# Controlling health risks from rosin (colophony)-based solder flux fume

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## Introduction

This leaflet gives guidance on how to protect your employees from the risk of ill health caused by rosin (colophony)-based solder flux fume at work. It will help you to understand how to comply with the Control of Substances Hazardous to Health Regulations 2002 (COSHH) (see Need to know more?).

It is aimed at employers but will also be useful to employees, their safety representatives and health and safety professionals.

## What is rosin-based fume?

Rosin (colophony)-based solder flux fume is a substance that is generated and released during the soldering process. It is hazardous to health, being a common cause of occupational asthma. Contact with this solder fume and its residues can also cause skin problems such as dermatitis. It mostly affects workers in the electronics and assembly industries.

## What does the law require?

COSHH requires employers to prevent or control exposure to rosin-based fume so as to prevent ill health.

Risk assessment will help you identify proportionate controls to prevent or reduce exposure to solder fume.

You should:

- identify hazards and assess the risk to health caused by exposure to solder fume;
- take action to prevent exposure and control risks;
- keep control measures under regular review.

As an employer, you should be taking effective measures to control exposure to fume, to protect the health of your employees. You should know what the health risks are and tell employees about spotting the early signs and symptoms.

When deciding on controls, think about:

- the route into the body, ie inhaled and/or through contact with skin;
- how often people solder with rosin-based solder fluxes and for how long;
- the specific methods of the soldering task being carried out;
- anyone else in the nearby area who could be exposed to the solder fume, eg maintenance workers.

In priority order, you should:

- eliminate the use of solder fume and consider alternative methods to soldering, eg mechanical jointing processes such as crimping and wire wrap or conductive adhesives;
- consider substituting rosin-based fluxes, eg choosing rosin-free or rosin-reduced fluxes;
- if you have to use rosin-based flux, use a combination of measures to reduce exposure, eg good general ventilation in the work area, temperature-controlled soldering irons, good worker posture, local exhaust ventilation (LEV);
- have as few workers in harm's way as possible and prevent people being exposed where it is reasonably practicable to do so, eg by automating and enclosing the soldering process;
- provide personal protective equipment (PPE) such as gloves, eye protection, coveralls and suitable respiratory protective equipment (RPE) and make sure all the controls work together;
- involve employees – this is a good way of developing control measures. Control measures are always a mixture of equipment and ways of working to reduce exposure – the right combination is crucial. No measures, however practical, can work unless they are used properly.

As rosin-based solder flux fume is known to cause occupational asthma, there is an additional requirement under COSHH for a high standard of control. Exposure must be controlled to as low a level as is reasonably practicable (ALARP) below the Workplace Exposure Limit (WEL). A full list of WELs can be found in Table 1 of the HSE publication EH40 (see Need to know more?).

# Be aware

Changing the process may introduce different risks, eg some adhesives may also present health hazards including occupational asthma and dermatitis. You should receive a safety data sheet from your supplier for the products you use which will provide information on the substances they contain and the health hazards associated with them.

PPE should be used for control only as a last resort when prevention or adequate control by other means is not reasonably practicable.

# Keep your employees informed

Employees must be given information on the health risks from the solder flux fume they are using and on the controls to reduce exposure. Where LEV needs adjustment or cleaning, employees will need training in how to do this. Your LEV manufacturer will have a recommended maintenance schedule which will help keep the equipment working as intended.

Employees, who may be exposed to solder flux fume, should be able to identify the early signs and symptoms that might indicate that their lungs are reacting to fume exposure or they are getting skin problems due to exposure to solder flux residues.

# What about health checks?

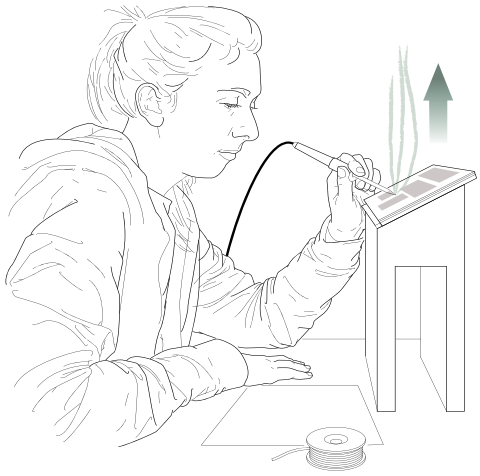
You should provide information on skin checks to employees and, where necessary, you should provide appropriate health surveillance (see www.hse.gov.uk/health-surveillance for more information).

# Controlling exposure

Where prevention or substitution is not reasonably practicable, your risk assessment should identify all appropriate fume control measures.

# Working posture

The worker soldering should be made aware that they can reduce the amount of solder fume they breathe in by changing their working posture. The workpiece should be positioned so the person can keep their head out of the fume generated from the soldering tasks.



In Figure 1, the workpiece has been elevated to enable the worker to perform the soldering task without breathing in the fume.

Careful positioning of the operator together with adequate ventilation may be sufficient for small-scale and very infrequent soldering tasks when you do not solder with rosin-based fluxes or other fluxes which can produce hazardous fume.

**Figure 1** Elevated workpiece

In most cases LEV will be required for production soldering. It can control solder flux fume very well when the correct design is selected, the system is kept in good working order and it is operated properly.

It is important to remember that RPE should not be used as a replacement for LEV in production soldering workplaces.

# Applying local exhaust ventilation (LEV)

LEV will be needed for most production soldering processes and the most suitable design for the LEV system required will depend on:

**The process:**

- the size and shape of workpieces;
- working position and accessibility stages of the process, including tinning the iron;
- the type and gauge of solder;
- residual fuming of the work and the soldering iron tip while at rest;
- the number and spread of joints;
- the frequency, duration and number of people soldering at any one time generating solder fume (ie continuous, repetitive work or intermittent, one-off jobs etc);
- the temperature of the iron (fume levels can triple between 250–400°C);
- the stickiness of fume affecting the extraction design, filtration and maintenance.

**The workplace and local conditions:**

- the size of room;
- general ventilation;
- provision of make-up air; ie air coming into the work area to replace any which is being extracted;
- air currents and sources of interference such as moving machinery and draughts from doors and windows.

Employers should check all engineering controls when they are installed to ensure they meet the specified technical performance.

All new or modified LEV systems should be checked by a commissioning test to ensure that the system is adequately capturing and removing the solder fume from the work room air, as well as performing as per the specification. There is a legal requirement for a thorough examination and test of LEV systems by a competent person, at least every 14 months.

Further information on commissioning, installing and maintaining LEV can be found in the HSE publication *Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV)* (see Need to know more?).

# Examples of LEV systems which may be used for fume control during manual soldering

## 1 Moveable capturing hood

Figure 2 shows a moveable capturing hood, this type of LEV control should only be used for low and medium exposure levels.

It is capable of reducing solder exposure to zero if used correctly. However, it will only reliably capture fume generated within a short distance of the hood face, typically 1–2 hood diameters, which in this case would be approximately 50–100 mm. Beyond this distance capture efficiency decreases causing potential exposure and releasing solder fume into the work room air.

To effectively capture fume, it should be repositioned whenever the solder generation point moves.

Advantages:

- The ability to set it to an optimum position.
- Flexibility in installation.
- Ease and frequency of maintenance and ability to capture large amounts of fume.

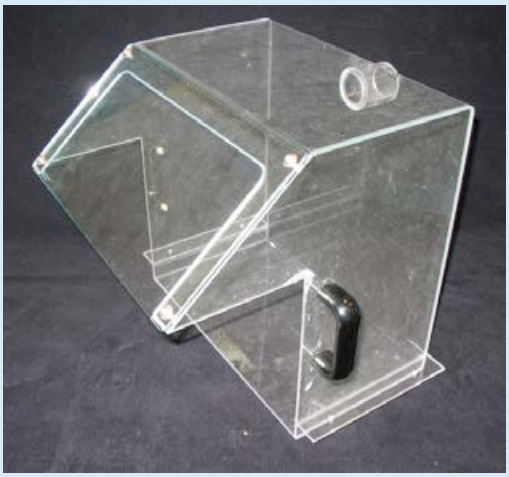
Disadvantages:

- Reliance on correct adjustment to the work by the operator.
- Applications where the arm needs to be continually moved over a wide area.
- Restricted movement of the operator and the workpiece at the workstation.

**Figure 2** A moveable capturing hood

## 2 Ventilated bench-top enclosure

An enclosure should always be used unless workpieces are too large or in situations where work does not always take place at one location. It is capable of reducing exposure to zero as long as soldering is located inside. Enclosures can be easily retrofitted to existing moveable capturing hoods. They are used for production line work where many similar workpieces are soldered one after the other. This particular enclosure was designed to sit on rails so it can be pushed back for assembly work and pulled forward for soldering with the soldering iron located inside it.



Advantages:

- The ability to control all fume sources within the enclosure.
- Relatively low maintenance needs.
- No reliance on correct adjustment by the operator.

Disadvantages:

- Lack of flexibility in installations.
- Possibly poor accessibility.
- Significant installation and running costs.
- Possible need for local lighting.

**Figure 3** Ventilated bench-top enclosure

## 3 On-tip solder fume extraction

Figure 4 shows an on-tip solder fume extraction system. It works on the principle of low-volume high-velocity air extraction. The narrow extract nozzle is permanently mounted onto the soldering iron and is always in the correct position to capture generated soldering fume. Most systems have an inbuilt fan and filtering system and return extracted air back into the workplace. This system can be used for any exposure level. They are most suited to soldering on large or irregularly shaped workpieces that would not fit into a bench-top ventilated enclosure or where the joints to be soldered are widely spaced and would require regular repositioning of a traditional capturing hood. The units can be mounted onto a trolley making them easily portable.

**Figure 4** An on-tip solder fume extraction system

Tip extraction uses a narrow tube on the iron itself to capture fume at source. The tube (typically 5 mm diameter) is either clipped to a normal iron or incorporated in a purpose-made iron. Careful attention should be given to the design of the tip or nozzle and extraction rates for effective fume capture.

**Figure 5** Tip extraction

Advantages:

- Continuous removal of fume from the iron while in use or at rest.
- Easy installation.
- Minimal volume/flow rate of air avoiding significant heat loss.

Disadvantages:

- Blockage of the narrow bore tubes with sticky residues requiring regular and frequent maintenance and cleaning.
- Failure to control fume from hot workpieces when they are moved away from the soldering position.
- Less effective for widespread fume production or where there is rapid air movement around the workpiece.

## 4 Downdraught bench

Figure 6 shows a downdraught bench or extracted surface, which is capable of reducing exposure to zero. As the whole surface is extracted, the solder fume is drawn downwards away from the workers' breathing zone. The effective capturing zone is large so there is no need for repositioning when the solder fume generation point moves. They are suited to irregularly shaped workpieces that will not fit inside a ventilated bench-top enclosure, eg pieces of electrical or electronic equipment. They require a large volume airflow to maintain good control, too large a workpiece can block the extracted surface and reduce the volume flow rate. They are not portable.

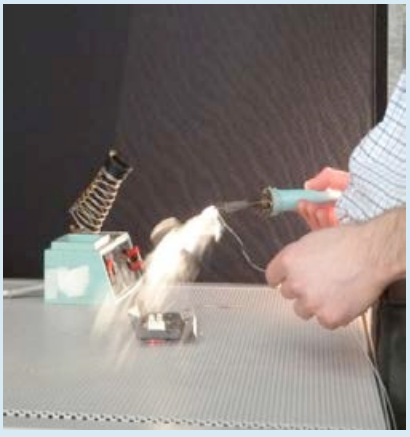


**Figure 6** A downdraught bench

Advantages:

- Suitable for widespread work on large workpieces.
- Suitable for work on irregularly shaped pieces.

Disadvantages:

- Without an enclosure, the capture of fume may not be as effective, but accessibility is improved.
- They are not portable.

## 5 Fume dispersers (also known as air displacement units or black boxes)

These units are commonly known as and can be incorrectly described as solder fume absorbers. Not all of the solder fume is absorbed by the filter and solder fume remains present in the air exhausted from the unit; therefore the term **fume disperser** is a more appropriate description of the unit.

Fume dispersers describe a range of small, boxed, portable, fan/filter, bench-mounted units which may be set close to the soldering operations. Although relatively inexpensive, they may not provide adequate control of the solder fume generated. This is because the pores in the filter are very large, so the jet of exhausted air coming out of the back of the unit still contains an appreciable concentration of solder fume.

The coarse carbon filters usually fitted in these units have been found in tests by HSE to remove only a small proportion of the harmful constituents of the fume. Care should be taken to site unit discharges away from other people as the fume disperser units do not capture and collect all of the fume particles which are drawn through the unit and released back into the work room.

This type of equipment is useful for very intermittent low-volume work where the exhausted air is not blown directly at another person, especially if the room has good general ventilation, as the unit serves to mix the fume with the room air diluting it.

Advantages:

- They are inexpensive.
- They are portable.
- Useful for intermittent low-volume work.

Disadvantages:

- The carbon filters may remove only a small proportion of the harmful constituents of the fume.
- Fume disperser units do not capture all of the fume particles.

**Figure 7** Fume disperser

## Preventative cleaning and maintenance of the LEV system

Solder fume forms a sticky residue in pumps, fans and ductwork unless these are protected. This residue can rapidly lead to poor extraction, premature pump/fan failure and duct blockage.

Blockage of the narrow tubes connected to the extraction nozzle for on-tip extraction systems can occur as sticky residues build-up. The tubing requires regular checks and frequent cleaning to ensure the extraction system can perform effectively and remove the solder fume from the air.

Suitable filters should be used in recirculating LEV systems installed to control solder fume. Solder fume particles are typically 0.5–1.0 micron in diameter, requiring high-efficiency filters for effective removal. A planned maintenance schedule using the manufacturer's instructions will help you to keep your LEV in an efficient state.

## Exhaust to atmosphere and recirculating ventilation systems

Systems which exhaust to atmosphere should vent to a safe place outside. Any decision to introduce a recirculating system should be included and taken into account in the risk assessment. A correctly designed system will adequately capture fume and effectively remove it before air is recirculated back into the workplace.

Recirculating systems may reduce the need for lengthy ductwork and prevent the need for some building alterations. They may also prevent significant heat loss. However, if not adequately designed, the reintroduction of harmful fumes back into the workplace will put people at risk. Fume filtration is critical and should remove both particulate and gaseous components. You should replace filters regularly. An estimate of likely life of the filter should be made and then filters replaced accordingly. A fresh air supply should be provided, together with adequate general ventilation of the work room.

## Automated soldering equipment

Automated soldering equipment can significantly reduce risks by keeping people remote from the fume, so long as it is properly controlled. Such machines usually have purpose-built enclosures to contain fume, with exhaust ports for connection to ducted local extract ventilation systems. Sufficient enclosure and exhaust ports should be provided to ensure effective capture of all fume. Further enclosure and extract ventilation may be required on conveyor transfer lines. Users and suppliers of plant and control systems will need to assess production operations as a whole, rather than just main soldering stations in isolation.

## Need to know more?

*Control of substances hazardous to health (COSHH). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance* L5 (Sixth edition) HSE Books 2013 ISBN 978 0 7176 6582 2 www.hse.gov.uk/pubns/books/l5.htm

*Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV)* HSG258 (Second edition) HSE Books 2011 ISBN 978 0 7176 6415 3 www.hse.gov.uk/pubns/books/hsg258.htm

*EH40/2005 Workplace exposure limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations (as amended)* Environmental Hygiene Guidance Note EH40 (Second edition) HSE Books 2011 ISBN 978 0 7176 6446 7 www.hse.gov.uk/pubns/eh40.htm

*Solder fume and you: An employee's guide* Leaflet INDG248(rev2) HSE Books 2015 www.hse.gov.uk/pubns/indg248.htm

## Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

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.

This document is available at www.hse.gov.uk/pubns/indg249.htm.