AWS

THE 2022 PRACTICAL GUIDE TO

WELDING FUME CONTROL

A PRACTICAL GUIDE TO WELDING FUME CONTROL

There is a critical need to give workplaces clear and practical advice that can help to keep welding fume exposure to an acceptable level.

This guide is based on a simple premise - the health risk posed by welding fume is serious, however, keeping yourself safe can be straightforward.

Consequently, in this guide, we outline the dangers of welding fume and then give you actionable and practical guidance based specifically on the welding industry.

CONTENTS

Welding Fume Is Serious. Action Is Required.

The important point to understand is that while the risk posed by welding fume is serious, keeping yourself safe can be straightforward.

The 2017 IARC reclassification of welding fume as 'carcinogenic to humans' simply confirmed what was already known – welding fume is extremely bad for health and workplaces must protect their workers. Excessive exposure to welding fume can cause multiple types of cancer, including lung, larynx, and urinary tract.

'Welders present, on average, a 43% increased risk of lung cancer when compared with those who have never welded or been exposed to welding fume'[1]. 'This increased risk of lung cancer is regardless of the type of steel welded, the welding process and independent of exposure to smoking'[1]. Precedent for workers' compensation based on a link between welding fume and cancer was established in the Australian courts back in 2014, opening the door for future compensation claims.

Aside from cancer, welding fume can also cause serious long-term health effects like lung function abnormalities, including bronchial asthma, chronic obstructive pulmonary disease (COPD), pneumoconiosis and other pulmonary fibrosis, as well as stomach ulcers, kidney damage and nervous system damage.

Recognising welding fume as carcinogenic and the other associated health risks should encourage all employers of welders to review their risk assessments and revise their control measures.

Welding fume is serious, action is required.

Simple Takeaway

Welding fume is serious, action is required.

A Practical Guide to Fume Control.

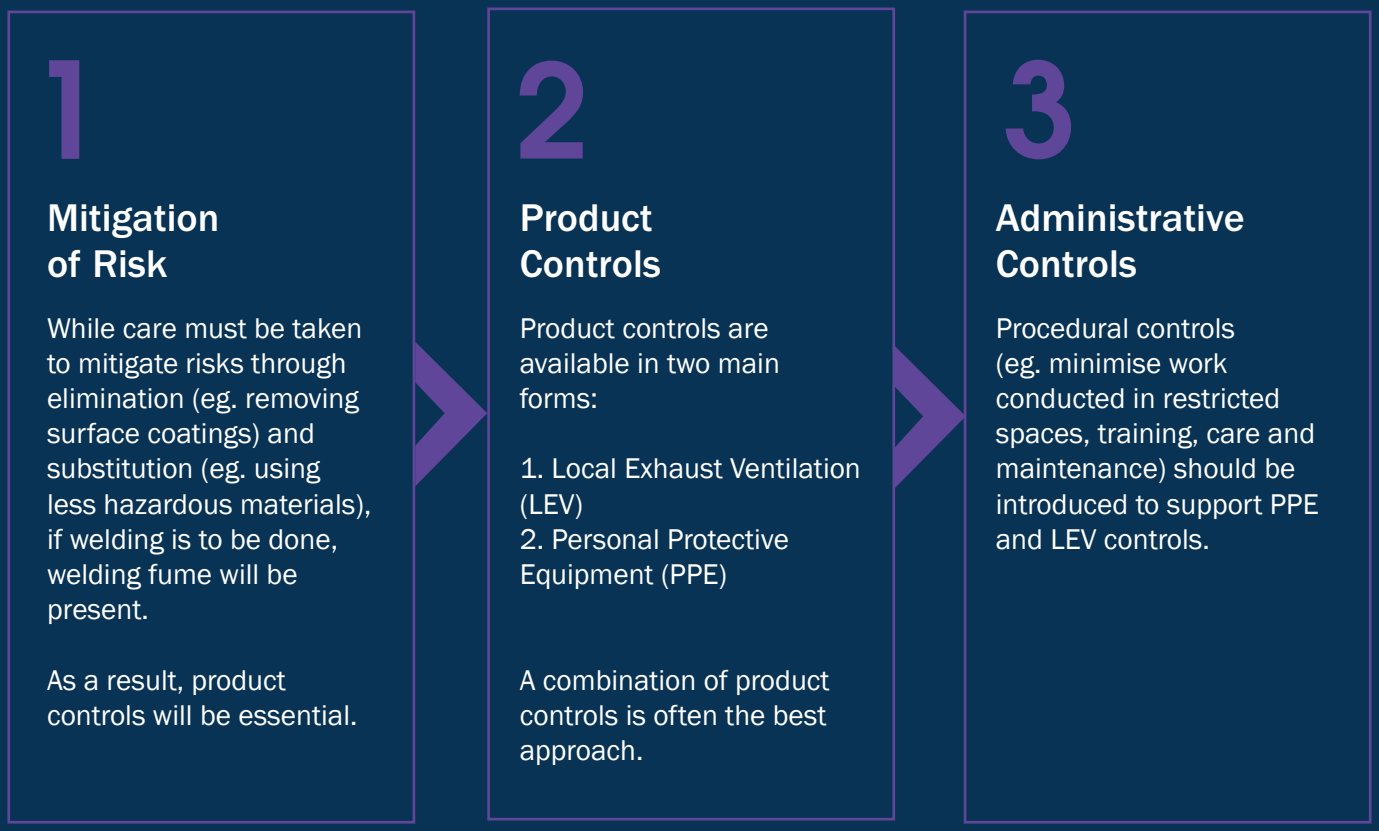
Applying a practical approach to the ‘Hierarchy of Control’.

The hierarchy of control is a step-by-step system for controlling risks in a workplace. This framework is used across a range of industries and while it applies to welding, it was not built specifically for the welding industry.

So, while it is important to understand the overall framework, a control framework built specifically for welding fume may be valuable to those seeking to understand how to protect their welders or themselves.

To give you a more simplified and practical approach to controlling welding fume, we offer the ‘Practical Guide to Fume Control’ comprising of three steps: 1. Mitigation of Risk, 2. Product Controls and 3. Administrative Controls.

Figure 1.1 - A Practical Guide to Fume Control



1 Mitigation of Risk

When it comes to welding fume, all efforts should be made to mitigate the risks where possible.

Examples include:

- Removing surface coatings on materials.
- Changing to less hazardous materials (both consumables and base materials).
- Using a welding technique that produces less fume (different application or working with lower amps)
- Where possible, workers should position themselves to ensure they keep their heads away from the plume and also ensure any ventilation airflow moves the welding fume away from the breathing zone, not through it.

While the highest levels of controls (elimination and substitution) within the 'hierarchy of control' give the highest level of protection and reliability in many industries, they are often not practicable or possible when it comes to the welding industry. Substituting materials can result in quality issues and using lower amps is often not an option.

Even when you can mitigate risk, if there is welding to be done, welding fume will be present. Welding fume is inherent in the process of welding. As a result, we see that in the welding industry, the higher levels of control can often only mitigate the risks associated with welding fume, making the lower levels of control essential.

Simple Takeaway

Higher levels of control can often only mitigate the risks associated with welding fume. Product and administrative controls are essential.

2 Product Controls

Product controls are available in two main forms:

1. Local Exhaust Ventilation (LEV)
2. Personal Protective Equipment (PPE)

Local Exhaust Ventilation (LEV)

LEV can assist in reducing exposure to welding fume and other airborne contaminants, not only for the welder, but also for those who work near welding operations. This is the key difference between LEV and Personal Protective Equipment (PPE). PPE can only protect the welder, while correctly located LEV can protect the welder and stop the spread of fume throughout the workplace. It is recommended that respiratory PPE is always worn in combination with LEV.

There are three main LEV options within the welding industry:

1) Fixed Installations

A key advantage of fixed installations is that they can deal with a large quantity of welding fume, making them ideal for heavy fume environments. A limitation of these systems is that they do not follow the welder as they move. Positioning is critical. If the welder moves away from the capture point, these systems are ineffective. They won't offer protection to the welder or control the spread of fume throughout the workplace.

If the welder is too close to the capture point, the extraction flow can affect the shielding gas, leading to porosity and poor weld quality. These systems can be a good control for heavy fume environments, where the welder remains positioned correctly, relative to the capture point.

2) Portable Systems

Portable systems can be a more economical option when compared to fixed installations and in many situations can offer more flexibility as requirements change over time. They can be carried or rolled around the workplace and positioned where required and are ideal for situations where the welder moves around the workspace. However, like fixed installations, once they are positioned, they do not follow the welder as they move.

Portable systems can be a good control for most welding applications, where the welder does not move away from the extraction point. However, ensure you consult an LEV expert, as different welding applications require different configurations. Portable LEV is not one-size-fits-all.

3) On-Gun Fume Extraction

On-Gun fume extraction is the only product control solution that removes welding fume from the environment and follows the welder as they move (unlike fixed and portable solutions), making it an extremely practical welding fume control solution.

Recent technological advancements have also meant that on-gun torches can now be the same size and weight as normal welding guns and deliver high capture rates (up to 98%), while leaving the shielding gas completely unaffected.

A limitation of on-gun fume extraction is that it is not available for all welding applications (eg. MMA).

For more information regarding on-gun fume extraction, please contact AWS.

	Advantages	Limitations
Fixed Installations	• Ideal for heavy fume environments	• Does not follow the welder • Positioning is critical (protection/porosity)
Portable LEV	• Lower cost vs fixed installations • Mobility and flexibility	• Does not follow the welder • Positioning is critical (protection/porosity)
On-Gun Extraction	• Follows the welder • High capture rates (up to 98%)	• Not available for MMA (Stick) welding • Parameters must be set correctly

Important Note – Opening a roller door is not enough!

Natural Dilution Ventilation

It should be noted that wind, a cross-breeze, or opening a roller door, should only be used for general comfort, not as an engineering control measure for atmospheric contaminants and fumes. While this can help disperse welding fume in combination with other controls, it must never be used as a control by itself.

Forced Dilution Ventilation

Occurs when contaminants released into the workshop mix with air flowing through the room via forced dilution ventilation systems. Forced dilution is also not an effective method to control welding fume exposure as large volumes of dilution air may be required and it is extremely difficult to control individual exposure near the contaminant source where dilution has not yet taken place.

Employers must also ensure that forced dilution systems, when relied upon, are not contaminating other areas.

Personal Protective Equipment (PPE)

In relation to the hierarchy of controls, PPE is often referred to as the last resort. When it comes to welding, suitable PPE must always be worn. PPE for respiratory protection from welding fume is commonly available in two main forms:

1) Welding Helmets with integrated respiratory protection
2) Half mask respirators.

1) Welding Helmets with Integrated Respiratory Protection

'Welding helmets with integrated powered air purifying respirators (PAPR) are the most widely used form of respiratory protection amongst welders in Australia and New Zealand'[2] and are mandatory within many businesses.

They have a Required Minimum Protection Factor (RMPF) of 50, meaning that they supply breathing air a minimum 50 times cleaner than the welder would otherwise be breathing unprotected and can also protect the welders' eyes and face from radiation and high velocity particles. Integrated hard hats (safety helmets) and earmuffs are also available with these systems to give welders five levels of protection (eye, face, respiratory, head, hearing).

With a flip-up welding helmet with powered air respiratory protection, welders can have completely clear and uninhibited views of their workpiece and surroundings while maintaining their desired level of respiratory protection with no breathing resistance. The powered air respirator goes where the welder goes, allowing unrestricted movement around the workplace with clear vision, comfort, and uninterrupted eye, face and respiratory protection.

A recent study conducted within a large manufacturing company with over 1,500 employees, including 600 certified welders, found that 'foreign body eye injuries decreased over 70% year-on-year in areas that implemented the PAPRs with integrated flip-up auto darkening welding helmets. Worker compensation claims decreased markedly while employee morale increased substantially'[3].

PAPRs can provide protection to welders using the most common materials (aluminium, steel, stainless steel, galvanised steel etc.) and applications (MMA, TIG, GMAW, FCAW, SAW) where there is an environment with good ventilation and/or extraction.

In restricted spaces*, a welding helmet with integrated supplied air respiratory protection will be effective.

The next page features a practical guide to welders' personal protective equipment based on the material to be welded, the welding process, and the ventilation conditions of your working environment.

Image: An example of a flip-up auto-darkening welding helmet with an integrated powered air purifying respirator.

Figure 2.1 - A practical guide to respiratory protection based on material, process, and environment.

P = Powered air purifying respirator.
P+A = Powered air purifying respirator with a A1 gas filter installed.
P+ODOUR = Powered air purifying respirator with an odour filter installed.
S = Supplied air via regulator and filtration unit.

Material to be welded	Welding method	Ventilation conditions of your working environment		
		Environment with good ventilation /extraction.	Environment with limited ventilation /extraction ------> increasing exposure.	Restricted space* Note: this respiratory protection solution may not be suitable for Confined Spaces as defined in AS2865.
Aluminium	GMAW	P	P or P+A	S
	TIG	P	P or P+A	S
	PLASMA (cutting and gouging)	P	P or P+A	S
Stainless steel	GMAW/FCAW/SAW	P	P or P+A	S
	TIG	P	P or P+A	S
	MMA (stick)	P	P or P+A	S
	PLASMA (cutting and gouging)	P	P+A or S	S
Steel not coated or painted	GMAW/FCAW/SAW	P	P	S
	MMA (stick)	P	P	S
	PLASMA (cutting and gouging)	P	P or S	S
Steel (lead based paints / oil and grease present)	GMAW/FCAW/SAW	P	P or P+ODOUR	S
	MMA (stick)	P	P or P+ODOUR	S
	PLASMA (cutting and gouging)	P	P or S	S
Steel galvanised	GMAW/FCAW/SAW	P	P or P+ODOUR	S
	MMA (stick)	P	P or P+ODOUR	S
	PLASMA (cutting and gouging)	P	P or S	S
Steel coated with 2-component paints or insulated with 2-part polyurethanes (risk of isocyanates)	GMAW/FCAW/SAW	P	P+A or S	S
	MMA (stick)	P	P+A or S	S
	PLASMA (cutting and gouging)	P	P+A or S	S

This chart has only been provided as an example and is provided as a basic guideline. It should not be used as the only means of selecting a respirator. Powered and supplied air respirators must never be used in atmospheres Immediately Dangerous to Life or Health (IDLH) without emergency breathing device capability (AS/NZS1715). Always consult your Safety Engineer or Occupational Hygienist.

**A 'restricted space' for the purposes of this document refers to a situation where 1) local exhaust ventilation (LEV) fume extraction is not possible due to a limitation of space, 2) the space is not a confined space as defined by Safe Work Australia's Confined Spaces Code of Practice.*

2) Half mask respirators

Disposable or reusable P2 rated half mask respirators can be worn underneath a welding helmet to provide a RMPF of 10. The welder must be fit tested (annually is recommended) and clean shaven (if relevant) to ensure an effective negative pressure seal. Never use a half mask that is flammable.

When compared to disposable and reusable half-face mask respiratory protection, PAPRs provide superior respiratory protection and comfort and do not require fit testing or a complete clean shaven condition.

Image: An example of a disposable half mask respirator (left) and a reusable half mask respirator with replaceable filters (right).

Figure 2.2 - Quick Reference Welding Respiratory PPE Comparison Chart

	Welding Helmets with Integrated Respiratory Protection	Half Mask Respirators
Protection Factor (RMPF)	50 (or 100+*)	10
Fit Testing Required	No	Yes, recommended annually
Requirement to be clean shaven	No	Yes
Breathing resistance	No	Yes
Comfort Considerations	A steady flow of fresh air helps to cool the welder down in hot conditions, reducing sweat and heat buildup.	The negative pressure seal can result in an uncomfortable fit in welding conditions (sweat, heat). Can interfere with the welding helmet.
Cost Considerations	A PAPR draws air into the system from behind the welder away from the greatest concentration of welding fume. For this reason, the filters on a PAPR will typically need to be changed far less frequently than a disposable respirator or reusable respiratory filters. Long term, a PAPR can be the more economical solution.	While half mask respirators have a lower upfront cost, they can be the more expensive long-term option. Worn on the welder's face in closer proximity to the plume, filters can become loaded extremely quickly in certain welding environments.

** Welding helmets with integrated powered air respiratory protection have a RMPF of 50. Welding helmets with integrated supplied air respiratory protection have a RMPF of 100+.*

A Practical Approach to Product Controls

A combination of LEV and respiratory PPE is the most practical and effective 'product control' method to protect welders and surrounding workers from welding fume. Respiratory PPE is an extremely effective control to protect the welder and LEV can prevent fume building up to dangerous levels and prevents the spread of fume throughout the workplace. Respiratory PPE should always be worn by welders to complement the use of LEV. The figure below gives you practical advice on how to select product controls for full-time welders based on the options outlined previously and what is most effective within the welding industry.

Figure 2.3 - A practical approach to product controls

This chart has been provided as an example and is provided as a basic guideline only. Always consult with your Safety Engineer or an Occupational Hygienist. This chart assumes that all efforts to mitigate risk associated with welding fume through elimination and substitution have been carried out. Procedural controls (eg. minimise work conducted in restricted spaces, training, care and maintenance) should be introduced to support PPE and LEV controls. This chart does not address confined spaces as defined by AS2865 or atmospheres Immediately Dangerous to Life or Health (IDLH). If you require advice on these environments please contact AWS (www.awsi.com.au). Consultation with a PPE and extraction expert such as AWS (www.awsi.com.au) and an occupational hygienist is recommended to ensure your specific application, environment, materials, and limitations (space, need for mobility) are considered.

3 Administrative Controls

Procedural controls must be introduced to support product-based controls.

Training and product maintenance

As an employer, once you have selected the appropriate PPE, 'you must provide the worker with information, training and instruction in the proper use and wearing of PPE'[4]. Proper guidance should be given on the storage of equipment and care and maintenance guidelines should be clear and followed.

For LEV systems, you must implement a maintenance and test regime to ensure proper operation.

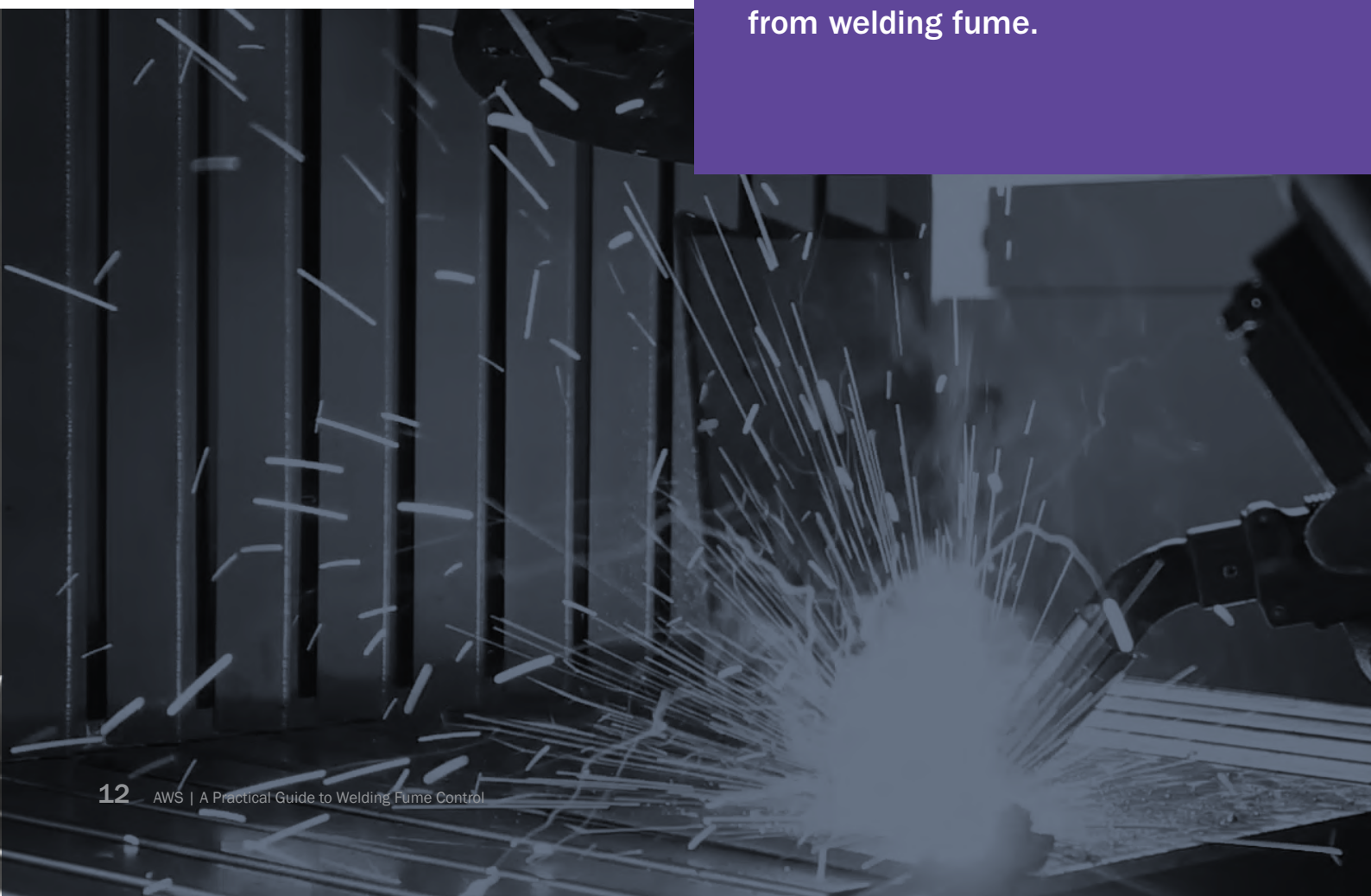
Ensure you select suppliers who can not only provide equipment, but also administer the required training and support. Also, ensure all required spare parts are readily available and stocked.

Working area considerations

- Minimise work conducted in confined spaces.
- Introduce a dedicated area for welding.
- Control access to the working area.

Simple Takeaway

A combination of LEV and PPE is the most practical and effective 'product control' method to protect workers from welding fume.



Confined Spaces

All practical advice in this guide to this point has excluded confined spaces.

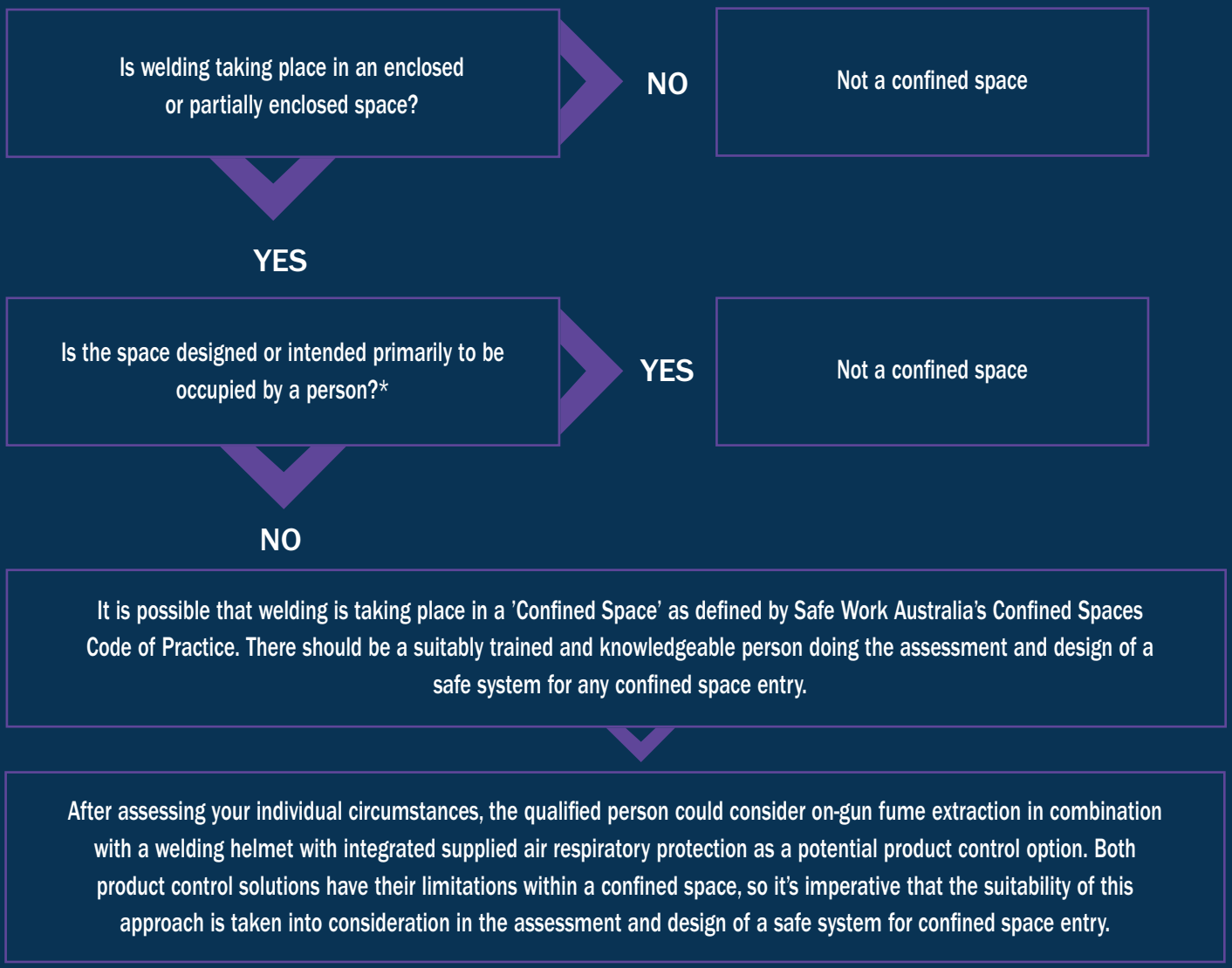
Confined spaces are complicated when it comes to welding. A safe atmosphere in a confined space is one that has a safe oxygen level, is free of airborne contaminants (or in concentrations known to be below their allowable exposure standard), and any flammable gas, vapour or mist is at concentrations below 5 percent of its lower explosive level.

However, when welding, especially in an enclosed or partially enclosed space, it is normal for any welding task to at least potentially create an atmosphere that has airborne concentrations above the relevant exposure standards or >5% of relevant explosive limits.

So, how do you identify a confined space and what practical steps can be taken should welding be required within a confined space?

Note: All information supplied regarding confined spaces is based on Safe Work Australia's Confined Spaces Code of Practice, July 2020 (www.safeworkaustralia.gov.au/doc/model-codes-practice/model-code-practice-confined-spaces). Consult the code of practice for further detail.

Figure 3.1 - Identification of a Confined Space and potential product control options.



*Spaces with poor ventilation, lighting, and restricted means of entry or exit are generally not designed for human occupancy.

‘Confined spaces pose dangers because they are usually not designed to be areas where people work. Confined spaces often have poor or no ventilation which allows hazardous atmospheres to quickly develop, especially if the space is small’[5].

‘A confined space is determined by the hazards associated with a set of specific circumstances and not just because work is performed in a small space’[5]. ‘Entry into a confined space means a person’s head or upper body is in the confined space or within the boundary of the confined space’[5].

Within the welding industry, confined spaces are commonly found in tanks, pipes, containers, pressure vessels, shafts, tunnels or other similar enclosed or partially enclosed structures.

If the space is a mine shaft or the workings of a mine, you must seek guidance from state/territory legislation and regulatory bodies.

How to control welding fume when welding in a confined space is unavoidable:

- Confined spaces can be deadly and decisions on how to handle a specific confined space must be assessed on the spot and always come down to the specifics of the individual situation.
- Confined spaces are a multifactorial issue, and protection against welding fume is only one of the issues that needs to be considered.
- There should be a suitably trained and knowledgeable person doing the assessment and design of a safe system for any confined space entry.

If welding in a confined space please ensure that the employee doing the confined space assessment is suitably trained, having completed a confined space course by a qualified training company, or engage a trained consultant. If unsure, please contact AWS (www.awsi.com.au) for more information.

Simple Takeaway

If welding is taking place in an enclosed or partially enclosed space, it’s likely a confined space.

Who is responsible?

The employer has the primary responsibility to ensure that welding fume exposure is controlled, and welders are protected. The two key points regarding employer responsibility are as follows:

- If employers are unsure whether the welding fume exposure at their workplace exceeds the relevant exposure standard, OH&S regulations require that they must ensure air monitoring is carried out.

- Under both the Australian Work, Health and Safety Laws and the New Zealand Health and Safety at Work Regulations, the employer is financially responsible for providing PPE to workers and must not charge anyone for using PPE.

When selecting suitable PPE, the employer, where reasonable, should consult with the welders. A welder's knowledge, experience and personal preferences improve the overall decision-making process. As someone who is directly affected by welding hazards, a welder is entitled to take part in the consultation process and selection of suitable PPE.

Personal preferences are the key to user acceptance – so look for gear that welders feel comfortable wearing. As a welder, you should aim to educate yourself on the risks, understand the appropriate PPE available and look to involve yourself in the consultation process and ultimate selection of suitable PPE.

For guidance on air monitoring in Australia and New Zealand, please contact AWS (www.awsi.com.au).

Simple Takeaway

The employer must ensure air monitoring is conducted when needed and is financially responsible for providing PPE.

Exposure limits are just the beginning

The exposure standards in Australia and New Zealand 'do not identify a dividing line between a healthy or unhealthy working environment'[6]. They simply establish a legal maximum upper limit. 'Therefore, exposure standards should not be considered as representing an acceptable level of exposure to workers'[6].

Take for example, a welder operating within the Workplace Exposure Limit (WEL) for 'welding fume not otherwise classified' (5 mg/m^3, TWA). Even if the welder is operating within the WEL, an unprotected welder could inhale up to 11 grams of a carcinogenic substance (welding fume) every year*. Moreover, an Australian or New Zealand welder operating under the legal workplace exposure limit for welding fume is exposed to 4 times the level of a known carcinogen than a German welder working under the TGRS 528 (1.25 mg/m^3) exposure limits in Germany. The world has shifted to more of a health and safety focus - the result of court cases and research.

Aside from the Workplace Exposure Limit (WEL) for 'welding fume not otherwise classified', workplaces must also ensure no other WELs are exceeded. Below we list the most common chemicals workers may be exposed to when welding, the source of these chemicals in the welding fume, respective health effects, and the current WEL released by Safe Work Australia[4,7].

Fume Type/Chemical	Source	Health Effect	TWA (mg/m^3)
Aluminium	Aluminium component of some alloys, e.g., nickel chromium, copper, steel, magnesium, brass and filler materials.	Respiratory irritant.	5
Beryllium	Hardening agent found in copper, magnesium, aluminium alloys and electrical contacts.	"Metal Fume Fever." A carcinogen. Other chronic effects include damage to the respiratory tract.	0.002
Cadmium	Stainless steel containing cadmium or plated materials, zinc alloy.	Irritation of respiratory system, sore and dry throat, chest pain and breathing difficulty. Chronic effects include kidney damage and emphysema. Suspected carcinogen.	0.01
Chromium	Most stainless steel and high-alloy materials, welding rods. Also used as plating material.	Increased risk of lung cancer. Some individuals may develop skin irritation. Some forms are carcinogens (hexavalent chromium).	0.5 or 0.05 (Depending on chemical form)
Copper	Alloys such as nickel-copper, brass, bronze. Also some welding rods.	Acute effects include irritation of the eyes, nose and throat, nausea and "Metal Fume Fever".	0.2
Iron Oxides	The major contaminant in all iron or steel welding processes.	Siderosis - a benign form of lung disease cause by particles deposited in the lungs. Acute symptoms include irritation of the nose and lungs. Tends to clear up when exposure stops.	5
Lead	Solder, brass and bronze alloys, primer/coating on steels.	Chronic effects to nervous system, kidneys, digestive system and mental capacity. Can cause lead poisoning. Ototoxic and therefore risk of hearing loss.	0.05
Manganese	Most welding processes, especially high tensile steels.	"Metal Fume Fever." Chronic effects may include central nervous system problems. Ototoxic and therefore risk of hearing loss.	1
Zinc Oxides	Galvanized and painted metal.	Metal Fume Fever.	5

*Based on the typical respiratory rate of 20 litres of air per minute or 2,300 m^3 of air per year

Simple Takeaway

Exposure standards do not represent an acceptable level of exposure to workers. Even when operating within the exposure standard for welding fume, unprotected welders could inhale up to 11 grams of a known carcinogen (welding fume) every year.

Australian and New Zealand companies are now completely changing their stance on welding fume and welders' PPE. The 2017 reclassification of welding fume as carcinogenic prompted many to rethink and challenge what was historically considered 'normal'.

The 2019 statistical analysis concluding that welders have a '43% increased risk of lung cancer'[1] regardless of the type of steel welded, the welding process or time-period is of serious public health relevance.

Being aware of information like this should act as the trigger at your workplace to introduce PPE with higher protection factors to give exposed workers the protection they deserve.

For a step-by-step summary on how to get started, please view the 'blue-print to welding fume control' on the next page or get in touch with AWS (www.awsi.com.au).

A Blueprint to Welding Fume Control

On the next page, the information within this guide has been condensed into a simple 'next steps' decision matrix.

The Blueprint to Welding Fume Control will determine what product control solution or combination of controls is suitable for your workplace based on your specific welding environment.

The recommendations will be based on cost, comfort, protection, and practicality considerations with the intention to reduce fume exposures to as low as reasonably practicable.

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A BLUEPRINT TO

WELDING FUME CONTROL

Is welding taking place in an enclosed or partially enclosed space?

YES

It is possible that welding is taking place in a 'Confined Space' as defined by Safe Work Australia's Confined Spaces Code of Practice. Confined spaces can be deadly and decisions on how to handle a specific confined space must be assessed on the spot and always comes down to the specifics of the individual situation. Confined spaces are a multifactorial issue and protection against welding fume is only one of the issues that needs to be considered. There should be a suitably trained and knowledgeable person doing the assessment and design of a safe system for any confined space entry. After assessing your individual circumstances, the qualified person could consider on-gun fume extraction in combination with a welding helmet with integrated supplied air respiratory protection as a potential product control option. Both product control solutions have their limitations within a confined space, so it's imperative that the suitability of this approach is taken into consideration in the assessment and design of a safe system for confined space entry.

NO

Is welding taking place in an environment with good ventilation or extraction?

YES

A Welding Helmet with a Powered Air Purifying Respirator is recommended for most common materials and welding applications.

NO

Is welding taking place on a bench and/or will the welder remain relatively static (no mobility required)?

YES

A combination of Portable or Fixed Local Exhaust Ventilation (LEV) and a Welding Helmet with a Powered Air Purifying Respirator is recommended for most common materials and applications*.

* If LEV is not possible due to a restriction of space or other factors, then supplied air respiratory protection is recommended.

NO

A combination of On-Gun Fume Extraction and a Welding Helmet with a Powered Air Purifying Respirator is recommended for most common materials and applications*.

* If On-Gun Fume Extraction is not possible (e.g. MMA Welding), then supplied air respiratory protection is recommended.

This chart assumes that all efforts to mitigate risk associated with welding fume through elimination and substitution have been carried out. Procedural controls should be introduced to support PPE and ventilation controls. This chart has been provided to give a practical 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. 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. If you require more information 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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Learn more about Welding Fume and Exposure Limits:

Watch the video here

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