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Welding fume health hazards

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According to the National Institute for Occupational Safety and Health (NIOSH), more than 400,000 U.S. men and women are employed in welding and related occupations. Some studies suggest that these workers are at risk of serious respiratory, neurological, and reproductive effects. More and better data is needed to assess the risks.

In 2003 NIOSH published a comprehensive review of scientific literature on health effects associated with welding. The article,

Health Effects of Welding, 1 noted that past investigations have found bronchitis, airway irritation, and other respiratory illnesses in large numbers of welders. However, critical differences between the studies and a shortage of dose/response data make it difficult to compare results and confidently link given exposures with given effects.

More Data Required

As the article also noted, some studies have suggested that welding fumes may pose risks for lung cancer and nervous system damage. This is because such fumes may contain nickel, chromium, and manganese. Nickel and hexavalent chromium are classified as potential occupational carcinogens, while studies have associated chronic exposure to manganese with a risk for a Parkinson's-like disease. But according to NIOSH, data is lacking for (1) determining whether welders are exposed to those or other fume components at levels that could trigger such effects and (2) understanding how exposures at given levels may lead to serious, long-term effects.

NIOSH suggested two complementary types of research to fill those gaps,:

- A continuation of epidemiological studies to provide a better understanding of the role that welding fumes may play in immunosuppression, lung cancer development, neurotoxicity, skin damage, reproductive disorders, and other effects that some studies have associated with the components of welding fumes.
- Toxicology studies using state-of-the-art techniques to examine key biochemical reactions to welding fumes, at the molecular level, in laboratory experiments. With such data, scientists will have better insight into the ways in which subtle genetic and cellular changes might lead to tumor formation, nerve damage, or other adverse changes in tissues and organs.

The American Federation of State, County, and Municipal Employees (AFSCME) offers a [welding hazards fact sheet](#) that lists health and safety issues associated with welding, brazing, soldering, and metal cutting.

According to the fact sheet, welding *smoke* is a mixture of very fine particles (fumes) and gases. Many of the substances in welding smoke, such as chromium, nickel, arsenic, asbestos, manganese, silica, beryllium, cadmium, nitrogen oxides, phosgene, acrolein, fluorine compounds, carbon monoxide, cobalt, copper, lead, ozone, selenium, and zinc, can be extremely toxic.



Generally, welding fumes and gases come from the base material or filler material; paints and coatings on the metal and covering the electrode; shielding gases; chemical reactions from arc ultraviolet light and heat; process and consumables; and contaminants in the air, such as vapors from cleaners and degreasers.

The AFSCME fact sheet also stated that the health effects of gas and fume exposure are difficult to list because the fumes may contain so many different substances that are known to be harmful. However, individual components of welding smoke can affect almost any part of the body, including the lungs, heart, kidneys and central nervous system.

Welders who smoke may be at greater risk of health impairment than welders who do not smoke, although all welders are at risk.

Short-term Effects

Among the short-term effects is metal fume fever, symptoms of which occur four to 12 hours after exposure and include chills, thirst, fever, muscle ache, chest soreness, coughing, wheezing, fatigue, nausea, and a metallic taste.

Welding smoke also can irritate the eyes, nose, chest, and respiratory tract and cause coughing, wheezing, shortness of breath, bronchitis, pulmonary edema (fluid in the lungs), and pneumonitis (inflammation of the lungs). Gastrointestinal effects, such as nausea, appetite loss, vomiting, cramps, and slow digestion, also have been associated with welding smoke.

Some welding fume components and welding processes can be especially dangerous in a short period of time. Cadmium in welding fumes can be fatal in a short time. Ultraviolet radiation given off by welding reacts with oxygen and nitrogen in the air to form ozone and nitrogen oxides, which are deadly at high doses, irritate the nose and throat, and cause serious lung disease.

Ultraviolet rays can react with chlorinated hydrocarbon solvents, such as trichloroethylene; 1,1,1,-trichloroethane; methylene chloride, and perchloroethylene, to form phosgene gas, a deadly substance, even at small amounts. The symptoms of exposure, dizziness, chills, and cough usually take five or six hours to appear. Arc welding should never be performed within 200 ft. of degreasing equipment or solvents.

Long-term Effects

Studies show that welders and those involved in brazing, soldering, and metal cutting have an increased risk of lung cancer and possible larynx and urinary tract cancer. According to the AFSCME fact sheet, these findings are not surprising in view of the large quantity of toxic substances in welding smoke, including cancer-causing agents such as cadmium, nickel, beryllium, chromium, and arsenic.

Welders also may have chronic respiratory problems, including bronchitis, asthma, pneumonia, emphysema, pneumoconiosis (dust-related diseases, decreased lung capacity, silicosis [caused by silica exposure], and siderosis (a dust-related disease caused by iron oxide dust in the lungs).

Other health problems that appear to be related to welding include heart disease; skin diseases; hearing loss; chronic gastritis (stomach inflammation); gastroduodenitis (stomach and small intestine inflammation); and stomach and small intestine ulcers.

Welding also poses reproductive risks. Studies have shown that welders, especially those who work with stainless steel, have poorer sperm quality than men in other work. Studies also have shown an increase in either miscarriages or delayed conception among welders and their spouses.

Welders who weld or cut surfaces covered with asbestos insulation are at risk of asbestosis, lung cancer, mesothelioma, and other asbestos-related diseases. Employees should be trained and provided with proper equipment before welding near asbestos-containing material.

All risks are greater for welders working in confined spaces.

Linked to Parkinson's Disease

Although not mentioned in the AFSCME fact sheet, recent research has shown a connection between welding fumes and Parkinson's disease, a neurodegenerative disease that affects mental and physical ability.

According to the [Welders Health Network](#), while there may be a genetic predisposition to developing Parkinson's, most doctors believe that some environmental factor is involved, which triggers the disease. Development of this condition especially is associated with welders who have worked with manganese.

Some of the primary symptoms of Parkinson's disease (which sometimes is diagnosed as manganese exposure) include tremors, slow and decreased movement, muscular rigidity, arm and leg stiffness, difficulty negotiating turns, and sudden freezing spells. The symptom most frequently associated with the disease is tremors, although 25 percent of patients report little to no tremors. Some patients report impaired reflexes, gait disturbances, and the loss of balance.

Secondary symptoms include depression; sleep disturbances; dizziness; stooped posture; constipation; dementia; and problems with speech, breathing, swallowing, and sexual function.

Manganese at high levels also can cause decreased motor skills, failing intellectual capacity, increased tremors, and memory loss.

Reducing the Hazards

According to the AFSCME fact sheet, before beginning a welding job, it is important to identify the hazards for the particular welding operation. The hazards will depend on the type of welding, the materials (base metals, surface coatings, electrodes) to be welded, and the environmental conditions (outside or in a confined space).

Ask for a material safety data sheet (MSDS) to identify the hazardous materials used in welding and cutting products and the fumes that may be generated. Make sure you know what you are welding before you start. Some fumes, such as those released from welding on a cadmium-plated surface, can be fatal in a short time. After identifying the hazard, implement appropriate control methods.

Substitute less hazardous materials for hazardous materials. Use cadmium-free silver solders and asbestos-free electrodes, gloves, and hot pads.

Use adequate ventilation. Local exhaust ventilation, which removes fumes and gases at the source, is the most effective method. Use a partial enclosure, such as a ventilated workbench, or hoods positioned as close to the point of welding as possible. Clean and maintain ventilation systems regularly. For gas-shielded arc welding processes, local exhaust can be provided by an extracting gun, which can reduce worker exposure to welding emissions by 70 percent. All hoods and ductwork should be constructed of fire-resistant materials.

General ventilation uses roof vents, open doors and windows, roof fans, and floor fans to move air through the entire work area. These methods are not as effective as local exhaust ventilation and may actually spread chemicals around the workplace. However, general ventilation often is helpful when used to supplement local ventilation.

Welding in confined spaces requires additional ventilation.

Sample the welding area fumes for both short-term and long-term evaluations using a filter-cassette placed on your collar or shoulder with the welding hood in the down position. More information about sampling can be found at http://www.msha.gov/illness_prevention/healthtopics/hhcm10.htm.

Be educated in the hazards associated with your welding job and materials, and make sure you're taking all possible precautions. Pay attention to your health, and have any suspicious symptoms checked out immediately.

1. The article "Health Effects of Welding" was published in the journal of *Critical Reviews in Toxicology*, 33(1):61-103 (2003).