

Soldering in Electronics

Occupational Health and
Safety Service
HSD193C (rev 1)



UNIVERSITY OF
CAMBRIDGE

Introduction

Soldering uses a range of low melting point alloys which may contain toxic substances. Most solders also contain a flux, which assists the solder in making a sound joint. A standard soldering iron melts the metal alloys and vaporises the flux. Therefore potentially toxic fumes could be inhaled.

What are the hazards to health?

Soldering fluxes vary in composition, but a number of them contain a resin from pine trees, which is called rosin (aka colophony).

Fume from rosin-based solder flux contains acidic particulates and other gaseous components that can cause irritation of the respiratory tract and eyes. It is also a known respiratory sensitiser, and

Repeated or prolonged exposure to rosin fume can cause occupational asthma.

Rosin fume is generated above 180° C, well below the temperatures used in soldering. Therefore high concentrations of fume can be evolved and the higher the temperature, the more fume is generated

Wherever reasonably practicable the rosin / colophony based solders MUST not be used.

Alternative fluxes should be used wherever possible. However many alternative fluxes are poorly defined in terms of their health effects and should be treated as potentially toxic, adopting the precautionary approach.

The use of lead solders was effectively banned in Europe for **most** purposes in 2006 by the Restriction of Hazardous Substances Directive. However there are still some applications where lead solders are permitted. Where lead solder is used, the risk of inhaling lead fume is low as the temperature of a standard soldering iron (~380° C) is too low to give rise to lead fume (>450° C); as recognised in the ACoP for the Control of Lead at Work Regulations.

However lead is also toxic if ingested and the use of lead based solders should be restricted as far as reasonably practicable.

It is recognised that the unique properties of these solder / flux combinations may be required in particular applications. However, the availability of rosin based solders should be restricted so as to prevent them being used as a 'norm' or purely as a matter of convenience.

Workplace Exposure Limit (WEL)

The HSE set a WEL for rosin based solder flux fume of 0.05 mg/m³ (8 hr TWA) and 0.15 mg/m³ (15 min TWA). However, University policy is to reduce exposure to any hazardous substance to as low a level as reasonably practicable in line with the COSHH Regulations.

Uncontrolled soldering can cause very high personal exposures in the breathing zone which may be 20 to 50 times the legal WEL.

Which solders contain rosin?

It is not always immediately apparent which solders contain rosin and care must be taken to ensure the correct Material Safety Data Sheet (MSDS) is consulted. Frequently the presence of rosin is only 'alluded to' on the labels of solder reels in the form of a vague warning in small print about 'the possibility of allergic reactions on prolonged exposure'.

Control Measures

Substitute with a rosin-free solder, or

- Use a solder with the minimum rosin content
- Minimise the fume generated by minimising the temperature of the soldering iron

If the alternatives are not reasonably practicable then the fume from rosin soldering **MUST** be controlled by capturing it at source and venting it to a safe place outside.

Soldering produces a narrow concentrated plume of hot fume which rises and only slowly dissipates in moving air.

The HSE quantitative assessment of control measures for solder fume (RR900) identified a number of potential control measures:

1. The enclosing hood is an efficient control measure, as it provides a physical barrier and air extraction, as little as 40 m³ per hour in a well-designed hood. However they may not be suitable for all soldering operations.
2. The downdraught bench is an efficient control measure encompassing the whole working area. However it requires a large volume of air (over 500 m³ per hour) and large items (>50% of surface area) may block the airflow and compromise control.
3. On-tip extraction is highly adaptable, having the point of extraction close to the source of the fume and low air flow rates (1.8 m³ per hour). However the nozzle and tubing can be cumbersome and can easily block after a couple of hours use.
4. Mobile capturing hoods are capable of working efficiently if they are positioned correctly. However they have a relatively small effective capturing zone and will need to be kept at a position close to the point of soldering to be effective.

The report also considered the use of 'Air Displacement Boxes' which purport to control soldering fume, but in reality do little more than dilute the fume by moving air away from the immediate soldering area and 'diluting' it in the room. Filters associated with these boxes were found to be very inefficient even if the boxes were correctly located. They are only of value for very infrequent soldering operations of short duration where relying on general room ventilation may be adequate as long as high concentration direct exposure is prevented.

Where 'one-off' small scale soldering is required and the provision of local exhaust ventilation is not reasonably practicable, then every effort **MUST** be made to avoid directly inhaling the fume. The work should be carried out in a large open area with good ventilation, windows opened and if possible a fan used to disperse the fume. Where necessary, work breaks should be used to allow the fume to dissipate.

In accordance with the COSHH Regulations engineering controls, such as those listed above (1 to 4), should be given preference over Personal Protective Equipment which only protects the wearer. However;

Eye protection, in the form of close fitting safety glasses must always be worn.

If a 'one-off' task requires extensive soldering where local exhaust ventilation is not reasonably practicable then the use of an appropriate face mask with an FFP3 particulate and acidic chemical absorbing filter could be considered. **The mask MUST be face fit tested for each individual user before use, as required by COSHH Regs.**

Care must be taken not to contaminate the skin with rosin, as it can cause dermatitis.

Hands MUST be washed after any soldering, especially before handling food or drink, and particularly if using lead based solders.

As ever, appropriate training and instruction must be given in the use of all equipment.

Health Surveillance

Those whose jobs involve soldering with rosin based products or who solder on a frequent or regular basis should complete a health record form and register on the **required** respiratory and skin health surveillance programme with the University's occupational health service.

If they develop any of the symptoms listed below they, or their supervisor, should contact Occupational Health for advice.

- Itchy eyes
- Sneezing, running or blocked nose
- Chest tightness and wheezing
- Itchy skin rash
- Swelling of lips and/or tongue

Additional Factors

- Soldering iron 'stands' should be used
- The iron must be maintained in a good condition with regular checks of the flex
- Always work on a fire resistant surface
- If soldering directly on a piece of electrical equipment it should always be electrically isolated (switched off AND unplugged)
- The use of clamps and ergonomic aids can reduce the risk of burns and fatigue injury

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