University of Reading

Safety Code of Practice 28

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THE ASSESSMENT AND CONTROL OF HAZARDOUS SUBSTANCES

Summary			
This code of practice summarises the requirements for assessing and controlling the risks to health caused by work involving hazardous substances.			
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	CoP- 49 pt2 Fume cupboard selection CoP-55 Spill management CoP-57 Maternity

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1 INTRODUCTION

The University of Reading uses a wide variety of naturally occurring and commercially produced substances, or those derived from our research activities, and these may cause harm to health if not adequately controlled. Substances hazardous to health are those which are classified as being toxic, very toxic, harmful, irritant, corrosive, sensitising, carcinogenic, mutagenic or toxic to reproduction (teratogenic), or biological agents (virus, bacteria, yeasts, TSE). The substances may have the potential to cause harm if inhaled, ingested, directly injected, or by contact with or absorbed through the skin.

2 SCOPE

This Code sets out the University's arrangements for assessing and controlling hazardous substances to achieve the requirements of the Control of Substances Hazardous to Health Regulations 2002 (COSHH). It covers the requirements to prevent the exposure or reduce it to as low reasonably practicable through means of the COSHH assessment, and by implementating the significant findings born out of the assessment. The findings will cover, information and training, the use of and maintenance of control measures, the provision of emergency arrangements, and if needed, the use of exposure monitoring or health surveillance.

This Code applies to all work activities involving substances hazardous to health including: maintenance, cleaning, catering, animal care, soil or crop handling, and activities in specialised facilities such as studios, workshop or laboratories. These may be routine work, occasional work, or one-off activities. It applies to the storage, handling, use and disposal of hazardous substances and wastes arising from or involving University of Reading (UoR) work activities under the UoR's control. It applied to work on the following premises: UoR campuses (including the Henley campus and the SportsPark), Bulmershe Pavilion, the UoR Boat House, Sonning and Hall Farms and non-tenanted areas of TVSP. It also applies to off-premise work but which remains directly under the control of UoR. It applies to all staff, students and visitors undertaking activities under the control of UoR.

This Code should be read in conjunction CoP-14 (pt1 and pt 7) on Biological Safety and CoP-15 on GMO safety for the COSHH assessment of biological agents and the laboratory containment standards for working with biological agents. Further relevant codes are listed on the front cover of this CoP-28 document. The following substances are not covered by COSHH Regulations and are covered by other University Health and Safety policies : asbestos, lead and lead salts, radioactive substances, or sufficient quantities of flamamable substances that can create a dangerous explosive atmosphere (DSEAR, 2002).

3 DEFINITIONS

Hazardous substances are any kind of substance or mixture that has the potential to cause harm if inhaled, ingested, directly injected, or absorbed through contact with skin or other body membranes. Substances include single compounds or a mixture of two or more compounds, and can be: solids, liquids, gases (including asphyxiants), fumes, aerosols or vapours, dusts, and biological agents. This includes substances that are not formally classified as hazardous, such as naturally occuring substances (e.g. flour, animal bedding), those collected from the environment (e.g. soil), or manufactured on site (e.g. synthesised new chemical entities NCE). Where possible

unclassified substances should be compared to related classified substances to identify potential hazard properties.

Workplace Exposure Limits (WELs) are statutory maximum exposure levels set by the Health and Safety Executive (HSE) for commonly used hazardous substances. WELs are expressed as concentrations (as mg/m^{-3} or ppm) of substances in air over a specified time period and are published by the HSE in document EH40. **Time weighted average (TWA)** is the maximum exposure level that can be sustained continuously over an 8 hour period. **Short term exposure limit (STEL)** is the maximum exposure level that can be sustained continuously over a 15 minute period. If no STEL is cited in EH40, a three times concentration value for the 8 hour TWA should be applied for setting exposure limits over the STEL period.

Dusts of any kind at a concentration of more than $10mg/m^{-3}$ for over 8 hours (TWA) for an inhalable dust, or $4mg/m^{-3}$ for over 8 hours (TWA) for a respirable dust, are classified as a hazardous substance.

Inhalable dusts are any airborne particles capable of being inhaled through the nose or mouth (BS EN 481:1993).

Respirable dusts are any airborne particles capable of penetrate deep into into the unciliated (gas exchange) parts of the lungs (BS EN 481:1993).

Carcinogens are substances known or regarded as being capable of cause cancer in humans, or a substance of suspected carcinogenic effects. These are classified as carinogencity categories 1A, 1B or 2 under CLP (2015).

Mutagens are substances known or regarded as been capable of inducing genetic changes in the germ cells in humans and can be transmitted to offspring. These are classified as mutagens categories 1A, 1B and 2 under CLP (2015).

Teratogens are substances known or regarded as being capable of causing advers effects to sexual reproductive function and fertility in humans, or a substance of suspected of reproductive toxicity, These are classified as reproductive toxicity categories 1A, 1B and 2 under CLP (2015).

Respiratory sensitisers are substances that can lead to the hyper-sensitivity of the airways following inhalation of the substance. These materials are recorded by a **SEN** in EH40. These are classified as respiratory sensitiser categories 1A and 1B under CLP (2015).

Skin sensitisers are substaces with reliable evidence that can cause an allergic response following skin contact. These materials are marked by an **SK** label in EH40. These are classified as skin sensitiser categories 1A and 1B under CLP (2015).

Biological agents include viruses, bacteria, fungi, agents that cause transmittable spongiform encephalopathies (TSEs), cells cultures and parasites that live inside hosts.

Asthmagen agents that can cause occupational asthma are listed on the HSE website and a more extensive list is provided in the section C of the HSE publication "Asthmagens?" Critical assessments of the evidence for agents implicated in occupational asthma"

A concise list of legally prohibited substances and processes is provide in schedule 2 of COSHH (ACOP L5 6th ed. 2013) .

Local Exhaust Ventilation (LEV) systems are systems designed to remove or reduce airborne contaminants from an atmosphere around the point of work to prevent worker exposure. They may be capture or extract systems and are covered by CoP-46.

Personal Protective Equipment (PPE) are items worn around the body of the worker to prevent the exposure to harm: substances, noise, vibration, damage to hearing or sight, or thermal discomfort and are covered by CoP-27.

Respiratory Protective Equipment (RPE) are items worn to cover the breathing zone (i.e. nose and mouth) to prevent the inhalation of harmful substances, and are PPE items . The RPE items should not interfere with the performance of other PPE worn (e.g. sight protection from chemical splashes).

Exposure Monitoring is the use of suitable techniques to check the adequancy of control measure performance in preventing a worker from being exposured to a hazardous substances. For example, using a dust lamp to obseve possible exposure and the insufficient performance of the controls.

Health surveillance is the use of suitable techniques to check the health of a worker for adverse changes (identifiable disease or health effect) caused by their residual exposure. For example, the inspection of hands for dermititis caused by exposure to a skin sensentiser.

Safety Data Sheets (SDS) are documents provided by manufacturers and suppliers that communicate the product safety information according to an internationally agreed 16-part standard format of information recording.

4 RESPONSIBILITIES

All staff students and visitors must not work with substances hazardous to health unless the findings of the COSHH assessment has been communicated to them by their managers or superviors in the form of a safe system of work (e.g. a Standard Operating Procedure [SOP] or the COSHH statement). Individuals should sign a training record to having received and understood the safe system of work before starting activities. They must be able to apply the control measures specified in the safe system of work and according to the training received.They are responsible for reporting to their managers or supervisors any difficulties in applying the control measures, or any unintentional exposure to hazardous substances. They are also responsible for storing, wearing and disposal of any Personal Protective Equipment (PPE) according to the training received and for reporting any PPE defects to their managers or supervisors. All individuals should co-operate with any health surveillance programs they are required to attend.

Heads of School and Function (HoS/F) are responsible for ensuring Schools and Functions have competent staff available to carry out COSHH assessments and that the assessments are regularly reviewed, as under section 8 of this Code. They are responsible for ensuring the training needs for those working with hazardous substances are identified by managers and supervisors and resources to complete the training are provided (e.g. time, financial means). The HoS/F must establish and maintain a system to record the information, instruction and training given to staff/students/visitors in order to achieve the safe system of work (e.g. COSHH assessments, SOPs, local rules of operation, inductions, training sessions, emergency safety drills, equipment inspections and maintenance records).These records will also provide evidence in any legal claims. HoS/F must also ensure that managers and supervisors can provide the emergency arrangements to meet the COSHH assessment requirements, or that the work must be prevented from starting.

Competent managers, superviors and researchers/post-docs (COSHH assessors) are responsible for completing the COSHH assessment prior to commencing activities. To be competent they should have completed risk assessment training and should have sufficient

knowledge or experience of working with the substance to understand the health risks that can arise from working with it and from the equipment involved. This is required so to make sound decisions on the suitability of the control measures for preventing exposure, or to reduce the exposure level to as low as reasonably practical (ALARP). The COSHH assessor should sign the COSHH assessment form and undertake regular reviews of the assessment (section 8 of this Code)

The COSHH assessor should have access to assistance from other competent staff in their School or Function to complete a suitable and sufficient assessment. Alternatively, the local Health and Safety Coordinator (HSC), or the Health and Safety Services staff, or the Chemical Safety Adviser (SCFP H&S Manager, supporting the Schools covered by Technical Services) may be able to provide advice within the scope of their competency. Work should not take place until a suitable and sufficient assessment has been completed.

Managers and supervisors are reponsible for having a suitable COSHH assessment in place before work commences and that those working with the substance(s) should have access to the assessment findings through a safe system of work. Managers and supervisors must make sure that all control measures are in place and functional *before* the work commences (including emergency arrangements). They are responsible to ensure that necessary corrective actions are carried out after receiving any reports of deficiencies in the control measures, including PPE. They shall ensure that all relevant information, instruction and training is provided to staff, students and visitors *prior* to commencing the work (see section 7), and users can maintain the control measures during the activities.

Local Health & Safety Committees are responsible for reviewing the arrangements for emergency prepardness in their School or Function as activities change, so that relevant equipment, procedures and training are provided. The Committees should review the outcomes of practice safety drills for implementing the lessons learnt to improve the emergency preparedness arrangements.

Health and Safety Services is responsible for revising this Code of Practice on COSHH and for developing the template COSHH assessment forms. H&S Services is also responsible for creating learning materials on COSHH assessments, the classification and labelling of hazardous substances and the understanding of safety data sheets. These learning materials can be used to supplement the information, instruction and training provided by managers and supervisors. H&S Service will on receiving incident notifications involving hazardous substances, or on receiving a notification of health condition from Occupation Health, will initiate an incident investigation processes according to the arrangements in CoP-9. H&S Services are responsible for deciding which incidents the University is legally required to report and will submit the University's RIDDOR or other reports to the relevant enforcing agency.

Occupational Health Service (OH) is responsible for organising the health surveillance of staff and students, as identified by the COSHH assessment. OH will ensure that the arising health records are confidentially maintained and that managers or supervisors are notifed of the findings and recommendations from the surveillance. Where a COSHH assessment identifies a need for exposure monitoring, OH is responsible for confidentially maintaining the resulting exposure records that are identifiable to a person.

5 REQUIREMENTS

5.1 Routes of exposure and adverse effects on the body

The major routes of exposure to hazardous substances are through the lungs (inhalation), the gastrointestinal tract (ingestion) or through the skin (absorption). Exposure through penetration, cuts or abrasion of the skin (injection) may also occur. The adverse effects of exposure may be local or systemic, or both. Local effects occur at the site of exposure while systematic effects occur remotely from the point of exposure, at target organs or whole body following absorption and translocation. Acute effects are immediate, while chronic effects are slower and result from accumulative exposure and lower exposure levels and symptoms may not present for an extended time after exposure. Reversible effects are damage that the body can repair while irreversible effects can not be repaired (e.g. dead nerve cells cannot be replaced).

5.2 COSHH assessment

COSHH aims to prevent the adverse effects on the body from hazardous substances by preventing exposure, or to reduce the exposure level to as low as reasonably practical (ALARP). No work with hazardous substances or mixtures should commence until a COSHH assessment has been completed by a competent person, and the steps to control exposure have been implemented. Assessments should be recorded on either a COSHH assessment form or combined COSHH-risk assessment form, available from H&S Services and these should be made available to all relevant prior to commencing activities and training.

The University assessment process is developed from HSG97 guidance "A step-by-step guide to COSHH assessment (2004).

5.2.1 Describe the activity and the hazardous substances used

Describe the activities and the hazardous substances involved at each stage of the work. Consider when the substances are being stored, moved/handled, used, or disposed. For each stage and substance think about the:

a). the physical form of the substance : solid, liquid, gas,vapour, fumes, dust, biological agents.
b). the quantities of substances or mixtures used.
c). the concentration of a substance or mixtures used.
d). how the substances reacts to external conditions (water, air, heat, pressure, other chemicals).
e). the volume of the work space the amount of substance is used in (for estimating exposure levels).

5.2.2 Identify the hazards of each substances and routes of exposure

The assessor must gather information for each substance before completing the COSHH assessment. The assessor should identify all substances by name and there possible by CAS number to avoid synomy confusion, and should identify the hazardous properties of each substance by reviewing the safety data sheets (SDS). While not a COSHH assessment the 16-part SDS document (appendix 1) records most of the information needed to complete the COSHH assessment. Within the 16-part document it records: the substance physical form, displays the diamond hazard pictograms (illustrated in Appendix 2), the hazard warning information recorded as hazard statemenst (H-statements, listed in Appendix 3) the precausionary advice recorded as precausionary statemenst (P-statements, listed in Appendix 4), information on WELs, PPE types

and standards. Other sources of information for identifying hazards can be found using the following sources:
a). the product packaging.
b). the European Chemical Agency (ECHA) website for chemical safety information including SDS, CAS number, synonyms, REACH regulation (2018) requirements.
c). the HSE EH40 document for any Workplace Exposure Limts (WELs).

Also consider the route of entry into the body for each substance during the activity: inhalation, ingestion, skin contact or absorption, injection. Furthermore, consider the effect the substances can have on the body by each route of entry. For example by inhalation and development of respiratory sensitisation.

Where work involves noval substances, such as nanomaterials, or a bespoke hazardous substance, assessors should contact H&S Services for advice.

5.2.3 Consider if two or more substances are used

Where more than one chemical is used in a mixture, consider any intermediates or by-products created when component chemicals are mixed. Mixing may create new hazards such as harmful gases or waste products, or exacerbates existing hazards (e.g. heat as a by-product and effect on reaction speed/intensity or unintended reaction products). Think about:
a). referring to the SDS for additional manufacture information.
b). refer to the table of incompatible chemicals by-products is given in Appendix 5.

5.2.4 Identify who might be exposed

Consider each work stage and identify who might be present. This includes those directly involved in the work activity (storing, handling, using, disposal of the substance), or others in the work area and may be indirectly exposed. This includes but not limited to: cleaners, IT workers, maintenance workers, technical support, students, contractors, visitors. Some individuals may also be at higher risk from exposure. These include young workers (under 18 years) who might be unfamiliar in understanding risk, new and expectant mothers (mutagens, reproductive toxin / teratogens), temporary workers/students/visitors who may have a lower level of experience, anyone with reduced mobility or disabilities, anyone with an existing health condition that makes them more susceptible to adverse effects from exposure to a substance.

The maternity risk assessment for expectant or new mothers should identify if the females are working with, or in the area of others working with substances classificed with the following list of H-statements: H340, H341, H350 and H350i, H360 (all variants F, D, FD,Fd, Df), H361 (all variants f, d, fd), H362, H370, H371, H372, H373. See CoP-57 Maternity for further details, including biological hazards.

5.2.5 Selection of Control measures

Control measures must be selected to prevent exposure or to reduce exposure to a level as low reasonable practicable (ALARP) and should and always below the statutory workplace exposure level (WEL). Control measures must be proportionate to the health risks and applied to each stage of work: storage, moving/handling, use and disposal. ALARP must be applied to all work involving carcinogens, mutagens, teratogens (reproductive toxins) and substances that can cause occupational asthma.

Before selecting the individual controls refer to section 2 of substance(s) safety data sheet and the P-statements (Precautionary-statements) for safety advice. Controls should then be selected following a risk reduction priority order known as the "hierarchy of control". The hierarchy of control is as follows:

- Eliminate the hazardous substances used or generated (including by-products) by modifying the process or activity.
- Replace the substance with a less hazardous alternative
- Substitute the form of the substance with a safer one (e.g. pellets instead of powder)

Where it is not reasonably possible to eliminate exposure, you must adequately control exposure using a combination of one or more of these alternative control measures.

Control by equipment

- Totally enclose the process
- Partially enclose the process and use extraction (e.g. use of fume cupboard, MSC)
- Use adequate room ventilation
- Maintain equipment installed (e.g. extraction equipment, RPE, handling equipment, pre-use visual checks, inspections, scheduled maintenance regimes)

Control by ways of working

- Design safe operating and handling process with safe work equipment that minimise the chance of uncontrolled release through spilling, leaking, or otherwise escape during storage, moving/handing, use and disposal of the substance.
  - review inventories before purchases to limit hazard loading in areas
  - purchase smaller container sizes to avoid decanting and to limit the volume of release
  - minimise the purchase or storage of substances in glass containers where possible
  - purchase prepared solutions to avoid handling components and concentrates
  - clearly label the substance name on containers and apply warning symbols, especially carcinogens, mutagens, senitisers, teratogens, which should also be stored securely (facility access controls)
  - choose the right equipment and layout for the task
  - equipment pre-use visual checks, regular inspections, scheduled maintenance regime
  - apply secondary containment when storing and moving substances (eg. bunded trollys, bunded storage cabinets)
  - transport carcinogens, mutagens, senitisers, terratogens in secondary containment
- Reduce to a minimum
  - the quantity and concentration of substance used during activities
  - the reaction temperature when appropriate to slow the reaction speed
  - the number of persons exposed (e.g, access controls, permit to work, scheduling the activities)
  - the duration of the exposure (e.g, careful designing the work flow)

Control by work behaviour

- Information, instruction and training to ensure all relevant can achieve and maintain the operation of the controls for existing or new procedures
- Control measures are used
- Prohibit eating, drinking and smoking in the work areas with hazardous substances

- Display warning signage of the hazardous substances being used in areas and on equipment
- Apply good hygiene when leaving the work area

The use Personal Protective Equipment (PPE) is in addition to other measures if exposure cannot be adequately controlled by any other measure alone, *PPE is a last resort only*. Each item of PPE must be carefully selected to protect against the substance being used, the duration of protection required to cover the planned tasks (e.g. glove breakthrough times), degree of protection needed for the activities (e.g. gloves with chemical splash protection vs full contact protection) and suitability of the PPE fit to the wearer (e.g. RPE and face fit testing). The specification of the PPE required for the activities must be recorded in the COSHH assessment and the arrangements for cleaning and storage as needed. An outline of the basic requirements for safe use of PPE is included in section 7 of this Code. For further details on PPE selection, access and storage, training needs and for the cleaning/repair/replacement, please see CoP-27 Personal Protective Equipment.

Disposal procedures
All hazardous substances that are defined as waste must be segregated from non-hazardous substances and also by hazard category (e.g. oxidising/flammable), correctly labelled as hazardous waste (e.g. hazardous property codes, dates, amounts) and disposed via the correct disposal route. Detailed guidance on the management of hazardous waste is given in CoP-48 Hazardous waste disposal.

5.2.6 Assess the remaining (residual) risk to health

Consider what risk of exposure remains given the control measures selected ? Review who was identified as at risk of exposure, how likely they are to be in contact with the substances, how often the activity take place? Are the quantities used or the rate of use too low to be consider a risk? Estimate the likely concentration of the hazardous substance during possible exposure periods and the length of possible exposed time. Is the level of possible exposure below the published EH40 exposure limit (legal maximum) under normal operations when the selected controls measures are maintained by the workers? Decide if further controls are needed and take action.

The assessor should calculate the *risk score* and enter this on the COSHH or combined COSHH-risk assessment forms. *The risk score = severity of harm x probability*

Table 1. Severity of harm

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 2. Probability

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

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.

Table 3. Risk Score matrix

RISK SCORE = S X P		SEVERITY OF OUTCOME (S)			
		Minor	Serious	Major	Fatal
P R O B A B I L I T Y (P)	Very Unlikely	1	2	3	4
	Unlikely	2	4	6	8
	Possible	3	6	9	12
	Likely	4	8	12	16

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.

Action plans – implementing risk controls

It is strongly recommended that you draw up a health and safety action plan to ensure that any further improvements needed to reduce the residual risk 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 the table below.

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

5.2.7 Deciding if health surveillance is required

Health surveillance is unlikely to be needed in most circumstances but will be required where work involves substances and processes specified in schedule 6 of the COSHH regulations. Surveillance will also be required if there is reasonable likelihood of exposure that could result in an identifiable occupational disease or adverse health effect and there is a valid technique for surveillance of the body. The need for health surveillance should be recorded on the COSHH assessment form and managers and supervisors should complete a Occupational Health surveillance enrolment form with the individual. Following surveillance an individual health record will be issued to the manager or supervisor advising of the outcome of the surveillance. Where a health condition is established by the Occuptational Health (OH), managers and supervisors will be advised on any work restrictions that may be required. In these circumstance, following the consent of the individual, H&S Services will be informed of a possible work-related health effect has been identified. Substances to seek health surveillance advice from OH will include but are not limited to:

Asbestos (not included in COSHH)

Lead or lead salts as dusts or vapours (not included in COSHH)

Mercury or mercuric compounds where exposure to vapours of dusts possible

Organophosphorus compounds

Nitro or amino derivatives or phenol and benzene

Potassium or sodium chromate or dichromate

Epoxy resins

Styrene

Isocyanates

Carcinogens, mutagens, teratogens, (annotated as CARC in EH40)

Respiratory sensitisers (annotated as SEN in EH40 as substances causing occupational asthma)

Skin Sensitisers (annotated as SK in EH40)

Biological agents in bio-hazard group 2 or above (see CoP-16 for guidance)

Genetically Modified organisms class 2 or above (see CoP-15 for guidance)

Laboratory animals

5.2.8 Decide if exposure monitoring is required

Where a COSHH assessment determines it is necessary to ensure that controls are adequately maintained to protect health, exposure monitoring will be required and a Occupational Health surveillance enrolement form should be completed. Monitoring will be required if activities involve the substances and processes listed in schedule 5 of the COSHH regulations but may also be needed if:

- The risk of exposure is unclear, an initial exploratory monitoring may be needed to reach an informed conclusion on the effectiveness of the control measures.
- There might be a significant risk to health if a control measure fails or deteriorated (e.g. LEV system).
- There is reasonable potential a WEL could be exceeded, in particular for substances classified as a carcinogen, mutagen or causing occupational asthma.
- Where there is a suspicion that changes in works means that the control measures may no longer adequately control the exposure levels (e.g. increase in the quantity of substance used, changes to the systems of work or introduction of new equipment).

Exposure monitoring will not be appropriate if suitable techniques for measuring do not exist, or if an alternative method of control validation has been used to ensure adequacy of the controls (for example, scheduled fume cupboards face velocity tests).

5.3 Maintenance of Control Measures

The university must take reasonable steps to ensure that all the control measures are maintained in an efficient state, in good working order and good state of repair. All engineering controls provided must have a through examination and testing at regular intervals. For LEV systems COSHH specificies this should occur every 14 months (practically annually). Responsibilities arranagements for LEV systems are described in CoP-46 part4. Non-disposable RPE must also undergo regular through examination (e.g. according to the manufacturer instructions, including visual checks to ensure all parts are correctly fitted and in good condition) and where appropriate tested (e.g. powered respirators). Filters must be appropriately selected to the hazards and checked regularly and used within the certification date and the user must be clean shaven and have had face-fit testing to ensure correct fit before use. PPE should be properly stored in a well defined place and checked regularly for cleaning, any damaged items should be repaired or replacement and damaged items correctly disposed in suitable hazardous waste streams, See CoP-27 Personal Protective Equipment for further details. Managers and supervisors are also required to review the safe systems for working with hazardous substances when the COSHH assessment is reviewed.

See section 9 for through examination and test record keeping.

6 EMERGENCY ARRANGEMENTS/EMERGENCY PREPAREDNESS

The COSHH assessment should must record the emergency arrangements required for reasonably foreseeable incidents of unintended exposure during work activity. The assessment should be made available to the emergency services in cases where they are asked to respond, so to communicate the substance names and hazard properties and potential quantities in order to prepare their response.

Local written procedures will be necessary if generic emergency procedures are not sufficient to cover all reasonable foreseeable eventuallities. These should include instructions on the use of warning signage, controlling facility access and evacuations, and how to communication the situation, and later, how to communicate when remedial actions are completed, and facilities have been safety re-opened.

Specialised arrangements may be required for first aid treatment (e.g. contact with contaminated sharps), for dealing with a fire (e.g. specialised fire extinguishers for pyrophoric metals), the loss of containment (e.g. a spill during storage or when use/handling/disposing of a substance), a significant exposure as a result of a sudden failure of extraction system (e.g. release of airborne hazard) or acute process failure and a sudden release of chemicals (e.g. exothermic reaction), or any other incident threating an exposure above a WEL. Specific local procedures must be in place for dealing with a uncontrolled release of carcinogens, mutagens, sensitisers, teratogens, or biological agents.

Safety drills for the emergency arrangements should be practiced regularly and safety equipment including suitable spill response equipment (e.g. kits, labels, pens, containers) and PPE and RPE must be stored in readiness for trained staff to use in the event of an incident. This includes the safe clean up and disposal of substances or contaminated materials generated by the release or the cleaning activities. The emergency procedures should be reviewed regularly and following any significant changes to activities (e.g. the quantities of substance used, the use of new substances, changes to the workplace) and the procedures updated and the changes trained out. Any deficiencies or alterations for emergency preparedness should be discussed at the local School or Function H&S Committee to ensure that any remedial actions to correct the emergency arrangements are completed in a reasonable period of time (see Safety Note 79 on Local Health and Safety Committees).

7 COMPETENCE/LEARNING REQUIREMENTS/TRAINING

Managers and supervisors should ensure that staff, students and visitors receive adequate information, instruction and training *prior* to the storing, moving, handling, use or disposal of hazardous substances. As a minimum, in addition to inductions and equipment training and standard operating procedures, managers and supervisors must ensure hazardous substance workers can read and understand the GHS hazard pictograms and labelling, and have received a safe system of work which described the significant findings of the COSHH assessment (see below paragraph). Individuals should sign a training record to confirm the receipt and understanding of the safe system of work. The COSHH assessments should be also be accessible, as a paper or electronic format, so to provide on-going access to information whilst working with the substance(s).

From the information and training received, users must be able to identify the substance(s) they are likely to be in contact with, have access to all relevent SDS, understand the hazardous properties and how the substances can cause health risks (routes of entry into the body and harm caused), to understand the control measures required to prevent the harm and to be able to reliably maintain the control measures during the activities. They should also understand what procedures are needed for dealing with the reasonably foreseeable emergencies identified by the COSHH assesment. Staff, students and visitors must receive training on the correct application and removal of PPE (including RPE), the means to clean and safely store any issued PPE, and who to report any defects for repair or replacement.

Following a COSHH assessment review, any changes rising must be communicated and trained out to all relevant staff, students and visitors using the substance(s) or anyone else regularly in the workarea (e.g Technical Services staff).

8 REVIEW & AUDIT

Assessments should be reviewed regularly, at least every 12 months, or if there have been any significant changes to either the work activity, the understanding of the health risks arising from the substance, or following an incident. For example:

- Changes made to the workplace, work activities or equipment so that the assessment is no longer valid.
- Changes to the staff involved to alter the risk profile and the assessment is no longer valid. For example, changes to the level of experience, physical or mental capabilities or they become pregnant (health of unborn child and mother),
- Changes in the law or the categorisation of the risk to health may require additional controls and the current assessment is no longer valid. For example, changes to a WEL or reclassification of the hazardous properties (H-Statements).
- Following an incident and which the investigation identifies previously unforeseen hazards or deficiencies in the existing risk control measures.

9 RECORDS & RETENTION REQUIREMENTS

Exposure monitoring records that identifties an individual must be kept 40 years after the date of the last entry. Other types of exposure monitoring that do not identifty an individual (i.e. static area monitoring) must be kept for 5 years after the last entry. The health records for each person placed on health surveillance must be kept for 40 years after the date of the last entry. Records for through examination and testing of engineering controls (i.e LEV systems) should be kept for 5 years from the date when it was made.

10 RELEVANT LEGISLATION

Control of Substances Hazardous to Health Regulations (2002)

Classification, Labelling and Packaging of Chemicals Regulations (2015)

GB mandatory classification labelling and packaging (2020)

Workplace Exposure Limits EH40/ (2005)

Personal Protective Equipment at Work Regulations (1998)

Management of Health and Safety at Work Rregulations (1999)

11 REFERENCES

HSE: A step-by-step guide to COSHH assessment - HSG97. (2004)

HSE: Control of Substances Hazardous to Health Regulations (2002) Approved code of practice and guidance (L5 6th Edition 2013)

HSE: Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma (2001)

Regulation (EC) No 1272/2008 of the European Parliament and of the council 16 December 2008 on the classification, labelling and packaging of substances and mixtures, amending and repealing directives 67/548/EEC and 1999/45/EC, and amending regulation (EC) No 1907/2006.

Workplace atmospheres — Size fraction definitions for measurement of airborne particles. BS EN 481:1993

12 APPENDIX

Appendix 1: Hazard Information

The Global Harmonisation System (GHS) sets out an international agreement by the UN in 2001 on the worldwide format for communicating standardised chemical hazard information. This agreement applies to the hazardous substances containers and packaging, to help COSHH assessors and users identify and understand the nature of the hazards when undertaking work with substances that can harm health.

In the UK the GHS is implemented by the Chemical Labelling and Package legislation (2015), which was re-adopted into UK law in December 2020 following the change in our EU membership, as GB mandatory classification and labelling (GB MCL 2020). All chemicals imported, manufactured, downstream used, or sold in the UK must now follow the GB MCL list.

Hazard Pictograms and signal words

Hazard pictograms are standardised set of nine GHS diamond-shaped symbols that suppliers and manufacturers must displayed on container labels and packaging, and also in the safety data sheet, giving hazard classes of a substance. All pictograms are shown in Appendix 2.

Two signal words may be added to packaging to describe the level hazard severity

Danger means a signal word indicating the more severe hazard categories

Warning means a signal word indicating the less severe hazard categories

Hazard Statements

Hazard statements are standardised GHS phrases declared by the suppliers and manufacturers for describing the hazard descriptions of a substance. Each H-statement also has a standardised three-character code of classification for communicating the hazard. The H-statements are organised into three groups of related hazards: physical hazards H-2XX, health hazards H-3xx, environmental hazards H-4XX. A further 24 H-statements recognised by a previous classification regime (CHIP 2009) were retained by the UK through implementation of CLP (2015) and its successor GB MCL (2020). These H-statements are classified with EUH codes. All H-statements and alpha-numerical codes are listed in Appendix 3.

Precautionary statements

Precautionary statements are standardised GHS phrases declared by the suppliers and manufacturers for describing safety advice for handling a substance. Each P-statement also has a standardised three-character code of classification for communicating the advice. The P-statements are organised into five groups of related advice: generalise advice P-1XX, preventative measures advice P-2XX, emergency response advice P-3XX, storage advice P-4XX, Disposal advice P-5xx. All P-statements and alpha-numerical codes are listed in Appendix 4.

Safety Data Sheets

Safety data sheet (SDS) provide the principle means to communicate product safety information by suppliers and manufacturers. They are not a COSHH assessment but provide much of the key

information needed to undertake an assessment. SDS are arranged under an internationally agreed 16-part format. The format is as follows:

SDS standardised 16-part format with highlighted key details

1. Identification of the substance/mixture and of the company/undertaking; *[location of CAS number]*
2. Hazards identification; *[location of: hazard pictograms and signal words, H-statements, P-statements]*
3. Composition/information on ingredients;
4. First-aid measures;
5. Fire-fighting measures
6. Accidental release measures;
7. Handling and storage;
8. Exposure controls/personal protection; *[location of: WELs as TWA or STEL, also PPE Standards]*
9. Physical and chemical properties;
10. Stability and reactivity;
11. Toxicological information;
12. Ecological information;
13. Disposal considerations;
14. Transport information;
15. Regulatory information;
16. Other information. *[location of: full H-statements]*

Appendix 2: GHS Hazard Pictograms, signal words and hazard categories

Hazard Pictogram	Hazard Class	Signal Words	Hazard Category	H-statements
(Physicochemical)				
	Explosive	Danger/ Warning	Unstable Explosives Explosive, divisions 1.1, 1.2, 1.3, and 1.4 Self-reactive substances/mixtures types A and B. Organic peroxides, types A and B.	H200. H201, H202, H203, H204. H240, H241. H240, H241.
	Oxidising	Danger/ Warning	Oxidising gases, category 1 Oxidising liquids, categories 1, 2 and 3 Oxidising solids, categories 1, 2 and 3	H270. H271, H272/ H272. H271, H272/H272.
	Flammable	Danger/ Warning	Flammable gases, category 1 Flammable aerosols, categories 1 and 2 Flammable liquids, categories 1, 2 and 3 Flammable solids, categories 1 and 2 Pyrophoric liquids, category 1 Pyrophoric solids, Category 1 Substance or mixtures which in contact with water emit flammable gases, categories 1, 2 and 3 Self-reacting substances or mixtures, type B, C, D, E and F Self-heating substances or mixtures, categories 1 and 2 Organic peroxides, type B, C, D, E and F	H220. H222, H229, H223, H229. H224, H225, H226. H228/H228. H250. H250. H260, H261/H261. H241, H242/H242. H251, H252. H241, H242/H242.
	Compressed gases	Warning	Compressed gases Liquefied gases Refrigerated liquefied gases Dissolved gases	H280. H280. H281. H280.

	Corrosive	Danger/ Warning	Corrosive to metals, category 1 Skin corrosion, categories 1A, 1B and 1C Serious eye damage, category 1	H290. H314. H318.
(Health Hazard)				
	Acutely toxic	Danger	Acute toxicity categories 1, 2, and 3 o oral o dermal o inhalation	 H300, H301. H310, H311. H330, H331.
	Serious systematic health hazard	Danger/ Warning	Germ cell mutagenicity, categories 1A, 1B and 2 Carcinogenic, categories 1A, 1B and 2 Reproductive toxins, categories 1A, 1B and 2 Specific target organ toxicity single exposure, category 1 and 2 Specific target organ toxicity repeated exposure, category 1 and 2 Respiratory sensitisation, category 1 Aspiration hazard, category 1	H340, H341. H350, H351. H360, H361. H370, H371. H372, H373. H334. H304.
	Harmful, Irritant	Danger/ Warning	Skin corrosion, category 2 Eye irritation, category 2 Skin sensitisation, categories 1A and 1B Specific target organ toxicity after single exposure, category 3 o Respiratory tract irritation o Narcotic effects Acute toxicity category 4 o oral o dermal o inhalation	H315. H319. H317. H335. H336. H302. H312. H332.
(Environmental)				
	Hazardous to the environment	Warning	Hazardous to the aquatic environment, acute category 1 Hazardous to the aquatic environment, chronic categories 1 and 2	H400. H401, H411.

Note. H420 = hazardous to ozone layer and is classified under the Harmful hazard class and explanation pictogram.

No pictograms are required for the following H-statements and corresponding hazard categories:

H205 (explosive division 1.5), H221 (flammable gases, category 2), H229 (flammable aerosols, category 3), H230 (flammable gases, chemical unstable, category A), H231 (flammable gases, chemical unstable, category B), H362 (reproductive toxicity, additional category for lactation), H412 (hazard to the aquatic environment, chonic category 3), H413 (hazard to the aquatic environment chonic category 4).

Appendix 3: GHS H-statements and codes

H-statement code	Hazard Statement
	Physicochemical
H200	Unstable explosives.
H201	Explosive; mass explosion hazard.
H202	Explosive, severe projection hazard.
H203	Explosive; fire, blast or projection hazard.
H204	Fire or projection hazard.
H205	May mass explode in fire.
H220	Extremely flammable gas.
H221	Flammable gas.
H222	Extremely flammable aerosol.
H223	Flammable aerosol.
H224	Extremely flammable liquid and vapour.
H225	Highly flammable liquid and vapour.
H226	HFlammable liquid and vapour.
H228	Flammable solid.
H240	Heating may cause an explosion.
H241	Heating may cause a fire or explosion.
H242	Heating may cause a fire.
H250	Catches fire spontaneously if exposed to air.
H251	Self-heating: may catch fire.
H252	Self-heating in large quantities; may catch fire.
H260	In contact with water releases flammable gases which may ignite spontaneously.
H261	In contact with water releases flammable gases.
H270	May cause or intensify fire; oxidiser.
H271	May cause fire or explosion; strong oxidiser.
H272	May intensify fire; oxidiser.
H280	Contains gas under pressure; may explode if heated.
H281	Contains refrigerated gas; may cause cryogenic burns or injury.
H290	May be corrosive to metals.
	Health
H300	Fatal if swallowed.
H301	Toxic if swallowed.
H302	Harmful if swallowed.
H304	May be fatal if swallowed and enters airways.
H310	Fatal in contact with skin.
H311	Toxic in contact with skin.
H312	Harmful in contact with skin.
H314	Causes severe skin burns and eye damage.
H315	Causes skin irritation.

H-statement code	Hazard Statement
H317	May cause an allergic skin reaction.
H318	Causes serious eye damage.
H319	Causes serious eye irritation.
H330	Fatal if inhaled.
H331	Toxic if inhaled.
H332	Harmful if inhaled.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H340	May cause genetic defects on exposure.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H351	Suspected of causing cancer.
H360	May damage fertility or the unborn child.
H361	Suspected of damaging fertility or the unborn child.
H362	May cause harm to breast-fed children.
H370	Causes damage to organs.
H371	May cause damage to organs.
H372	Causes damage to organs through prolonged or repeated exposure exposure cause the hazard.
H373	May cause damage to organs through prolonged or repeated exposure exposure cause the hazard.
	Environmental
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
H411	Toxic to aquatic life with long lasting effects.
H412	Harmful to aquatic life with long lasting effects.
H413	May cause long lasting harmful effects to aquatic life.

H-statements for hazards not classified under GHS but adopted under CLP (2015) / GB MCL.

H-statement code	Supplymentary Hazard Statement
EUH 001	Explosive when dry.
EUH 006	Explosive with or without contact with air.
EUH 014	Reacts violently with water.
EUH 018	In use, may form flammable/explosive vapour-air mixture.
EUH 019	May form explosive peroxides.
EUH 044	Risk of explosion if heated under confinement.
EUH 029	Contact with water liberates toxic gas.
EUH 031	Contact with acids liberates toxic gas.
EUH 032	Contact with acids liberates very toxic gas.
EUH 066	Repeated exposure may cause skin dryness or cracking.
EUH 070	Toxic by eye contact.
EUH 071	Corrosive to the respiratory tract.
EUH 059	Hazardous to the ozone layer.
EUH 201	Contains lead. Should not be used on surfaces liable to be chewed or sucked by children.
EUH 201A	Warning! Contains lead.
EUH 202	Cyanoacrylate. Danger. Bonds skin and eyes in seconds. Keep out of the reach of children.
EUH 203	Contains chromium (VI). May produce an allergic reaction.
EUH 204	Contains isocyanates. May produce an allergic reaction.
EUH 205	Contains epoxy constituents. May produce an allergic reaction.
EUH 206	Warning! Do not use together with other products. May release dangerous gases (chlorine)
EUH 207	Warning! Contains cadmium. Dangerous fumes are formed during use. See information supplied by the manufacturer. Comply with the safety instructions.
EUH 208	Contains (name of sensitising substance). May produce an allergic reaction.
EUH 209	Can become highly flammable in use.
EUH 209A	Can become flammable in use.
EUH 210	Safety data sheet available on request.
EUH 401	To avoid risks to human health and the environment, comply with the instructions for use.

Appendix 4: GHS P-statements and codes

P-statement code	Precautionary Statement
	Generalised Advice
P101	If medical advice is needed, have product container or label at hand.
P102	Keep out of reach of children.
P103	Read label before use.
	Emergency Response
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. — No smoking.
P211	Do not spray on an open flame or other ignition source.
P220	Keep/Store away from clothing/combustible materials.
P221	Take any precaution to avoid mixing with combustibles…
P222	Do not allow contact with air.
P223	Keep away from any possible contact with water, because of violent reaction and possible flash fire.
P230	Keep wetted with…
P231	Handle under inert gas.
P232	Protect from moisture.
P233	Keep container tightly closed.
P234	Keep only in original container.
P235	Keep cool.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P244	Keep reduction valves free from grease and oil.
P250	Do not subject to grinding/shock/friction.
P251	Pressurized container: Do not pierce or burn, even after use.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P262	Do not get in eyes, on skin, or on clothing.
P263	Avoid contact during pregnancy/while nursing.
P264	Wash … thoroughly after handling.
P270	Do no eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P281	Use personal protective equipment as required.
P282	Wear cold insulating gloves/face shield/eye protection.
P283	Wear fire/flame resistant/retardant clothing.
P284	Wear respiratory protection.
P285	In case of inadequate ventilation wear respiratory protection.
P231 + P232	Handle under inert gas. Protect from moisture.
P235 + P410	Keep cool. Protect from sunlight.

P-statement code	Precautionary Statement
	Preventative measures
P301	IF SWALLOWED:
P302	IF ON SKIN:
P303	IF ON SKIN (or hair):
P304	IF INHALED:
P305	IF IN EYES:
P306	IF ON CLOTHING:
P307	IF exposed:
P308	IF exposed or concerned:
P309	IF exposed or if you feel unwell:
P310	Immediately call a POISON CENTER or doctor/physician.
P311	Call a POISON CENTER or doctor/physician.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P313	Get medical advice/attention.
P314	Get medical advice/attention if you feel unwell.
P315	Get immediate medical advice/attention.
P320	Specific treatment is urgent (see … on this label).
P321	Specific treatment (see … on this label).
P322	Specific measures (see … on this label).
P330	Rinse mouth.
P331	Do NOT induce vomiting.
P332	If skin irritation occurs:
P333	If skin irritation or rash occurs:
P334	Immerse in cool water/wrap in wet bandages.
P335	Brush off loose particles from skin.
P336	Thaw frosted parts with lukewarm water. Do no rub affected area.
P337	If eye irritation persists:
P338	Remove contact lenses, if present and easy to do. Continue rinsing.
P340	Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P341	If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
P342	If experiencing respiratory symptoms:
P350	Gently wash with plenty of soap and water.
P351	Rinse cautiously with water for several minutes.
P352	Wash with plenty of soap and water.
P353	Rinse skin with water/shower.
P360	Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P361	Remove/Take off immediately all contaminated clothing.
P362	Take off contaminated clothing and wash before reuse.
P363	Wash contaminated clothing before reuse.
P370	In case of fire:
P371	In case of major fire and large quantities:
P372	Explosion risk in case of fire.
P373	DO NOT fight fire when fire reaches explosives.
P374	Fight fire with normal precautions from a reasonable distance.
P375	Fight fire remotely due to the risk of explosion.

P-statement code	Precautionary Statement
P376	Stop leak if safe to do so.
P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P378	Use … for extinction.
P380	Evacuate area.
P381	Eliminate all ignition sources if safe to do so.
P390	Absorb spillage to prevent material damage.
P391	Collect spillage.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P301 +P330 + P331	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P302 + P334	IF ON SKIN: Immerse in cool water/wrap in wet bandages.
P302 + P350	IF ON SKIN: Gently wash with plenty of soap and water.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P304 + P341	IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P306 + P360	IF ON CLOTHING: rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P307 + P311	IF exposed: Call a POISON CENTER or doctor/physician.
P308 + P313	IF exposed or concerned: Get medical advice/attention.
P309 + P311	IF exposed or if you feel unwell: Call a POISON CENTER or doctor/physician.
P332 + P313	If skin irritation occurs: Get medical advice/attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/attention.
P335 + P334	Brush off loose particles from skin. Immerse in cool water/wrap in wet bandages.
P337 + P313	If eye irritation persists: Get medical advice/attention.
P342 + P311	If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
P370 + P376	In case of fire: Stop leak if safe to do so.
P370 + P378	In case of fire: Use … for extinction.
P370 + P380	In case of fire: Evacuate area.
P370 + P380 + P375	In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.
P371 + P380 + P375	In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

Appendix 5: 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