumes and gases—this means protective (leather, rubber) gloves, goggles, and full clothing with long sleeves and long pants (not shorts).
- Avoid breathing the dust or fumes and gases. Keep your head out of the fumes, dust, and gases. Use enough ventilation, exhaust at the arc, or both, to keep fumes, dust, and gases from your breathing zone and the general area. When necessary, wear an approved mask or respirator.
- Do not consume food or beverages in areas where flux dust or fumes or gases may be generated or may be present.
- During brazing, do not overheat the fluxes. Follow the manufacturer's recommended procedures. Overheating results in the generation of, and potential exposure to, excessive fumes and gases.

INFORMATION SOURCES

American Welding Society (AWS) Study. *Fumes and Gases in the Welding Environment* and other Safety and Health publications, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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, P.O. Box 371954, Pittsburgh, PA 15250.

American Conference of Governmental Industrial Hygienists (ACGIH) publication, *Threshold Limit Values (TLV®) for Chemical Substances and Physical Agents in the Workroom Environment*, available from American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240.

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.

National Institute for Occupational Safety and Health (NIOSH). *Criteria For A Recommended STD – Welding, Brazing And Therm*, NIOSH Publication No. 88-110. Cincinnati, Ohio: National Institute for Occupational Safety and Health.

American Welding Society (AWS). Safety And Health Fact Sheet No. 1, *Fumes And Gases,* available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

American Welding Society (AWS). Safety And Health Fact Sheet No. 25, *Metal Fume Fever,* available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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

American Welding Society (AWS). *A Sampling Strategy Guide for Evaluating Contaminants in the Welding Environment* (AWS F1.3), available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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Thoriated Tungsten Electrodes

INTRODUCTION

Thoriated tungsten electrodes contain thorium, a radioactive material that can pose health and environmental risks at elevated exposure levels. Thorium is a low-level radioactive material that primarily emits alpha particles as well as some beta and gamma radiation. These electrodes are normally sharpened by grinding as part of the standard procedure while preparing to perform gas tungsten arc welding (GTAW). Dust particles from this grinding process can cause internal radiation exposure if the dust is accidentally ingested or inhaled, so caution is necessary. Concern regarding radiation exposure to the external body from these electrodes is minimal.

Thoriated tungsten electrodes are widely used because they make good welds and are long lasting and quite easy to use. A thoriated tungsten electrode operates at a temperature well below its melting temperature compared to a pure tungsten electrode. This results in a much lower rate of consumption of the electrode during welding, which eliminates much of the “arc wander” associated with balled pure tungsten. Other reasons for their use include easier arc initiation, reduced weld metal contamination, higher current-carrying capacity, the ability to sharpen the electrode, and long life.

IS THERE A CONCERN TO THE USER?

The risk of internal exposure during welding is negligible in most circumstances since the thoriated electrode is consumed at a very slow rate.

During the grinding of the thoriated tungsten electrodes, radioactive dust is created, posing the potential hazard of internal radiation exposure by inhalation or ingestion unless care is taken to control the dust.

HOW TO REDUCE EXPOSURE

- Choose thorium-free tungsten electrodes such as those containing cerium, lanthanum, yttrium, or zirconium whenever possible.
- Read, understand, and follow all information in the Material Safety Data Sheet (MSDS) for the selected tungsten electrode.
- Use a high-efficiency dust collection system to capture particles created during the grinding of electrodes or disturbed during housekeeping.
- Evaluate the ventilation system before acceptance and periodically thereafter to minimize personnel and environmental contamination.

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- Develop and implement standard operating procedures for the use of thoriated tungsten electrodes, including proper procedures for storage, grinding, use, housekeeping and disposal.

- Provide training in the operation of the welding and grinding equipment, personal hygiene, and safety.

WHAT TO DO WITH THE COLLECTED DUST PARTICLES

- Regularly remove the dust generated by grinding.

- Properly dispose of the dust and spent electrodes in accordance with federal, state, and local regulations.

SUMMARY

Several of the information sources listed indicate that the risk of occupational exposure to radiation during storage, handling, and welding with thoriated tungsten electrodes is negligible where simple precautions are taken. Special care should be taken to control and collect dust from grinding these electrodes in order to prevent a potential ingestion and inhalation exposure to radioactive dust particles resulting from this operation.

INFORMATION SOURCES

International Institute of Welding (IIW). Statement from Commission VIII, Health and Safety 2000. *Welding with Non-Consumable Thoriated Tungsten Electrodes.* Document IIW-VIII-1901-00. np: np.

Jankovic, J. T., W. S. Underwood, and G. M. Goodwin. 1999. Exposures from Thorium Contained in Thoriated Tungsten Electrodes. *American Industrial Hygiene Journal* 60: 384 – 389.

Nuclear Regulatory Commission (NRC). *Code of Federal Regulations, Title 10 Energy, Part 40.13 (c) (1) (iii)* (Available from the U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954; tel: 800-321-6742; Web site: www.nrc.gov).

Oak Ridge National Laboratory (ORNL): Estimated Radiation Doses from Thorium and Daughters Contained in Thoriated Welding Electrodes, by L. M. McDowell-Boyer (ORNL/NUREG/TM-344). Oak Ridge, TN: ORNL, 1979.

Sinclair, M. L., and K. S. Thind: "Assessment of Thorium Exposure Due to Grinding of Thoriated Tungsten Electrodes." Paper presented at the American Industrial Hygiene Conference, Boston, MA., May 1992,

Breslin, A. J., and W. B. Harris: Use of thoriated tungsten electrodes in inert gas shielded arc welding. *Ind. Hyg. Q. 13*:191-195 (1952).

United States Nuclear Regulatory Commission. (February 1995). *Airborne Thorium from Welding Rods.* HPPOS-255 PDR-9308020142. U.S. NRC, Washington, DC. (Web site: www.nrc.gov).

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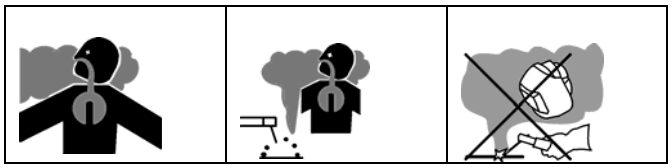
Ventilation for Welding and Cutting

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.

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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.

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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.

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.

Edison Welding Institute (EWI). *Reduction of Worker Exposure and Environmental Release of Welding Emissions* (NSRP report No. 43149GTH, November 30, 2003), available from the Edison Welding Institute, 1250 Arthur E. Adams Drive, Columbus, OH 43221; telephone: 614-688-5000; web site: www.ewi.org.

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.

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