



# Clearing the air about welding fumes and gases

Most welders know that the gases and fumes produced from welding are unsafe. But the health effects from breathing in those materials can vary significantly depending on the work environment, the type of welding, the material being welded, and several other factors. In addition, co-workers nearby may not be aware of the dangers and often don't take the same precautions as welders.

Welding fumes are formed when the heated metal vapourizes and then cools. This causes small particles of metal and other material to become suspended in the air. Breathing in these particles can cause immediate health effects or serious health effects over time.

Welding fumes and gases come from

- the welding rod
- the base metal
- paints and coatings on the metal or electrode (degreasers, etc.)
- shielding gases
- chemical reactions from ultraviolet light and heat.

The table on the next page contains a list of fumes and gases produced from welding, the places where they're found, and the effects they can have on the human body.

Contaminant	Source	Health Effect
<b>Cadmium</b>	<ul style="list-style-type: none"> <li>Some paint pigments</li> <li>Cadmium-plated hardware</li> </ul>	<ul style="list-style-type: none"> <li>Kidney damage</li> <li>Lung cancer</li> </ul>
<b>Hexavalent Chromium</b>	<ul style="list-style-type: none"> <li>Stainless steel</li> <li>Inconel metal</li> <li>Electrode</li> </ul>	Lung cancer
<b>Lead</b>	<ul style="list-style-type: none"> <li>Paint</li> <li>Primer</li> </ul>	<ul style="list-style-type: none"> <li>Destruction of red blood cells</li> <li>Damage to kidneys and nervous system</li> </ul>
<b>Manganese</b>	<ul style="list-style-type: none"> <li>Mild steel</li> <li>Welding rod</li> </ul>	Central nervous system effects that resemble Parkinson's disease with uncontrollable tremors
<b>Nickel</b>	<ul style="list-style-type: none"> <li>Stainless steel</li> <li>Monel</li> </ul>	<ul style="list-style-type: none"> <li>Bronchitis</li> <li>Long-term exposure can lead to nasal and lung cancer</li> </ul>
<b>Thorium</b>	Thoriated tungsten electrodes used in TIG welding (mainly alpha and some beta radiation)	Cancer (cannot penetrate skin but a hazard when inhaled)
<b>Zinc oxide</b>	Galvanized coatings	Metal fume fever, which resembles flu. Lasts 18-24 hours after exposure
<b>Acetylene</b>	From acetylene not completely used up in oxyacetylene welding	Can displace oxygen and cause asphyxiation in confined spaces
<b>Argon and Helium</b>	Used in MIG and TIG welding to shield electrode from oxygen	Can displace oxygen and cause asphyxiation in confined spaces
<b>Carbon Monoxide</b>	<ul style="list-style-type: none"> <li>Welding arc changes carbon dioxide in the air to carbon monoxide</li> <li>MIG and arc air gouging</li> <li>Incomplete burning during welding</li> </ul>	<ul style="list-style-type: none"> <li>Headache</li> <li>Dizziness</li> <li>Difficulty concentrating</li> <li>Heart disorders</li> <li>Coma</li> <li>Death</li> </ul>
<b>Nitrogen Oxides (NO and NO<sup>2</sup>)</b>	<ul style="list-style-type: none"> <li>Welding arc changes nitrogen in air to nitrogen oxides</li> <li>MIG and plasma arc welding</li> </ul>	<ul style="list-style-type: none"> <li>Respiratory irritation</li> <li>Pulmonary edema</li> </ul>
<b>Ozone</b>	<ul style="list-style-type: none"> <li>Ultraviolet light used by the welding arc changes oxygen in air to another form of oxygen called ozone</li> <li>MIG and plasma arc welding</li> </ul>	<ul style="list-style-type: none"> <li>Irritation of eyes, nose, and throat</li> <li>Chest pains</li> <li>Wheezing</li> <li>Pulmonary edema</li> </ul>
<b>Phosgene</b>	Ultraviolet radiation from welding arc decomposes chlorinated degreasers such as trichloroethylene and 1,1,1 trichloroethane	<ul style="list-style-type: none"> <li>Respiratory irritation</li> <li>Chest pains</li> <li>Pulmonary edema</li> <li>Death (at high concentrations)</li> </ul>

## Prevention

The hazards from welding fumes and gases must be recognized, assessed, and controlled or eliminated to protect workers. You may be able to eliminate them by joining metal together by some other means such as bolting them.

If it's not possible to eliminate the hazards, implement controls at the source, along the path, or at the worker.

### At the source

- Remove paints and coatings such as rust inhibitors from areas that are to be welded. However, do not use solvents for removal because they can release other toxins when heated.
- If possible, use welding rods or electrodes made of material that releases the least amount of toxic substances.
- Take special precautions when welding in a confined space. Follow the requirements of the Confined Spaces Regulation (632/05).
- If possible, use a shielding gas that produces fewer contaminants. For example, using a mixture of argon and carbon dioxide instead of straight CO<sub>2</sub> has been shown to reduce welding fumes by 25 per cent.
- Use only the current, rod size, and arc length that is necessary for the job. A higher current, larger rod, and longer arc length will produce more fumes.
- Welding with reversed polarity (workpiece negative) produces more fumes than welding with straight polarity (workpiece positive). NOTE: You can only weld with straight polarity if the welding rod is compatible.
- Adjust your posture and technique. Welders who bend over close to the welding location and position themselves in the smoke plume will have a greater risk of exposure.
- Read the warning label or M(SDS) for any hazardous material you're working with and follow the recommended safety precautions.





### Along the path

If it's not possible to control hazards at the source, implement them along the path to the worker. Use ventilation to reduce the concentrations of airborne contaminants in the worker's breathing zone and the work area. A combination of ventilation types should be used to control welding gases and fumes.

Ventilation can include:

- **Local exhaust ventilation** – smoke eaters, exhaust fans, air cleaners, or duct systems that remove airborne contaminants and exhausts them outdoors or away from a worker's breathing zone
- **Natural dilution ventilation** – welding outside in a light breeze or inside with doors and windows open (Note: When using natural dilution ventilation, make sure to keep your head out of the welding fume.)
- **Mechanical dilution ventilation** – industrial fans.

Local exhaust ventilation should be used wherever possible as it is the most effective way to protect workers.

### At the worker

According to section 46(2) of the Regulation for Construction Projects (213/91), respiratory equipment must be provided and used by workers if the hazard cannot be controlled through ventilation. In some cases, a respirator in combination with ventilation may be required.

The type of respirator required depends on the amount of exposure and the toxicity of the fumes. Refer to IHSA's Respirator Selection Chart in Chapter 15 of the *Construction Health and Safety Manual* (M029) to choose the correct one for the type of work being done.

**Remember: A welder who is required to wear a respirator must be instructed in its proper fitting, use, and maintenance and must have a fit test performed.**

In addition, post signs warning others of the welding hazards in the area and letting them know the protective equipment that needs to be worn.

## How IHSA can help

IHSA has several resources to help you control welding hazards at your workplace.

- Health and Safety Guide: Arc Welding (B012)
- Construction Health and Safety Manual (M029)—Chapter 41: Welding and Cutting
- Health and Safety Advisory: Toxic Exposure to Manganese in Welding Fume (W156)
- Safety Talks (V005)
  - Welding – Inhalation Hazards
  - Lead-based Paint – Welding and Cutting

