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Hazards of Welding Fume

A closer look at the dangers of welding fume and a strategic approach that can help to reduce exposure.

 **Speedglas**™

What is Welding Fume?

Welding is a process that joins selected work pieces together by melting them to form a strong joint. As part of this process, there is an amount of metal fume produced – basically microscopic particles of hot metal and gases that are small enough and buoyant enough to be released from the welding arc and rise in a cloud of metal fume into the workplace air. This fume is then able to be inhaled by the welder or others close to the source. There can be significant exposures to workers if effective controls are not in place, potentially leading to significant short and long term health effects.

Welding fume can contain a mixture of airborne gases that may include oxides of nitrogen (NO_x),

carbon monoxide (CO), carbon dioxide (CO₂), ozone (O₃) and shield gases eg argon, helium.

The visible part of the fume cloud is mainly particles of metal, metal oxides and flux (if used). The exact level of risk from the fume will depend on what metals are involved in the work eg iron, aluminium, copper, lead, manganese, chromium, nickel, and others. Each of these can have a different toxic effect on the body so exposure needs to be effectively controlled.

The airborne concentrations and total exposure time to these fumes are also significant factors in determining the overall exposure of the welder.

Known Health Effects from Welding Exposures

There are a number of known health effects that can occur from welding exposures:

- Short term exposures to significant levels of welding fume and gases can result in eye, nose and throat irritation, dizziness and nausea. Ozone is a particular cause of this when TIG welding stainless steels and aluminium.
- Long term significant exposure to welding fume can cause lung damage and various types of cancer, including lung, larynx and urinary tract. Chromium (VI), a specific chemical form of chromium can be created during welding of many stainless steels and non-ferrous alloys and is highly toxic and can cause cancer. Certain fumes (zinc is one) may induce metal fume fever, stomach ulcers, kidney damage and nervous system damage. Prolonged exposure to manganese fume can cause Parkinson's-like symptoms.
- Pneumonia - Welders are particularly prone to a lung infection that can lead to severe and sometimes fatal pneumonia. Modern antibiotics usually stops

the infection however in severe cases you could end up in hospital. Pneumonia kills about 2 welders* in the UK each year. It can affect young welders as well as older people.

- Asthma- this is a common complaint for welders, with components of stainless steel fume containing chromium oxide (CrO₃) and Nickel Oxide which cause asthma. For this reason, stainless steel welding fume is considered more harmful than mild steel fume.
- Cancer - In early 2017, welding fume was reclassified from IARC classification Group 2B (possibly carcinogenic to humans) to Group 1 (Carcinogenic to humans). This change was primarily associated with the effects of UV exposure on the skin and eyes and also for lung cancers and limited evidence for kidney cancer from welding fume exposures.

Some strategies that can help to reduce exposure to welding fume:

Welders should understand the hazards of the materials they are working with reference to the relevant Safety Data Sheets and identification of size and scale of exposures to welding fume.

OH&S Regulations requires employers to provide information and training for workers on exposure to hazardous materials in the workplace.

- Welding surfaces should be as clean as practicable of any coating or oil/grease etc that could potentially increase the overall exposure to airborne concentrations of hazardous particles or vapours.
- Workers should position themselves in respect of the fume source as efficiently as possible to avoid or reduce exposure to the welding fume and gases e.g. welders can try to position themselves to be upwind when welding in open or outdoor

environments. When working inside, welders should take advantage of any natural drafts by positioning themselves to keep fume and gases away from themselves and other workers.

- Local exhaust ventilation systems can be used to remove fume and gases from the welder's breathing zone. Any air extraction system inlet should be located as close to the plume source as possible to remove the maximum amount of fume and gases. Keep any exhaust points away from other workers.
- Investigate consumable options to see if there are less toxic alternatives or a welding type that produces less fume.
- Use of appropriate respiratory protection equipment.

The 3M™ Speedglas™ Flip-Up Welding Helmet FX Air

The Speedglas™ Welding Helmet 9100 FX Air is available with both powered and supplied air respiratory protection. The 9100 FX Air welding helmet is unique in that it provides the welder with a smooth flip-up function that reveals a large 170×100mm curved and clear visor. This feature although perfect for grinding is an important safety feature for respiratory protection as it allows the welder to flip-up the auto-darkening lens after welding so that they have a perfectly clear and uninhibited view of their surroundings while maintaining their desired level of respiratory protection. This encourages the welder to keep their visor in the safe down position as opposed to flipping-up or removing their welding helmet and breaking their positive pressure seal. When this visor is combined with the Speedglas 9100XXi TrueView and Speedglas SideWindows, this helmet gives the welder a view of their surroundings like no other respiratory welding helmet on the market.



Welder's Powered Air Respiratory Protection

The [Speedglas 9100 FX Air with the award winning 3M™ Adflo™ Powered Air Welding Respirator](#) has become synonymous with welders powered air respiratory protection and is standard issue for welders on most large projects in Australia. The Adflo™ PAPR provides the welder with a cooler, cleaner and more comfortable environment supplying air 50 times cleaner than the welder would otherwise be breathing (RMPF of 50). With the right type of filter, the Adflo respirator effectively protects against both particles and gases.

Because you can selectively replace either the particle filter or the gas filter as needed, you don't need to change both filters at the same time. The Adflo PAPR allows flow rates up to 200 litres per minute and is suitable for stick, MIG and TIG welding with aluminium, stainless steel, galvanised steel and many other types of material when used in an area with good ventilation or limited ventilation. A gas filter is required for aluminium and stainless steel in areas with limited ventilation. Powered air is not suitable for confined spaces as defined by AS2865.



Welder's Supplied Air Respiratory Protection

The [Speedglas 9100 FX Air is also available with supplied air respiratory protection](#) for hot and strenuous welding conditions or where a higher level of respiratory protection is required. The 3M™ Speedglas™ 9100 FX Air with 3M™ Versaflo™ V-500E Supplied Air regulator provides the welder with a required minimum protection factor of 100+. Or in other terms, this system delivers air to the welder that is at least 100 times cleaner than the air in the surrounding environment. With high flow rates up to 300 litres per minute this system when used with a compressor and filtration system is suitable for stick, MIG and TIG welding with aluminium, stainless steel, galvanised steel and many other types of material when used in areas with restricted space. Supplied air is not suitable for confined spaces as defined by AS2865.



Powered or Supplied Air?

The major differences between welder's powered air and supplied air respiratory protection are as follows:

- **Required Minimum Protection Factor (RMPF)** - The Adflo powered air respirator provides a RMPF of 50 while a supplied air set-up provides a RMPF of 100+. To put this into perspective, disposable and reusable respirators provide a RMPF of 10 and this is only on the proviso they are fitted correctly.
- **Flow Rates** - The Adflo powered air respirator provides flow rates from 170 litres per minute to 200 litres per minute whereas the supplied air set-up can provide flow rates from 170-300 litres per minute.
- **Mobility** - A supplied air regulator is attached to a hose which is connected to a filtration system that is connected to a compressor by a second hose. Therefore when using supplied air respiratory protection the welder's mobility is limited to the length of the hose connected to the filtration system. In contrast the slim and light profile of the Adflo PAPR provides complete mobility to the welder.

- **Run time & charging** - The Adflo powered air purifying respirator has a battery run time of 8 hours with the standard battery and 12 hours with the heavy duty battery. The new Adflo battery with Rapid Charge (RC) charges from 0-80% capacity in one hour. The supplied air regulator obviously requires no charging.
- **Cost** - Although cost shouldn't be a consideration when determining the suitable level of respiratory protection, unfortunately many companies still put cost above the health of their welders. However, over time both powered air and supplied air systems can be more cost effective to run than disposable and reusable respiratory protection.

Note that powered or supplied respirators must never be used in atmospheres immediately dangerous to life or health (IDLH). Always consult your safety engineer or occupational hygienist.





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References

*Palmer et al (2009). Mortality from infectious pneumonia in metal workers: a comparison with deaths from asthma in occupations exposed to respiratory sensitizers. THORAX Online first, published on August 23, 2009 as 10.1136/thx2009.114280

If you'd like more information on the hazards of welding fume, selecting suitable respiratory protection for your specific welding application or to do an analysis on the true cost of disposable/reusable respiratory protection versus powered/supplied air respiratory protection please get in touch with AWS at www.awsi.com.au



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