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WORKSAFE NEW ZEALAND | MAHI HAUMARU AOTEAROA

FACT SHEET

WELDING AND LOCAL EXHAUST VENTILATION – INFORMATION FOR EMPLOYERS

As an employer you have a responsibility to protect your employees from exposure to hazardous fumes. Local exhaust ventilation (LEV) is an engineering control commonly used for welding. When designed, used and maintained properly it is an effective control measure.

This factsheet explains some of the health risks associated with welding, common types of LEV and its limitations.

WHAT IS WELDING FUME AND WHAT ARE THE HEALTH EFFECTS?

Welding and hot cutting processes produce metal and fluxing fumes made up of toxic gases and very fine particles. Inhaling welding fume can cause occupational diseases. Some diseases linked to welding are:

- **Occupational asthma** is commonly associated with exposure to welding fume. Symptoms include chest tightness, wheezing and shortness of breath. The more a employee is exposed to the asthma-causing fume, the more likely they will suffer long-lasting or permanent symptoms.
- **Chronic obstructive pulmonary disease (COPD)** includes chronic bronchitis and emphysema. COPD causes permanent lung damage. Symptoms include difficulty breathing, coughing, mucus, and chest tightness. Damage happens gradually over a long period of time so regular health monitoring is important to detect changes.
- **Metal fume fever** is caused by inhaling metal oxides. The symptoms are similar to the flu but the effects usually aren't long lasting.
- **Hard metal respiratory disease** is linked to exposure to tungsten carbide and cobalt. Symptoms are irreversible inflammation and scarring of the lung tissue leading to increased likelihood of fatal COPD.
- **Cancers** in the lung, larynx and urinary tract have been linked to exposure to welding fume.
- **Irritation of throat and lungs** such as dryness, tightness of chest and coughing.

Fatalities have occurred when extremely toxic metals (such as beryllium or cadmium) have been welded or used in welding rods.

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ASSESSING THE RISK

You must conduct a thorough risk assessment of the hazards in your workplace before you can decide which control measures to use. Exposure monitoring[1] (including assessing air quality) should be completed by a competent person. Employers without appropriate in-house expertise should seek advice from professionals such as occupational hygienists, industrial ventilation engineers and LEV suppliers.

You need to consider:

> What substances are in the fume and the risks associated with them? Detailed information can be found on the Safety Data Sheet.
> How concentrated is the fume?
> What are the relevant workplace exposure standards (WES)[2]?
> What welding process are used (arc, flame, resistance)?
> Are welding surfaces coated or painted?
> Which processes create fumes?
> Where will the welding be done (inside, outside or confined space)?
> Who is exposed to the fume and for how long?

REDUCING THE RISK FROM WELDING FUMES

Where there is a hazard in the workplace, you must first try to apply eliminating, then isolating control measures. Minimising controls are the last option and should only be used when elimination or isolation is not reasonably practical.

Can you modify the process to eliminate or reduce the amount of hot work or fume?

Options include:

> using cold joining techniques such as mechanical fasteners or adhesives
> redesigning the job so thinner gauge material is used
> gas welding rather than full penetration welding
> cleaning welding surfaces to remove any coating that may be toxic such as paint or solvent residue
> using a welding technique that creates less fume:

Highest fume

Arc gouging
Flux core
MMA
MAG
Flame cutting
MIG
Plasma cutting
TIG
Laser cutting
Resistance welding
Submerged arc.

Lowest fume

VENTILATION AS A CONTROL MEASURE

The Welding Fume Control Tool can be used as a guide when selecting what type of ventilation to use.

Table 1: Welding Fume Control Tool

PROCESS	WEIGHT
Submerged arc welding (remote); laser cutting and welding; micro plasma; Gas cutting (remote operations).	0
Submerged arc welding (manual); submerged arc welding (multi arcs).	2

[1] Monitoring involves an employee wearing a personal air monitor for a full work day. The results are then analysed by an occupational hygienist and compared to workplace exposure standards.

[2] An workplace exposure limit is an upper limit for the acceptable concentration of a hazardous substance in the air in a workplace. They are a guide only and do not guarantee protection from ill health.

PROCESS	WEIGHT
Brazing (manual operation); TIG (manual operations); gas welding and cutting (manual); silver soldering (manual); resistance spot welding (manual); plasma cutting (under water table); plasma arc welding; MIG (remote operation); resistance seam welding (remote operation); electroslag welding.	4
MIG (hand held); MMAW; Resistance seam welding (manual operation); thermit welding; electrogas welding.	7
Arc cutting; plasma arc gouging; air arc gouging; flux cored arc welding (manual and remote operation).	9
Plasma arc cutting	15

FUME GROUP	WEIGHT
A: Iron, aluminium, tin, titanium with < 5% of group B or C < 0.05% of group D.	0
B: Copper, magnesium, manganese, molybdenum, silver, tungsten, zinc. Flux fumes such as fluorides, rosin, phosphoric acid, zinc chloride and boric acid.	10
C: Barium, chromium, cobalt, lead, nickel, ozone, vanadium, phosgene, organic fume.	20
D: Beryllium, Cadmium.	55

LOCATION	WEIGHT
Outdoors	0
Open	12
Limited	16
Confined	24

CONTROL REQUIREMENTS	
< 9 or 9	Natural Ventilation
> 9 to 21	Mechanical ventilation
> 21 to 54	Local exhaust ventilation
> 54	Local exhaust ventilation and respiratory protection.

Example: TIG Welding is carried out on manganese steel in a confined space.

The weighting factors are 4 + 10 + 24.

The total of 38 indicates that local exhaust ventilation is required.

WHAT IS LOCAL EXHAUST VENTILATION?

LEV is an engineering control that captures hazardous fumes close to their source and removes them from the workplace. Most LEV systems will have the following components:

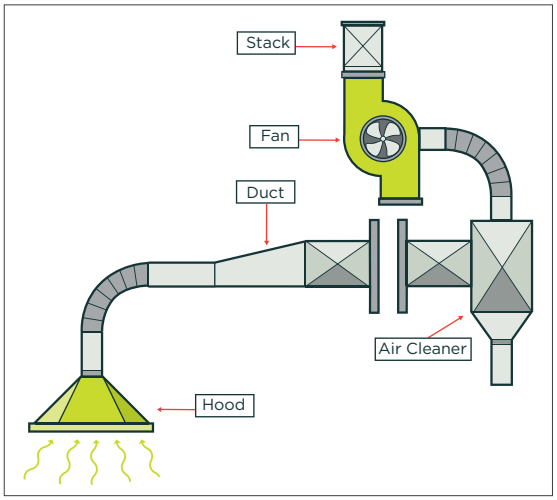

Figure 1: A basic LEV system

The **hood** captures the fume at the source. To be effective:

> the hood should be positioned as close as possible to the source, ideally less than one hood diameter away

> the welding area should be enclosed as much as possible to avoid drafts that will blow the fume away from the hood and/or further into the workplace

> ensure the hood is the right design for the process and type of fume

> install an airflow indicator such as a manometer to check that the LEV is working properly

> the welder must not be positioned between the fume and the hood.

Enclosing hoods

Enclosing hoods are an effective type of hood because the fume is completely contained. A glove box encloses the process, protecting the operator and preventing the fume from entering the workplace. Spray booths enclose the process and the operator, the fume is contained but further controls such as personal protective equipment (PPE) are needed to protect the operator.

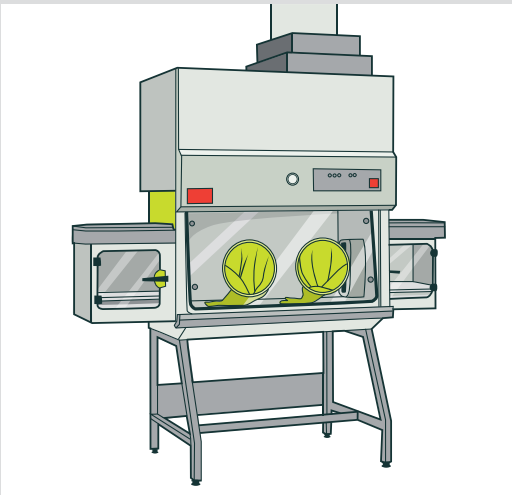

Figure 2: Glove box enclosing hood

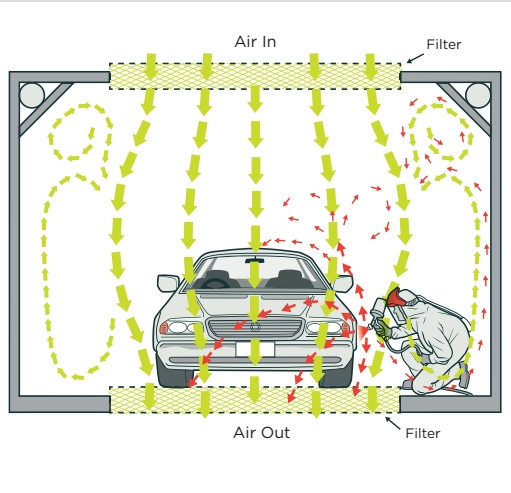

Figure 3: Spray booth

Receiving hoods

The process takes place outside of the hood, the hood receives the contaminant cloud. The width of the hood should be greater than the width of the work area. A canopy hood over a hot process is a classic example.

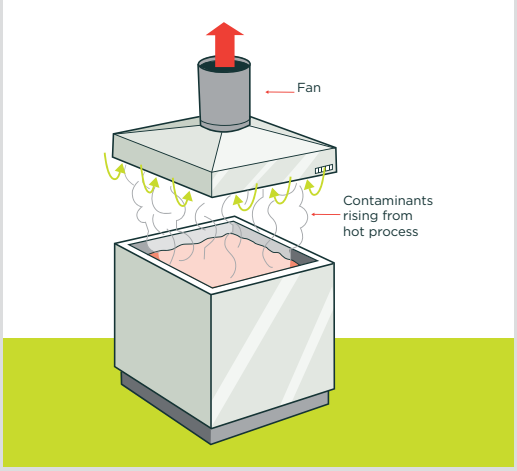

Figure 4: Receiving hood

Capturing hoods

Capturing hoods are the most common type of LEV hood. The process happens outside the hood. This type of hood requires the LEV system to generate enough air-flow to draw in the fume. There are several types of capturing hood used for welding processes: on-tool, moveable capturing hood fixed capturing hood and extracted workbench.

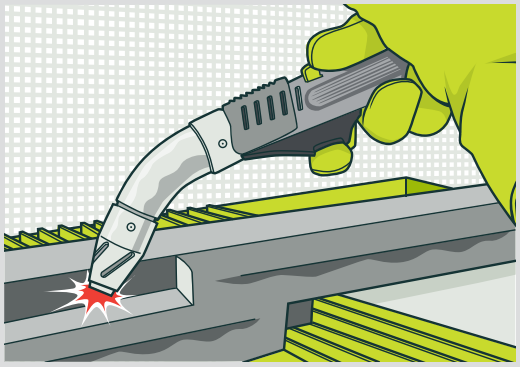

Figure 5: On-tool capturing hood

Figure 6: Capturing hood

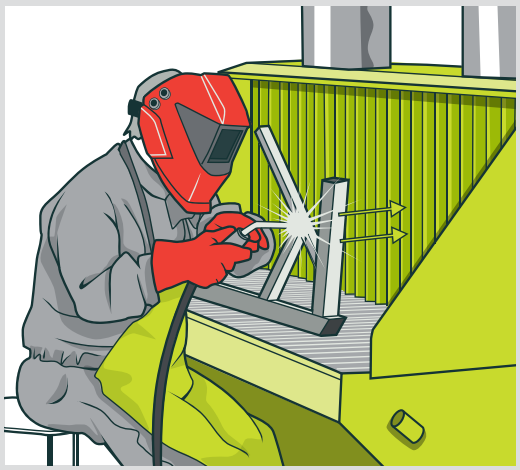

Figure 7: Extracted workbench

The **ducting system** carries the contaminated air away from the work area. Recommended duct velocities are 5 m/s for gasses and non-condensing vapours, and 10 m/s for condensing vapours, fume and smoke.

The **air cleaner** filters/cleans the air before it's released (outside, away from inlets).

Fans provide airflow to move the contaminated air from the workplace though the hood and ducting to the exhaust stack.

An **exhaust stack** or other means of discharging the decontaminated air.

You must make sure that LEV is fit for purpose. The LEV should be designed by an industrial ventilation engineer who has assessed the ventilation needs of your workplace.

The following table provides some examples of the type of extraction that can be used for some common welding processes.

MIG and MAG welding **MMA**	> If possible install on-tool extraction on the welding gun. > Work should be done: – in an extracted welding booth (1-1.5 m/s airspeed), or – on an extracted workbench (2m/s airspeed), or – with a moveable capture hood (5-10 m/s air speed). > Ensure there is clean air supply into work area to replace extracted air.
TIG	> Provide a good standard of ventilation of 5-10 air changes per hour with a through draft.
Oxy-gas welding and brazing	> Use a moveable hood duct with an airflow of 5-10 m/s. > Provide a good standard of ventilation of 5-10 air changes per hour with a through draft.
FCA and MCA	> If possible use a welding gun with on-tool extraction. > Work should be done: – in an extracted welding booth (1-1.5 m/s airspeed), or – on an extracted workbench (2m/s airspeed) or – with a moveable capture hood (5-10 m/s air speed). > Ensure there is clean air supply into work area to replace extracted air.
Arc-plasma cutting (fixed equipment)	> Use a water-table or downdraught table (2m/s airflow) to capture fume. > Provide a good standard of general ventilation.
Air carbon arc gouging	> Provide respiratory protection equipment (RPE). > Where possible do work in an enclosed booth. The booth will require an inward airflow of 1-1.5 m/s. The extraction will need to be 2.5-10m/s. > The extraction should be as close as possible to the point at which the fume is generated.

WHAT ARE THE LIMITATIONS OF LEV?

> Selecting and installing LEV can be complicated – you will need to engage a professional to help you select the right system.

> Poor design, installation and maintenance of any one component will reduce the ability of the system to remove the fume.

> LEV systems require regular checks and maintenance to continue to work properly. You will need to train employees to complete routine daily checks to see if the LEV is operating as it should. Defects must be reported to supervisors and any faults fixed immediately to ensure effectiveness of this control measure.

> The fans, ducts and hoods will vibrate and are a source of noise.

> Fitting additional hoods can significantly detract from the system's effectiveness.

> An industrial ventilation engineer should review any changes or additions to the system.

USING LEV AND OTHER CONTROLS

The LEV system won't necessarily capture enough of the fume to keep the workplace safe. Other controls such as job rotation and PPE can be used to ensure employee exposure remains within WES.

LEV engineering controls will usually reduce the level of respiratory protection needed to limit employee exposure; however you may still need to provide employees with RPE. You should conduct further exposure monitoring to determine the type of RPE needed. Exposure monitoring should be conducted yearly or following any modifications to the process. Your employees should also be subject to ongoing health monitoring. You will need to obtain the consent of your employees for the health monitoring to be undertaken and for the results to be made available to you.

FURTHER READING

Health and Safety in Welding

Welding Technology Institute of Australia publications

Workplace Exposure Standards and Biological Exposure Indices

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