

# Immersion and cold cleaning of engineering components

## HSE information sheet

## Engineering Information Sheet No 21 (rev1)

This guidance is aimed at employers, managers and workers who carry out or specify cleaning and degreasing work in various industries.

### Introduction

Cleaning and degreasing metal and other parts by dipping, soaking or spraying them with liquid cleaners is common. It is often referred to as 'immersion' or 'cold' cleaning (although the cleaning liquids are sometimes warmed). Many other components have to be degreased or cleaned in situ on plant or equipment.

This leaflet outlines the main health and safety hazards and risks. It includes the legal requirements applying to this work, which aim to minimise the risks to health and risks from fire and explosion.

Further general information is available in *Working safely with solvents: A guide to safe working practices*.<sup>1</sup>

### Is cleaning necessary?

This is the first question to ask. Changing processes or operation can avoid components becoming soiled or can reduce the level of soiling, making subsequent cleaning easier. Cleaning may not be critical or needed, saving money.

If cleaning is necessary then you should next consider the use of less hazardous alternatives.

### Alternatives

A wide variety of hydrocarbon solvents and water-based formulations are now being used for the cleaning processes, which are less hazardous than those previously used.

### Aqueous cleaning

Water-based formulations using detergent-type substances can be used. These may be alkaline or acid and therefore corrosive to skin and eyes. Working solutions and, more particularly, concentrates, may contain ingredients harmful to health if breathed or ingested, for example as dust or spray. Some organic solvents may be used in water-based mixtures.

In all cases a COSHH assessment should be made and appropriate precautions taken to avoid risks to health. Certain flammable solvents can also be used mixed into aqueous formulations. These should present no fire risk when in an aqueous working solution, but you should check the safety data sheet (see below).

### Wipes

Pre-moistened water- or solvent-based wipes are a real alternative to traditional solvent and rag cleaning, reducing the risks and the costs. If you find yourself using large quantities then other degreasing methods might be appropriate.

### What the law says

#### Risk assessment

Risk assessments are required by the Control of Substances Hazardous to Health Regulations (COSHH)<sup>2</sup> and the Management of Health and Safety at Work Regulations. Employers should use the information from suppliers, and especially the Safety Data Sheet (SDS) or extended SDS (eSDS) to help them carry out these risk assessments.

The inherent hazards of the chemicals used should be linked by the assessment to risks from an employer's particular operations. The assessment should determine the appropriate precautions. In addition, if the flammability or the method of use of the solvent presents a fire or explosion hazard, an assessment of the risk should be carried out in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).

## Information from suppliers

Suppliers of dangerous substances are required to provide a SDS, or an eSDS for REACH-registered substances. This should contain information to enable the recipient to take necessary measures relating to the protection of health and safety at work and the environment ([www.hse.gov.uk/reach/resources/reachsdgs.pdf](http://www.hse.gov.uk/reach/resources/reachsdgs.pdf)).

Employers should use this information to control the risks identified in the risk assessment process ([www.hse.gov.uk/reach/supplyuseduties.htm](http://www.hse.gov.uk/reach/supplyuseduties.htm)).

There are other requirements on suppliers under the Supply of Machinery (Safety) Regulations 2008 and section 6 of the Health and Safety at Work etc Act 1974. See [www.hse.gov.uk/work-equipment-machinery/supplier.htm](http://www.hse.gov.uk/work-equipment-machinery/supplier.htm).

## Confined spaces

In any enclosed or confined space, such as the inside of a tank, even a non-toxic solvent may have anaesthetic or asphyxiating effects if it is used in sufficient quantities. Breathing apparatus and other precautions may be required to prevent serious injury or even death. The Confined Spaces Regulations will apply to such work.<sup>3</sup>

## Solvents user

### Chlorinated solvents

Trichloroethylene, perchloroethylene and methylene chloride (dichloromethane or DCM) are available and widely used for vapour degreasing operations.<sup>4,5</sup> DCM is now banned as a paint stripper unless in industrial installations with certain other conditions. It can still be used for degreasing as long as it is not stripping paint, varnish or lacquer.

These solvents are all volatile and as such suppliers do not normally recommend them for cold or in situ cleaning. Control measures would be required to prevent operators breathing the solvent vapours if it were necessary to use them.

### Other organic chemical solvents

A wide variety of other organic chemical solvent cleaners are available, including petroleum distillates, terpenes and alcohols. A number of products based on bromine compounds are also now being marketed.

In selecting a product, users have to take into account not only how effectively it cleans but also any health, fire and environmental risks it may present in the

way they propose to use it. For example, n-Propyl Bromide (nPB) is classified as highly flammable, as well as being on the 'candidate list' of the European Chemicals Agency as a chemical that might go on their Substance of Very High Concern list which would then require authorisation for specified uses.

## Health hazards from the use of solvents

Some of the products available are highly toxic, but many are of low toxicity. Suppliers should advise on hazards and any precautions which may be needed. In some cases good natural ventilation may be adequate to minimise the risks from solvent vapours but in other cases, local exhaust ventilation will be needed. In some circumstances respiratory protective equipment (RPE) may also be necessary. The COSHH assessment should inform the precautions needed.

Inhalation exposure to organic solvent vapour or liquids may be harmful to health. The severity of ill-health effects depends on:

- the substance;
- its concentration (in air);
- the length and frequency of exposure.

In addition to risks from inhalation, solvents can affect the skin as well as pass through unbroken skin leading to ill-health effects in other parts of the body.

There are three main areas of concern for workers' health:

- Situations which **are immediately dangerous to life** such as unconsciousness or asphyxiation, sometimes resulting in death, are usually the result of bad working practices associated with entry into or leaning over confined spaces, usually larger open topped tanks. The majority of serious incidents have occurred while:
  - degreasers are being maintained;
  - tanks are being cleaned out;
  - solvent is being replaced or topped up;
  - emergency rescues are being attempted.
- Short-term (**acute**) effects on health such as dermatitis caused by de-fatting of the skin, narcotic effects (dizziness, disorientation), nausea, headaches, fatigue and lethargy. These are usually caused by skin contact to neat solvents or breathing in high concentrations of solvent vapour in air. Severe cases of inhalation can result in death.
- Long-term (**chronic**) effects on health, such as liver diseases, nervous system damage and dermatitis, can be caused by regular exposure to solvents during use, maintenance and cleaning. Trichloroethylene is classified as carcinogenic;

nPB is classified as may damage fertility or may damage the unborn child; and perchloroethylene and dichloromethane are classified as suspected carcinogens.

Since all of the products are designed for cleaning and degreasing they will present some possibility of skin irritation or dermatitis. Some solvents are also able to penetrate intact skin and enter the bloodstream. This may not be a problem for intermittent or short-term skin exposures but may cause problems for prolonged skin exposure.

## **Control measures**

Handling and application methods which avoid skin exposure should be considered first and may still require the use of suitable protective equipment such as chemical protective gloves, and sometimes overalls, to protect against residual risks. Care should be taken in selecting gloves and other protective clothing as different solvents affect the materials from which they are made in different ways. Some solvents may pass through some glove materials in a very short time. Use the SDS (or eSDS) and/or your supplier of personal protective equipment (PPE) for advice.

Where provided in an eSDS an exposure scenario describes the operating conditions and risk management measures that have been identified by the supplier as necessary to use the chemical safely. REACH requires you to follow the advice on the risk management measures or if you chose to use different risk management measures to those described then you should be able to justify why your measures offer an equivalent (or better) level of protection for human health (and the environment) for a particular job.

Chemical splashes to the eyes can be very dangerous, including serious and possibly lasting effects. Prolonged exposure to solvent vapours may also cause eye irritation. Some eye protection will be advisable for most operations. Chemical-resistant goggles or a face shield will be required where there is a significant risk of splashing with a chemical which may be harmful to the eyes.

## **Fire and explosion risks**

Most of the hydrocarbon solvents likely to be used are flammable or combustible to some extent. Flashpoint gives an indication of flammability of a solvent but the method of use is also important in minimising the creation of flammable vapours during the work. In addition, it is important to eliminate possible sources of ignition in the vicinity.

Solvents for cold and in situ cleaning should be chosen with as high a flashpoint as is reasonably practicable. Most of the proprietary formulations available have flashpoints around 45 °C or above. Heating of the solvent and spraying or splashing during use will significantly increase the risk.<sup>6,7</sup>

If lower-flashpoint solvents need to be used for immersion cleaning they should be used in purpose-designed plant incorporating specific precautions to contain solvent vapours. If lower-flashpoint solvents are used for cold or in situ cleaning, measures to minimise flammable solvent/air mixtures and to eliminate sources of ignition will be essential.

Guidance on fire safety can be found on HSE's dangerous substances and explosive atmospheres website ([www.hse.gov.uk/fireandexplosion/dsear.htm](http://www.hse.gov.uk/fireandexplosion/dsear.htm)). Detailed guidance on the use of flammable liquids is available in *The safe use and handling of flammable liquids*.<sup>6</sup>

## **Cleaning methods**

### **Immersion cleaning**

The cleaning vessel can range from a suitable open container to a large sophisticated plant with handling equipment for components, means of agitating or spraying solvent or the provision of ultrasonics. To avoid fire risks the supplier's guidance should be followed. Ultrasonics, for example, generate heat.

Where cleaning is carried out relatively routinely, properly engineered and installed equipment should be used, even if that is simple in design. If there are genuine ad hoc, short cleaning jobs then a suitable open container might be used in a way that minimises risks of solvent spillage and vapour release. The solvent should not be left in the open container after use.

If solvents are warmed to assist cleaning the maximum permissible operating temperature should be at least 15 °C below the flashpoint of the solvent used. Reliable, properly maintained thermostats and safety cut-outs will be needed to prevent overheating. Uncontrolled heating of flammable solvents should be avoided.

Measures appropriate to the plant and solvent will be required to control flammable vapours. Sources of ignition should be excluded from the area.

High-pressure spraying of flammable or combustible solvents can increase the risk of ignition and should only be carried out in an enclosure. Some high-flashpoint solvents sprayed under high pressure are

much more readily ignitable than they are in bulk. The risk of ignition in these circumstances may be hardly different from what would arise with low-flashpoint material. Static may be a source of ignition for some solvents. Suppliers should be able to advise on an appropriate standard of enclosure, possibly including vapour recovery and suitably protected electrical equipment.

Precautions should be taken to avoid spillage when transferring solvent from storage to the cleaning plant. Piped systems significantly reduce the risk. Closed containers and drum pumps are useful precautions. Open containers should not be used for transporting solvents.

Appropriate and adequate maintenance of any cleaning plant will be necessary to ensure continued solvent and vapour containment and recovery. For more information on vapour degreasing and recovery see HSE information sheet *Safe use of solvent degreasing plant*.<sup>7</sup>

### In situ cleaning

In situ cleaning can be an effective way of cleaning a specific area with less cleaning solution use than might otherwise be needed. Pre-moistened wipes provide a real alternative and are available in water-based and solvent-based forms. If your degreasing or cleaning can be done in this way then the risks and the costs can be reduced. If you are using considerable quantities of wipes a closed system will result in lower exposures to any solvent and is likely to be more cost effective.

In general, the use of highly flammable solvents is not recommended for in situ cleaning. If, exceptionally, such materials have to be used, stringent precautions will be necessary to prevent a flammable mixture forming and remove or control all sources of ignition.

Solvents should be decanted into suitable sealed containers for transporting around the workplace and use. Open containers should not be used. Specially designed, non-spill swab pails are available to dispense flammable solvent safely. Their use is strongly recommended and would be essential in a confined space.

Flammable or combustible materials sprayed from an aerosol (or other high-pressure spray device) may also ignite readily whatever their flashpoints. Aerosol propellants are usually flammable, butane or propane for example. If aerosols or sprays are used, stringent precautions will be required to prevent a flammable vapour/air mixture forming and to ensure that there are no sources of ignition in the vicinity. The use of aerosols containing low-flash solvents

may be particularly attractive to those needing rapid drying of cleaned parts such as electrical switchgear. Flammable materials must not be sprayed onto any ignition source including hot or electrically 'live' equipment.

Rags or swabs that have flammable solvent on them can ignite spontaneously and any such use should be avoided where reasonably practicable. If used, then they should be removed promptly from workrooms and disposed of in fire-resistant bins. Suppliers may recommend soaking them in water before disposal. See the SDS or eSDS for details.

### Assisted drying

If forced drying is required, special care needs to be taken to avoid flammable solvent/air mixtures and sources of ignition: pre-moistened wipes minimise the amount of cleaner used and so the drying time.

### Storage of solvents

Bulk supplies of flammable solvents should be stored in a safe place in the open air or in a fire-resisting store as described in *The storage of flammable liquids in containers*.<sup>8</sup>

### References and further reading

- 1 *Working with solvents: A guide to safe working practices* Leaflet INDG273(rev1) HSE Books 2013 [www.hse.gov.uk/pubns/indg273.htm](http://www.hse.gov.uk/pubns/indg273.htm)
- 2 *Working with substances hazardous to health: A brief guide to COSHH* Leaflet INDG136(rev5) HSE Books 2012 [www.hse.gov.uk/pubns/indg136.htm](http://www.hse.gov.uk/pubns/indg136.htm)
- 3 *Safe work in confined spaces. Confined Spaces Regulations 1997. Approved Code of Practice, Regulations and guidance* L101 (Third edition) HSE Books 2014 ISBN 978 0 7176 6622 5 [www.hse.gov.uk/pubns/books/l101.htm](http://www.hse.gov.uk/pubns/books/l101.htm)
- 4 *Surface Cleaning and Preparation: Choosing the best option* GG354 Envirowise [www.wrap.org.uk/sites/files/wrap/GG354.pdf](http://www.wrap.org.uk/sites/files/wrap/GG354.pdf) [www.envirowise.gov.uk](http://www.envirowise.gov.uk)
- 5 *Degreasing with solvents (low volatility, small scale work)* COSHH Essentials Sheet SR23 HSE 2007 [www.hse.gov.uk/pubns/guidance/sr23.pdf](http://www.hse.gov.uk/pubns/guidance/sr23.pdf)
- 6 *The safe use and handling of flammable liquids* HSG140 (Second edition) HSE Books 2014 ISBN 978 0 7176 6609 6 [www.hse.gov.uk/pubns/books/hsg140.htm](http://www.hse.gov.uk/pubns/books/hsg140.htm)

7 *Solvent vapour degreasing plant: Use, maintenance and cleaning* Engineering Information Sheet EIS47 HSE 2015  
[www.hse.gov.uk/pubns/eis47.pdf](http://www.hse.gov.uk/pubns/eis47.pdf)

8 *Storage of flammable liquids in containers* HSG51 (Third edition) HSE Books 2014  
ISBN 978 0 7176 6608 9  
[www.hse.gov.uk/pubns/books/hsg51.htm](http://www.hse.gov.uk/pubns/books/hsg51.htm)

## **Further information**

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit [www.hse.gov.uk/](http://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.

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