HSE

& Health and Safety Executive

# WL3

COSHH essentials for welding, hot work and allied processes

# Welding fume control

Control approach 1 General ventilation
Control approach 2 LEV and RPE

**The Control of Substances Hazardous to Health Regulations 2002 (COSHH) require employers to ensure that exposure is prevented or, where this is not reasonably practicable, adequately controlled. This guidance gives practical advice on how this can be achieved by applying the principles of good practice for the control of exposure to substances hazardous to health, as required by COSHH.**

**It is aimed at people whose responsibilities include the management of substances hazardous to health at work (eg occupational health specialists, anyone undertaking COSHH assessments and supervisors). It is also useful for trade union and employee safety representatives. It will help you carry out COSHH assessments, review existing assessments, deliver training and supervise activities involving substances hazardous to health.**

**This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance, you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.**

**See Essential information near the end of the sheet.**

## What this sheet covers

This sheet describes good control practice when using:

- local exhaust ventilation (LEV) Control approach 2;
- respiratory protective equipment (RPE) Control approach 2;
- general ventilation Control approach 1.

It covers the key points you should follow to reduce exposure to an adequate level for the following welding processes:

- manual metal arc (MMA or stick) welding;
- flux-cored arc (FCA) welding;
- metal inert gas (MIG) and metal active gas (MAG) welding;
- gas welding;
- tungsten inert gas (TIG) welding;
- resistance spot welding.

**Good control practice for welding fume**

| Frequency and duration of welding | Type of welding | Good control practice | Recommended Systems from a-mac |
|---|---|---|---|
| Sporadic or occasional low- intensity welding | Gas, MMA, FCA and MIG, MAG | LEV where reasonably practicable Otherwise good general ventilation + RPE | Plymovent PHV Unit, MobileGo Plus, PersonalPro Helmet. |
| Regular high-intensity welding | Gas, MMA, FCA, MIG, MAG | LEV + Consider supplementary RPE | On torch system, Mobile Unit. Fully ducted arm system. |
| Regular high-intensity welding outdoors in the open air | Gas, MMA, FCA, MIG, MAG, TIG | RPE where LEV is not reasonably practicable | Plymovent PHV Unit, MobileGo Plus, PersonalPro Helmet. |
| Sporadic or occasional low- intensity welding | TIG and resistance spot welding | General ventilation | Plymovent Diluter, Push Pull system |
| Regular high-intensity welding | TIG and resistance spot welding | LEV | On torch system, Mobile Unit. Fully ducted arm system. |

**Definitions used in above table:**

- High-intensity welding: repeated welding throughout the shift. Welding arc time of more than 1 hour per welder per shift
- Low-intensity welding: welding lasting less than 1 hour per welder per shift
- Regular welding: daily or weekly welding

**Sporadic welding: occasional welding carried out less than once per week which is incidental to the businesses core activity and cannot be planned for, eg repair or maintenance work**

## Hazards

✓ Welding fume (which includes irritating gases such as, oxides of nitrogen and ozone) may cause respiratory irritation and metal fume fever. It can also increase susceptibility to pneumonia. In the longer term, it can lead to serious lung diseases including occupational asthma and cancer. Current evidence suggests that exposure to welding fume may cause chronic obstructive pulmonary disease (COPD). However, there are insufficient statistics to prove a definitive link. Welding fume may also cause adverse neurological effects resultant from exposure to manganese, ubiquitous in mild steels, some stainless steels and welding consumables.


✓ Shielding gases (such as argon, helium and nitrogen, or argon-based mixtures containing carbon dioxide, oxygen or both) can cause asphyxiation (suffocation from lack of oxygen), usually resulting from accumulation of the gases in confined spaces and/or displacement of the oxygen.

## Equipment and procedures

**Before undertaking welding:**

✓ Design the job so less welding is needed, eg by using cold joining techniques, mechanical fasteners, thinner gauge metal or new adhesive technologies.

✓ Remove grease and all surface coatings first before welding. Paint and resin coatings may release toxic components when heated.

✓ Position the workpiece and LEV hood to reduce the worker being exposed to the rising fume.

✓ When welding outdoors in the open air, LEV is usually not a practical option for fume capture, use RPE as a suitable alternative choice of control.

**Have well designed local exhaust ventilation (LEV).**

✓ Ensure you select the most appropriate extraction design for your welding processes. It is important that all elements are well designed and matched to the requirements of your process. The design of the hood is particularly important as it is the air inlet into the LEV system; it determines how well the system captures the fume.

✓ Use a reputable supplier of LEV systems. Ventilation engineers you invite to bid for a contract should be able to show their experience of this type of work.

✓ Provide an easy way of checking the LEV is working, eg airflow indicator.

✓ Ensure extracted air is discharged ideally outside the building to a safe place away from doors, windows and air inlets. When this is not possible, air extracted by the LEV system needs to be thoroughly cleaned, eg filtered before returning it to the workplace.

✓ Provide a suitable filter for welding fume in the extraction unit and ensure that it is regularly inspected and replaced when necessary.

✓ Fit an indicator or alarm to show if filters have blocked or failed.

## LEV for welding on small and medium-sized workpieces

**These are workpieces that can be transported to a workshop and positioned on a welding bench or inside a booth.**

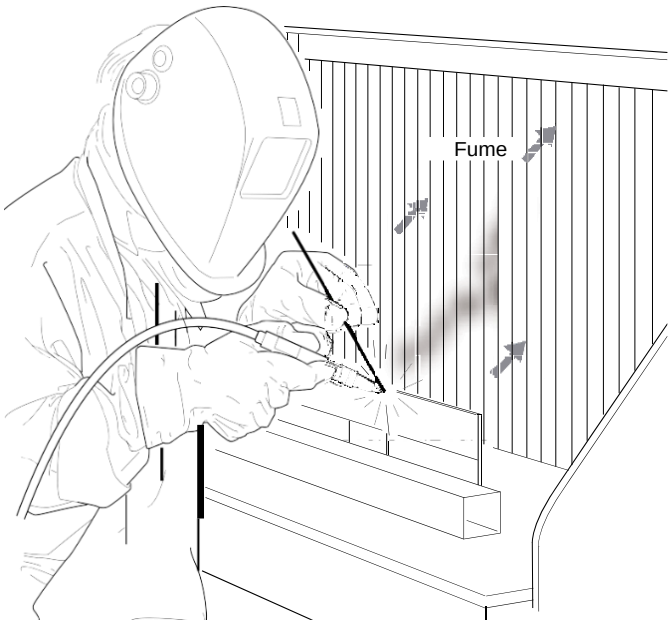
✓ Use an extracted bench or extracted booth which draws fume away from the welder and towards the air inlet at the back, when welding small to medium sized articles. With this design of LEV, the extraction hood does not need to be repositioned during welding to maintain adequate fume capture.

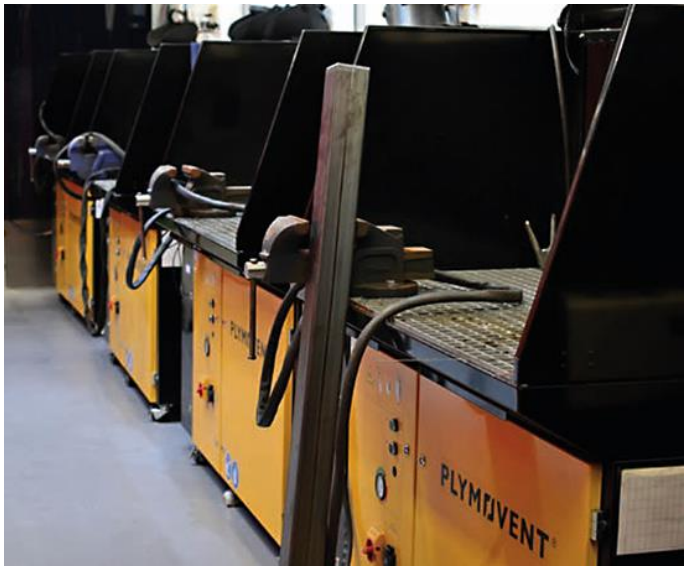
✓ Ensure the fume is drawn away from the welder through the series of extraction holes or slots in the bench or booth. Enclose as much of the bench as practicable to prevent cross-draughts and improve fume capture effectiveness. Keep the work surface of the extracted bench free from clutter so as not to restrict the air movement.

✓ Position the workpiece correctly on the bench to ensure effective capture of fume.

✓ Ensure that the workpiece (or the area to be welded) is entirely within the booth.

✓ Use of a turntable or bespoke jig allows positioning to ensure fume is taken away from the welder.

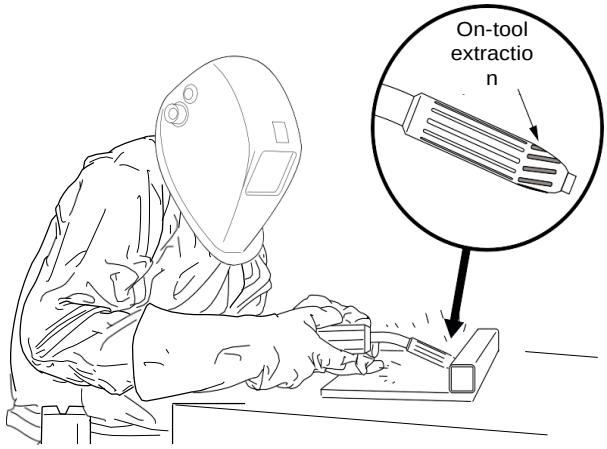




**Welding table where the welding fume is captured and extracted by the airflow at the back.**

## LEV for welding on large and extra-large workpieces

**These are workpieces that are typically too large to transport to a work bench, eg bigger than a small car and may be part of a large construction project.**

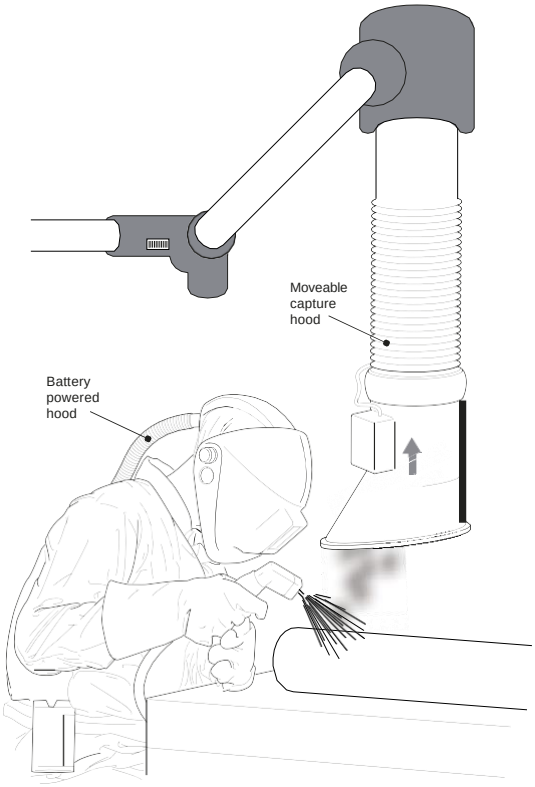
- ✓ Use on-torch extraction as this is the most effective fume control for MIG welding when it is set up and used correctly.
- ✓ For other types of welding where on-torch extraction cannot be used, use LEV with a movable fume capture hood.
- ✓ Ensure the correct set-up so it can be used without compromising weld integrity.
- ✓ On-torch extraction is effective because:
  - the extraction is integrated with the welding gun;
  - the extraction moves with the weld;
  - the extraction is very close to the source at all times; and
  - it does not rely on the welder to reposition the extraction to maintain good fume capture.
- ✓ Be aware of the limitations of this on-torch extraction design:
  - The extraction unit needs to be located close to the welding area. Therefore, it is not always practical to use when welding is carried out while working at height.
  - Research has shown that on-torch is more effective when groove welding on a flat surface (eg. downhand, horizontal or vertical) than when fillet welding or groove welding in the overhead position.
  - The diagram below shows on-torch fume extraction for MIG welding.





- ✓ Use a movable fume capture hood on a flexible extraction arm for large to extra-large workpieces when other, more effective LEV designs are not practical.
- ✓ Select an appropriate design of hood to maximise the fume capture from your welding process by considering its shape, size or hood diameter and whether flanged capture hoods can be used.

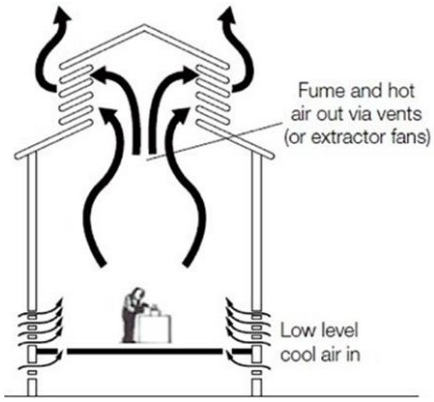
- ✓ Position movable hoods within one hood diameter of the welding point to collect fume effectively, otherwise they will not capture the welding fume.
- ✓ It can be helpful to mark out the capture zone of a moveable hood.
- ✓ Ensure the careful positioning and repositioning of the capture hood as often as necessary to maintain the optimal fume capture.
- ✓ Ensure ducting is free from acute bends and kinks, holes and cracks and avoid long sections of flexible ducting.
- ✓ The diagram below shows suitable welding fume controls for regular high-intensity welding on large to extra-large workpieces.




## Respiratory protective equipment (RPE)

- ✓ RPE may be needed where fume extraction alone cannot provide dequate control and when welding outdoors. Some welding processes of high-intensity and/or significant duration with LEV will also require supplementary RPE to be worn to protect the health of the welder:
  - when using a welding process which generates lots of fume, eg MMA, FCA or MIG welding for a significant duration of the shift; AND
  - the size or shape of the workpiece to be welded means that the LEV provided is not able to provide reliable and consistent fume control for all welds.
- ✓ RPE may also be needed in situations when the LEV system is not able to achieve and maintain consistent capture of the fume generated, eg using a movable fume capture hood on a flexible arm on a large workpiece with long runs of welds requiring frequent repositioning of the capture hood to maintain consistent and reliable fume control is likely to lead to welding fume exposure as the fume control is heavily dependent on the welder.

- ✓ An occupational hygiene air monitoring survey designed to measure welders' exposure to welding fume might be needed to confirm effectiveness of controls and determine if RPE is also required.
- ✓ Some welding tasks may have to be undertaken in a temporary work location, eg work at height, where the risk assessment has determined that it is not reasonably practicable to use LEV. In these situations, provide RPE to all workers in the area who are likely to be exposed to the fume and ensure good general ventilation is provided to prevent the fume lingering.
- ✓ Provide RPE with an assigned protection factor (APF) of at least 20. Fit testing is required for RPE with a tight-fitting face seal.
- ✓ Workers wearing tight-fitting RPE must be clean-shaven, trained how to fit it properly and how to look after it.
- ✓ Tell workers to discard disposable RPE at the end of the shift, or sooner if their RPE becomes blocked with fume or dust. Change the filters on respirators in accordance with manufacturers' recommendations and if:
  - the shelf-life expiry date has passed;
  - they are damaged or visibly contaminated;
  - they become harder to breathe through.
- ✓ Examine and test non-disposable RPE thoroughly at least once every month and record this.
- ✓ Tell workers to check RPE is working properly before every use.
- ✓ Use a powered respirator when a welder is required to carry out welding for more than 1 hour per day.
- ✓ There are additional benefits when selecting a powered respirator which has an integral welding visor to protect the skin and eyes from UV and an additional clear viewing window. This device protects welders as the respirator remains in place when checking their weld. If they do not have this device, welders must wait until all the visible fume has disappeared before lifting their visors.
- ✓ Powered respirators used for welding should have a particulate filter. TH2 filters have an assigned protection factor of 20. TH3 filters have a higher protection factor of 40.




## General ventilation when welding indoors

- ✓ Effective general ventilation provides rapid fume clearance and a through draught. It is necessary to minimise the fume build-up over the shift in any situation where welding fume is not fully removed by LEV.
- ✓ Effective general ventilation must ensure that fume generated from welding is dispersed and removed. In most welding workshops mechanical general ventilation will be required because natural ventilation from open doors and windows is not sufficient to disperse the fume generated from the work tasks.
- ✓ For processes which produce little fume in a substantially sized work area, effective general ventilation may adequately control exposure. Examples include low-intensity resistance spot welding and low-intensity TIG welding.
- ✓ Mechanical general ventilation uses fans mounted in the ceiling or high up on a wall to extract the air in the room and draw in clean air to
  disperse airborne contaminants. These ventilation systems work well with a number of low-fume sources in large work areas with high ceilings.

## Commissioning, maintenance, examination and testing of LEV


**When a LEV system has been purchased ensure it is commissioned. This can be carried out by the LEV supplier or by a LEV testing company. The commissioning provides:**

- the design specification;
- the checks that were carried out to ensure fume control;
- the data needed for its technical performance.

✓ Keep all equipment used for the task in effective working order.

✓ Maintain it as advised by the supplier or installer.

✓ Check for signs of damage to LEV equipment before starting work.

✓ Your LEV supplier should have provided a user manual that includes how to use the system, how to maintain it, the spares available and a list of things that can go wrong.

✓ LEV systems require a statutory 'thorough examination and test' (TExT).

✓ Get a competent ventilation engineer to perform the TExT at least once every 14 months.

✓ Carry out all actions arising from the TExT.

✓ Keep an employer record for at least 5 years of each TExT. Paragraph 186 of L5 COSHH ACOP details the information that should be kept in order to show the LEV is performing as originally intended.

✓ Carry out weekly visual checks that the LEV is working and keep a record.

✓ You should have an LEV system logbook that contains schedules and records of regular checking, maintenance and repair.

✓ Several measures are available to check effectiveness of controls. These range from simple qualitative (use of dust lamp) to complex quantitative techniques (eg air sampling).