



Welding Fume is in the News!

What happens if the Exposure Standard
for Welding Fume changes to $1\text{mg}/\text{m}^3$?

What Happened?

On June 1st, 2023, Channel 9 News featured a report on welding fume...



Some of the key takeaways of this report were:

- » The exposure standard for welding fume has not been updated since 1991 and based on new information there is a push for the exposure standard to be **reduced to 1 mg/m³**
- » A **Welding Fumes Exposure Register** has been established for all welders seeking future compensation should they get sick from welding fume exposure
- » Welding fume is a **Group 1 Carcinogen** (just like Asbestos and Silica)
- » **Tens of thousands** of workers are still exposed
- » Exposure to welding fume is **preventable**.



What is potentially changing?

In 2017, the International Agency for Research on Cancer reclassified welding fume as a group 1 carcinogen. The same group as Asbestos and Silica. However, in Australia, the exposure standard for Welding Fume has remained unchanged since 1991.

The **AMWU** is leading a huge push on behalf of the welding industry for the exposure standard for welding fume to be lowered from $5\text{mg}/\text{m}^3$ to $1\text{mg}/\text{m}^3$. If successful, this would bring Australia's exposure standards more closely in-line with countries like the Netherlands and Germany.

What does this mean?

Currently, the Safe Work Australia workplace exposure standard for welding fume is $5\text{mg}/\text{m}^3$. This means that the maximum average airborne concentration of welding fume inhaled by a worker when calculated over an 8-hour working day, over a five-day working week, must not exceed 5 milligrams of welding fume per cubic metre of air.

The AMWU is proposing that considering everything we now know about welding fume being a carcinogen and welders running a significantly higher risk of developing cancer, that this exposure standard is reduced to $1\text{mg}/\text{m}^3$.

"The incidence of cancer is usually dose related" meaning that "the greater the exposure to the carcinogen, the higher the risk of developing the cancer associated with that substance or mixture. Conversely, the smaller the exposure, the lower the probability of developing cancer"¹.

Therefore, a move to $1\text{mg}/\text{m}^3$ would send a message to the industry that welding fume is serious, and that action is required.

Why is this needed?

Based on a recent survey (June 2023) conducted by AWS, **39%** of welders in Australia and New Zealand are still using no form of protection from welding fume and **67%** feel that welding fume is not reduced to as low as reasonably practicable at their workplace.²

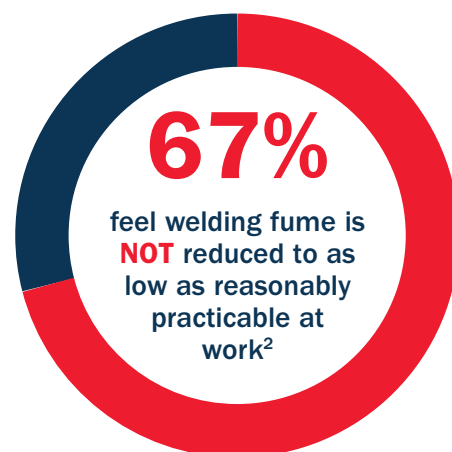
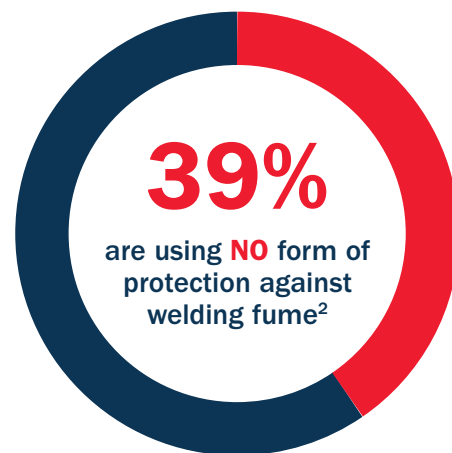
In short, even with all the known risks associated with welding fume, it appears tens of thousands of welders, over one third of the welding industry, are still being exposed to a group 1 carcinogen with no protection.

Moreover, based on the typical respiratory rate of 20 litres of air per minute or 2,300m³ of air per year, a welder operating within the current workplace exposure standards for general welding fume (5mg/m³), and wearing no respiratory protection could inhale up to 11 grams of welding fume per year.

So, year on year, an unprotected welder operating within the current workplace exposure limits can potentially inhale 11 grams of a known and identified carcinogen.

A successful AMWU campaign to reduce the exposure standard would mean that many employers would have a legal obligation to ensure that welders' exposure to welding fume is significantly reduced.

By employing the right combination of controls, welding fume exposure can be minimised to not just 1mg/m³ but well below this level.



Even when operating within the current workplace exposure standard for welding fume, unprotected welders could inhale up to **11 grams** of a known carcinogen every year.





As an employer what should I do?

As an employer, you have the primary responsibility to ensure that welders, as far as reasonably practicable, are not exposed to health and safety risks whilst performing their job.

Regardless of whether the new exposure standard comes into effect or not, it's the employer's responsibility to reduce welding fume exposure to as low as reasonably practicable.

The proposed reduction in the exposure standard and the [**National Welding Fumes Exposure Register \(NWFER\)**](#) which has been launched to record information for workers who may have been exposed to welding fumes, for their future reference, are both very clear signals to employers that they should get their welding fume controls in order.

Furthermore, in the midst of a global welder shortage, with welders in high demand, the employers who offer the best working conditions will have a better chance of attracting and retaining the best welders.



As a welder what should I do?

As a welder, you should aim to educate yourself on the risks and understand what types of controls can be introduced to reduce exposure to welding fume.

You should look to involve yourself in the consultation process and selection of suitable welding fume product controls.

If your employer is not aware of the risks associated with welding fume or the controls that can be introduced to minimise exposure, you should look to make your employer aware.

The important thing to understand is that overexposure to welding fume is preventable and that once the correct combination of controls has been introduced, welding can be a safe occupation.

What can be done to control welding fume exposure?

In 2022, AWS commissioned an **Independent Scientific Study** to compare the effectiveness of different welding fume product control methods in reducing exposure to welding fume.³

This study was peer reviewed and published in the Safety Journal in 2023. The results of the study can help workplaces and welders understand which controls can be introduced to have the greatest effect in minimising welding fume exposure.

Based on the results of the study, AWS have launched a welding fume product control selector to help take the guesswork out of welding fume product control selection.

The Effectiveness of Welding Fume Product Controls: A Scientific Study



Read the White Paper on the Scientific Study Here!

www.apexweldingsafety.com.au

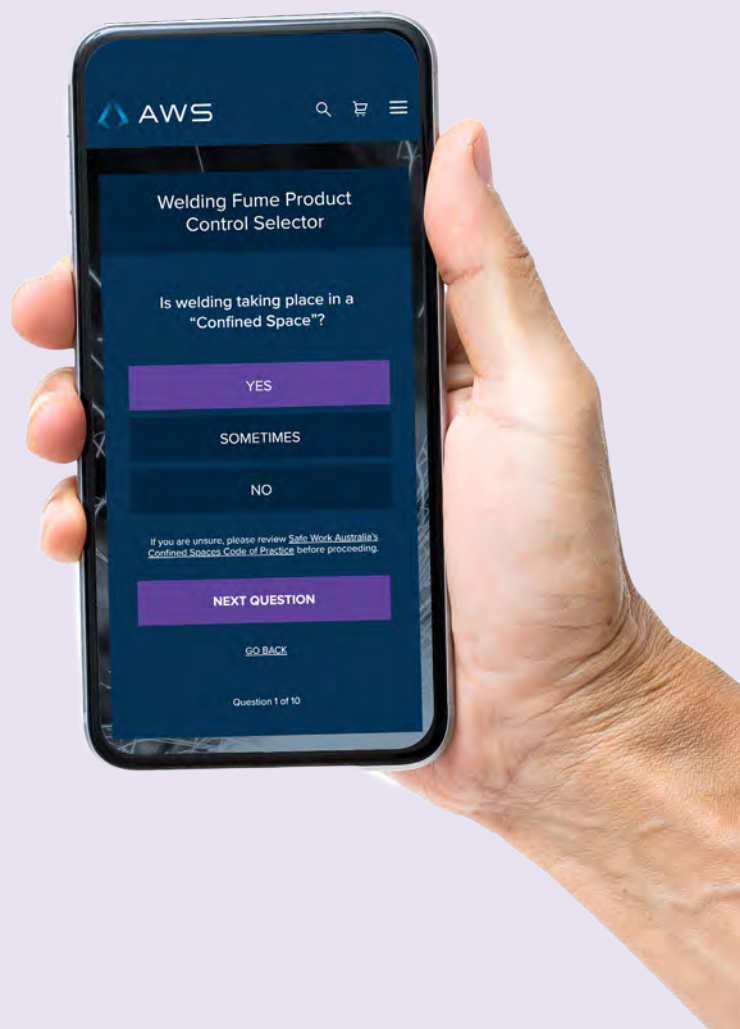
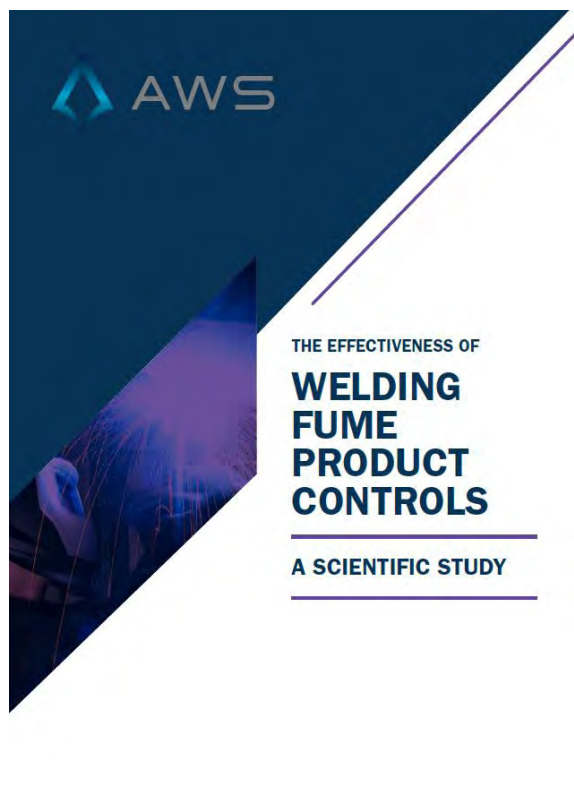
NEW

Welding Fume Product Control Selector



Scan to use the Product Selector or visit:

www.weldingfume.com.au



Can you explain how a welding fume product control can be used to reduce exposure for the welder to below 1mg/m³?

Take for example, a measurement of 20mg/m³ of welding fume in the welder's breathing zone. This would be a relatively heavy welding fume environment. We can use the product control reduction factors that we recorded within the AWS scientific study to see what kind of an impact they would have on this level of exposure.

Within the AWS study, a **Welding Helmet with a Powered Air Purifying Respirator** was by far the most effective control measure in protecting the welder from welding fume exposure when compared to **On-Gun Fume Extraction** and **Hooded Capture LEV**.

The Welding Helmet with an Integrated Powered Air Purifying Respirator provided an **Effective Protection Factor (EPF) of at least 2,600**. Meaning, in this study, a PAPR was able to reduce welding fume exposure to at least 1/2600th of the workplace air concentration.³

Therefore, if we divided 20 mg/m³ by the minimum effective protection factor of 2,600 from the study, welding fume exposure would be reduced to 0.0077mg/m³, taking the welders' exposure to well below the proposed 1mg/m³[^].

As you can see from this example, protecting the welder from welding fume can be straightforward and reducing exposure to welding fume to below the proposed exposure standard is well within reach.



**AT LEAST
2,600
EFFECTIVE
PROTECTION
FACTOR (EPF)³**

MOST EFFECTIVE METHOD TO PROTECT ONLY THE WELDER³

[^] Please note the findings within the referenced AWS study are unique to the study parameters and conditions and should not be used to calculate your workplace exposure and are simply used as an example to demonstrate how a product control can be used to reduce welding fume exposure. A welding helmet with a powered air purifying respirator has a required minimum protection factor of 50 as specified in the Australian and New Zealand standard AS/NZS 1715:2009, and this is the protection factor that should be used when calculating how your exposure can be reduced (20mg/m³ / 50 = 0.4mg/m³). However, as demonstrated within the study, the protection afforded by a PAPR can be much higher than the RMPF specified in the AS/NZS standard.

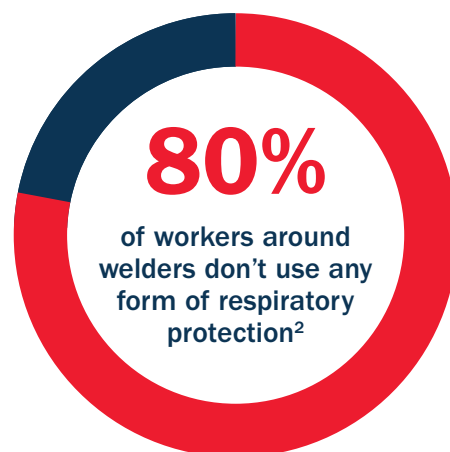
What about other workers who work around welders?

Based on a recent survey conducted by AWS, only **10%** of Australian and New Zealand workplaces use engineering controls (such as on-gun fume extraction or hooded capture LEV) to remove welding fume from the environment and **28%** can still see and smell welding fume in the workshop before the welding starts in the morning.

This is a concern when the same survey found that **80%** of workers who work around welders are not wearing ANY form of respiratory protection.²

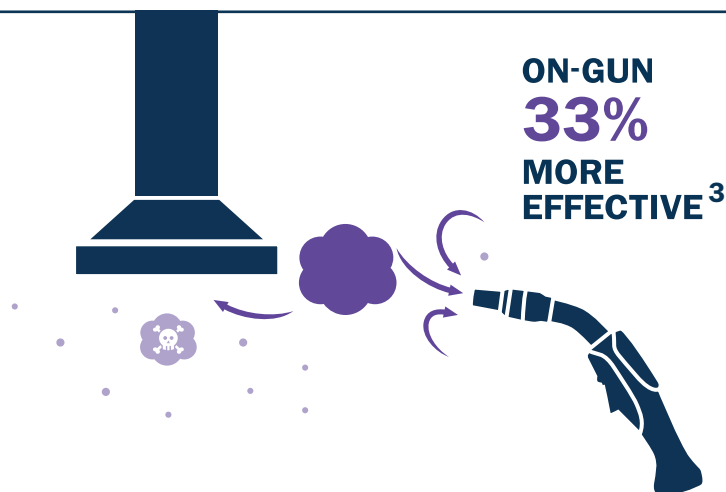
It is an employer's legal responsibility to reduce welding fume exposure to as low as reasonably practicable for all persons, not just the welder.

On-Gun Fume Extraction LEV and **Hooded Capture LEV** are two common methods used to reduce welding fume exposure to all workers by capturing welding fume at the source and removing it from the environment.



Within the AWS study, on-gun fume extraction was found to remove **33%** more welding fume from the workplace environment compared to LEV hooded capture.³

On-gun fume extraction also has the added benefit of following the welder as the welder moves, unlike fixed LEV hooded capture that requires the welder to be perfectly positioned relative to the capture hood and for the welder and welding arc location to remain relatively stationary.



Measurements taken during the study suggested that exposure to welding fume can approximately double when the capture hood distance from the arc increased from 30cm (correct distance from the arc based on manufacturer's instructions) to 50cm.³

This has large implications for welders who do not remain stationary or for those who are doing long welds. For this reason, it's important that employers match the engineering controls with their welders' needs, requirements, and environmental factors. Based on the recent AWS survey, **78%** of welders require mobility when they are welding.²

Can I just use engineering controls to reduce welding fume exposure for everyone?

Let's take the example of 20 mg/m^3 in the breathing zone of the welder again. In the scientific study, On-Gun Fume Extraction was found to have a fume reduction factor of 12 and Hooded Capture LEV was found to have a fume reduction factor of 9.³

In this example, neither of these controls would be able to reduce the exposure for the welder to below the proposed 1 mg/m^3 ($20 \text{ mg/m}^3 / 12 = 1.7 \text{ mg/m}^3$ and $20 \text{ mg/m}^3 / 9 = 2.22 \text{ mg/m}^3$). In this situation, based on the results of the study, a welding helmet with a PAPR would be the most effective method to protect the welder.

However, the welder is exposed to the highest concentration of welding fume. The exposure within the breathing zone of surrounding workers would likely be far less than what the welder is exposed to due to distance and dilution effects.

Let's use an example of 5 mg/m^3 welding fume concentration in areas close by the welding operation. Therefore, if we used the reduction factors from the study on the example of 5 mg/m^3 , engineering controls like on-gun fume extraction or hooded capture local exhaust ventilation could be used to reduce exposure to surrounding workers to well below the newly proposed exposure standard ($5 \text{ mg/m}^3 / 12 = 0.42 \text{ mg/m}^3$ and $5 \text{ mg/m}^3 / 9 = 0.56 \text{ mg/m}^3$).

Within the study, on-gun fume extraction was the most effective engineering control with an average capture efficiency of 90% across all tests.³

The law in Australia and New Zealand clearly states that if there is any remaining risk after the higher controls, such as engineering controls, have been implemented, it must be minimised with suitable personal protective equipment (PPE).

Based on the results of the AWS study, a PAPR is an extremely effective method to reduce the remaining risk and within the study delivered a minimum 99.96% reduction of welding fume.³

Therefore, where an employer has already implemented engineering controls (On-Gun Fume Extraction or Hooded Capture LEV), a welding helmet with PAPR is an extremely effective method to minimise the remaining risk for the welder.

Are we protected if we use half mask respirators and keep the roller door open?

It's extremely important for workplaces to understand that wind, a cross-breeze, or opening a roller door, should only be used for general comfort, not as an engineering control measure for welding fume. While this can help disperse welding fume in combination with other controls, it must never be used as a control by itself.

In short, opening a roller door is not enough. A welding fume product control or a combination of welding fume product controls must be introduced.

Similarly, a half mask respirator, with respect to minimising exposure to a known carcinogen like welding fume, has its limitations.

A half mask respirator has a Required Minimum Protection Factor (RMPF) of 10 compared to a PAPR with a RMPF of 50 (please note that the results for the PAPR from the study show a level of performance at least 52 times better than the RMPF of 50).³

However, this is only if the half mask respirator is worn and fits correctly. Any issue with the seal and the welder's respiratory protection is compromised.

Almost all welding fume particles are smaller than 1 micron. The average human hair has an average thickness of about 150 microns. A single human hair can hold the half mask respirator off the face allowing the welding fume particles to leak past. Even stubble can have a significant impact.



As an extremely physical occupation, it's often difficult to wear a half mask respirator correctly as a welder, especially when wearing a welding helmet in combination. A 2020 study determined that "the performance of a half mask respirator decreased when worn in methods outside of recommendations; however, there was no significant decrease in the performance of PAPR under any method of wear"⁴. Therefore, the authors recommended a PAPR for work where it is difficult to guarantee that a half mask respirator is being worn correctly.

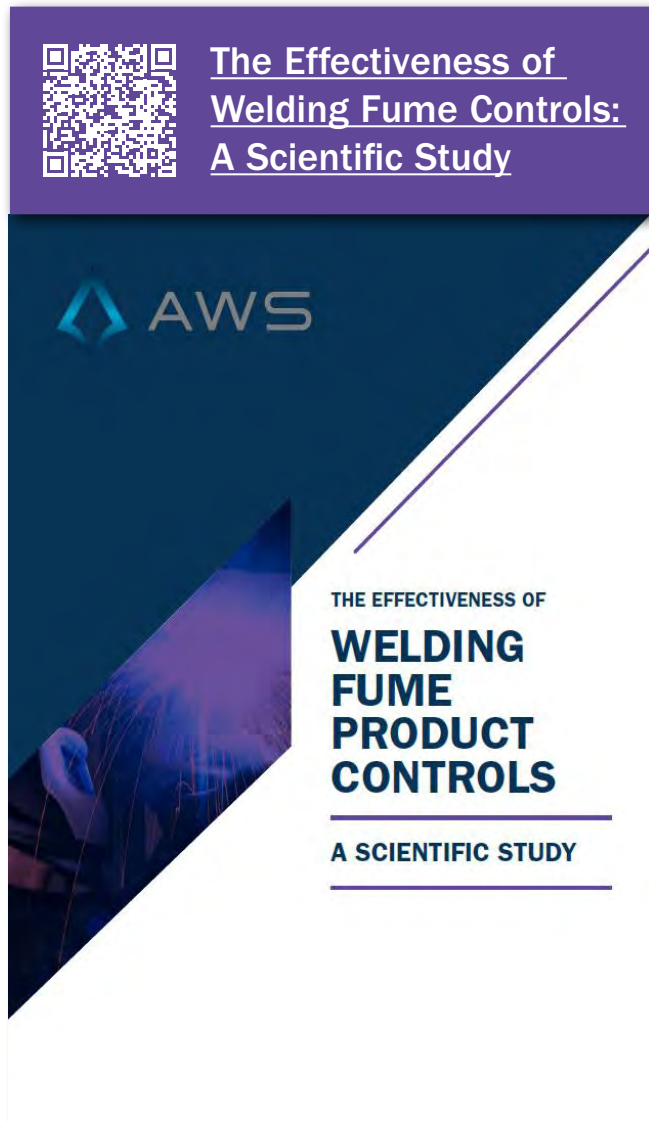
Unlike most disposable respirators, a PAPR equipped with the correct filters can offer protection against ozone and other volatile substances that can be generated during welding.

Unlike many industries, welders have PPE specifically designed for their occupation to protect them from welding fume and other welding hazards – A welding helmet with a powered air purifying respirator can offer the welder protection from eye (IR, visible, UV), face, respiratory, head, and hearing hazards.

As already discussed, engineering controls (like on-gun fume extraction or hooded capture local exhaust ventilation) can be introduced to reduce welding fume exposure to workers in areas in proximity to welding operations.

Where do I go for more information?

AWS have launched many resources for employers and welders looking for practical guidance on controlling welding fume. See the resources below:

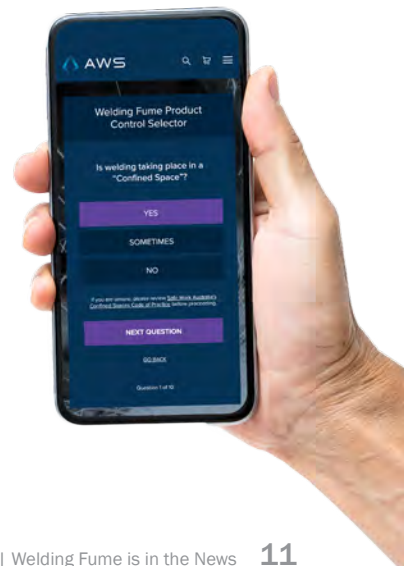


NEW: Welding Fume Product Control Selector



Based on welders' needs and environment, this selector has been launched to help workplaces navigate the available product control solutions to reduce welding fume exposure to as low as reasonably practicable.

www.weldingfume.com.au



For more information on our range of Welding Safety White Papers, Welding Industry Reports, and Welding Fume Control Frameworks, please **contact AWS**.



About AWS

AWS was established in 1994 and has played a key role in the welding industry ever since.

As an advocate for welders' safety in Australia and New Zealand, AWS has published numerous Welding Safety White Papers, Welding Industry Reports, and Welding Fume Control Frameworks.

As a company that specialises in welding safety equipment, it is our goal to raise awareness on the important issues that welders face.

For more information on welding fume monitoring, welding PPE, or welding fume extraction options, please contact AWS.

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 youtube.com/awsspeedglas

References

1. Guidance on the interpretation of workplace exposure standards for airborne contaminants, Safe Work Australia, April 2013
2. Welding Fume Product Controls Survey, AWS, June 2023 (560 respondents)
3. 2023 Peter Knott, Georgia Csorba, Dustin Bennett, Ryan Kift. Welding fume; a comparison study of industry used control methods. Safety Journal.
4. S. Sekoguchi, T. Shirasaka, H. Ando, K. Ikegami, and A. Ogami, Evaluation of the performance of replaceable particulate and powered air-purifying respirators considering non-recommended wearing methods, Department of Work Systems and Health, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Fukuoka, Tech. Rep., 2020.

IMPORTANT INFORMATION

The examples used throughout this document are simply used to demonstrate how product controls can be introduced to reduce exposure to welding fume. However, these are just example numbers and should not be used to make judgements or decisions on exposure at your workplace.

The findings within the referenced AWS study are unique to the study parameters and conditions. Brands and product names used within the AWS study have been omitted to keep this paper focused solely on the different forms of product controls as opposed to pushing specific brands or products. However, it's important to note that the results are only applicable to the brands and products used in the study – these can be made available upon request.

All guidance is provided to give an example of how to control welding fume and is provided as a basic guideline only. It should not be used as the only means of selecting a respirator or control method. It's always recommended to have a welding fume product control expert visit your premises as onsite variables can impact product control effectiveness (e.g. weld position, and environmental factors).

Powered and supplied air respirators must never be used in atmospheres Immediately Dangerous to Life or Health (IDLH). Always consult your Safety Engineer or Occupational Hygienist. Air monitoring should take place if you are unsure about the level of welding fume exposure to workers.

This publication contains work health and safety information and is provided as guidance, it should not be relied upon as legal compliance. It includes obligations under legislation that health and safety regulators administer. To ensure you comply with your legal obligations you must refer to the appropriate legislation. This publication does not represent a comprehensive statement of the law as it applies to particular problems or to individuals or as a substitute for legal advice. You should seek independent legal advice if you need assistance on the application of the law to your situation.

This document does not address confined spaces. Confined spaces should be avoided where possible. All of today's current welding fume product controls have their limitations in a confined space. There should be a suitably trained and knowledgeable person doing the assessment and design of a safe system for any confined space entry. Consultation with a welding fume product control expert should always be carried out to understand the limitations of each product control within a confined space. For more information on welding fume product controls within confined spaces, please contact AWS.