WORKSAFE NEW ZEALAND | MAHI HAUMARU AOTEAROA

HEALTH & SAFETY AT WORK ACT · HSWA

FACT SHEET

WELDING AND LOCAL EXHAUST VENTILATION

This fact sheet is for 'persons conducting a business or undertaking' (PCBUs) that carry out welding work. Local exhaust ventilation (LEV) is an engineering control commonly used to control the risks to workers' health from welding fumes. When designed, used and maintained properly it is an effective control measure.

This fact sheet provides information on some of the health risks associated with welding, LEV systems used for welding and their limitations.

WHAT ARE WELDING FUMES AND WHAT ARE THE HEALTH EFFECTS?

Welding and hot cutting produce metal and fluxing fumes made up of toxic gases and very fine particles.

Inhaling welding fumes can cause ill health.

ACUTE (SHORT-TERM) HEALTH EFFECTS

Acute bronchitis is short-term inflammation of the large and medium sized airways of the lungs. Symptoms include chest discomfort, wheezing, coughing up mucus and shortness of breath.

Airway irritation

Breathing welding fumes can cause a dry tickly throat, cough and tight chest. Ozone gas produced during plasma-arc, metal inert gas (MIG) and tungsten inert gas (TIG) processes can cause blood and fluid to build up in the lungs.

Occupational asthma is commonly associated with exposure to stainless steel fumes. Stainless steel fume contains chromium oxide and nickel oxide which cause asthma. Symptoms include chest tightness, wheezing and shortness of breath.

Metal fume fever is caused by inhaling metal oxides from galvanised welding. Exposure to metal fumes such as zinc, magnesium, copper and copper oxide can cause metal fume fever. The symptoms are similar to the flu and are often worse at the start of the week. Effects usually aren't long-lasting.

Pneumonitis is inflammation of the lung tissue which can lead to severe and sometimes fatal pneumonia.

CHRONIC (LONG-TERM) HEALTH EFFECTS

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

Cancers in the lung, larynx and urinary tract have been linked to exposure to welding fumes.

Pneumoconiosis is a restrictive lung disease caused by ongoing exposure to fumes from aluminium arc welding.

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Note: Research has shown that smoking makes these health effects much worse.

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

IDENTIFYING AREAS OF RISK

You must start by conducting a risk assessment of the hazards in your workplace before deciding which control measures to use.

The assessment could consider:

> Which processes create fumes?
> What substances are in the fumes and the risks associated with them? Detailed information can be found on the Safety Data Sheets for welding electrodes or rods, and shielding gases.
> The type of metal being welded eg galvanised steel, stainless steel, aluminium.
> What welding process are used (TIG, MIG, arc-plasma, brazing or soldering)?
> Are welding surfaces coated or painted with lead based paint, epoxy resins or degreasing agents?
> How concentrated are the fumes?
> The welding temperature.
> Who is exposed to the fumes and for how long?
> Where will the welding be done (inside, outside or confined space)?

Where work activities expose workers to welding fume, WorkSafe recommends PBCUs carry out exposure monitoring to assess the air quality. Exposure monitoring is done by an occupational hygienist or other suitably trained people. They will compare the concentration of contaminants in the air with the relevant workplace exposure standards (WES)[1]. They can recommend the right controls for your workplace.

WHAT ARE THE PCBU'S RESPONSIBILITIES?

PCBUs have a duty to ensure, so far as is reasonably practicable, the health and safety of their workers and other workers whose activities they influence or direct. PCBUs must eliminate risks so far as is reasonably practicable and where this is not possible they must minimise them. PCBUs have a duty to monitor the health of workers and the conditions at the workplace to ensure that workers are not injured or made ill by their work.

REDUCING THE RISK FROM WELDING FUMES

When PCBUs are selecting controls WorkSafe expects, so far as is reasonable practicable, preference to be given to controls that protect multiple at-risk workers at a time. For example local exhaust ventilation (LEV) will protect everyone in the workplace but respiratory protective equipment (RPE) only protects the person wearing it.

PCBUs should apply the most effective controls measures reasonably practicable. In most cases personal protective equipment (PPE) such as RPE shouldn't be the first or only control considered.

Think about ways to modify the process to eliminate or reduce the amount of hot work or fumes?

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

[1] A 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.

> cleaning welding surfaces to remove any coating that may be toxic such as paint or solvent residue

> using a welding technique that creates less fumes:

Highest fume
Arc gouging
Flux core
Manual metal arc welding (MMA)
Metal active gas (MAG)
Flame cutting
MIG
Plasma cutting
TIG
Laser cutting
Resistance welding
Lowest fume
Submerged arc

VENTILATION AS A CONTROL MEASURE

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

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
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); MMA; 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.

LOCAL EXHAUST VENTILATION

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

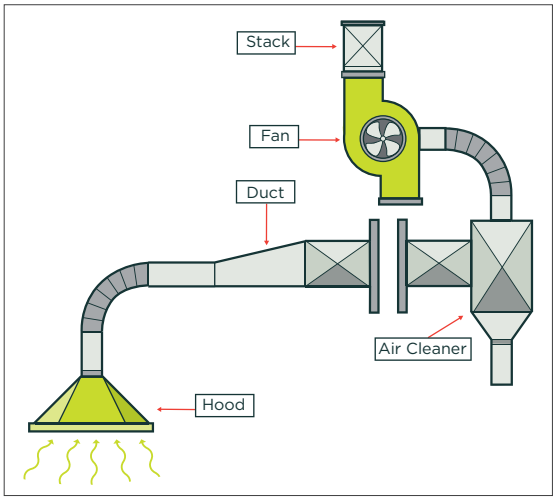

Figure 1: A basic LEV system

The hood captures the fumes 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 fumes away from the hood and/or further into the workplace.

> Ensure the hood is the right design for the process and type of fumes.

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

> The welder must not be positioned between the fumes and the 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.

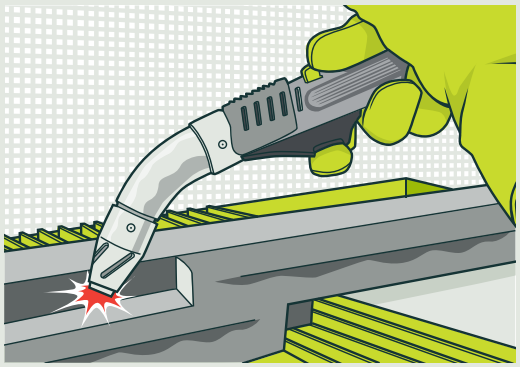

Figure 2: On-tool capturing hood

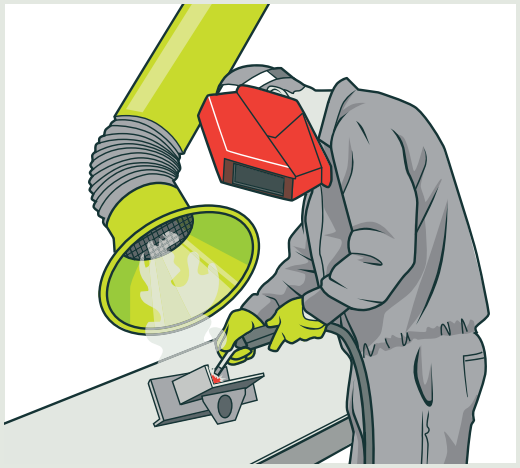

Figure 3: Capturing hood

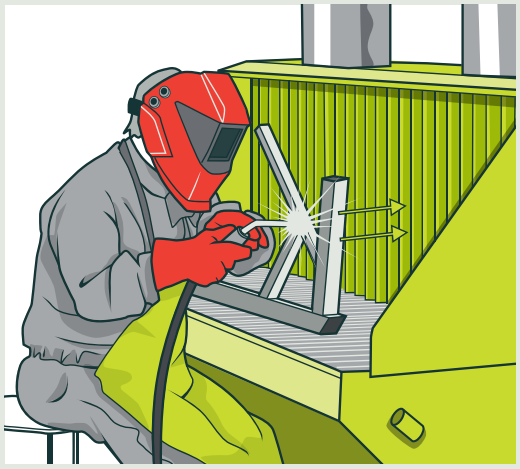

Figure 4: Extracted workbench

The **ducting system** carries the contaminated air away from the work area. Recommended duct velocities are 5 m/s for gases and non-condensing vapours, and 10 m/s for condensing vapours, fumes 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, or – on an extracted workbench, or – with a moveable capture hood. > 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. > Provide a good standard of ventilation of 5-10 air changes per hour with a through draft.
Flux-cored arc (FCA) and metal-cored arc (MCA)	> If possible use a welding gun with on-tool extraction. > Work should be done: – in an extracted welding booth, or – on an extracted workbench, or – with a moveable capture hood. > 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 to capture fume. > Provide a good standard of general ventilation.
Air carbon arc gouging	> Provide airline respiratory protection equipment (RPE). > Where possible do work in an enclosed booth. The booth will require an inward airflow. > 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 fumes.

- LEV systems require regular checks and maintenance to continue to work properly. You will need to train workers 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 RPE

The LEV system won't necessarily capture enough of the fumes to keep the workplace safe. LEV engineering controls will usually reduce the level of respiratory protection needed to limit worker exposure. You should conduct further exposure monitoring to determine the type of RPE needed.

MONITORING

Exposure monitoring should be conducted periodically or following any modifications to the process. If the monitoring shows that the current controls are not working effectively PCBUs should seek advice from an occupational health specialist or LEV engineer.

Worker health monitoring is a way to check if workers are getting sick from being exposed to hazards while carrying out their work, it aims to detect early signs of ill-health or disease. Health monitoring can also show if control measures are working effectively.

Where workers are routinely exposed to welding fumes, PCBUs should arrange regular health monitoring for their workers. Monitoring should include a baseline and then annual lung function test and a respiratory questionnaire.

Include results from exposure and health monitoring, including participation levels in the PCBUs health and safety reporting.

The PCBU should follow the recommendations of an occupational health practitioner with experience in health monitoring when determining what type of health monitoring is required.

MORE INFORMATION

1. Respiratory Equipment – Advice for Employers
2. Workplace Exposure Standard and Biological Exposure Indices February 2013
3. To find professional occupational health associations – Health and Safety Association of New Zealand

Key points to remember:

1. Conduct a thorough risk assessment.
2. Engage a professional to help you select and install the right LEV system.
3. Train workers on how to use and check the LEV system.
4. Get advice on exposure and health monitoring requirements from a occupational health professional.

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