Solvent vapour degreasing plant

Use, maintenance and cleaning

HSE information sheet

Engineering Information Sheet No EIS47

Introduction

This information sheet provides guidance on the hazards, risks and precautions required when carrying out vapour (or elevated temperature) solvent degreasing. It also gives advice about maintaining and cleaning the degreasing plant.

This guidance is aimed at companies who operate solvent degreasing plant. It will be useful to those who directly supervise these operations and for employees working with this plant. This information may also be of use to suppliers of degreasing solvents and associated plant/equipment.

Degreasing is widespread in the production of engineering components. Historically, degreasing has taken place in open-topped tanks using various organic solvents. For health, safety and environmental reasons, many have been replaced by 'closed' and 'enclosed' plant using organic solvents or by aqueous, or non-solvent, cleaning. However, some traditional plant and organic solvents remain in use.

Further general information is available in *Working safely with solvents: A guide to safe working practices* (www.hse.gov.uk/pubns/indg273.htm).

What are the health hazards and risks?

The most commonly used organic solvents have been chlorinated solvents such as trichloroethylene, dichloromethane (methylene chloride) and perchloroethylene. The solvent 1-bromopropane (also known as n-propyl bromide or, more commonly, nPB) is also sometimes used. There is a vast range of proprietary mixtures containing these and other solvents.

Inhalation exposure to organic solvent vapour 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.

As well as 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 immediately dangerous to life;
- short-term (acute) effects on health;
- long-term (chronic) effects on 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 confined spaces – usually larger, open-topped tanks. Most serious incidents have occurred while:

- degreasers are being maintained;
- tanks are being cleaned out;
- solvent is being replaced;
- emergency rescues are being attempted.

Deaths have also occurred when workers have been overcome by solvent fumes while leaning over or into an open-topped tank. There is also a risk of large emission of solvent vapours where cold solvent is poured onto the surface of hot solvent in an open-topped tank during manual replenishing of solvents.

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 with neat solvents or breathing in high concentrations of solvent vapour in air. Severe cases of inhalation can result in a risk of death as indicated above.

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. Additional chronic health risks are presented by trichloroethylene being classified as carcinogenic; nPB classified that it may damage fertility or an unborn child; and perchloroethylene and dichloromethane being classified as suspected carcinogens.

Fire risks

There are fire risks associated with the use of flammable solvents, or non-flammable solvents which have become heavily contaminated by oils and grease. Fire and explosion advice is available at www.hse.gov.uk/fireandexplosion/index.htm and in the HSE publication *Dangerous substances and explosive atmospheres* (www.hse.gov.uk/pubns/books/l138.htm).

Principal legal requirements

COSHH

The Control of Substances Hazardous to Health Regulations (COSHH) (www.hse.gov.uk/pubns/books/l5.htm) requires employers to take measures to ensure that exposure to substances hazardous to health are prevented or, where that is not reasonably practicable, adequately controlled. In addition, the law requires:

- the principles of good practice as set out in Schedule 2A of COSHH are applied;
- any workplace exposure limit is not exceeded;
- for any substance with risk (R) phrase 'R42 – May cause sensitisation by inhalation', 'R42/43 – May cause sensitisation by inhalation and skin contact', 'R45 – May cause cancer', 'R46 – May cause heritable genetic damage','R49 – May cause cancer by inhalation', or which is a potential cause of occupational asthma, exposure is reduced to as low a level as reasonably practicable (ALARP). The equivalent Hazard (H) Statements from the European Regulation on Classification, Labelling and Packaging of Substances and Mixtures (known as CLP) are H334, H334/317, H350, H340 and H350 respectively.

Trichloroethylene is assigned the risk phrase 'R45 – May cause cancer' (equivalent H Statement – H350 'May cause cancer') and therefore, control to ALARP principles apply. Suppliers of 'closed' and 'enclosed' plant using trichloroethylene claim that during normal operation exposure can be maintained below 10 ppm. The current Workplace Exposure Limit (WEL) of 100 ppm (this is currently under review) is contained in EH40/2005 *Workplace exposure limits* (www.hse.gov.uk/pubns/books/eh40.htm).

When using hazardous substances you should first carry out a risk assessment (see 'COSHH assessment'). This is not just a paper exercise; it is about identifying risks and then taking sensible steps to prevent ill health to workers. You will need to know how workers are exposed, and to how much, before you can decide if you need to do anything further to reduce their exposure.

Further information on COSHH can be found at www.hse.gov.uk/coshh/index.htm and in the HSE leaflet *Working with substances hazardous to health* (www.hse.gov.uk/pubns/indg136.htm).

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

This is the current system that regulates the supply and use of chemicals (including solvents) in Europe. It became law in the UK on 1 June 2007. It includes an obligation for substances supplied in quantities of one tonne per year or more to be 'registered' with the European Chemicals Agency (ECHA).

It also includes an 'authorisation' procedure for substances that have been identified as 'Substances of Very High Concern' or SVHCs (see www.hse.gov.uk/reach/resources/svhc.pdf) and included within Annex XIV of REACH (which is regularly updated). When a substance has been listed on Annex XIV it will be necessary for companies wishing to use these substances to seek an 'authorisation' from the EC unless it meets one of the exemptions in REACH. Further information can be found in the leaflet REACH – *Authorisation* (www.hse.gov.uk/reach/resources/19authorisation.pdf), produced by the UK REACH Competent Authority.

Trichloroethylene has been registered under REACH. It is also on Annex XIV – the authorisation list with a latest application date for authorisation of 21 October 2014 and a 'sunset date' of 21 April 2016. This means that after 21 April 2016 an authorisation will be needed for continued use of trichloroethylene. Users will have to follow the terms of any authorisation with respect to the specified risk management measures in order to continue using trichloroethylene. If an authorisation is either not applied for or not granted for any specific use, then that use must cease after the sunset date.

Note that current information (November 2014) indicates that the largest supplier of trichloroethylene has applied for authorisation for 'closed' systems only. Therefore, use of 'enclosed' systems will have to cease after 21 April 2016. For definitions of 'closed' and 'enclosed' systems, see the European Chlorinated Solvent Association's information, *Recommendations for cleaning machines using chlorinated solvents* (www.eurochlor.org).

The solvent nPB has also been added to the candidate list for inclusion in Annex XIV and therefore, it is likely that nPB will also become subject to authorisation (but with different latest application and sunset dates). Similarly, continued use will rely on authorisation and the implementation of the specific risk management measures for that use.

Current users of trichloroethylene and nPB are recommended to discuss the implications of REACH with their chemical and equipment suppliers as a matter of priority.

You will also notice changes to the information your supplier provides in the new 'extended' safety data sheets (eSDS) (see *REACH and safety data sheets* at www.hse.gov.uk/reach/resources/reachsds.pdf), and a move from R phrases to H statements. Once chemicals are registered, safety data sheets will list their 'registration' numbers and may also include exposure scenarios. The supplier is required to send you (the user) a new eSDS and whenever you request it. This information should be used to inform your decisions in the COSHH assessment (see 'COSHH assessment'. 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 risk management measures given in the exposure scenario attached to the safety data sheet. However, if you choose to use different risk management measures to those described in the exposure scenario, you should be able to justify why your measures offer an equivalent (or better) level of protection for human health (and the environment) to those described in the exposure scenario.

Further information on REACH can be obtained at www.hse.gov.uk/reach/index.htm.

The Confined Spaces Regulations identify degreasing plant as a confined space, as there is a risk of death or serious injury due to the hazardous substances or dangerous conditions (eg lack of oxygen) that could arise.

The Regulations contain the following key duties:

- avoid entry to confined spaces, eg by doing the work from outside;
- if entry to a confined space is ***unavoidable***, follow a safe system of work;
- put in place adequate emergency arrangements before the work starts.

Further information on confined spaces can be found at www.hse.gov.uk/confinedspace/index.htm and in *Confined spaces: A brief guide to working safely* (www.hse.gov.uk/pubns/indg258.htm).

Controlling health risks

COSHH assessment

A 'suitable and sufficient' assessment will determine what steps should be taken to reduce risks. When carrying out an assessment, the information on the product label and its safety data sheet will help to identify its harmful constituents. This information gives you the 'hazard' or its potential to cause ill health. You should then examine:

- how the substance is used;
- how employees are exposed;
- and to what extent.

This will help you identify what controls are required.

Controlling the risk: Is cleaning/degreasing necessary?

If cleaning cannot be avoided, alternative methods of surface cleaning to using solvents in degreasing plant should also be considered. There are three main categories of alternative cleaning methods:

- mechanical cleaning (eg sanding, blasting, dry-ice bombardment);
- aqueous cleaning (water or water-based cleaning processes);
- biological cleaning (eg enzyme cleaners, bacterial remediation systems).

There are other health and safety risks which need to be controlled when implementing these alternative methods. There will also be potential environmental issues arising from these methods which should receive your consideration.

The Envirowise document *Surface cleaning and preparation: Choosing the best option* (www.wrap.org.uk/sites/files/wrap/GG354.pdf) offers further detailed advice about this and the benefits of changing to alternative cleaning methods (for environmental reasons).

If solvent cleaning cannot be avoided, you should look for opportunities to reduce the level of soil, or the number of times cleaning has to be carried out, eg:

- improving handling procedures to reduce soiling;
- applying a temporary protective coating or wrapping to reduce soiling;
- changing working methods to eliminate the need for cleaning between processes.

Substitution

If solvent degreasing is necessary and you are using a known or suspected carcinogen and/or mutagen, such as trichloroethylene, perchloroethylene, methylene chloride or nPB, you should substitute it with a less hazardous solvent (or mixture) (eg modified alcohols) if possible. However, switching to an alternative solvent will mean that some adjustment to, or modification of, the plant will be necessary since no alternatives are true 'drop-in' replacements. For example, boiling points are likely to differ, so safety devices will need to be reset. You need to be aware that replacement solvents will still present some health risks to users (or even increase fire/explosions risks) and that adequate precautions will need to be implemented as part of your risk assessment process.

Suppliers of equipment and solvents should be able to advise on measures needed to be taken when converting existing equipment for use with a different organic solvent.

Plant and equipment

Good design, operation, and regular maintenance of degreasing plant can reduce operator exposure to solvents and improve efficiency and productivity. This includes the following.

Containment: Total or partial enclosure

Solvent degreasing plant should be designed and operated to minimise emission, release and spread of the solvents.

The current REACH registration for trichloroethylene indicates that it should only be used in either closed or enclosed plant although it would be for a user to demonstrate that exposure could be controlled in other ways which also meet the requirements of REACH. The authorisation application for trichloroethylene will mean that this will supersede the registration requirements, so that use of enclosed plant will not be permitted after the sunset date of 21 April 2016.

For **non-carcinogenic solvents**, if it is not reasonably practicable to substitute or provide closed or enclosed plant, the following precautions should be adopted:

- Open-topped tanks should be enclosed as far as possible. Retrofitting a properly designed enclosure on an open-topped vapour degreaser may significantly reduce exposure to solvent vapour.
- The enclosure should include a tank lid. Segmented lids are useful on long degreasing units, as they allow partial opening for degreasing smaller items. Sectional lids or roller shutters, where fitted, should only be opened as far as is needed for loading or unloading. Lids should be maintained so that they are kept in an efficient working order at all times.
- Lids on a conventional open-topped vapour degreaser should be designed to fit within the freeboard zone (see definition below), and below the rim extraction vents. When retrofitting lids, preference should be given to roller or slide design lids rather than lift-out panels, as horizontal movement on roller and sliding shutters is less likely to disturb the vapour in the plant, as well as being more user friendly.

Cooling water supply

For open-topped vapour degreasers, ensure that the temperature and flow of water through the condensing system is set correctly, as this is the primary means of containing solvent vapour. Your supplier should be able to offer advice on correct temperatures for different solvents. It is important that cooling coils are maintained in good working order and kept clean.

Freeboard zone

Above the cooling coils in open-topped vapour degreasers is what is known as the freeboard zone (FBZ). There is always some movement of vapour from the vapour zone into the FBZ and from the FBZ into the workroom owing to turbulent air diffusion. The rim ventilation is there to reduce and control the movement of solvent vapour from the FBZ into the workroom but it does not stop it.

The freeboard ratio is defined as the freeboard height divided by the width of the open area of the tank. A freeboard ratio of at least 0.75:1 and preferably 1:1 should be achieved. A freeboard ratio of less than 0.75:1 is likely to lead to costly loss of solvent vapour and consequently, high operator exposure.

Extraction systems

Exhaust ventilation should be provided to remove solvent vapours from the load/unload zone of both multiple door degreasers and the enclosure on open-topped degreasers.

Separate lip extraction is an important control measure to prevent exposure and the escape of solvent vapour into the workroom. The ductwork and vent slots on this extraction should be inspected regularly, as they are susceptible to damage caused by impact from loads being loaded into the degreaser, or other impact. Exhaust ventilation should also be provided to remove vapours from the sludge door when it is opened, or from a pit in which a degreaser may be located.

All extraction systems should be regularly maintained, and thoroughly examined and tested at least every 14 months by a competent person and records of examination kept for at least 5 years. Further information about these requirements can be found at www.hse.gov.uk/lev/index.htm and in the HSE publication *Controlling airborne contaminants at work* (www.hse.gov.uk/pubns/books/hsg258.htm).

Setting of safety devices
Safety devices, such as sensors controlling sump level, sump temperature and top and bottom safety cut-outs should be set correctly for the solvent in use. These devices are to protect against fire risk, especially when the solvent is heavily contaminated. Information should be obtained about each solvent, including what temperature the cut-outs should be set at. Cut-outs should be tested regularly, usually weekly, to ensure they are working correctly.

Water separator
Water separators remove excess water. If excess water is allowed to remain in a degreaser, it can cause the solvent to degrade and lead to corrosion. Ongoing maintenance and cleaning is required to ensure that dirt and debris does not build up in the gutters below the cooling coils. If the gutters block, then overflow can occur when the plant is running. Separators need to be frequently drained, usually daily.

Solvent management
It is important to have correct procedures for the management of solvent use. This should form part of a solvent management plan. The Envirowise document GG429 *Cost-effective solvent management* (http://ec.europa.eu) offers more practical advice about this.

Working methods

Modern, closed and enclosed solvent degreasing plant usually has arrangements that prevent (or adequately control) exposure to solvent during normal operation, ie while loading and unloading and during the cleaning cycle. However for open-top solvent vapour degreasing plant, correct working practices are very important in controlling exposure to harmful vapour. In particular, the following.

Correct stacking of hollow components

Hollow or partially enclosed components (eg open tubing) require careful stacking or rotational jigs to facilitate draining; otherwise they will not drain properly and will still contain liquid when removed from the degreaser. This leads to significant (and costly) but entirely avoidable exposure to solvent vapour.

Loading, unloading and transferring components at the correct speed

Introducing the load too quickly can push solvent out of the degreaser, and withdrawing the load too quickly can create excessive ‘drag-out’. A mechanical hoist set at slow speed can help reduce exposure (both inhalation and dermal) and also reduces manual handling.

Transfer of components between compartments in the plant should also be done slowly and preferably below the vapour zone. Components should be turned in the FBZ to minimise solvent drag-out.

Workload

Loads should not exceed 50% of the open horizontal area of the plant. Large area or tall components or baskets can cause problems, as they may cause a pumping action, pushing vapour-laden air out.

Drying time in the freeboard zone

For open-topped vapour degreasers, components should be allowed to hang dry in the freeboard zone until all residual solvent has evaporated (known as the dwell time). If the degreaser does not have a hoist, there should be a rest, hook or other fixture in the FBZ to allow components to be left to stand and dry.

Avoid spraying in the freeboard zone

The use of a manual spray lance can cause a lot of turbulence and vapour emission, so its use should be avoided wherever possible. Where the use is unavoidable, it should be justified in a risk assessment and suitable control measures should be in place. For example, the parts being sprayed should remain within the vapour zone below the cooling coils.

Clean-out procedure

Solvents in degreasers become contaminated with deposits and sludge.

With open-topped tanks, even with good regular maintenance of plant and management of solvents, the solvent will eventually need to be replaced and sludge or other deposits removed from the base of the degreaser. How often this is needed depends on the level of contamination of the components cleaned and the degreaser throughput.

If an open-topped degreaser is cleaned regularly, it should also mean that physical entry into the plant is seldom required. This is important, as fatal accidents (sometimes involving several casualties, when rescue attempts go wrong) have occurred to people entering degreasers without adequate precautions.

For closed and enclosed plant, the solvent passes through a filtration and recovery system inside the machine during each cycle. Contaminated solvent waste is pumped out to a waste solvent drum. At some time, both the waste solvent drum and the fresh supply solvent drum will need to be removed. However, special release connectors to these drums will limit any potential exposure to the solvent.

Methods of cleaning

The principles of COSHH and the Confined Spaces Regulations should be followed when cleaning out degreasers. This means that entry should be avoided wherever possible. Two common ways of cleaning open-topped degreasers without entering are given below:

- Many degreasers can be set to distil off most of the solvent to an external drum, leaving a smaller heavily contaminated residue in the base. If the distillation and cleaning cycle is performed regularly, in most cases the cooled residue will be sufficiently mobile to run from the degreaser drain line into a suitable, enclosed container. Any remaining deposits can be removed via the sludge door at the base of the degreaser, working from outside the degreaser using long-handled scrapers and wearing suitable personal protective equipment (PPE) and respiratory protective equipment (RPE) (as specified in the extended safety data sheet).
- Dirty solvent can be pumped out of the degreaser for safe disposal or recycling. Some sludge may need to be removed, but the solvent should be changed often enough to ensure that heavy sludge deposits do not build up.

If these methods are adopted, only very infrequent entry into the degreaser should be required.

Entry into degreasing tanks

Precautions can be summarised as follows:

- Employers must establish a safe system of work. This should be in writing, and must be followed each time entry is required. Entry should be authorised each time by a manager or supervisor. A written permit-to-work system is often used to implement these requirements.
- Before entry is allowed, as much solvent and sludge as possible should be removed by working from outside. Disturbing sludge deposits can generate very high solvent levels in the air. The degreaser must be cooled and ventilated from low level and via the lip extraction, ideally for about 24 hours. Extraction should continue throughout the cleaning process and the solvent vapours vented to a safe location.
- Anyone entering a degreasing tank must use suitable breathing apparatus (BA). This must meet the requirements of the Personal Protective Equipment Regulations 2002 (see 'Further reading') and display a 'CE' mark. BA providing adequate protection for the high solvent levels likely to be encountered will be positive pressure full-facepiece, self-contained compressed air, or compressed airline type. They must be suitable for the wearer. Filtering respirators such as canister or cartridge types are **not** acceptable. Lives can depend on the correct use of BA. The training of those using and maintaining BA is particularly important. Other PPE required includes suitable gloves, overalls and boots to prevent skin contamination.
- A rescue plan must be part of the safe system of work. Rescue and resuscitation equipment should be provided and be appropriate to the risks identified in the risk assessment. A suitable harness attached to a rope must be worn, so that the free end can be used to pull the person out in an emergency, eg with a suitable hoist.

All equipment used in connection with confined spaces entry and rescue should be maintained in efficient working order and good repair. This should include carrying out periodic examination and testing as necessary and keeping records. BA should be inspected each time before use. A sign clearly prohibiting entry into a solvent degreaser without authorisation and use of BA should be fixed to each degreaser.

For more detail on the requirements for confined space entry see www.hse.gov.uk/confinedspace/index.htm.

Adding or removing solvent at open topped degreasers

Gassing accidents may occur when plant attendants manually replenish open-topped vapour degreasing tanks by pouring significant amounts of cold solvent onto the hot surface of the hot liquid already in the tank. The exchange of heat between the hot and cold liquids can cause the temperature of the added liquid to rise very rapidly and vaporise violently into the face of the attendant. Replenishing the solvent should

be carried out when the tank is cold, or by use of a properly designed pumped system by which cold solvent can be added to a tank safely, below the hot surface of the solvent already in the tank.

If solvent is to be removed from the tank, it should preferably be carried out by pump. In some circumstances, the solvent may be removed by distillation. In either case, the plant should be properly designed to minimise the risk of exposure to vapours, and in the case of distillation by use of a proper solvent recovery system.

Selection and use of PPE and RPE

Wherever there are risks to health and safety that cannot be adequately controlled in other ways, you should provide adequate and suitable PPE and RPE. This should be detailed in the extended safety data sheets. Employees should use and look after this equipment as instructed and in accordance with the training provided.

If the use of RPE is justified, the HSE publication *Respiratory protective equipment at work: A practical guide* (www.hse.gov.uk/pubns/books/hsg53.htm) and the RPE selector tool (www.healthyworkinglives.com/advice/work-equipment/rpe) can help with selecting the correct equipment. RPE with tight-fitting face masks will require face-fit testing to ensure correct size selection.

The use of gloves is usually required for operations involving exposure to solvents. The type and shape/size etc of the glove will be determined by the work being carried out, the temperature of surfaces where gloves may come in to contact, duration of wear and solvent being handled. You can use the glove selection checklist in *Managing skin exposure risks at work* (www.hse.gov.uk/pubns/books/hsg262.htm) to help when talking to your glove supplier.

Monitoring emissions and exposure

Air monitoring

The COSHH risk assessment should identify whether monitoring of employee exposure to substances hazardous to health is required for ensuring the maintenance of adequate control of exposure and for protecting the health of employees, in accordance with a suitable procedure. Air sampling can form part of such monitoring, and is normally required for substances that have been assigned a WEL.
Air monitoring is necessary when any of the following circumstances apply:

- when failure or deterioration of the control measure could result in a serious health effect, either because of the toxicity of the substance or because of the extent of potential exposure, or both;
- when measurement is required so as to be sure that a WEL is not exceeded;
- as an additional check on the effectiveness of any control measures provided;
- when any change occurs in the conditions affecting employees' exposure which could mean that adequate control of exposure is no longer being maintained, eg an increase in the quantity of a substance used, changing systems of work or introducing new plant.

Further information on monitoring can be found in the HSE publication *Monitoring strategies for toxic substances* (www.hse.gov.uk/pubns/books/hsg173.htm).

In practice it is likely that closed and enclosed plant should be able to provide evidence and assurance that exposure to solvents is negligible during normal operation, such that air monitoring is not required. However, for open-topped plant it is likely monitoring will be required.

Biological monitoring

Biological monitoring (BM) can be used to indicate how much of a chemical has entered the body. It involves measuring chemical exposure in a sample of breath, urine or blood. BM does not indicate any effect on health, only that exposure has occurred.

There are valid BM techniques for trichloroethylene, perchloroethylene, dichloromethane and several other commonly used solvents. A BM method for nPB is currently under development and details will be available from the Health and Safety Laboratory (www.hsl.gov.uk) once approved. BM can be used in addition to air sampling to assess all routes of exposure and as a check to ascertain whether exposure may be of concern through routine sampling.

An elevated result may indicate increased exposure to the relevant substance. The control measures should then be reviewed to see where exposure is occurring and suitable steps then taken to reverse this exposure. A retest BM sample should be taken to demonstrate that adequate control has been achieved once more.

Further information for employers is available in *Biological monitoring in the workplace: A guide to its practical application to chemical exposure* (www.hse.gov.uk/pubns/books/hsg167.htm) and for employees in the leaflet, *Biological monitoring in the workplace: Information for employees on its*

application to chemical exposure (www.hse.gov.uk/pubns/indg245.htm).

Health surveillance

Health surveillance means watching out for early signs of work-related ill health in employees exposed to certain health risks. Consult your occupational health provider to discuss health surveillance requirements.

Further information for employers is available at www.hse.gov.uk/health-surveillance/index.htm.

Further reading

Guidance

Biological monitoring in the workplace: A guide to its practical application to chemical exposure HSG167 (Second edition) HSE Books 1997 ISBN 978 0 7176 1279 6 www.hse.gov.uk/pubns/books/hsg167.htm

Biological monitoring in the workplace: Information for employees on its application to chemical exposure Leaflet INDG245 HSE Books 1997 www.hse.gov.uk/pubns/indg245.htm

Confined spaces: A brief guide to working safely Leaflet INDG258(rev1) HSE Books 2013 www.hse.gov.uk/pubns/indg258.htm

Control of substances hazardous to health. 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

Cost-effective solvent management GG429 Envirowise 2004 http://ec.europa.eu/environment/archives/stationary/solvents/activities/pdf/d036_cost_effective_solvent_mgt.pdf

Dangerous substances and explosive atmospheres: Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance L138 (Second edition) HSE Books 2013 ISBN 978 0 7176 6616 4 www.hse.gov.uk/pubns/books/l138.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/books/eh40.htm

Managing skin exposure risks at work HSG262 HSE Books 2009 ISBN 978 0 7176 6309 5 www.hse.gov.uk/pubns/books/hsg262.htm

Monitoring strategies for toxic substances HSG173 (Second edition) HSE Books 2006 www.hse.gov.uk/pubns/books/hsg173.htm

Personal Protective Equipment at Work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations L25 (Second edition) HSE Books 2005 ISBN 978 0 7176 6139 8 www.hse.gov.uk/pubns/books/l25.htm

REACH – Authorisation Leaflet Information Leaflet 19 UK REACH Competent Authority 2014 www.hse.gov.uk/reach/resources/19authorisation.pdf

REACH and safety data sheets www.hse.gov.uk/reach/resources/reachsds.pdf

Recommendations for cleaning machines for the use of chlorinated solvents in dry cleaning and surface cleaning European Chlorinated Solvent Association www.eurochlor.org

Respiratory protective equipment at work: A practical guide HSG53 (Fourth edition) HSE Books 2013 ISBN 978 0 7176 6454 2 www.hse.gov.uk/pubns/books/hsg53.htm

RPE selector tool www.healthyworkinglives.com/advice/work-equipment/rpe

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

Surface cleaning and preparation: Choosing the best option Envirowise 2002 www.wrap.org.uk/sites/files/wrap/GG354.pdf

Working safely with solvents: A guide to safe working practices Leaflet INDG273(rev1) HSE 2014 www.hse.gov.uk/pubns/indg273.htm

Working with substances hazardous to health: A brief guide to COSHH Leaflet INDG136(rev5) HSE Books 2012 www.hse.gov.uk/pubns/indg136.htm

Websites

www.hse.gov.uk/fireandexplosion/index.htm

www.hse.gov.uk/coshh/index.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 leaflet is available at: www.hse.gov.uk/pubns/eis47.pdf