Guidance on Risk Assessment and Risk Management of Processes Using Hazardous Substances [Excluding Biological Agents & Radioactive Substances]

1. Introduction

This guidance will assist research workers in undertaking risk assessment of processes which involve the use of hazardous substances as required by the Control of Substances Hazardous to Health Regulations (COSHH) and or the Dangerous Substances and Explosive Atmospheres (DSEAR). It is not intended that this guidance be applied for simple processes that use proprietary products, for example cleaning products used in building maintenance activities or offices.

The COSHH Regulations deal with hazards to health and DSEAR concentrates on physical hazards such as flammability and explosion which in addition to causing damage to property and the environment can also cause harm to people. The ultimate outcome of the risk assessment will be the production of a Standard Operating Procedure [SOP] which contains step by step instructions for the process with safety control measures included at relevant points in the procedure. Compliance with the requirements of the SOP should then effectively manage the risk.

This guidance can also be supplemented by reference to various guidance documents held on the HSE website, www.hse.gov.uk.

2. Responsibilities

Schools/departments where hazardous substances are used must have systems in place for risk assessments to be undertaken. A series of forms and associated information which reflects the contents of this guidance is provided to assist the process (Risk Assessment Form). However the standard University Risk Assessment forms or a bespoke local system may be used.

The responsibility for ensuring a risk assessment is undertaken lies with the Principal Investigator/Senior Scientist and although s/he may not undertake the assessment they are responsible for ensuring it is suitable and sufficient and approved by them. The approval of risk assessment may be delegated to a suitably **competent** individual e.g. senior member of technical staff/ senior post doc or local safety officer.

Individual workers should be made aware of the content of the assessment and must be trained in the procedure against the SOP, and deemed competent. They are then responsible for ensuring they follow the procedure and apply all control measures specified.

3. The Risk Assessment Process

There are 6 steps in the process:

1. Identifying the Hazard
2. Assigning substance to hazard band
3. Evaluating Risk of exposure
4. Determining control strategies
5. Writing a standard operating procedure [SOP]
6. Reviewing risk assessment SOP

Step 1 - Identify the Hazard

A hazard is something that has the potential to cause harm or ill health. Chemical substances may possess a variety of properties that can cause someone to be hurt, experience ill-health or could cause damage to the immediate and or wider environment. There are a number of sources of information on the hazardous properties of substance which include:

- The label on the container
- The Safety Data Sheet
- EH40 Workplace Exposure limits [HSE Document]

Labels & Safety Data Sheets

Products may be classed as 'dangerous for supply'. If so, they will have a label that has one or more hazard symbols. These products include common substances in everyday use such as paint, bleach, solvent or fillers. When a product is 'dangerous for supply', by law, the supplier must also provide you with a safety data sheet.

Details of the various hazard symbols and explanation of the hazardous properties of chemicals can be found at http://www.nottingham.ac.uk/safety/documents/hazard-symbols.pdf.

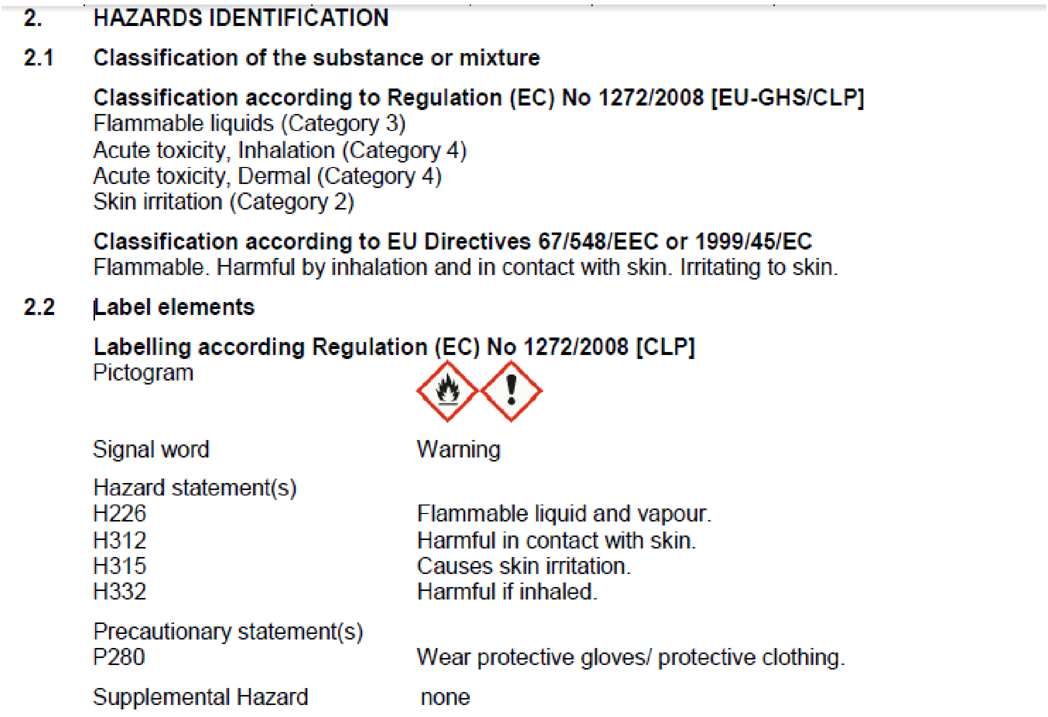
The Classification Labelling & Packaging [CLP] of Substances and Mixtures Regulations entered into legal effect in all EU Member States on 20 January 2009 and is subject to a lengthy transitional period. These new regulations will come fully into force on 1st June 2015 and is progressively superceding the Classification, Hazard Information and Packaging Regulations (CHIP) – more detailed information can be found here.

Hazard & Precautionary Statements/Risk & Safety Phrases [HS & PS /RP & SP]

Section 2 of the Substance Data Sheet (SDS) contains statements about the nature of the hazard and summarises precautions. Until June 2015 you will also see Risk and Safety phrases as required by the outgoing CHIP regulations along with the new Hazard & Precautionary Statements. These provide key information on the hazards and safe use of substances. A full list of all these phrases or statements can be found in appendix 3. Hazard statements are grouped as follows:

- **HS 200** onwards : Physical Hazards
- **HS 300** onwards : Health Hazards
- **HS 400** onwards : Environmental Hazards

The following example shows the relevant information for Xylene provided by one of the main suppliers of chemicals to the University.



2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [EU-GHS/CLP]
Flammable liquids (Category 3)
Acute toxicity, Inhalation (Category 4)
Acute toxicity, Dermal (Category 4)
Skin irritation (Category 2)

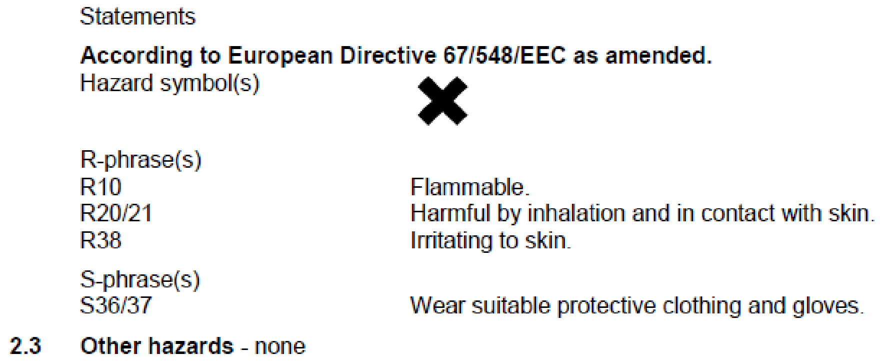
Classification according to EU Directives 67/548/EEC or 1999/45/EC
Flammable. Harmful by inhalation and in contact with skin. Irritating to skin.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008 [CLP]

Pictogram	
Signal word	Warning
Hazard statement(s)	
H226	Flammable liquid and vapour.
H312	Harmful in contact with skin.
H315	Causes skin irritation.
H332	Harmful if inhaled.
Precautionary statement(s)	
P280	Wear protective gloves/ protective clothing.
Supplemental Hazard	none

These are the statements and symbols made under the new regulations (CLP)



Statements

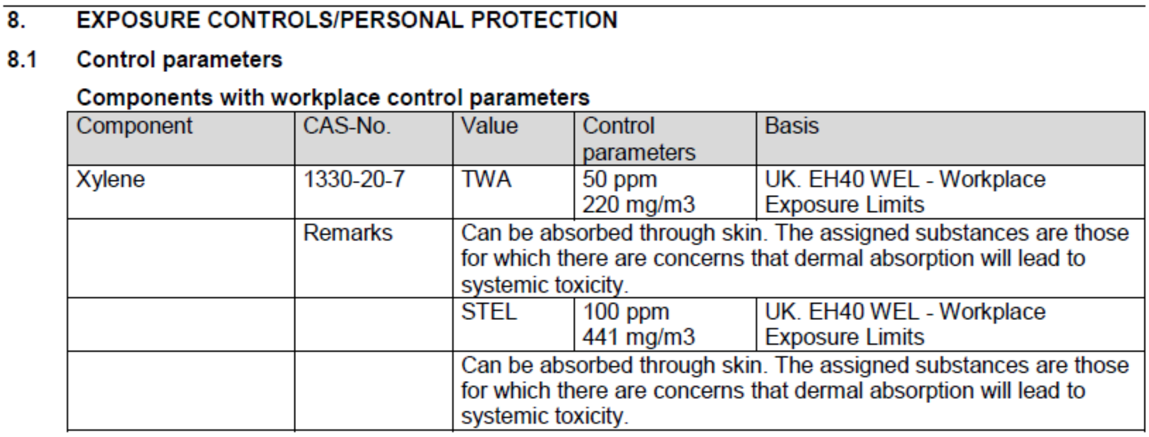
According to European Directive 67/548/EEC as amended.

Hazard symbol(s)	✖
R-phrase(s)	
R10	Flammable.
R20/21	Harmful by inhalation and in contact with skin.
R38	Irritating to skin.
S-phrase(s)	
S36/37	Wear suitable protective clothing and gloves.

2.3 Other hazards - none

These are Risk and Safety Phrases made under CHIP and will be phased out by June 2015

Section 8 of the SDS gives information on Workplace Exposure Limits



8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Xylene	1330-20-7	TWA	50 ppm 220 mg/m3	UK. EH40 WEL - Workplace Exposure Limits
	Remarks	Can be absorbed through skin. The assigned substances are those for which there are concerns that dermal absorption will lead to systemic toxicity.		
		STEL	100 ppm 441 mg/m3	UK. EH40 WEL - Workplace Exposure Limits
		Can be absorbed through skin. The assigned substances are those for which there are concerns that dermal absorption will lead to systemic toxicity.		

Workplace exposure limits [WELs] are UK occupational exposure limits set by the Health and Ssafety Executive (HSE) in order to help protect the health of workers. WELs are concentrations of hazardous substances in the air. These are averaged over a specified period of time, referred to as a time-weighted average (TWA,) which employees may be exposed to by inhalation. Two time periods are used:

- long-term (8 hours); to help prevent chronic/cumulative effects which may arise from prolonged and/repeated exposure.
- short-term exposure limits [STELs] (are averaged over 15 minutes). - substances assigned a STEL can have acute effects and the purpose of the short-term limit is to protect against the adverse health effect occurring from brief exposures to the substance.

HSE's publication EH40/2005 *Workplace exposure limits* includes the list of substances assigned a WEL. It also provides more **detailed guidance on the use of WELs.**

For substances assigned a WEL exposure must be reduced as far a reasonable practicable below the WEL. For substances assigned a STEL that level must never be exceeded. The absence of a substance from the list of WELs does not indicate that it is safe. For these substances, exposure should be controlled to a level to which nearly all the working population could be exposed, day after day at work, without any adverse effects on health.

To establish whether a WEL has or has not been exceeded it would be necessary to carry out a programme of air monitoring. However where a risk assessment identifies that the level of exposure is unlikely to be exceed a limit then monitoring would not be deemed necessary. For processes involving vey hazardous substances with both acute and long term effects air monitoring may be deemed appropriate to show that control measures are adequate.

Some substances will also have the potential to cause physical harm to the immediate or the wider environment such as fire, explosion or pollution which will need to be considered in the risk assessment. This aspect is dealt with later in the guidance.

Physical Hazards (Flammable, Oxidising & Explosive substances)

In addition to health hazards, many substances will also pose a physical hazard in that they cause fire and/or explosion or pollution. Fire and explosion risks are covered in separate policy and guidance - Dangerous Substances and Explosive Atmospheres Regulations (DSEAR).

The following examples illustrate the type of activities covered by DSEAR:

- storage of petrol as a fuel for cars, boats or horticultural machinery;
- use of flammable gases, such as acetylene, for welding;
- generation, handling and storage of flammable dusts, including waste dusts from grinding etc;
- handling and storage of flammable wastes such as chemicals and fuel oils;
- welding or other 'hot work' on tanks and drums that have contained flammable material;

- **use of flammable solvents in laboratories;***
- storage and display of flammable goods, such as paints;
- **transporting flammable substances in containers around a workplace;***

***Note** For many laboratory processes the quantities involved will mean that the process is outside the scope of DSEAR, however these hazards still need to be considered alongside those that pose a hazard to health.

Sections 2 & 9 of the safety data sheet contain relevant information. See examples above.

In relation to flammability/explosivity the following definitions are relevant:

The flash point of a chemical is the lowest temperature where it will evaporate enough fluid to form a combustible concentration of vapour. The flash point is an indicationof how easy a chemical may burn.

Materials with higher flash points are less flammable or hazardous than chemicals with lower flash points. Xylene flash point is 25^{0}C which makes it Highly Flammable.

– Flammable	FP < 55 °C
– Highly Flammable	FP < 32 °C
– Extremely Flammable	FP < 21 °C

Auto-ignition temperature is the lowest temperature where a substance will auto-ignite and combust in normal atmospheric conditions without any external influences. For Xylene this is 432°C to 530°C, that of paper is 451°C, but diethyl ether is 160°C and therefore much more likely to ignite unless reaction temperatures are controlled.

Many organic peroxides are thermally unstable and have a characteristic temperature above which exothermic runaway decomposition takes place, known as the self-accelerating decomposition temperature (SADT) (see HSE guidance)

Explosive limits – lower and upper limits are normally expressed as % in air.

The Lower Explosible Limit (LEL) is the lowest concentration (percentage) of a gas or vapour in air capable of producing a flash of fire in presence of an ignition source. Concentrations lower than LEL are 'too lean' to burn. Also called lower flammability limit.

The Upper Explosible Limit (UEL) is the highest concentration (percentage) of a gas or vapour in air capable of producing a flash of fire in presence of an ignition source. Concentrations higher than the UEL are 'too rich ' to burn. Also called upper flammability limit.

In the case of xylene LEL is 1.1% and UEL is 7%. If the concentration of xylene in the air is within this range then there is a serious risk of explosion/ignition. However this range is quite narrow compared to hydrogen which has a very wide range of 4 to 75% and therefore more hazardous.

The following table shows comparison data for xylene and diethyl ether. From this it is obvious that diethyl ether is far more hazardous than xylene in terms of flammability and explosion risk. In addition diethyl ether when stored in the presence of air or oxygen, may form explosive peroxides therefore it is important to ensure correct storage conditions and ensure good stock control so old bottles of opened product are not kept beyond safe date (as shown on the supply container). It is also recommended thatwhen an ether is used as a solvent not to distill it to dryness as any peroxides that may have formed, being less volatile than the original ether, will become concentrated in the last few drops of liquid.

	Xylene	Diethyl ether
Vapour pressure	24 hPa	563 hPa
Density	0.86	0.7
Flash point	25°C	-45°C
Auto-ignition temperature	432-530°C	160°C
Explosive limits	1.1-7%	1.9-48%
Boiling point	137°C	34.6°C
Vapour density	3.67	2.56

Step 2 – Assign the substance to a hazard band

Allocate the substance to a hazard group (A to E below) based on Health Hazard Statement or Risk Phrase.

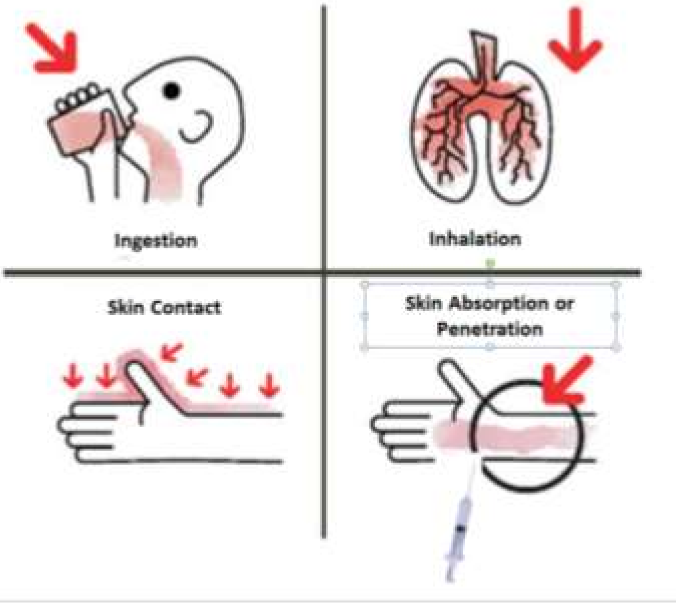
A	R36, R38 and all R numbers not otherwise listed	H303, H304, H305, H313, H315, H316, H318, H319, H320, H333, H336 and all H-numbers not otherwise listed
B	R20/21/22 and R68/20/21/22	H302, H312, H332, H371
C	R23/24/25, R34, R35, R37, R39/23/24/25, R41, R43, R48/20/21/22, R68/23/24/25	H301, H311, H314, H317, H318, H331, H335, H370, H373
D	R26/27/28, R39/26/27/28, R40, R48/23/24/25, R60, R61, R62, R63, R64	H300, H310, H330, H351, H360, H361, H362, H372
E	R42, R45, R46, R49, R68	H334, H340, H341, H350

Step 3 – Evaluate risk of exposure

1. **Consider Routes of Exposure**

For ill health or harm to occur the substance must come into contact with the body or relevant internal organ. The main ways that exposure can occur are:

a) **Inhalation** of respirable material into the lungs. This can also result in exposure of mucous membranes of the mouth and nose and then



subsequent ingestion into the stomach. This is most likely to occur when dispensing particulates, carrying out procedures that generate aerosols (vigorous mixing, shaking, sonication) or working with gases or volatile substance. This is usually the most serious route of exposure since the lungs are a vulnerable part of the body that readily absorb gases, vapours and soluble dusts which can then be absorbed into the bloodstream and transported to other parts of the body.

b) Skin Contact/Penetration/Absorption & Eye Exposure. The skin is the next most vulnerable area. Breaks in the surface such as cuts, grazes and certain skin conditions increase the risk. Activities involving 'sharps' also present the risk of direct injection.

Some substances are corrosive to skin [acids/bases] and can cause serious burns, or may be irritants. Some chemicals by their very nature are readily absorbed through the skin or mucous membranes. These are identified in EH 40 by the annotation **Sk**.

c) Ingestion of material into GI tract– this is the least likely route of exposure given current laboratory practices, (note mouth pipetting is prohibited) however poor occupational hygiene practices (hand to mouth contact, poor hand hygiene) can result in exposure.

2. Consider Physical Form

This will influence how a substance can enter the body. Fine dust will be more easily inhaled than substances that are in crystalline form. The physical property for solids is a subjective assessment of the materials dustiness. HSE COSHH essentials uses the following as a guide.

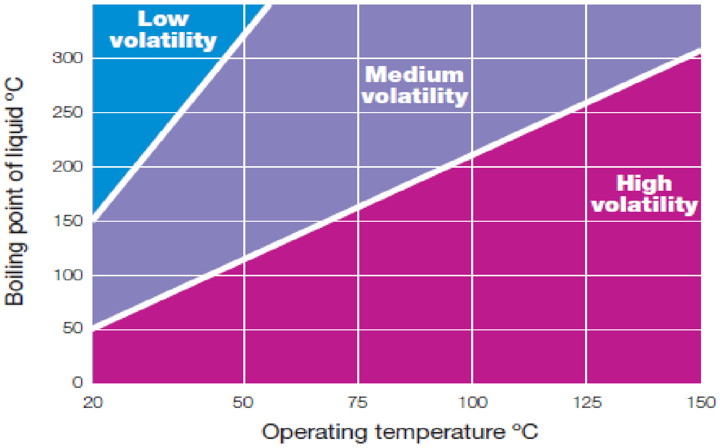
Low dustiness	good pellets which do not easily break up [e.g. |NaOH pellets] and none dusty solids
Medium dustiness	Granular or crystalline and coarse dusts
High dustiness	Fine powders and solids which produce fine dusts. This would also include nanoparticles.

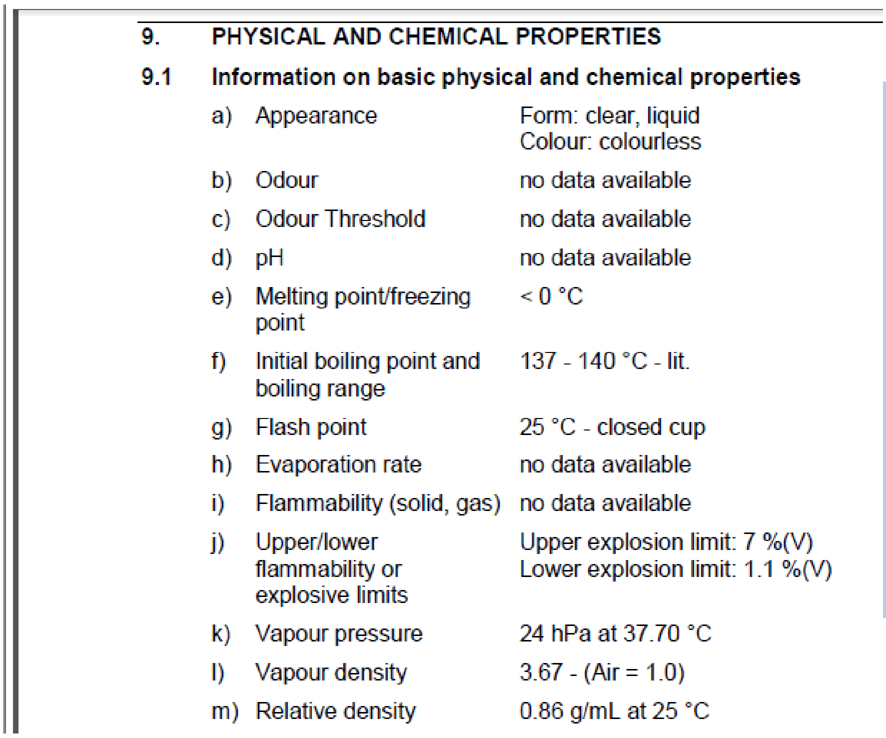
Gases and vapours will obviously have greater potential for inhalation. Solvents/liquids with high vapour pressure/lower boiling point will more readily give off vapours which can then be inhaled and they are more likely to be absorbed through the skin than aqueous solutions.

Again HSE provide the following guidance on assessing volatility on basis of Vapour Pressure

Low volatility liquids	Vapour pressure < 500Pa
Medium volatility	Vapour pressure between 500 and 25000Pa
High volatility	Vapour pressure > 25000Pa

and Boiling Point





9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: clear, liquid Colour: colourless
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	< 0 °C
f)	Initial boiling point and boiling range	137 - 140 °C - lit.
g)	Flash point	25 °C - closed cup
h)	Evaporation rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 7 %(V) Lower explosion limit: 1.1 %(V)
k)	Vapour pressure	24 hPa at 37.70 °C
l)	Vapour density	3.67 - (Air = 1.0)
m)	Relative density	0.86 g/mL at 25 °C

Section 9 in the SDS gives details of boiling point and vapour pressure amongst other information, which is useful in determining physical risks in addition to health risks. More on this later. In the example for Xylene [left] we can deduce that its volatility is **low** using Vapour pressure, or just on the very edge of **medium** using boiling point.

3. Identify Quantity used

The other risk factor is the amount used for the task. In terms of risk assessment of the actual process this will be the amount dispensed/used in the procedure.

Small amount	Milli- litres	Grams
Medium amount	Litres	Kilograms
Large amount	>1000 litres	> 1Tonne

However consideration should also be given to the quantity of supply as this is the maximum amount that could be spilled, and this will determine emergency response in event of a spillage. More about this later.

Frequency & Duration of Exposure

Consider the length of time people are likely to be potentially exposed and how often they will carry out the process.

4. Identify Persons at Risk

Identify the persons at risk. Where there are increased risks to certain risk groups such as new and expectant mothers this must be considered and controls must be adopted that will protect the health of anyone involved in the work. Where it is subsequently identified that a person may be at increased risk [e.g. pregnancy] then a specific risk assessment must be done for that individual in the context of the role they perform, See separate guidance.

5. Consider potential exposure events.

Identify any specific hazardous operations /steps within the procedure that could increase the likelihood of exposure occurring. For example:

- Vigorous mixing, homogenisation, sonication or shaking of liquids will result in generation of aerosol which could enter the breathing zone.
- Dispensing operations [pipetting, weighing]
- Generation/release of toxic/flammable gases
- Use of sharps or glassware.
- Working at elevated temperatures,
- Use of naked flames or equipment that generate heat/ spark
- Operations that result in pressure build up/release
- Operations that could result in liquid splash
- Production of hazardous intermediate reaction substances
- Interactions with other substances.

Step 4 Determine Control Strategies

Having considered the hazardous nature of the substances and any hazardous operations within the procedure the next step is to define the control measures which should be applied. The COSHH regulations set out a hierarchy of control measures which should be applied (see appendix 1) and are set out in order of preference. Controlling the risk might include a combination of control measures that should relate to the hazardous properties, quantities used etc.

The first priority is prevention of exposure, for example by;

- changing the method of work or modifying the process so that operations that give rise to the exposure no longer occur,
- substituting a hazardous substance with one that is of no, or less, hazard. Care is needed as a potential substitute may be much less toxic but considerably more flammable so the overall risk needs to be considered.

Examples of the above would include

- Substituting SYBR SafeTM for Ethidium Bromide

- Use of liquid rather than solid form of chemical.
- Use pellets, tablets or flakes in preference to respirable powders.
- Purchase of ready-made solutions in preference to weighing and dissolving powders.

If prevention cannot be achieved then control, must be achieved by applying a hierarchy of control measures as follows:

- Total enclosure of the process, - e.g. contained within the primary container such as the reaction vessel, or by a glove box
- Plant, processes or procedures that minimise the creation of, or suppress or contain the substance (gas, fume, dust etc),
- Partial enclosure with local exhaust ventilation (LEV) e.g fume cupboard
- LEV, e.g. capture hoods
- Good general ventilation,
- Restriction of access, reduce the number of people exposed,
- Reduce exposure time,
- Contamination control, e.g. regular cleaning and good housekeeping regimes in laboratories.
- Safe storage and disposal arrangements,
- Adequate stock control to ensure that only the minimum quantities of hazardous substances to satisfy requirements are held on the premises
- Good personal hygiene, i.e. washing facilities; clothes changing and storage; laundering of contaminated clothes; no eating, drinking etc.; eating facilities.
- Personal protective equipment. **Only where all of the above have been considered and provided wherever practicable**.
- Information, instruction and training in the SOP and ensuring level of supervision relevant to the complexity of the control measures and the degree of risk.

Consideration will need to be given as to which activities are of sufficiently low risk to be undertaken on the open bench and which will require some form of LEV.

Substances that are not:
- harmful via the inhalation route, or
- are used in small quantities, or
- are non-volatile and non-dusty

are likely to be suitable for use on the bench in a well-ventilated laboratory. However in in making this judgement consideration must be given to the supply quantity, not the actual amount dispensed as this is the maximum amount that the person could be exposed to, particularly in event of a spill.

Activities involving larger quantities of volatile or flammable liquids and those involving substances which are harmful via the inhalation route are likely to need to be used in a fume cupboard or with other form of local exhaust ventilation (LEV). The following matrix will assist in evaluating the control measure that should be implemented to control exposure via the airborne route.

Using the information gathered in Steps 1 to 3 select the box for the relevant risk rating of the substance based on its hazard group, quantity, dustiness/volatility and then assign the relevant engineering control strategy.

CONTROL APPROACHES

General Ventilation	a good standard or general ventilation and the application of good working practices [e.g. working over spill tray]
Engineering control	Use of LEV ranging from well positioned capturing/receiving hoods and partial enclosing hoods e.g. fume cupboards
Containment	Full enclosures and containment
Special	Expert advice required to select appropriate control

Amount Used	**LOW dust SOLID**	**LOW volatility LIQUID**	**MEDIUM dust SOLID**	**MEDIUM volatility LIQUID**	**HIGH Dust SOLID**	**HIGH Volatility LIQUID**
HAZARD GROUP A						
Small (grams / millilitres)	🟩	🟩	🟩	🟩	🟦	🟩
Medium (Kilograms / litres)	🟩	🟩	🟩	🟩	🟦	🟦
Large (tonnes / cu.metres)	🟩	🟩	🟦	🟩	🟩	🟦
HAZARD GROUP B						
Small (grams / millilitres)	🟩	🟩	🟩	🟩	🟩	🟩
Medium (Kilograms / litres)	🟩	🟩	🟦	🟦	🟦	🟦
Large (tonnes / cu.metres)	🟩	🟩	🟧	🟦	🟧	🟧
HAZARD GROUP C						
Small (grams / millilitres)	🟩	🟩	🟩	🟦	🟦	🟦
Medium (Kilograms / litres)	🟦	🟦	🟧	🟧	🟧	🟧
Large (tonnes / cu.metres)	🟦	🟦	🟥	🟥	🟥	🟥
HAZARD GROUP D						
Small (grams / millilitres)	🟦	🟦	🟧	🟧	🟧	🟧
Medium (Kilograms / litres)	🟧	🟧	🟥	🟥	🟥	🟥
Large (tonnes / cu.metres)	🟧	🟧	🟥	🟥	🟥	🟥
HAZARD GROUP E						
All quantities	🟥	🟥	🟥	🟥	🟥	🟥

Source - The technical basis for *COSHH essentials: Easy steps to control chemicals*

Disposal

The risk assessment will need to take account of any waste or surplus chemicals arising out of the process. It is important that supply quantities are kept to a minimum so as to reduce the amount of waste. **Section 13** in the SDS contains some very limited and generic information on disposal which is often unhelpful. E.g. the xylene SDS states '*Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting*'. Obviously the University does not have direct access to any such facility, therefore the disposal arrangement included in the assessment and SOP must reflect University and School waste stream arrangements. i.e. *'solvent waste should be collected in appropriate waste container and sent for disposal as Hazardous Waste via UoN approved contractor'*.

Some substances may be subject to 'threshold limits, which are concentrations below which they are not considered hazardous waste. This could include small quantities of chemical material which could be disposed of via the clinical waste route e.g. polyacrylamide gels, sharps and other disposables contaminated with trace amounts of chemical, or very dilute aqueous solutions that can be discharged to drain.

Waste solvents should not be allowed to accumulate on the bench or in a fume cupboard. They should be labelled appropriately and stored in a labelled solvent cabinet or transferred to a chemical waste store if one is available to the department.

The university's arrangements for waste management fall within the remit of the Sustainability Team who should be able to provide advice sustainability@nottingham.ac.uk.

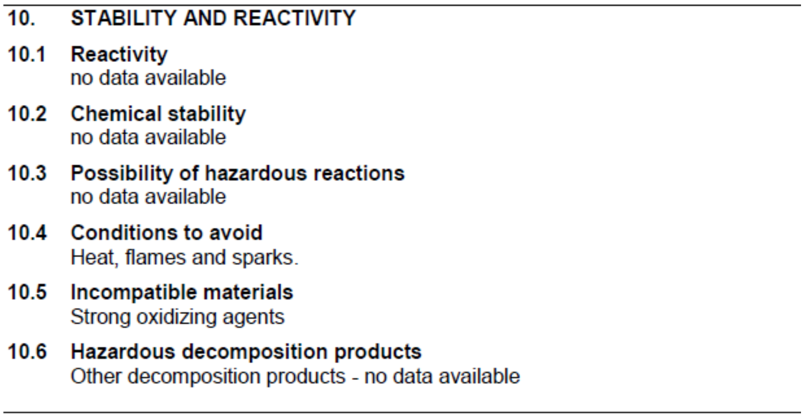
Storage

Hazardous substances must be safely stored and segregated to take account of any cross reactivity that could result in adverse effect. For example flammable substances should be stored separately from acids and oxidising agents.

Section 7 in the SDS provides some information on safe handling and storage of the substance. Using the example of Xylene the SDS states:

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic
charge. Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Section 10 of the SDS provides information on Stability and Reactivity.



10. STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
no data available

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - no data available

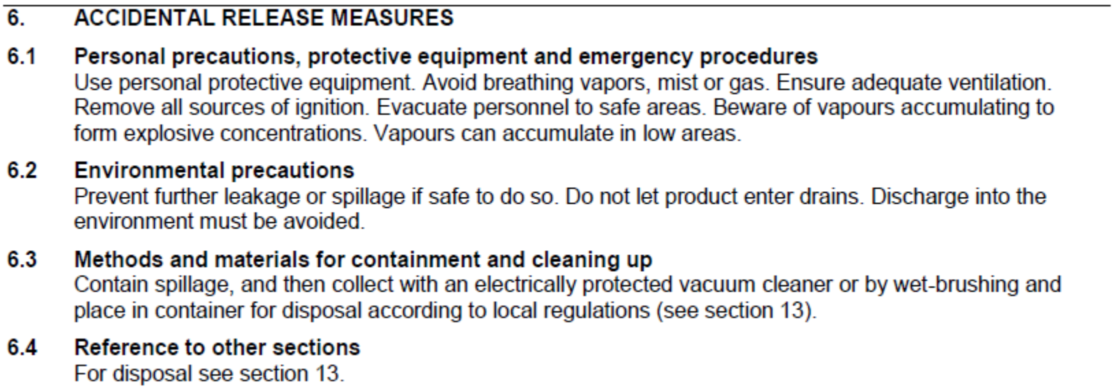
Detailed guidance on storage of hazardous substances is available on the Safety Office web site but briefly:

- Stock quantities of flammables should be held in fire-rated metal cabinets. Those situated beneath fume cupboards that have forced extraction are the best option.
- Acids, alkalis and non-flammable organic liquids should be adequately segregated from each other in suitably resistant cabinets equipped with drip trays. Another good method of minimising the risk of leakage is to leave the primary glass container inside the secondary screw-capped transport container.
- All cabinets should bear suitable signage.
- Bulk solvents should be stored in dedicated storage areas preferably outside the building.
- Toxics, carcinogenics, controlled drugs etc. should be stored in lockable ‘poisons’ cabinets.
- Solids presenting lesser hazards may be stored on open shelving (within easy reach).
- Substances that react violently when mixed should be segregated

Emergency procedures

The risk assessment and SOP must consider response in the event of an accidental release such a spill outside of primary containment. This should be based on a ‘worse case scenario’ where the entire contents of the substance in its supply quantity is spilled in the open laboratory. Where concentrations in the room could approach unsafe levels which are a risk to human health or pose a fire/explosion risk then evacuation of the room or area will be required.

Section 6 of the SDS general advice in relation to dealing with a release.



6. ACCIDENTAL RELEASE MEASURES

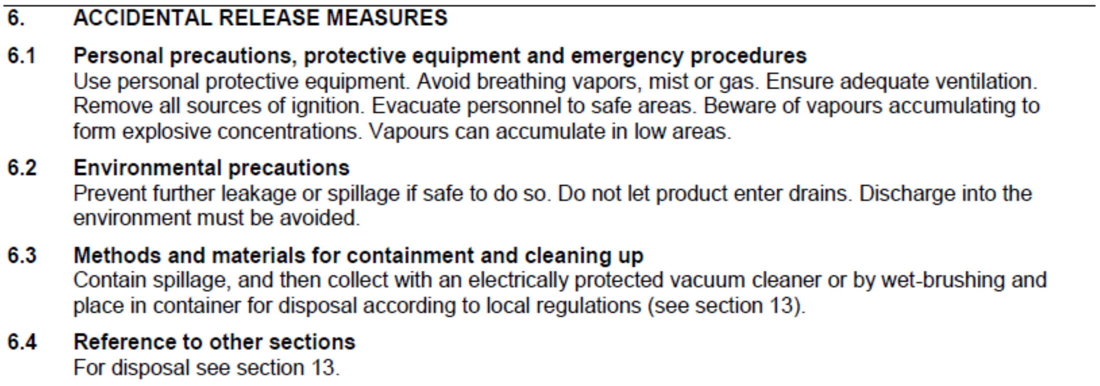
6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

However it is important that workers have access to spill control equipment, and if appropriate RPE and are trained in how to deal with a spill. If in doubt evacuate the area and then assess the situation from a place of safety, take appropriate advice from the School Safety Officer and/or University Safety Office and decide what action to take. The University has agreements in place with two companies who can be called upon to deal with spillages that our beyond our capabilities.



6. ACCIDENTAL RELEASE MEASURES

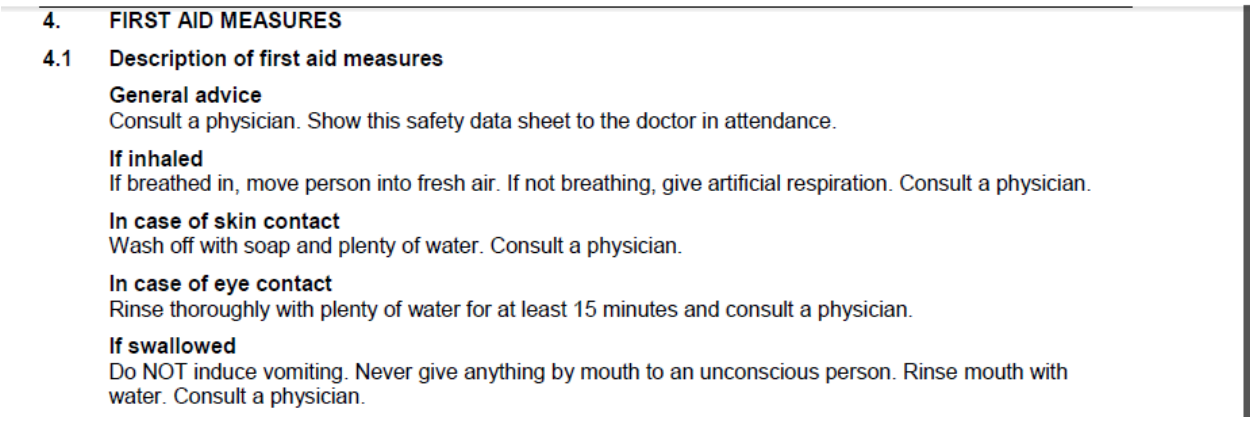
6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

Section 4 of the SDS contains relevant first aid advice. Ensure that there are lists of local University First Aiders available in or near the lab.



4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

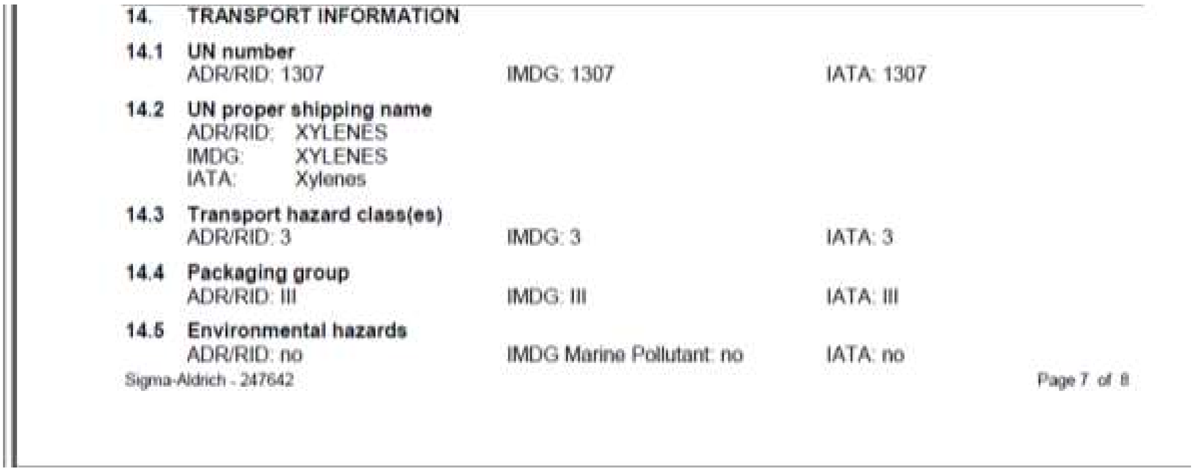
Transport and Movement

Ideally substances should be located close to the areas where they are to be used to avoid the need to move them within the area/building. Where this is not practicable there must be suitable arrangements to avoid risk of spill during movement. This will include

- Use sealed secondary containment – do not carry primary containers by hand through 'public' areas.
- Do not wear disposable gloves in 'public' areas where there is a risk of contaminating door handles, lift buttons etc. with hazardous substances. Remove gloves once samples have been placed in secondary containment and put on a new pair when the destination is reached.
- Use a trolley etc. to move the substances to reduce manual handling.
- Use of proprietary carriers, e.g Winchester carriers.

Transport of hazardous substances off site by road, rail or air are subject to Carriage of Dangerous Goods Regulations. The University has engaged the services of a Dangerous Goods Safety Adviser to advise on this. Contact details available from the School Safety Officer or University Safety Office.

Section 14 of the SDS contains relevant information which will be of use to the DGSA in providing appropriate advice. Additionally certain individuals within Schools have received relevant training and can provide basic advice locally and have arrangements in place with specific couriers who are licensed to transport hazardous substance.



14. TRANSPORT INFORMATION

14.1 UN number
ADR/RID: 1307 IMDG: 1307 IATA: 1307

14.2 UN proper shipping name
ADR/RID: XYLENES
IMDG: XYLENES
IATA: Xylenes

14.3 Transport hazard class(es)
ADR/RID: 3 IMDG: 3 IATA: 3

14.4 Packaging group
ADR/RID: III IMDG: III IATA: III

14.5 Environmental hazards
ADR/RID: no IMDG Marine Pollutant: no IATA: no

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Personal Protective Equipment (PPE)

PPE will normally be necessary in addition to the application of engineering controls and application of good practices. It is important to remember that PPE only protects the user and does not afford protection to anyone else in the vicinity – this is one of the reasons that it is at the bottom the list in the hierarchy of control measures and is often used in conjunction with other control measures.

However it may be appropriate in temporary situations such as dealing with spillages.

PPE should be selected in order that it affords suitable protection against the specific substances that are being used. The individual must also be involved in the selection process to ensure that it affords a suitable level of comfort in the circumstances in which it will be worn.

Examples of PPE used in association with hazardous substances and links to relevant University guidance are given below:

- Laboratory Coats – style & material
- Gloves
    - Selection & Use
    - Comparison table for selection of single use gloves
    - Good gloving practice

- Respiratory protective equipment [RPE] – selection & use.
- Safety eye ware.

Monitoring

Monitoring takes two forms:

- Air sampling (either in the person's breathing zone or in the general workplace)
- Biological (analysis of breath, urine, blood samples etc. for the presence of hazardous substances or their metabolites)

Monitoring is a requirement for some substances used in commercial processes (COSHH Schedule 5) but is not necessary if adequate systems are in place to control exposure. It is unlikely that monitoring would be a routine requirement for most activities. The most likely use of monitoring is to periodically confirm the efficacy of control measures such as LEV.

Health Surveillance

COSHH Regulations require that health surveillance is undertaken where employees are handling substances and engaged in processes listed in Schedule 5 of the regulations (unlikely to be relevant in UoN) or if:

- they are exposed to a substance which could result in disease/adverse health effect, and
- there is reasonable likelihood of the effect occurring under the conditions of work, and
- that there are valid techniques for detecting indications of disease/effect.

The substances most likely to require health surveillance are those that are respiratory or skin sensitisers.

The University Safety Office has issued separate guidance on health surveillance which is undertaken by the Occupational Health Provider.

Step 5 Write the Standard Operating Procedure [SOP]

The ultimate outcome of the risk assessment process is to produce an SOP, which is a step by step set of instructions in how to carry out the procedure which contains all the relevant control measures that the assessment has identified as being appropriate to control risk. A template for a suitable SOP is available (Word Format/PDF Format).

The SOP should then be used as standard document which is issued to workers and against which they are trained and competency assessed.

Step 6 Reviewing the assessment and SOP

All risk assessments should be periodically reviewed, particularly in the event of significant changes to the activity or in the event of an accident or dangerous occurrence. The latter may either involve an incident in your own laboratory or an incident elsewhere which has been brought to your attention and is relevant to your own activity.