University of Reading

Safety Code of Practice 28

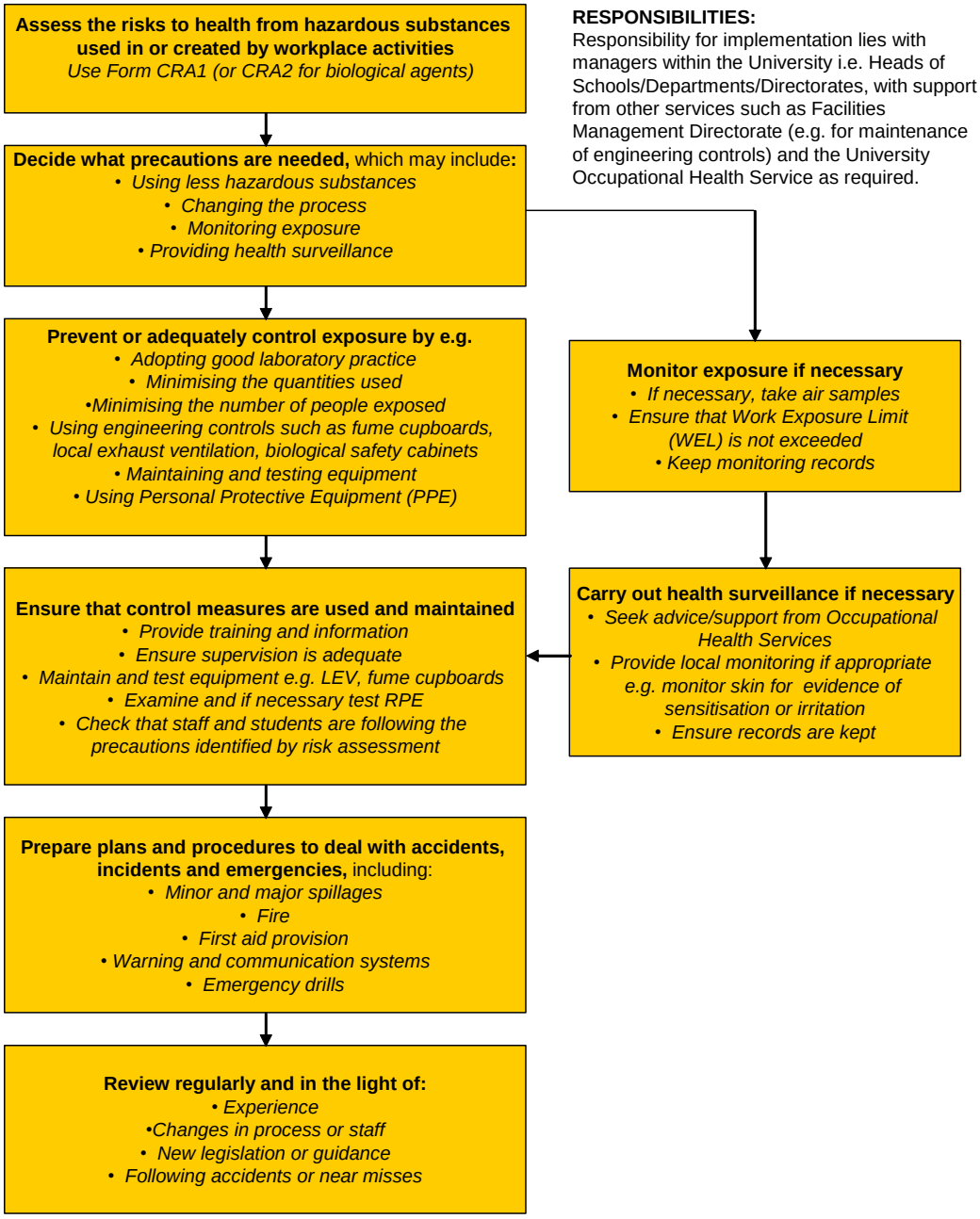
1st Edition, March 2006

THE ASSESSMENT AND CONTROL OF HAZARDOUS SUBSTANCES

Contents

1 SUMMARY

The flow chart below summarises the key requirements and responsibilities to enable the University to comply with the Control of Substances Hazardous to Health Regulations (COSHH).



Guidance on the full requirements of COSHH, and what the University has to do to ensure compliance, is set out in the main text of this Safety Guide. A step-by step guide is provided in Part B to help managers assess the risks from hazardous substances and identify control measures. Forms CRA1 (at Appendix 1 and Forms page of H&SS web site) and CRA2 (for the assessment of biological agents, see Safety Guide 14 and the Forms page of H&SS web site) are provided to enable assessments to be recorded. Other sources of information are listed in the Reference section.

2 SCOPE

This Safety Guide takes into account the requirements of the Control of Substances Hazardous to Health Regulations 2002, as amended. It deals with controlling substances hazardous to the health of staff, students and visitors, from substances such as a single or compound of chemicals, micro-organisms, biological agents, solvents, paints, cleaning agents, dusts, gases, vapours etc. These substances may be used in, or generated as a result of, any work activity under the employer's control (e.g. research, student studies, laboratory work, cleaning, maintenance, printing etc). They may have the potential to cause harm if they are inhaled, ingested or come into contact with or are absorbed through the skin.

2.1 Responsibilities

It is the responsibility of managers to ensure that the measures set out in this Safety Guide are implemented locally. Management oversight of day-to-day implementation lies with Heads of Schools/Departments/Directorates. Individual members of academic staff, support staff, technicians, supervisors, purchasing and stores staff etc have a responsibility to comply with the requirements of this Guide. This includes a need to prevent exposure, or where this is not reasonably practicable, control the exposure to hazardous substances of students and other persons not employed by the University.

3 WHY CONTROL SUBSTANCES HAZARDOUS TO HEALTH?

The failure to control substances hazard to health in the workplace has the potential to cause injury or serious illness to staff, students, contractors and visitors.

Physical contact with substances harmful to health can cause injuries to employees and others, including students. Injuries may be the result of an accident such as splashing, spillage or from prolonged contact with a substance. The majority of injuries involving substances hazardous to health result from exposure to liquids, followed by exposure to gases and then from exposure to dust or solids. Burns are the most common type of injury, with a quarter of injuries from asphyxiation, poisoning or gassing.

Workplace exposure to hazardous substances is a major causal or contributory factor of occupational dermatitis. Dermatitis is described as an inflammation of the skin, and can arise as a result of contact or exposure to certain substances and irritants such as soaps or allergens. An estimated average of 3600 new cases of work-related skin disease were diagnosed each year between 2001 and 2003 by specialist physicians: approximately 80% of these were contact dermatitis.

The inhalation of substances hazardous to health is the foremost cause of occupational respiratory disease and therefore the main focus of the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH). Consequently, the Health and Safety Executive sets maximum limits for airborne concentrations of substances hazardous to health to which employees may be exposed (called Work Exposure Limits, WELs).

Substances that are safe to touch or ingest may have severe consequences if inhaled. For example, talcum powder is a non-toxic substance, harmless to touch or ingest, but when inhaled, above a certain concentration (1mg /m3 over an 8-hour time-weighted average), there is a significant risk of the development of pulmonary fibrosis or damage to lung tissues.

There are also substances, which are not hazardous to health (and therefore not covered by the COSHH Regulations) which may have other hazardous properties. These substances may be covered by other regulations e.g. flammable or explosive substances, which are covered under the Dangerous Substances and Explosive Atmosphere Regulations (DSEAR – see Safety Guide 24). These properties must always be considered when conducting a risk assessment.

4 WHAT ARE THE REQUIREMENTS OF THE COSHH REGULATIONS?

The Control of Substances Hazardous to Health Regulations 2002 (as amended) places duties on the University with the aim of protecting employees, students, visitors, contractors and neighbours from the adverse effects of substances hazardous to health that are used or produced in the workplace. Duties towards employees are absolute i.e. must be fulfilled, whereas duties towards visitors, contractors and neighbours must be implemented 'so far as is reasonably practicable*'.

Guidance:

*'So far as is reasonably practicable'

Interpreted by the courts as allowing economic considerations to be taken into account as one factor with for example, time or trouble to be offset against the risk. It is reasonably practicable to take measures up to a point where the taking of further measures becomes grossly disproportionate to any residual risk. The greater the risk, the more likely that it is reasonable to go to substantial expense trouble and intervention to reduce it. However if the risk is small, it would not be considered reasonable to go to great expense. Ultimately, the judgement is an objective one based on the health risks and not the size or financial position of the employer.

HSE, COSHH ACoP 5th Ed. , L5

The key requirements of the COSHH regulations are:-

4.1.1 Regulation 6 - Assessment of risks to health

An employer must not carry out work that is liable to expose employees to any substances hazardous to health unless they have made a suitable and sufficient assessment of:

- the risks created by the work; and
- the steps needed to meet the regulations.

The risk assessment be recorded, enabling the University to demonstrate that it has:

- Considered all factors pertinent to the work
- Reached an informed and valid judgement about the risks

- Considered the practicability of preventing exposure to hazardous substances
- Considered steps required to achieve and maintain adequate control of exposure

The assessment must be made by someone who is competent to do so, taking account of their knowledge, training and experience in understanding hazard and risk, and of the work activity.

4.1.2 Regulation 7 - Prevention or control of exposure

The University must ensure that the exposure of staff members to substances hazardous to health is either prevented or, where this is not reasonably practicable, the risks must be adequately controlled.

In order to demonstrate adequate control of substances hazardous to health, Schedule 2A of the COSHH Regulations 2002 (as amended) states eight principles of good practice that the University must apply:-

1. Design and operate processes and activities to minimise emission, release and spread of substances hazardous to health.
2. Take into account all relevant routes of exposure (inhalation, skin absorption and ingestion) when developing control measures.
3. Control exposure by measures that are proportionate to the health risk.
4. Choose the most effective and reliable control options which minimise the escape and spread of substances hazardous to health.
5. Where adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures, suitable personal protective equipment (PPE).
6. Check and review regularly all elements of control measures for their continuing effectiveness.
7. Inform and train all employees on the hazards and risks from the substances with which they work and the control measures developed to minimise the risks.
8. Ensure that the introduction of control measures does not increase the overall risk to health and safety.

In addition to the eight principles, the University must also:

- Ensure that Workplace Exposure Limits (WELs) are not exceeded.
- Ensure that exposure to substances which can cause occupational asthma, cancer or damage to genes is reduced to as low as is reasonably practicable.

4.1.3 Regulation 8 - Use of control measures

The University must take reasonable steps to ensure that all the control measures identified are properly used or applied.

Employees must make full and proper use of any control measure(s) identified by the University. If personal protective equipment is identified as a control measure, they must take reasonable steps to keep it in good condition. If he or she discovers any control measure has a fault or is damaged they must report it to their line manager immediately.

4.1.4 Regulation 9 - Maintenance, examination and testing of control measures

The University must ensure that all control measures provided are maintained in an efficient state, good working order, good repair and in the case of PPE, in a clean condition.

All engineering controls must have thorough examinations and tests at regular intervals to ensure that the system is performing as intended by design and is adequate to control exposure. Where local exhaust ventilation is provided, it must be examined at least every 14 months and the air velocity must be sufficient to remove any contaminants.

Non-disposable respiratory protection equipment (RPE) must also be thoroughly examined at regular intervals and where appropriate, tested. The filters must be changed on a regular basis and RPE must fit the employee properly and be worn correctly. To ensure correct fitting the employee must have a face fit test wearing the RPE to be used. A procedure for face fit testing is laid down in Health and Safety Executive Information Document HSE 282/28: 'FIT TESTING OF RESPIRATORY PROTECTIVE EQUIPMENT FACE PIECES' which is available on the Health and Safety Services website A-Z under - 'P' - PPE.

A suitable record of the results of examinations, tests or any repairs carried out must be kept for a least 5 years from the date of examination.

4.1.5 Regulation 10 - Monitoring exposure in the workplace

Monitoring of the concentrations of hazardous substances in the air must be carried out in certain circumstances e.g. where there could be a serious risk to health if control measures failed or deteriorated, or where employees are exposed to substances specific in Schedule 5 of the COSHH Regulations.

Where suitable methods exist, monitoring will be necessary for any of the following circumstances:

- When failure or deterioration of the control measures could result in a serious health effect because of the toxicity of the substance and/or the extent of potential exposure;
- When a measurement is required to establish that a WEL is not exceeded;
- As an additional check to on the effectiveness of any control measure provided; or
- When any change occurs in the conditions affecting employees' exposure which could mean that existing controls may no longer be effective (e.g. an increase in the amount of substance used or a change in system or equipment).

Employees must be made aware of any monitoring results and records of the results must be kept for a minimum of 5 years. Where it has been shown by monitoring that there is a significant health risk (e.g. exposure to a substance known to cause occupational asthma or severe dermatitis) or the likelihood of an exposure exceeding a WEL, then health surveillance must be carried out.

4.1.6 Regulation 11 - Health surveillance

When the health risks are significant, (e.g. a failure of control measures would expose persons to a substance level that may cause them or others harm) there will be a need for health surveillance. Health surveillance must be appropriate to the risks of the work and at periodic intervals as prescribed by the occupational health service.

Health surveillance is a requirement when the substance or process is listed in Schedule 6 of the COSHH Regulations. In addition, surveillance must be conducted where an exposure to a substance produces an identifiable adverse health effect, there is a reasonable likelihood that the disease or effect may occur under the conditions of work, and there are methods of detecting exposure through health surveillance.

Health surveillance is conducted by the University Occupational Health Service provider - contact information is available on the Health and Safety Services website A-Z under – 'O' – Occupational Health.

4.1.7 Regulation 12 - Information, instruction and training

COSHH requires that the University provide employees with suitable information, instruction and training about:

- the nature of the substances they work with or are exposed to and the risks created by exposure to those substances;
- the precautions they should take;
- control measures and how to use them;
- the correct use of any personal protective equipment and clothing;
- results of any exposure monitoring or health surveillance; and
- emergency procedures.

4.1.8 Regulation 13 - Arrangements to deal with accidents, incidents and emergencies

The University must ensure that there are documented procedures for dealing with accidents, incidents and emergencies including:

- spill procedures
- first-aid facilities
- relevant safety drills (which must be tested regularly);
- information on emergency arrangements; and
- suitable warning and communication systems.

Relevant information must be made available to the emergency services and persons at risk must be fully conversant with the arrangements.

In many cases, the local fire alarm and evacuation procedures fulfil this regulation, but where a risk assessment identifies an additional and local need (for example, where cyanides or hydrofluoric acid are used), departments must ensure that there are specific local arrangements.

5 WHAT IS A SUBSTANCE HAZARDOUS TO HEALTH UNDER THE COSHH REGULATIONS?

Substances hazardous to health can take many forms including liquids, aerosols, dusts, gases, fumes, vapours and biological agents. Regulation 2(1) of COSHH 2002 defines a substance hazardous to health as:

.... any substance (including preparations) -

(a) which is listed in Part 1 of the Approved Supply List as dangerous within the meaning of the Chemicals (Hazard, Information and Packaging for Supply) Regulations and for which an indication of danger specified for the substance is very toxic, toxic, harmful, corrosive or irritant; [see Annex 4]

(b) for which the Health and Safety Commission has approved a Workplace Exposure Limit [these can be found in HSE publication EH40];

(c) which is a biological agent;

(d) which is dust of any kind except dust which is a substance within paragraph (a) or (b) above, when present in a concentration in air equal to or greater than -

(i) 10mg/m^3, as a time-weighted average over an 8-hour period, of total inhalable[1] dust or;

(ii) 4mg/m^3, as a time-weighted average over an 8-hour period, of respirable[2] dust;

(e) which, not being a substance falling within sub-paragraphs (a) to (d), because of its chemical and toxicological properties and the way it is used or is present in the workplace creates a risk to health (e.g. simple asphyxiants).

In simple terms, COSHH applies to a wide range of substances and mixtures of substances which have the potential to cause harm if they are inhaled, ingested or come into contact with or are absorbed through the skin. These may include paints, cleaning materials, metals, pesticides, insecticides, chemicals, and the products of chemical reactions. They can also be biological agents such as pathogens or cell cultures. Substances hazardous to health can occur in many forms e.g. solids, liquids, vapours, gases, dusts, fibres, fumes, mist and smoke.

6 WHAT IS NOT A SUBSTANCE HAZARDOUS TO HEALTH UNDER THE COSHH REGULATIONS?

COSHH does not apply to the following substances, most of which are covered by other regulations:

- Asbestos (Control of Asbestos at Work Regulations 2002)
- Lead (Control of Lead at Work Regulations 2002)
- Substances which are hazardous purely because they are:
    - radioactive (The Ionising Radiations Regulations 1999);
    - at high pressure;
    - at extreme temperatures; or
    - have explosive or flammable properties (Dangerous Substances and Explosive Atmospheres Regulations 2002 apply);
- Biological agents if they are *not* directly connected with the work and they are outside the employer's control, such as catching a cold from a work colleague.

For the vast majority of commercial chemicals, the presence (or not) of a warning label will indicate whether COSHH is relevant. For example, there is no warning label on ordinary household washing-up liquid, so if it is used at work you do not have to worry about COSHH; but there is a warning label on bleach, and so COSHH does apply to its use in the workplace.

[1] Inhalable = any airborne material capable of entering the nose and mouth during breathing (BS EN 481:1993)
[2] Respirable = any airborne material capable of penetrating to the gas exchange region of the lung (BS EN 481:1993)

7 IS A GENERIC OR SPECIFIC RISK ASSESSMENT APPROPRIATE?

With the large number of chemicals used in the University, it is impractical to expect that every process involving hazardous substances require a specific assessment.

To overcome this problem, Schools and departments have to decide whether a generic (universal) risk assessment and standard precautions are sufficient to identify and control the risks, or if a specific risk assessment identifying explicit controls is required.

This decision should be based on:

- the level of risk to health posed by the substance;
- the nature of the substance;
- the quantity of the substance to be used;
- the likelihood of the workplace exposure limit being exceeded;
- the nature of the activity; and
- the length of exposure to the substance.

Manufacturers Safety Instructions or University Good Laboratory Practice Guides can be considered as generic risk assessments if in the event of control measures failing, the exposure is unlikely to be at a level to cause harm. If following the requirements of the relevant guidance will adequately control the risks, then a specific risk assessment does not need to be carried out.

Work in the open with dusty toxic substances always requires a specific COSHH risk assessment, as does work involving exposure to substantial quantities of relatively non-toxic "nuisance" dusts (e.g. soil dust, house dust).

A specific risk assessment must always be carried out if a substance is carcinogenic, teratogenic, mutagenic, has the potential to cause occupational asthma or is a skin sensitizer.

8 WHAT IS REQUIRED FOR A SPECIFIC COSHH RISK ASSESSMENT?

Risk assessment forms the basis of COSHH implementation. Key features of a risk assessment are:

1. Assessing the risks to health;
2. Considering the practicability of preventing exposure to hazardous substances;
3. Identifying steps which need to be taken in order to achieve adequate control of exposure where prevention is not readily practicable, in accordance with regulation 7; and
4. Identifying any other necessary action to comply with the regulations 8 -12.

A suitable and sufficient risk assessment will therefore ensure that there is compliance with the requirements of regulations 7 to 12 when identifying and assessing potential risks.

HSE guidance recommends two approaches to risk assessment; activity or substance based. In order to assess the potential risks posed by hazardous substances when they are being used, the guidance recommends an activity based risk assessment rather than a substance based risk assessment. The activity-based assessment is preferred because if the same hazardous

substance is used in separate processes it may pose a different hazard. More information on this is given in Part B.

A substance-based approach would only look at hazards of the stand-alone substance and not allow for all the activities a substance is used in or for process-produced hazards such as welding fume or dust. However in some circumstances, such as receipt and storage (but not use) of pre-packaged chemicals, a substance-based approach may be sufficient.

8.1 A Step by Step guide to COSHH assessment

In order that a methodical, recognised, legally compliant method of assessment is carried out, the University's risk assessment process is based on the HSE's guidance, "A step-by-step guide to COSHH assessment" (HSE 2004). This recommends a step by step procedure for carrying out an assessment. A summary of each of the basic steps is given below.

Part B of this Safety Guide breaks the process down into more detailed stages, which will assist you in completing the University's Hazardous Substances Risk Assessment Form (CRA1).

NB Form CRA2 should be used for the assessment of biological agents, see Safety Guide 14.

Other forms of assessment may be adopted by Schools/Departments (such as an on-line database system), provided that such systems meet the requirements of the COSHH Regulations and the principles of this Safety Guide. Use of any such system must be agreed in advance with Health and Safety Services.

Gather information about the substances, the work and the working practices:

a) Decide who will carry out the assessment.
b) Which substances are present or are likely to be.
c) Identify hazards the substances have.
d) Find out who will be exposed and how.

Evaluate the risks to health. Find out:

e) The chance of exposure occurring?
f) How often is exposure likely to occur?
g) What level of exposure could happen and for how long?

Then:

- Decide whether nor not the exposure poses a significant risk
- Assess the level of risk when current control measures are used.

Decide what needs to be done in terms of:

h) Preventing or controlling exposure
i) Maintaining controls
j) Using controls
k) Planning for emergencies
l) Monitoring exposure
m) Health surveillance
n) Information instruction and training

Record the assessment

The results should be recorded in sufficient detail to demonstrate that the assessment is suitable and sufficient, taking into account the risks presented by the work. Actions identified to protect the health of employees and others should then be implemented.

Review the assessment

The assessment should be reviewed when:

- there is evidence to suggest that it is no longer valid e.g. from the results of engineering tests, exposure monitoring or health surveillance
- when there has been a significant change in circumstances e.g. use of a different hazardous substance, change in process or ventilation.

It is essential that the results of COSHH assessments are made available to those working with, or who may come into contact with, the hazardous substance e.g. undergraduate and post graduate students, staff, technicians, cleaners. They must know and understand what they need to do to store, handle, use and dispose of these substances and the arrangements that must be followed in the event of an emergency (i.e. a spillage or release).

9 SOURCES OF HAZARD INFORMATION FOR HAZARDOUS SUBSTANCES

Information about hazardous substances can be gained from a wide variety of sources. The key sources of information about the hazardous nature of commercially produced/purchased products used in the workplace are:

9.1 Safety Data Sheets

Under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3) suppliers of substances (chemical elements such as mercury or compounds such as sulphuric acid); and preparations (mixtures or solutions of substances, such as paints or inks) must provide information on the hazards relating to their products.

The object of CHIP3 is to help protect people and the environment from the adverse effects of chemicals. CHIP3 works on the basis that the more information a person has about a chemical the less likely it is to harm them. The regulations require suppliers of hazardous substances to:

- Identify the hazards (dangers) of the chemical. This is known as 'classification';
- Give information about the hazards to their customers ;
- Package the chemical safely.

Suppliers usually provide this information on the package itself (e.g. a label) and, if supplied for use at work, in a SDS. Where Purchasing and Stores staff are involved with the purchase and receipt of hazardous substances, they may be required to ensure that the users of the hazardous substances receive essential safety information that is supplied with the product e.g. Safety Data Sheets.

CHIP3 applies to most chemicals but not all. Some chemicals, such as cosmetics and medicines, are outside the scope and have their own specific laws. Biocides and plant protection products have had to be classified and labelled according to CHIP since July 2004. Flammable, explosive and oxidising materials are also covered by the Dangerous Substances and Explosive Atmospheres Regulations 2002 (see University Safety Guide 24).

The key information for a substance written in the SDS will include:

a) Identification of the substance or preparation and the company/ undertaking.
b) Composition/information on ingredients.
c) Hazards identification.
d) First-aid measures.
e) Fire-fighting measures.
f) Accidental release measures.
g) Handling and storage.
h) Exposure controls and personal protection.
i) Physical and chemical properties.
j) Stability and reactivity.
k) Toxicological information.
l) Ecological information.
m) Disposal considerations.
n) Transport information.
o) Regulatory information.
p) Other information.

Although an SDS identifies potential health hazards and is the ideal starting point to identify any potential health hazards posed by a product, it is not a COSHH risk assessment. It does not take into account how a product is being used and merely gives guidance as to precautions that may be required in handling that substance.

9.2 Labels

A substance/preparation label will provide basic information including warnings, safety advice and hazard symbols – black symbols on orange signs with an indication of the symbols' meaning (see Annex 4). Note that substances may have hazards not covered by COSHH (such as flammability) that should be included in the risk assessment.

9.3 Risk phrases

After a manufacturer has classified a chemical according to its hazard, the appropriate risk phrase is allocated and provided on the container label and SDS. A risk phrase is a standard phrase, which gives simple information about the hazards of a chemical in normal use. Each risk phrase has a

unique risk code. There may be more than one phrase or a combination of phrases to describe the risks associated with the product.

e.g. *R26 - Very toxic by inhalation*

R35 - Causes severe burns

R48/23 - Toxic: danger of serious damage to health by prolonged exposure through inhalation

A list of risk phrases (or R-phrases) and the corresponding number codes are is available in Annex 2.

9.4 Workplace Exposure Limits

For a number of commonly used hazardous substances the Health and Safety Commission has assigned and published workplace exposure limits (WEL). A WEL describes the concentration limits of airborne hazardous substances, averaged over a specific period of time, referred to as a *time-weighted average* (TWA).

A TWA can be short-term, averaged over 15 minutes or long term, over 8 hours. Short-term exposure limits (STEL) are set to prevent effects such as eye irritation, which may occur following exposure for a few minutes. Long-term exposure limits (LTEL) are intended to control prolonged or accumulative effects, restricting the total intake by inhalation, over one or more work shifts.

A WEL is a maximum threshold and must not be exceeded. In addition, substances that,

- carry the risk phrase R45, R46 or R49;
- that are listed in Schedule 1 of the COSHH regulations;
- carry the risk phrase R42 or R42/43;
- are listed in section C of HSE publication "Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma"; or
- have been identified by risk assessment to be a potential cause of carcinogenic, teratogenic or mutagenic effects or occupational asthma,

must the have concentrations kept as low as is reasonably practicable below the maximum exposure limit.

A list of current WEL can be found in the HSE Publication - *EH40/2005 Workplace Exposure Limits*.

9.5 European Chemical Substances Information System

All classifications of chemicals are set a European level and have been harmonized across the European Union. A searchable database of all substances classified in Europe is available on line and can be used to identify the hazards associated with each.

It can be searched by:

- CAS Number
- Substance Name
- Molecular formula
- EC Number

The web address is: http://ecb.jrc.it/ESIS/

9.6 Other Sources of Information

Where substances are combined (e.g. synthetic chemistry or lab work) also consider any intermediates or by-products that may be created – it is probable that there will be no Safety Data Sheet (SDS) available for these or the end product. A combination of non-hazardous substances may produce a hazardous result. This information may be included in the SDS or manufacturers' instructions for the original substances, but it is unlikely. It may be necessary to consult other sources of information (see below) in order to establish the hazards. A table of common incompatible chemicals and the by-products they produce is listed in Annex 5. Also, consider any by-products that may be produced due to physical interaction (e.g. heating, pressure), such as fume or aerosol.

Other sources of information on hazardous substances include:	
• Health & Safety Executive • Health & Safety Services • World Health Organisation • Unions • Text books	• Internet • Project supervisors • Do not forget to consult those carrying out the work – they are often the experts!

10 HOW CAN HAZARDOUS SUBSTANCES CAUSE HARM?

10.1 Routes of Exposure

Major routes of exposure are through the lungs (inhalation), gastrointestinal tract (ingestion) or the skin (topical). In general, inhalation is likely to cause more damage than ingestion, which, in turn, is more harmful than skin exposure.

Inhalation

Gases, vapours, aerosols and fumes are readily inhaled. They can cause harm (including asphyxiation) anywhere in the respiratory system and may also be absorbed into the bloodstream. The inhalation of dusts and particulates depends upon their size and shape - the smaller the particle, the further into the respiratory tract it can go.

- Large particles are filtered out in the nose.
- Smaller particles, or those breathed in by mouth, settle on the walls of the upper respiratory tract or throat and are coughed up and either ejected or swallowed. If swallowed, they may enter the gut and cause damage in the same way as if they had been ingested.
- The smallest particles of dust and fibres can be inhaled down into the lungs where they can cause local damage, sometimes by interaction with the cells in the lungs that normally remove bacteria. These particles may also be absorbed into the bloodstream.

Ingestion

Airborne particles that are eventually swallowed are the most likely source of ingested chemical. Otherwise, ingestion of potentially toxic substances is likely to be accidental on contaminated

food, drink or make-up. Once absorbed through the stomach or intestine, the route to excretion may be complex and damaging, especially to the kidneys.

Skin Absorption

This is the least likely route of exposure because the natural thickness of the skin plus its natural coating of grease and sweat provides some protection against chemicals. However, some materials are capable of penetrating intact, healthy skin e.g. aniline, hydrogen cyanide, some steroid hormones, organic mercury compounds, nitrobenzene, organophosphate compounds and phenol. Phenol itself can be lethal if absorbed for a sufficient time through a few square centimetres of skin and inappropriate protective clothing e.g. incorrect gloves may cause absorption rate to increase. Harmful substances that can be absorbed through the skin and lead to systemic toxicity are identified in EH40/2005 by the annotation Sk. The natural protection of the skin may also be bypassed through cuts, abrasion or puncture wounds e.g. needle-stick injury.

10.2 Adverse Effects

Adverse effects may be:-

Local or systemic*.

- Local Effects occur at the site of exposure e.g. corrosives and often irritants.
- Systemic Effects occur at a target organ or at site remote from the point of contact following absorption and distribution around the body.

*Some substances produce both effects e.g. lead tetraethyl damages the skin on contact and is then absorbed and transported to the central nervous system where it may cause further damage.

Acute or chronic

- Acute Effects are immediate such as the effect of inhaling chlorine.
- Chronic Effects are much slower, often cumulative following repeated exposures. Chronic effects can be the most difficult to avoid because damage may not become evident for many years after exposure.

Reversible or irreversible

- Reversible Effects: damage that can be repaired by the body's natural processes.
- Irreversible Effects: damage that cannot be repaired e.g., dead nerve cells cannot be replaced.

There may be psychological effects as well as the purely physical.

10.3 Response of the Body

The body may respond in different ways, depending on the type and circumstances of exposure.

Irritation

Respiratory: Certain types of chemicals can irritate the nose and upper respiratory tract causing sneezing, coughing and, in some cases, bronchitis. They may also damage lung tissue.

Skin and Eyes: Chemicals in contact with skin can cause dermatitis (Inflammation of the skin). In acute form, it produces itching and blisters. In chronic form, it causes thickening, scaling and darkening of the skin. Solvents can de-grease the skin causing it to become red and sore.

Corrosive material such as strong acids and bases can be irritants in dilute form but may cause severe burns when concentrated. Eyes are particularly vulnerable and damage can be permanent.

Sensitisation

Respiratory: Some chemicals can cause sensitisation leading to asthma. Once sensitised, even minimal exposure can cause a severe allergic response.

Skin: Sensitisation can occur through contact with a chemical and the skin. Once sensitised, minimal contact on a subsequent occasion can cause allergic response causing severe itching or discomfort and may result in chronic dermatitis.

Long-term Effects

Carcinogens cause the most serious of long-term effects i.e. cancer, a disorder of cell growth. Here the effect of exposure may not be evident for many years. Mutagens are any substance that causes or promotes genetic mutation. Teratogenic materials are any substance, agent, or process that induces the formation of developmental abnormalities in a foetus. These substances carry the risk phrases R45, R46, R49 or R61.

N.B. Pregnancy (or the possibility thereof) must be considered when assessing the risk to women of childbearing age where exposure to teratogens is a possibility.

Reproductive Disorders

Possible effects are loss of fertility in men and women, heritable genetic damage or harm to the unborn child.

11 PROHIBITED SUBSTANCES

Under Regulation 4, the manufacture and use for any purposes or the importation into the UK of the following substances and articles is prohibited:

2-naphthylamine, benzidine, 4-aminobiphenyl, 4-nitrobiphenyl, their salts and any substance containing any of those compounds at a concentration exceeding 0.1 per cent (NB the use of benzene is also generally prohibited **except** for research and development purposes).

A complete list of prohibited substances is available in Schedule 2 of the COSHH 2002 Regulations (as amended).

References

1. HMSO: *The Control of Substances Hazardous to Health Regulations 2002* SI 2002/2677, ISBN 0-11-042919-2

2. HMSO: *The Control of Substances Hazardous to Health (Amendment) Regulations 2004* S.I. 2004/3386, ISBN 0-11-051407-6

3. HSE: *Control of Substances Hazardous to Health (5th Edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended) Approved Code of Practice and Guidelines - L5.* (2005) ISBN 0-7176-2981-3

4. HSE: *A step-by-step guide to COSHH assessment - HSG97.* (2004) ISBN 0-7176-2785-3

5. HSE: *EH40/2005 Workplace exposure limits.* (2005) ISBN 0-7176-2977-5

6. HSE: *CHIP for everyone. CHIP3 – HSG228.* (2002) ISBN 0-7176-2370-X5.

European Chemicals Bureau: *ESIS (European chemical Substances Information System)* - http://ecb.jrc.it/ESIS/

12 PART B : A STEP-BY-STEP GUIDE TO THE HAZARDOUS SUBSTANCES RISK ASSESSMENT PROCESS

12.1 THE HAZARDOUS SUBSTANCE RISK ASSESSMENT PROCESS:

University COSHH risk assessments should be recorded using the standard CRA1 COSHH Risk Assessment Form (Annex 1).

NB Other forms of assessment may be adopted by Schools/Departments (such as an on-line database system), provided that such systems meet the requirements of the COSHH Regulations and the principles of this Safety Guide. Use of any such system must be agreed in advance with Health and Safety Services.

12.2 STEP 1: Describe the activity/ project to be assessed

Describe the activity and the process in which the hazardous substance is to be used. In order to assess the potential risks posed by hazardous substances whilst being used, an activity based risk assessment rather than a substance based risk assessment is necessary. The activity-based assessment is preferred because if the same hazardous substance is used in separate processes it may pose different hazards due to;

a) The quantities of a substance used in a process.
b) The concentration of a substance used.
c) Size of the area a substance is used in.
d) Intrinsic process controls in place.
e) Processes may use more than one substance therefore creating a secondary hazard from the combination of two or more substances.
f) Number of people involved either directly or indirectly.

A substance-based approach only looks at hazards of the substance and does not allow for all the activities a substance is used in or for process-produced hazards such as welding fume or dust.

An activity/process can be made up of one or a series of tasks. For example:

- mixing several substances together;
- heating the product of the mixture; and
- applying the end product to a surface.

Describe the whole process by giving a description of each task, how often it is done, and the length of time it takes.

12.3 STEP 2: Identify the substances to be used, and the hazards associated with them

Identify and describe which substances will be used (e.g. chemical, product) or produced (e.g. welding fume, wood dust) during the activity/process. Next describe the hazards associated with them using the sources described in Section 7 of the University COSHH guidance (e.g. physical properties [see Annex 4], Workplace Exposure Limits, Safety Data Sheets, R-Phrases, etc.). Do not forget other hazardous properties not covered by COSHH.

12.4 STEP 3: If two or more chemicals are used, consider whether secondary hazardous substances will be produced

Where more than one chemical is used, consider any by-products that may be created when chemicals are mixed. This information may be included in the Safety Data Sheet (SDS) or manufacturers' instructions. A table of common incompatible chemicals and the by-products produced is listed in Annex 5. Also, consider any by-products that may be produced due to physical interaction (e.g. heating, pressure), such as fume or aerosol.

12.5 STEP 4: Decide who might be exposed, for how long and to how much

In addition to staff and students actually involved with the activity, you should also consider risks to cleaners, contractors, maintenance workers and agency workers who may not be in the workplace all of the time and therefore are unfamiliar with the risks. Do not forget visitors (including children) or other organisations you share your workplace with; there is a chance they could be harmed by your activities. Specific risk assessments should be conducted for workers with higher risk factors such as young workers (under 18), trainees, new and expectant mothers or people with reduced mobility or disabilities. As a control measure for higher risk areas (e.g. a lab with an experiment running, or an area where spray painting is being carried out), it may be necessary to identify authorised staff that are allowed access and exclude other unauthorised persons.

Estimate the likely level/concentration of the hazardous substance(s) and the length of time persons may be exposed to it.

12.6 STEP 5: Consider how people might be harmed from these hazards

Consider and describe what kind of injury or ill–health people might suffer if exposed to the hazards and how severe the outcome is likely to be. Identifying the route of exposure and the likely effects that might be caused will provide the information on which to base the level of the control measures required.

12.7 STEP 6: List the controls currently in place to reduce the identified risks

Under COSHH, adequate control means reducing exposure to a level that most workers could be exposed to, day after day at work, without adverse effects on their health. In other words what steps do you currently take to protect the health and safety of the groups of people identified, from the hazards under consideration?

Consider whether the recommended risk controls in the manufacturers safety instructions or relevant University Good Lab Practice Guide are in place and reduce the risks to an acceptable level. If they do, note this on the risk assessment form and list any extra risk controls that may be in place in place. Compare them with legal requirements, relevant standards and the hierarchy of control measures* (see below) to ensure that the risk has been reduced to as low as is reasonably practicable.

*Hierarchy of Risk Controls

- Change the process or activity *so that the hazardous substance isn't needed or generated;*
- Replace it *with a safer alternative;*
- Use it in a safer form, *e.g. pellets instead of powder, lower concentration.*

If prevention is not reasonably practicable, you must adequately control exposure. You can use one or more of these measures:

- Totally enclose *the process;*
- Partially enclose it *and use extraction equipment ('local exhaust ventilation') e.g. work in a fume cupboard*
- Provide general room ventilation*;*
- Use systems of work and handling procedures *which minimise the chances of hazardous materials spilling, leaking or otherwise escaping; It may be necessary to clarify the safe systems of work you introduce by issuing them*
- Plan for emergencies*; identify procedures to follow in the event of a spillage, accident or fire*
- Reduce the number of persons exposed, *or the duration exposure after considering, and where possible using, the above measures*
- Information Training and Supervision; *ensure relevant staff receive adequate training in any new procedure/systems of works and are aware of the risks.*

If you cannot adequately control exposure by any of the above measures, you should provide

- Personal Protective Equipment (PPE)* *as a means of control e.g. RPE, protective clothing like overalls, gloves, eye protection & safety footwear*

PPE is a last resort only

**N.B. the Regulations only permit the use of PPE to achieve adequate control if other means of control cannot be used alone.*

A product Safety Data Sheet will list SAFETY PHRASES (See Annex 3) relating to a product/substance. A safety phrase (S-Phrase) is a standard phrase that gives advice on safety precautions that are appropriate for using an identified substance.

It is important to monitor whether all the control measures identified are actually used in practice. Also, think about what is done to check that these controls are in good working order, what preventive maintenance or servicing is carried out, and if there are any visual checks and inspections.

12.8 STEP 7: Assessing the level of remaining (or residual) risk

Consider what the remaining level of risk actually is, given the existing safety measures and risk controls in place. This is where knowing how your current arrangements compare with best practice and legislative requirements is important - how else do you know whether you are doing all you should be doing to reduce health and safety risks.

Risk assessments are more objective if the approach taken to evaluating the risk considers the factors that contribute to increased risk in a consistent way, these factors are:

i. The **severity** of the harm that exposure to the hazard could cause (S)
ii. The **probability** of exposure to the hazard (P)

To help evaluate the level of risk you can do a very simple calculation to produce a risk score that corresponds to a risk level of *low, medium* or *high*. Simply decide the level of severity (S) (Table 2.) and a level of probability (P) (Table 3.) for the hazard in question and multiply the scores together as described below. On the risk assessment form, space is provided to record these scores (and the scores are given in brackets for each category selected).

Severity X Probability = Risk Score

If a substance has a risk phrase, a severity score has been allocated in Annex 2

Category	Example	Score
MINOR	Superficial injuries - mild skin irritation, nausea – requiring first aid only. Minor property damage.	1
SERIOUS	More serious ill-health/injuries requiring time off work, study, or a hospital visit, e.g. minor burns, nausea and vomiting, diarrhoea. More serious property damage.	2
MAJOR	Acute illness/injury requiring medical treatment. loss of consciousness or loss of sight. Major property damage.	3
FATAL	Exposure which leads to death either at the time or soon after the incident, or eventually, as in the case of certain occupational diseases, such as cancers. Chronic illness. Mutagenic, teratogenic and carcinogenic effects.	4

Table 1 Risk Severity (S)

Category	**Example** ***(for guidance only - some or all may apply for each category)***	**Score**
VERY UNLIKELY	Good control measures are in place. Controls do not rely on a person using them (i.e. personal compliance). Controls are very unlikely to break down. People are very rarely in this area or very rarely engage in this activity.	1
UNLIKELY	Reasonable control measures are in place but they do rely on a person using them (some room for human error). Controls are unlikely to breakdown. People are not often in this area / do not often engage in this activity / this situation is unlikely	2
POSSIBLE	Inadequate controls are in place, or likely to breakdown if not maintained. Controls rely on personal compliance. People are sometimes in this area or sometimes engage in this activity / this situation sometimes arises	3

LIKELY	Poor or no controls are in place. Heavy reliance on personal compliance (lots of room for human error). People are often in this area / engage in this activity on a regular basis / this situation often arises.	4

Table 2 Risk Probability (P) - the likelihood of the hazard causing harm

The scores can be represented in a matrix, shown as in Table 3 below. Risk scores correspond to a risk level – high, medium, low etc.

RISK SCORE = S X P		SEVERITY OF OUTCOME (S)			
		Minor	Serious	Major	Fatal
PROBABILITY (P)	Very Unlikely	1	2	3	4
	Unlikely	2	4	6	8
	Possible	3	6	9	12
	Likely	4	8	12	16

Risk Level

High

Table 3 Risk Score Matrix

What about the number of people at risk?

Another risk factor that should be considered when evaluating the level of risk is the actual number of people at risk at any one time (sometimes known as *the extent of risk*). In general, for risks at a similar level, a higher priority should be given to actions that reduce risks affecting a greater number of people.

Why use a quantitative (numerical) system of categorising risks?

Expressing risk levels as scores can very useful when making decisions about prioritising action and allocating resources. Scores derived using a common method will enable comparisons to be made between one activity or part of the organisation, and another.

12.9 STEP 8: Deciding what further action is required - now and in the future

You may discover that the existing control measures do not adequately control or sufficiently reduce the risks. This may be either because controls do not meet the required standard, are not working properly, are not being used, or are deteriorating due to lack of maintenance and checking. In this case, you must establish what further action is required to reduce risks so far as is reasonably practicable and by when this should be achieved. If action can be taken immediately to improve health and safety standards, then this should be carried out without delay, and recorded on the risk assessment form.

When considering what further control measures you should adopt to reduce or manage health and safety risks, you should follow the *Hierarchy of Risk Controls* (see Step 6). Priority should be given to collective protective measures, over individual protective measures. Controls such as personal protection should only be a last resort, if there is no other way of reducing risk at source. In practice, a combination of these risk controls is often required.

Action plans – implementing risk controls

It is strongly recommended that you draw up a health and safety action plan to ensure that improvements needed are prioritised according to the level of risk identified. Remember to include realistic time scales in your action plan and identify who will be responsible for checking that the objectives of the plan have been met. It is up to you to decide on appropriate time scales for action, but some typical timescales, according to risk are given as a guide in Table 5.

SCORE	RISK LEVEL	TYPICAL TIME SCALES FOR ACTION REQUIRED
1	Insignificant	No further action needed
2 – 3	Low	Action within 12 months if improvements are reasonably practicable
4 – 6	Medium	Action within 6 months based on reasonable practicability
8 – 9	High	Action within 1 month to reduce risk (immediate action may be needed in some circumstances)
12 – 16	Very high	Immediate action required – work should stop / not commence until risk has been reduced to acceptable levels

Table 4 Scores and Typical Action Plan Time Scales

12.10 STEP 9: Decide if health surveillance and/or exposure monitoring is required

Health Surveillance

In most circumstances, health surveillance is usually not necessary. However, there are special circumstances where the Occupational Health Service should be given details of individual users of

hazardous substances, so that appropriate health checks can be made and/or health records kept. Examples of work with substances that require health surveillance are:

- Asbestos (not covered by COSHH);
- Epoxy resins;
- Genetic modification (class 2 or higher);
- Isocyanates;
- Laboratory animals;
- Lead (as dust or vapour) (not covered by COSHH);
- Mercury or mercury compounds (where exposure to vapour or dust is possible);
- Organophosphorus compounds;
- Styrene;
- Carcinogens mutagens or teratogens;
- Respiratory Sensitizers (identified on the container or in suppliers' literature as "may cause respiratory sensitisation" or annotated as Sen in EH40/2005); and
- Pathogens or biological agents in Hazard Category 2 or above (Legal requirement for Category 3 & above).

Where staff or students work with such substances, the Occupational Health Service should be approached for advice on health surveillance.

In addition to the requirement to notify work in these categories to Occupational Health Services, anyone who is concerned about a possible effect on their health due to the use of hazardous substances is welcome to contact the Occupational Health Service for advice.

Occupational Health Service is responsible for maintaining records of health surveillance for at least 40 years after exposure ceases.

Monitoring

Monitoring is necessary if any of the following circumstances apply:

- When failure or deterioration of the control measures could result a serious health effect because of the toxicity of the substance and/or the extent of potential exposure;
- When a measurement is required to establish that a WEL is not exceeded;
- As an additional check to on the effectiveness of any control measure provided; or
- When any change occurs in the conditions affecting employees' exposure which could mean that existing controls may no longer be effective (e.g. an increase in the amount of substance used or a change in system or equipment).

List the type of monitoring required and refer to the location of any results.

12.11 STEP 10: Identify actions in the case of an emergency

List the first aid actions for contact/exposure to the chemicals being used. In addition, list procedures for dealing with a spill and any special fire precautions required (e.g. special fire extinguishers).

Written procedures will be required if local generic emergency procedures are not sufficient to cover all eventualities.

12.12 STEP 11: Identify disposal procedures

All hazardous substances must be disposed of as hazardous waste via the correct disposal route. They must not be flushed down the sink or disposed of in normal waste skips. Information on the disposal of waste is available from Health and Safety Services, and from the University Waste Services webpage at http://www.rdg.ac.uk/fm/waste/index.htm or the University Waste Coordinator (Ext. 6968). You must include the method/route of disposal on the risk assessment.

12.13 STEP 12: Review the risk assessment

Risk assessments should be reviewed regularly and modified if necessary. They should not be a "once-and-for-all" activity, but equally, they do not have to be re-written every year. As the nature of work changes and the understanding of hazards and risks develops over time, so risk assessments should evolve accordingly.

Assessments should be reviewed:

- If significant changes are made to existing workplaces, work activities, projects or equipment, such that the original assessments are no longer valid;
- If new or temporary members of staff are employed who may be more at risk due to inexperience, age or physical or mental health conditions and disabilities;
- If female staff announce that they are pregnant, and their work could give rise to a health risk to the mother or unborn child;
- If new legislation, guidance, codes of practice or national standards are introduced;
- Following accidents or near misses which highlight deficiencies in existing risk control measures or previously unforeseen hazards;

AND on a regular basis – every 12 months is recommended.

Appendix 1: Hazardous Substances Risk Assessment Form (CRA1)

School / Dept / Unit						
A: Identifying hazardous substances and existing controls						
1. Brief summary of work activity or project assessed						
2. List the substances hazardous to health that are to be used and the hazard(s) relating to them *Very toxic , toxic, harmful, corrosive or irritant*	**Substance**	**Hazard**	**WEL (Y/N)**	**8hr limit**	**15min limit**	**R-Phrase(s)**
3 .If more than one chemical is used are there secondary hazards produced?						
4. List who might be exposed to the hazard substance(s), how often and to how much. *(e.g. staff, students, visitors, cleaners & consider numbers at risk)*						

5. How might they be exposed? *(routes of entry and injuries or health problem that might result)*	**Route of exposure**	**'X' if yes**	**Consequence of exposure**
	Inhalation		
	Ingestion		
	Absorption		
	Injection		
	Skin		
	Eyes		
	Other		

6. List control measures in place to reduce risks *Assess whether these controls are adequate, actually used in practice and regularly checked, where appropriate:* *Eliminate the need* ↓ *Substitute substance* ↓ *Enclose the process* ↓ *Engineering controls (LEV)* ↓ *PPE*	**Are Manufacturers Safety Recommendations or Good Lab Practice sufficient to control the risks? Yes □ No □ (if Yes go to section 7)** □ **Fume cupboard** □ **Local exhaust ventilation** □ **Other (Please specify)…….**	□ **Gloves** **(Specify type……..)** □ **Safety Glasses/Goggles/ Face Shield** **(Specify type……..)** □ **RPE** **(Specify Type……..)** □ **Protective clothing** **(Specify Type……..)**

B: Assessing the level of risk and further action needed

7.1 How severe is any injury or health effect likely to be?	**Tick one box** (**S** =score given in brackets)	**Minor** ☐ (1)	**Serious** ☐ (2)	**Major** ☐ (3)	**Fatal** ☐ (4)
7.2. How likely is exposure to the hazard?	**Tick one box** (**P** =score given in brackets)	**Very unlikely** ☐ (1)	**Unlikely** ☐ (2)	**Possible** ☐ (3)	**Likely** ☐ (4)
7.3. Calculate the risk score by multiplying the 2 scores in Q7.1 & 7.2	**Risk Score** **(S x P) =**	**Low** ☐ (1–3)	**Medium** ☐ (4–6)	**High** ☐ (8–9)	**Very High** ☐ (12–16)

8. Further action/control measures to be taken to make the situation safe / reduce risk to health	**Action to be taken by whom?**	**Implementation Date**

9. Is health surveillance or exposure monitoring required?	
10. Emergency Procedures *(first aid actions, spill action, fire etc - refer to local rules if in place*)	
11 What are the disposal requirements?	

Name of Assessor (please print)		
Signature of Assessor		**Date:**
Signature of Head of Dept/School/Unit		**Date:**

12. Date for Review **(maximum 12 months from date of assessment recommended)**	

Appendix 2: Risk Phrases

Risk Number	Severity Score	Risk Phrase
R1	3	Explosive when dry
R2	3	Risk of explosion by shock, friction, fire or other sources of ignition
R3	4	Extreme risk of explosion by shock, friction, fire or other sources of ignition
R4	3	Forms very sensitive explosive metallic compounds
R5	3	Heating may cause an explosion
R6	4	Explosive with or without contact with air
R7	2	May cause fire
R8	3	Contact with combustible material may cause fire
R9	4	Explosive when mixed with combustible material
R10	2	Flammable
R11	3	Highly flammable
R12	4	Extremely flammable
R14	3	Reacts violently with water
R14/15	3	Reacts violently with water, liberating extremely flammable gases
R15	3	Contact with water liberates extremely flammable gases
R15/29	4	Contact with water liberates toxic, extremely flammable gases
R16	4	Explosive when mixed with oxidising substances
R17	3	Spontaneously flammable in air
R18	4	In use, may form flammable/explosive vapour-air mixture
R19	4	May form explosive peroxides
R20	2	Harmful by inhalation
R20/21	2	Harmful by inhalation and in contact with skin
R20/21/22	2	Harmful by inhalation, in contact with skin and if swallowed
R20/22	2	Harmful by inhalation and if swallowed
R21	2	Harmful in contact with skin
R21/22	2	Harmful in contact with skin and if swallowed
R22	2	Harmful if swallowed

Risk Number	Severity Score	Risk Phrase
R23	3	Toxic by inhalation
R23/24	3	Toxic by inhalation and in contact with skin
R23/24/25	3	Toxic by inhalation, in contact with skin and if swallowed
R23/25	3	Toxic by inhalation and if swallowed
R24	3	Toxic in contact with skin
R24/25	3	Toxic in contact with skin and if swallowed
R25	3	Toxic if swallowed
R26	4	Very toxic by inhalation
R26/27	4	Very toxic by inhalation and in contact with skin
R26/27/28	4	Very toxic by inhalation, in contact with skin and if swallowed
R26/28	4	Very toxic by inhalation and if swallowed
R27	4	Very toxic in contact with skin
R27/28	4	Very toxic in contact with skin and if swallowed
R28	4	Very toxic if swallowed
R30	3	Can become highly flammable in use
R31	3	Contact with acids liberates toxic gas
R32	4	Contact with acids liberates very toxic gas
R33	3	Danger of cumulative effects
R34	2	Causes burns
R35	3	Causes severe burns
R36	1	Irritating to eyes
R36/37	1	Irritating to eyes and respiratory system
R36/37/38	1	Irritating to eyes, respiratory system and skin
R36/38	1	Irritating to eyes and skin
R37	1	Irritating to respiratory system
R37/38	1	Irritating to respiratory system and skin
R38	1	Irritating to skin
R39	4	Danger of very serious irreversible effects
R39/23	4	Toxic: danger of very serious irreversible effects through inhalation
R39/23/24	4	Toxic: danger of very serious irreversible effects through inhalation and in contact with skin

Risk Number	Severity Score	Risk Phrase
R39/23/24/25	4	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/23/25	4	Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/24	4	Toxic: danger of very serious irreversible effects in contact with skin
R39/24/25	4	Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/25	4	Toxic: danger of very serious irreversible effects if swallowed
R39/26	4	Very Toxic: danger of very serious irreversible effects through inhalation
R39/26/27	4	Very Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/26/27/28	4	Very Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/26/28	4	Very Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/27	4	Very Toxic: danger of very serious irreversible effects in contact with skin
R39/27/28	4	Very Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/28	4	Very Toxic: danger of very serious irreversible effects if swallowed
R40	3	Limited evidence of a carcinogenic effect
R41	3	Risk of serious damage to eyes
R42	3	May cause sensitisation by inhalation
R43	3	May cause sensitisation by skin contact
R42/43	3	May cause sensitisation by inhalation and skin contact
R44	4	Risk of explosion if heated under confinement
R45	4	May cause cancer
R46	4	May cause heritable genetic damage
R48	3	Danger of serious damage to health by prolonged exposure
R48/20	3	Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/20/21	3	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/20/21/22	3	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed

Risk Number	Severity Score	Risk Phrase
R48/20/22	3	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/21	3	Harmful: danger of serious damage to health by prolonged exposure in contact with skin
R48/21/22	3	Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/22	3	Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/23	3	Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/23/24	3	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/23/24/25	3	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/23/25	3	Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/24	3	Toxic: danger of serious damage to health by prolonged exposure in contact with skin
R48/24/25	3	Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/25	3	Toxic: danger of serious damage to health by prolonged exposure if swallowed
R49	4	May cause cancer by inhalation
R50	4	Very toxic to aquatic organisms
R50/53	4	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R51	3	Toxic to aquatic organisms
R51/53	3	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R52	3	Harmful to aquatic organisms
R52/53	3	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R53	3	May cause long-term adverse effects in the aquatic environment
R54	2	Toxic to flora
R55	2	Toxic to fauna

Risk Number	Severity Score	Risk Phrase
R56	2	Toxic to soil organisms
R57	2	Toxic to bees
R58	3	May cause long-term adverse effects in the environment
R59	1	Dangerous for the ozone layer
R60	4	May impair fertility
R61	4	May cause harm to the unborn child
R62	4	Possible risk of impaired fertility
R63	4	Possible risk of harm to the unborn child
R64	4	May cause harm to breast-fed babies
R65	3	Harmful: may cause lung damage if swallowed
R66	1	Repeated exposure may cause skin dryness or cracking
R67	3	Vapours may cause drowsiness and dizziness
R68	4	Possible risk of irreversible effects
R68/20	4	Harmful: possible risk of irreversible effects through inhalation
R68/20/21	4	Harmful: possible risk of irreversible effects through inhalation and in contact with skin
R68/20/21/22	4	Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed
R68/20/22	4	Harmful: possible risk of irreversible effects through inhalation and if swallowed
R68/21	4	Harmful: possible risk of irreversible effects in contact with skin
R68/21/22	4	Harmful: possible risk of irreversible effects in contact with skin and if swallowed
R68/22	4	Harmful: possible risk of irreversible effects if swallowed

Appendix 3: Safety Phrases

Safety Number	Safety Phrase
S1	Keep locked up
S(1/2)	Keep locked up and out of the reach of children
S2	Keep out of the reach of children
S3	Keep in a cool place
S3/7	Keep container tightly closed in a cool place
S3/7/9	Keep container tightly closed in a cool, well-ventilated place
S3/9/14	Keep in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/14/49	Keep only in the original container in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/49	Keep only in the original container in a cool, well-ventilated place
S3/14	Keep in a cool place away from ... (incompatible materials to be indicated by the manufacturer)
S4	Keep away from living quarters
S5	Keep contents under ... (appropriate liquid to be specified by the manufacturer)
S6	Keep under ... (inert gas to be specified by the manufacturer)
S7	Keep container tightly closed
S7/8	Keep container tightly closed and dry
S7/9	Keep container tightly closed and in a well-ventilated place
S7/47	Keep container tightly closed and at temperature not exceeding ... ^{O}C (to be specified by the manufacturer)
S8	Keep container dry
S9	Keep container in a well-ventilated place
S12	Do not keep the container sealed
S13	Keep away from food, drink and animal feeding stuffs
S14	Keep away from ... (incompatible materials to be indicated by the manufacturer)
S15	Keep away from heat
S16	Keep away from sources of ignition - No smoking
S17	Keep away from combustible material

Safety Number	Safety Phrase
S18	Handle and open container with care
S20	When using do not eat or drink
S20/21	When using do not eat, drink or smoke
S21	When using do not smoke
S22	Do not breathe dust
S23	Do not breathe gas/fumes/vapour/spray (appropriate wording to be specified by the manufacturer)
S24	Avoid contact with skin
S24/25	Avoid contact with skin and eyes
S25	Avoid contact with eyes
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S27	Take off immediately all contaminated clothing
S27/28	After contact with skin, take off immediately all contaminated clothing, and wash immediately with plenty of ... (to be specified by the manufacturer)
S28	After contact with skin, wash immediately with plenty of ... (to be specified by the manufacturer)
S29	Do not empty into drains
S29/35	Do not empty into drains; dispose of this material and its container in a safe way
S29/56	Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point
S30	Never add water to this product
S33	Take precautionary measures against static discharges
S35	This material and its container must be disposed of in a safe way
S36	Wear suitable protective clothing
S36/37	Wear suitable protective clothing and gloves
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection
S36/39	Wear suitable protective clothing and eye/face protection
S37	Wear suitable gloves
S37/39	Wear suitable gloves and eye/face protection
S38	In case of insufficient ventilation wear suitable respiratory equipment
S39	Wear eye/face protection
S40	To clean the floor and all objects contaminated by this material use ... (to be specified by the

Safety Number	Safety Phrase
	manufacturer)
S41	In case of fire and/or explosion do not breathe fumes
S42	During fumigation/spraying wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer)
S43	In case of fire use ... (indicate in the space the precise type of fire-fighting equipment. If water increases the risk add - Never use water)
S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)
S46	If swallowed, seek medical advice immediately and show this container or label
S47	Keep at temperature not exceeding ... ^{O}C (to be specified by the manufacturer)
S47/49	Keep only in the original container at temperature not exceeding ... ^{O}C (to be specified by the manufacturer)
S48	Keep wet with ... (appropriate material to be specified by the manufacturer)
S49	Keep only in the original container
S50	Do not mix with ... (to be specified by the manufacturer)
S51	Use only in well-ventilated areas
S52	Not recommended for interior use on large surface areas
S53	Avoid exposure - obtain special instructions before use
S56	Dispose of this material and its container at hazardous or special waste collection point
S57	Use appropriate containment to avoid environmental contamination
S59	Refer to manufacturer/supplier for information on recovery/recycling
S60	This material and its container must be disposed of as hazardous waste
S61	Avoid release to the environment. Refer to special instructions/safety data sheet
S62	If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label
S63	In case of accident by inhalation: remove casualty to fresh air and keep at rest
S64	If swallowed, rinse mouth with water (only if the person is conscious)

Appendix 4: Symbol, abbreviation/description of hazard

Symbol		Hazard	Description of hazard
(Physicochemical)			
	E	explosive	Chemicals that explode.
	O	oxidising	Chemicals that react exothermically with other chemicals.
	F+	highly flammable	Chemicals that may catch fire in contact with air, only need brief contact with an ignition source, have a very low flash point or evolve highly flammable gases in contact with water.
	F	extremely flammable	Chemicals that have an extremely low flash point and boiling point, and gases that catch fire in contact with air.
(Health)			
	T+	very toxic	Chemicals that at very low levels cause damage to health.
	T	toxic	Chemicals that at low levels cause damage to health.
	T	category 1 carcinogens	Chemicals that may cause cancer or increase its incidence.
	T	category 2 carcinogens	
	Xn	category 3 carcinogens	
	T	category 1 mutagens	Chemicals that induce heritable genetic defects or increase their incidence.
	T	category 2 mutagens	
	Xn	category 3 mutagens	
	T	category 1 reproductive toxins	Chemicals that produce or increase the incidence of non-heritable effects in progeny and/or an impairment in reproductive functions or capacity.
	T	category 2	

		reproductive toxins	
	Xn	category 3 reproductive toxins	
	Xn	harmful	Chemicals that may cause damage to health.
	C	corrosive	Chemicals that may destroy living tissue on contact.
	Xi	irritant	Chemicals that may cause inflammation to the skin or other mucous membranes.

(Environmental)			
	N	dangerous for the environment	Chemicals that may present an immediate or delayed danger to one or more components of the environment

Notes:

Extremely Flammable F+ and Highly Flammable F

- For the purposes of CHIP, a Flammable Liquid is one with a flash point of less than 55°C.
- A Highly Flammable Liquid (**F**) is one with a flash point of less than 21°C
- A Highly Flammable solid is one that is spontaneously combustible in air at ambient temperature, readily ignites after brief contact with a flame or evolves highly flammable gases in contact with water or moist air.
- An Extremely Flammable Liquid (**F+**) is one with a flash point less than 0°C and a boiling point of 35°C or less

Carcinogens

Category 1 - substances known to be carcinogenic to humans

Category 2 - substances that should be regarded as if they are carcinogenic to humans, for which there is sufficient evidence, based on long-term animal studies and other relevant information, to provide a strong presumption that human exposure may result in the development of cancer.

Category 3 - substances that cause concern owing to possible carcinogenic effects but for which available information is not adequate to make satisfactory assessments.

Categories 1 and 2 carry the "toxic" (**T**) symbol and the Risk Phrase R45 (may cause cancer) or R49 (may cause cancer by inhalation).

Category 3 carries the "harmful" (**Xn**) symbol and the Risk Phrase R40 (possible risk of irreversible effects).

Very Toxic (T+) and Toxic (T)

- **LCn** This abbreviation is used for the exposure concentration of a toxicant lethal to n% of a test population e.g. LC_{50}
- **LDn** This abbreviation is used for the dose of a toxicant lethal to n% of a test population.
- **Evident Toxicity** - this concept is used to designate toxic effects after exposure to a substance tested, which are so severe that exposure to the next highest fixed dose would probably lead to death.

Very Toxic (T+)

Acute lethal effects:

- **R28 "Very Toxic if swallowed"**: LD_{50} oral, rat < or = 25mg/kg : less than 100% survival at 5mg/kg oral, rat.
- **R27 "Very Toxic in contact with skin"**: LD_{50} dermal, rat or rabbit: < or = 50mg/kg.
- **R26 "Very Toxic by inhalation"**; LC_{50} inhalation, rat, for aerosols or particulates < or = 0.25mg/litre/4h

Non-lethal irreversible effects after a single exposure:

- **R39 "Danger of very serious irreversible effects":** Irreversible damage is likely to be caused by a single exposure by an appropriate route, generally in the above dose ranges. In order to indicate the route of exposure, combinations of Risk Phrases may be used e.g. R39/23 i.e. "Danger **of very serious irreversible effects by inhalation".**

Toxic (T)

Acute lethal effects:

- **R25 "Toxic if swallowed"**: LD_{50} oral, rat 25 < LD_{50} < or = 200mg/kg: At 5mg/kg, oral, rat less than 100% survival but evident toxicity.
- **R24 "Toxic in contact with skin"**: LD_{50} dermal, rat or rabbit: 50 < LD_{50} < or = 400mg/kg.
- **R23 "Toxic by inhalation"**; LC_{50} inhalation, rat, for aerosols or particulates: 0.25 < LD50< or = 1mg/litre/4hr

Non-lethal irreversible effects after a single exposure:

R39 "Danger of very serious irreversible effects": Irreversible damage is likely to be caused by a single exposure by an appropriate route, generally in the above dose ranges. In order to indicate the route of exposure, combinations of Risk Phrases may be used e.g. R39/23 i.e. "Danger **of very serious irreversible effects by inhalation".**

Severe effects after repeated or prolonged exposure:

R48 "Danger of serious damage to health by prolonged exposure": Serious damage is likely to be caused by repeated or prolonged exposure by an appropriate route. "Toxic with R48" is used when effects are observed at levels of the order of:

Oral, rat < or = 5mg/kg(bodyweight)/day

Dermal, rat or rabbit < or = 10mg/kg(bodyweight)/day

Inhalation, rat < or = 0.025mg/l, 6hr/day

In order to indicate the route of exposure, combinations of Risk Phrases may be used e.g. R48/23 i.e. "Danger **of serious damage to health by prolonged exposure by inhalation"**

Appendix 5: List of Common Chemical Incompatibles

List of Common Chemical Incompatibles	
Chemical	Incompatibles
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulphuric acid mixtures
Alkali and alkaline earth metals (such as powdered aluminium or magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulphur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water

Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulphur, finely divided organic or combustible materials
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulphide
Chromic acid and chromium	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulphide	Fuming nitric acid, oxidizing gases

Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulphuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen: flammable liquids, solids or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulphuric and other acids
Potassium perchlorate (see also chlorates)	Sulphuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid
Selenides	Reducing agents

Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphides	Acids
Sulphuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

Appendix 6: Version control

VERSION	KEEPER	REVIEWED	APPROVED BY	APPROVAL DATE
X.X	H&S	Every four years	XXXXX	XX/XX/XX
X.X	H&S	Annually	XXXXX	XX/XX/XX