University of Glasgow

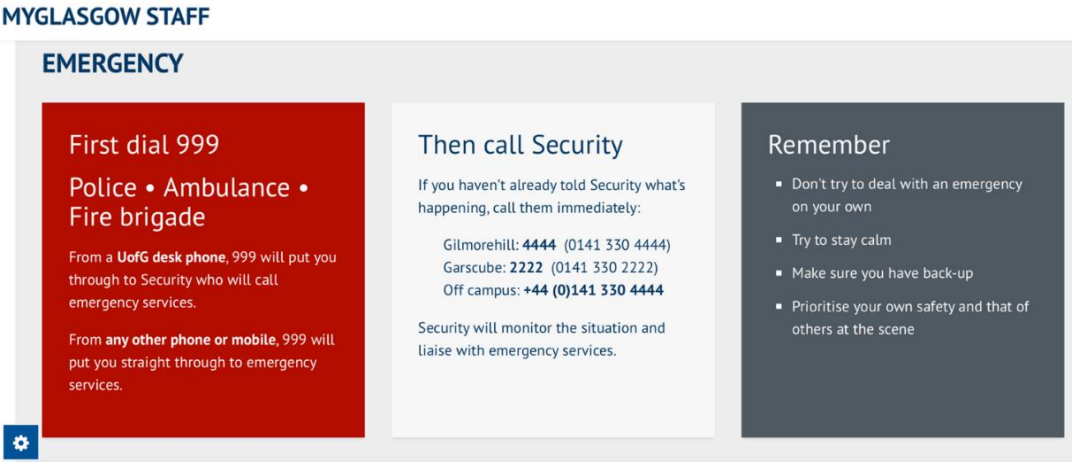
School of Chemistry

Health and Safety Manual

October 2025

Preface: Accidents and Emergencies

IN THE EVENT OF AN EMERGENCY FOLLOW THE GUIDANCE BELOW:



Screen capture from University of Glasgow webpages (https://www.gla.ac.uk/myglasgow/staff/emergencyandcrisissupport/) showing information on to contact during an emergency.

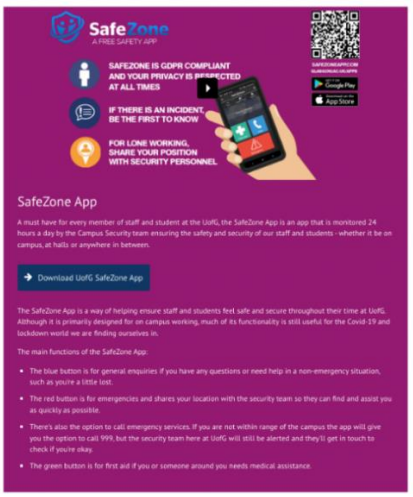
GENERAL EMERGENCY CONTACT INFORMATION:

A list of trained first aiders is given in Appendix 1.

SafeZone App - an app that is monitored 24 hours a day by the Campus Security team ensuring the safety and security of our staff and students. All staff and students in the School of Chemistry should have this app on their personal smart phone or tablet, if they own one.

https://www.gla.ac.uk/myglasgow/securityandoperationalsupport/

https://youtu.be/rm0WAD-kMM4



Screen capture from University of Glasgow webpages showing information on SafeZone app.

Preface: University of Glasgow Safety Advisers

Safety and Environmental Protection Services (SEPS):		
General enquiries: safety@glasgow.ac.uk		
Interim Director of Safety and Resilience:	David Harty	david.harty@glasgow.ac.uk
Chemical Safety Adviser	Ross Slavin	Ross.slavin@glasgow.ac.uk
Safety & Environmental Adviser	Alex Shearer	alex.shearer@glasgow.ac.uk
Biological Safety Adviser	Aude Aumeunier	aude.aumeunier@glasgow.ac.uk
Senior Fire Safety Adviser	Billy Russell	billy.russell@glasgow.ac.uk
Fire Safety Adviser	David Scott	david.g.scott@glasgow.ac.uk
Radiation Protection Service (RPS):		
General enquiries: RPS@glasgow.ac.uk		
Head of Radiation Protection Service (inc. Laser Safety Officer)	Bruce Jolliffe	bruce.jolliffe@glasgow.ac.uk
Occupational Health and Wellbeing:		
General enquiries: ohu@admin.gla.ac.uk		
Head of Occupational Health and Wellbeing	Hazel Bookham	hazel.bookham@glasgow.ac.uk
Gilmorehill Campus Security		
General Enquiries: security-main-campus@glasgow.ac.uk 0141 330 4444		
Head of Security and Logistics	Gary Stephen	gary.stephen@glasgow.ac.uk
Security Operations Managers	Jethro Barclay Conall Rodgers Gerry Moore	security-management-team@glasgow.ac.uk

Contents

FOREWARD

Under the Health and Safety at Work Act, 1974, the University and its employees have legal obligations to ensure that all work is carried out according to safe working practices. In particular, the act requires:

"Clause 7. It shall be the duty of every employee while at work

(a) to take all reasonable care for the health and safety of himself/herself and of other persons who may be affected by his/her acts or omissions at work; and

(b) as regards any duty or requirement imposed by their employer or any other persons by or under any of the relevant statutory provisions, to co-operate so far as necessary to enable that duty or requirement to be performed or complied with.

Clause 8. No person shall intentionally or recklessly interfere with or misuse anything provided in the interest of health, safety or welfare in pursuance of any of the relevant statutory provisions."

Within the Universities, the spirit of the Health and Safety at Work Act is incorporated in the Committee of Vice-Chancellors and Principals of Universities in the U.K. document entitled "Code of Practice for Safety in Universities", which states that:

> **"It is the duty of students to take reasonable care for staff and other students, and anyone else they can reasonably foresee as likely to be affected by their negligence."**

Section 6 of the Health and Safety at Work Act also requires that research workers who design equipment for use in the University are responsible for ensuring that the equipment is safe and without risks to health when properly used. If equipment or materials are ordered from outside suppliers, it is the duty of the research workers to ensure that adequate information about the safe use of the equipment, or details of any precautions to be observed, are obtained from the suppliers. (For postgraduate research students, these responsibilities rest with the supervisor.)

This Safety Manual outlines the **minimum** safety standards required by the School of Chemistry and draws attention to some of the hazards that can arise. It does **NOT** replace the need to take expert advice, to consult the relevant literature, or to design all work to minimise risk to yourself or other workers.

Safety depends on good working practices in such things as the **handling, storage and disposal of chemicals**, the use of protective equipment, design of experiments and equipment and proper care in the use of dangerous substances. The Control of Substances Hazardous to Health (COSHH) Regulations formalise this process and

require that **Written Risk Assessments** are made **BEFORE ANY WORK IS UNDERTAKEN**.

Safety Policy is equally applicable to the environment, and we as a School have ***a duty of care*** to minimise any impact our work may have on the environment. All risk assessments should include detail on the safe disposal of waste or surplus material, whether it is chemical, equipment or electrical.

Special Safety Procedures are required for work with Biological Hazards, Lasers, Radioactive Materials or X-rays and Specialist Advisers for each of these, whose names appear in the Safety Management Structure shown on p. 5, and on p.10, are appointed. These advisers **MUST** be consulted before any work is undertaken in any of these areas.

> **It is a requirement of the School that, before undertaking any practical work, all postgraduate research students (i) undertake the School safety course; (ii) obtain a thorough understanding of all the various procedures detailed in this safety manual and (iii) pass the appropriate safety examination.**

This Safety Manual should be kept available for consultation at all times and should be read in conjunction with the specialist texts which are available for consultation in the Safety Section of the Chemistry Branch Library.

Whilst, as Head of School, I carry ultimate responsibility for all aspects of safety within the School, clearly I cannot do this without the full co-operation of every member of the School in maintaining the highest safety standards in their particular area of work and this is an expectation of you. Please do not hesitate to let me know at any point if you have any concerns etc.

Finally, we wish to acknowledge the help we have received from many UK sources in compiling this manual.

Professor Justin Hargreaves, Head of School of Chemistry

Policy Statement

The Health and Safety at Work Act, 1974, the object of which is to secure the health, safety and welfare of persons at work, came into force on 1st April, 1975. This Act seeks to unify and strengthen existing legislation relating to safety and may be regarded as an enabling Act which lends the force of law to safety regulations introduced in the workplace.

It is the School's policy not only to comply fully with the Health and Safety at Work Act as required by law, but to act positively to prevent injury, ill-health, damage and loss arising from work carried out within its precincts.

Safety Policy is equally applicable to the environment and we as a School have a ***duty of care*** to minimise any impact our work may have on the environment. All risk assessments should include detail on the safe disposal of waste or surplus material, whether it is chemical, equipment or electrical.

It considers the promotion and management of the safety and health of all persons working in the School to be an essential part of the supervisory and academic staff's duties for which they are accountable at all levels. The School will seek to encourage all members of the School to participate in and contribute to the establishment and observance of safe working practices.

However, the School expects all persons working within its precincts to recognise that equally there is a clear duty on them to exercise self-discipline and accept responsibility to do everything they can to prevent injury to themselves and others and loss to the School. Health and Safety must be given equal weight when determining the objectives of any work.

The Control of Substances Hazardous to Health Regulations, 2002 (COSHH) which came into force on 21st November 2002 apply in full to all work carried out in the School.

The School expects all personnel to co-operate fully in carrying out the procedures required by these Regulations and in obeying the Rules of the School, arising from them.

- In accord with the above policy the School of Chemistry will:
- Ensure resources are available to ensure competent advice on safety and health matters.
- Continue to develop and implement procedures and codes of safe working practice.

- Maintain systems for exchange of information with other chemistry schools and schools of chemistry for reporting and controlling safety performance and for monitoring and assessing health at work.
- Provide training in safe working methods.
- Maintain an appropriate framework for consultation on effective measures for continual development and the promotion of safety and health.
- **Where practical, eliminate or minimise all potential risks to health.**

Professor Justin Hargreaves, Head of School of Chemistry

Safety Management Structure

Head of School		
	Justin Hargreaves	Justin.hargreaves@glasgow.ac.uk
Research Section Heads		
Lee Cronin	Complex Chemistry	Lee.cronin@glasgow.ac.uk
Graeme Cooke	Energy Conversion & Storage	Graeme.cooke@glasgow.ac.uk
Ross Forgan	Functional Molecules and Assemblies	Ross.forgan@glasgow.ac.uk
Andrew Jamieson	Chemical Biology & Organic Synthesis	andrew.jamieson.2@glasgow.ac.uk
David Lennon	Heterogeneous Catalysis	David.lennon@glasgow.ac.uk
Adrian Lapthorn	Chemical Photonics	Adrian.lapthorn@glasgow.ac.uk
School Safety Support		
	School Safety Committee	See Appendix 3
Mark Wildman	Safety Coordinator (Technical Services Manager - Research Services)	Chem-safety@glasgow.ac.uk Mark.wildman@glasgow.ac.uk
Alec Mungal	Depute Safety Coordinator (Analytical Services)	Alexander.mungall@glasgow.ac.uk
Joseph Steel	Depute Safety Coordinator (Research Labs)	Joseph.steel@glasgow.ac.uk
Jessica Walker	Depute Safety Coordinator (Teaching Labs)	Jessica.walker@glasgow.ac.uk
John Liddel	Fire Safety Coordinator	John.liddell@glasgow.ac.uk
Finlay Smith	Waste Coordinator	Finlay.smith@glasgow.ac.uk
Carol-Ann Smith	ARC Technical Operations Manager	Carol-anne.smith@glasgow.ac.uk
Cameron Fletcher Mi Mi Sham	Facility Co-ordinators	chemfacilitycoordinator@glasgow.ac.uk
Teaching		
Haralampos Moiras	Director of Learning & Teaching	charalampos.moiras@glasgow.ac.uk
Lloyd Henry	Technical Services Manager – Teaching Services	Lloyd.henry@glasgow.ac.uk
Research		
	Principal Investigators	All academic staff involved in research
	Laboratory Responsible Persons	See Appendix 2
Claire Wilson	Technical Services Manager – Analytical Services	Claire.wilson@glasgow.ac.uk
Subject Specialist Advisors		
Gordon Hedley	Laser	Gordon.hedley@glasgow.ac.uk
Adrian Lapthorn	Biological	Adrian.lapthorn@glasgow.ac.uk
Joy Farnaby	Radiation	Joy.farnaby@glasgow.ac.uk

Glossary of Terms

WEL - Workplace Exposure Limits These are set out by the Health and Safety Executive in guideline EH40, Workplace Exposure Limits in order to help protect the health of workers. WELs are concentrations of hazardous substances in the air, averaged over a specified period of time referred to as a time weighted average (TWA). Two time periods are used: Long term (8hours) and short term (15minutes). Short term exposure limits (STELs) are set to help prevent effects, such as eye irritation, which may occur following exposure for a few minutes. WELs are numerically equivalent to the old OESs and MELs. Previous risk assessments which quote these Occupational Exposure Limits should still be regarded as valid.

OES - Occupational Exposure Standards (Now replaced with WELs). These are the levels set out by the Health and Safety Executive to which people may be exposed during a normal working lifetime without any adverse effect to their health. This normally implies an 8 hour day, 40 hour week. Occasionally a Short Term Exposure Limit, STEL, is quoted for 15 minute exposures.

MEL - Maximum Exposure Limit (Now replaced with WELs). These may be set for substances which may cause serious health effects and for which no "safe" level can be determined. They may also be set for substances for which, although safe levels exist, control to those levels is not reasonably practicable. Limiting concentrations allowed are for short exposures. These levels should never be exceeded.

TLV - Threshold Limiting Values. These levels are set by the American Conference of Governmental Industrial Hygienists. They are quoted in many publications and in all American publications. They have the same effect as the Occupational Exposure Standard set out above and are quoted for both long-term and short-term.

MAC - Maximum Allowable Concentrations. These are the equivalent of the Maximum Exposure Limit.

Flash Point - This is the lowest temperature at which a chemical will, in the presence of air and an ignition source, ignite. It may be quoted for closed or open cup.

Lachrymator - Substances which will attack and irritate the eyes and mucous membranes.

Sensitiser -These are compounds which can cause an allergy or hypersensitivity if a further exposure occurs.

Synergists - Synergists are compounds which, while in themselves may be inactive or weakly active, can greatly enhance the activity of other compounds present in the system.

Carcinogens - Substances known to cause the development of malignant cells in animals.

Mutagens - Chemicals substances or physical agents which raise the frequency of mutation greatly above the normal level. Many chemical mutagens are carcinogens.

Teratogens - Agents which, in pregnancy, produce or induce a physical or functional defect in the embryo, foetus or offspring.

Pyrophoric - Substances which are often spontaneously flammable when exposed to the atmosphere are termed pyrophoric.

LD50 - Lethal Dose 50. It is the lethal dose administered in a single unit which will kill 50% of a population of test animals, normally rats. It is usually quoted for both male and female, based on a 1 kg body weight. Three versions of the LD50 value are normally quoted:

Inhalation - normally expressed as a concentration per litre of air over a 4 hour period.

Oral - Value is for a single dose.

Dermal - The material is applied to the shaved skin of the animal.

1. Organisation and Arrangements

The Safety management structure within the school is outlined on page 5. Line managers are responsible for their staff, PIs and supervisors are responsible for their students and lab users, and lab responsible persons/lab guardians are responsible for safety management in the labs. From here responsibility passes to the individual experimenters or those who organise and run the undergraduate courses. It is emphasised that responsibility for safety and safe working includes all laboratory workers, from undergraduate and project students, through visitors to post-doctoral research associates.

In support of the management team an advisory structure consisting of the Safety Coordinator, Specialist Subject Advisers and the School Safety Committee has been established.

1.1. Head of School

The Head of School is responsible to their line manager and ultimately to the University Court for the management of health and safety matters within their area of control, **so far as these matters are under their control**. This means that a Head of School will have a responsibility for the activities of the staff and students associated with the School but is **NOT** expected to be responsible for matters that fall to other units such as Estates. The Head of School is responsible for ensuring that the University Safety Policy is implemented, current safety legislation is obeyed and safe working practices are adhered to at all times.

1.2. School Safety Coordinator

The role of the Safety Coordinator (and depute safety coordinators if required) is to assist the Head of School, or Service, to discharge their responsibilities for management of health and safety, including environmental protection matters. Duties will normally be delegated by the Head of Unit and will normally include those detailed here:

https://www.gla.ac.uk/myglasgow/seps/safetymanagementforheadsofmanagementunit/appendix2-examplelocalsafetyduties/

The Safety Coordinator(s) will support the implementation of safety control mechanisms and ensure that they are functioning correctly. The Safety Coordinator(s) has the authority to stop any activity which is considered to be unsafe.

1.3. Heads of Sections

Heads of Sections support the Head of School in ensuring that safety policy is known and complied with in all teaching and research activities within their jurisdiction and are

responsible for implementing safety management systems and good practice in their areas of control.

1.4. Laboratory Responsible Persons

These are appointed by the Head of School, with the agreement of the relevant Head of Section. They will normally be a member of the academic staff and will be responsible for safety matters in the laboratory or suite of laboratories which they will oversee such as approval of COSHH forms and risk assessments, record keeping, following up on safety inspections and incidents.

It is also their responsibility to ensure that information on safety and hazards in their laboratories is communicated to all who need to know. Categories at particular risk are undergraduates, visitors and cleaners.

Laboratory Responsible Persons can insist that any activities they regard as unsafe are stopped and if necessary, call upon the Head of Section or, if they are not immediately available, the Head of School, to ensure compliance. The Laboratory Responsible Person will liaise with the Safety Coordinator and/or Head of Section to ensure that any remedial safety work (for example, to rectify unsafe situations uncovered during a safety inspection) is assigned to the appropriate person or persons, and to report to the Head of Section, any non-compliance.

Copies of the risk assessment forms should normally be kept just inside the door of the laboratory. Any exceptions to this should be agreed with the Safety Coordinator. A web-based Risk Assessment templates are available on the SEPS website: https://www.gla.ac.uk/myglasgow/seps/forms/.

Appendix 2 lists the current laboratory Responsible Persons.

1.5. Principal Investigators and Supervisors

PI's are responsible for the safety and safe working of their group, ensuring that the group members are aware of and follow all School safety policies. They are also responsible for checking and signing off all group risk assessments/safe systems of work/SOPs and the appropriate training of post-graduates.

1.6. Teaching Class heads

Teaching Class Heads are responsible for the choice and design of suitable experiments for their class. This will normally be done via staff members appointed to organise specific laboratory courses. It is expected that they will liaise with the Laboratory Responsible Person for the teaching labs (Jessica Walker, Jessica.walker@glasgow.ac.uk), who is responsible for day-to-day safety matters within these labs.

Each class head must carefully check the undergraduate lab manuals for their class to ensure that every procedure is clearly and correctly detailed. This is necessary to protect ourselves, both corporately and as individuals, from any improper or illegal laboratory activities by any of our students.

1.7. Staff

All members of staff are responsible for:

- Demonstrating their personal concern with health and safety at work.
- Engaging the interest and commitment of all persons under their supervision to healthy and safe working practices.
- Requiring that School safety rules are obeyed.
- Complete all mandatory training for the school, College and University.
- Ensuring that the necessary safety equipment is available and used.
- Where appropriate, instructing members of their research groups and technicians under their supervision in safe working practices.
- Where appropriate, nominating an alternative supervisor, who must be informed of the work in progress, during absences from the School of more than three working days.

1.8. Specialist Subject Advisers

Ross Slavin	Chemical Safety Adviser (SEPS)	ross.slavin@glasgow.ac.uk
Gordon Hedley	Laser Safety Adviser	Gordon.hedley@glasgow.ac.uk
Joy Farnaby	Radiation Hazards Adviser	Joy.farnaby@glasgow.ac.uk
Adrian Lapthorn	Biological Hazards Adviser	Adrian.lapthorn@glasgow.ac.uk
Finlay Smith	Waste Disposal	Finlay.smith@glasgow.ac.uk

1.9. Safety Committee

The Safety Committee is convened by the Head of School or their representative, and includes the Safety Coordinator, Specialist Subject Advisers, Area Fire Officer (AFO), representatives of technical staff, post-doctoral research assistants, research students and trade unions. Its role is to advise the Head of School on safety issues by supporting the development of local policy and procedures on the operational aspects of the work within the unit and to monitor compliance with safety regulations. Its members may be called to make inspections. The committee meets on a regular basis to discuss safety issues and formulate safety policy. Requests to bring matters concerning safety onto a meeting agenda can be made to the Chair of the Safety Committee, Safety Coordinator

or any committee member. A list of the current membership of the Safety Committee is to be found in Appendix 3.

1.10. Training of Research Workers

Safety training must be given to all post-graduate and undergraduate students, and will be arranged via the Class Head, PI, Section Head or Safety Coordinator as appropriate.

All post-graduate researchers are required to read this Safety Manual and to attend a series of safety lectures.

There is a procedure for safety training of short-term placements/visitors (up to 3 month), who will be required to complete a Moodle quiz (the type of which is to be advised by PI/Supervisor).

A written exam will be set based on the manual and Chemistry Safety Course on Moodle, and a successful outcome (with a pass mark of 65%) is required before practical work can commence.

Lab work cannot take place until the safety exam is passed!

Contact John Liddell (John.Liddell@glasgow.ac.uk) to arrange the exam.

Demonstrations will be given, normally by local lab technicians, in the correct use of various items of safety equipment.

PhD students that demonstrate to undergraduate practical classes are required to attend the Graduate Teaching Assistant training provided by the University, to attend subject specific training and practical demonstrations/run-throughs of experiments.

2. Risks and Hazards.

For each experiment or mini project, researchers must complete a risk assessment form listing substances to be used, the procedures to be followed, and evaluation of the risks.

It is important to understand the difference between hazard and risk. A hazard is anything which has the potential to cause harm. A risk is a combination of the likelihood and consequences of harm if actually exposed to the hazard.

2.1. Risk Assessment

The purpose of risk assessment is to help you identify the significant risks of your work to ensure that control measures are in place to protect people against harm so that the work can be carried out safely. The Health and Safety at Work Act and the Management of Health and Safety at Work Regulations require a suitable and sufficient assessment of the risks to the health and safety of workers to which they are exposed whilst at work

and to others who might be affected by the work. You are legally required to assess the risks in your work so that you can put in place measures to control the risks. The law does not expect you to eliminate all risks, but you are required to protect people as far as reasonably practicable by controlling the risks of your work. University policy requires that all units have robust systems in place to manage the risks associated with their activities and risk assessment and control are critical for this process.

Managers, principal investigators and supervisors of UG and PG students are responsible for ensuring that risk assessments are actually done, effective controls are established for the work and they are recorded, regularly monitored and reviewed when needed. Review should occur annually, following a change that affects the task, or following an incident. The risk assessment should identify the hazards, decide who is at risk, assess the level of risks to people and establish suitable controls to ensure that the work can be done safely. Risk assessments must be carried out by competent persons and done before work starts. Remember that the objective of risk assessment is to enable you to identify and to control the risks of your work in actual practice.

To carry out your risk assessment you should first download a risk assessment form. This can be found here: https://www.gla.ac.uk/myglasgow/seps/forms/

You should follow the HSE guidance on five steps to risk assessment which is described below and will help you carry out your risk assessment. You should follow the HSE guidance on five steps to risk assessment which is described below and will help you carry out your risk assessment.

2.1.1. HSE Five Steps to Risk Assessment

The Health and Safety Executive provide practical step by step guidance on its website on how to carry out a risk assessment together with supporting information and example risk assessments for all sorts of work. https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm

Please read the following guidance on each step since it will help you understand how to best do your risk assessments and safely carry out the work. Risk assessment: Steps needed to manage risk - HSE

Step 1: Identify Hazards: https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Identify_hazards

Step 2: Assess the risks: https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Assess_the_risks

Step 3: Control the risks: https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Control_the_risks

Step 4: Record your findings: https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Record_your_findings

Step 5: Review the controls: https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Review

If you need any advice on risk assessments and controls then please first contact your line manager or supervisor, then the identified subject experts as nominated in this manual. The Safety coordinator can help identifying advisors. Managers and safety coordinators can be obtain more detailed advice where necessary from SEPS. When mitigating risk, look at what you are already doing, and the controls you already have in place, and follow the hierarchy of control measures:

www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm#_Control_the_risks

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment

Risk Assessments Must Be Suitable and Sufficient

Risk assessments have to be suitable and sufficient and as such must have a broad enough scope so that they identify and establish measures to protect against all significant risks not just the most obvious ones associated with the work. This will enable valid decisions to be made about what needs to be done to eliminate or adequately control the risks related to all aspects of the work including the routine and non-routine work as well as any reasonably foreseeable emergencies where things may go wrong. The risk assessment must take account of groups of people who may be particularly vulnerable to risks such as visitors, young persons and new or expectant mothers.

It is important that the risk assessment is clear and statements about risks and controls are properly justified. Avoid being unnecessarily restrictive and try to anticipate future changes and incorporate these into the risk assessment. The information should be kept as brief as possible and focused on what is needed to understand the risk assessment. It must be able to be understood without referring to any other documents, but you can certainly add useful supporting references such as official guidance, standards and scientific publications. Remember that you are writing a risk assessment so you do not have to justify doing the work only that it will be done safely.

The controls must be effective enough to ensure that the work can be done safely while protecting workers and any other people who might be affected by the work. Risk assessments need to be sufficiently specific but should however be easily understood by your colleagues, workers, safety advisers and HSE inspectors. All workers must be provided with appropriate information, instructions and training on the hazards, risks and controls of the work to enable them to safely and competently perform their work.

2.2.Control of Substances Hazardous to Health (COSHH) Regulations

The current Control of Substances Hazardous to Health Regulations, known by the acronym COSHH, came into force on 21st November 2002 and has had the effect of formalising what was good working practice.

The Regulations were brought in to allow the UK government to comply with a European Community directive and to fulfil its obligations under an International Labour Organisation convention. They also clarified aspects of the Health and Safety at Work Act and allowed some outdated legislation to be eliminated.

The requirements of the Regulations are to:

- Assess the risk to health arising from work and to assess what precautions are needed.
- Introduce appropriate measures to prevent or control the risk.
- Ensure that control measures are used and that equipment is properly maintained and procedures observed.
- Where necessary, monitor the exposure of the workers and carry out an appropriate form of surveillance of their health.
- Inform, instruct and train employees about the risks and the precautions to be taken.

2.3. Implementation of the COSHH Regulations

For Control of Substances Hazardous to Health, it is necessary to consider the **RISK** related to the probability of exposure of worker and public to substances and the seriousness of such exposure. It is necessary that workers are aware of the **RISK** involved in what they are doing and take action to minimise it. **EVIDENCE** of both knowledge and action must exist. Our internal rules are framed to satisfy these requirements but, at the same time, allow intelligent initiative on the part of researchers.

We choose to work in terms of an **EXPERIMENT** or a **PROCESS** which is broadly defined as a sequence of **OPERATIONS** involving the use of hazardous **SUBSTANCES** (reagents, solvents) which starts and finishes from situations at or near zero risk. A typical example could be a preparative reaction, which starts from clean glassware and safely

stored reagents. Typically, it might involve glassware set-up, transfer of reagents, heating, reaction monitoring, isolation and characterisation of a product. It would finish with reagents and products being safely stored, and residues correctly disposed of.

The **RISK** in an experiment reflects the nature of the **SUBSTANCES** used (toxicity, physical form) and the exposure potential of the **OPERATIONS** involved. Prior to **EXPERIMENT**, the research worker must estimate contributions to the **RISK** and combine them in a **COSHH ASSESSMENT** which will guide him as to the **ACTION** they should take in Control of his substances, and as to the **DOCUMENTATION** required. The matrices shown are based on those in the RSC leaflet entitled "COSHH IN LABORATORIES" https://edu.rsc.org/resources/coshh-resource/1116.article and provide a common sense guide to the assessment of risk, and appropriate precautions in an experiment. Information on good laboratory practice is contained in the RSC leaflet entitled "SAFE PRACTICES IN CHEMICAL LABORATORIES" https://edu.rsc.org/resources/laboratory-best-practices/1418.article.

Current risk assessment & COSHH forms are available here:

https://www.gla.ac.uk/myglasgow/seps/forms/

International COSHH hazard symbols can be found via the link below and in Appendix 4.

https://www.hse.gov.uk/chemical-classification/labelling-packaging/hazard-symbols-hazard-pictograms.htm

2.4. Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)

Where quantities of flammable liquid/vapour or compressed gases are being used or have a potential to be released into the atmosphere, specific control measures relating to controlling these flammable and/or explosive atmospheres must be put in place. Please contact SEPS for specific advice on DSEAR risk assessment:

https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/

https://www.gla.ac.uk/media/Media_932429_smxx.docx

3. Safety Regulations and School Practice

3.1. Training Needs Analysis

Incoming research workers will be familiar with most standard laboratory techniques to a greater or lesser extent. Inevitably new operations will be required at some stage, and even familiar operations may take on a new emphasis when applied to more hazardous substances or more extreme conditions than have been encountered before. Both students and supervisors should carefully consider each experimental operation being

planned when risk assessment forms are being completed. If either feels that additional training is necessary or desirable for any operation, the supervisor should arrange to have this carried out at the appropriate time. Details should be outlined on the risk assessment form. Formal records of training should be kept for audit purposes.

3.2. Substances

All commercial chemicals in laboratories will have had their hazards identified by the manufacturer/supplier or safety literature and will have a Safety Data Sheet (SDS). The hazards, both physical and chemical, should then be listed when completing a risk assessment. If you are unfamiliar with the techniques needed to handle materials with a high or unusual (to you) hazard, consult your supervisor and note on your risk assessment form when appropriate training will be provided.

3.3.Assessment and Documentation

The Risk Assessment form must be written by and signed by the researcher; submitted to, checked and signed by the supervisor; and a digital copy retained for auditing purposes. Only one copy of the completed form will need to be printed, signed and retained in a secure place in the research laboratory. Each Risk Assessment form must have an assessment number affixed to it.

Where practical digital copies of completed and signed Risk Assessments should also be sent to the School Safety Coordinator at chem-safety@glasgow.ac.uk with the subject line: 'Completed Risk Assessment'.

It is recommended that all experiments should have a top-level risk assessment that is signed off, stored centrally in an accessible drive and stored locally as a hard-copy in the lab. Dynamic risk assessments for evolving experimental conditions can be written and stored locally in lab books. However, where possible, these should have a back-up digital copy (e.g. scan/photograph) and should be submitted to the safety coordinator for record keeping.

Further general information on COSHH regulations can be obtained from the website of Safety and Environmental Protection Services (SEPS) of the University of Glasgow at:

https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/

https://www.gla.ac.uk/myglasgow/seps/biological%20safety/

3.3.1. Additional Risk Assessment Guidance

- If an experiment involves unfamiliar operations and substances, or the scale is increased, then a full new assessment must be carried out and discussed with the supervisor before starting experimental work. A Risk Assessment form must be completed and signed by the researcher and countersigned by the supervisor.

- If an experiment involves familiar operations and reagents and the use of substances closely related to those in a previously assessed experiment and the scale remains unchanged then a cross reference in your laboratory notebook to the earlier assessment will normally be sufficient.
- If an experiment or project develops and the materials to be used have not been covered in the original assessment, a new Risk Assessment must be made and recorded.
- A digital copy (e.g., on digital notebooks, or scanned hard copy) of the lab notes should be retained either by the researcher or supervisor to prevent loss in the event of fire or accident.
- Operations using certain specialised techniques, or where particularly unpleasant chemicals, e.g. anhydrous HF, F_2 or volatile fluids, are involved, must be based on written protocols. Digital copies should also be filed with the research group and hard copies available within the laboratory for immediate reference. A digital copy should also be sent to the Safety Coordinator for record keeping.
- Update risk assessments regularly. If there has been no change after one year, you should re-evaluate, re-sign and date your last COSHH form as evidence of continuing risk assessment.
- The assessment dictates location, level of containment, and any additional control measures for the experiment. It is the responsibility of both researcher and supervisor to ensure that appropriate action follows the assessment.

In case of doubt about Assessment, Documentation or Action, the Supervisor, Specialist Subject Adviser or Safety Coordinator should be consulted.

4. Fire Safety

EMERGENCY EVACUATION

Continuous sounding of the alarms will normally mean that there is a fire and that everyone must leave the building and assemble at the nearest muster point. There will be practice fire drills from time to time.

Staff, students or visitors with mobility impairment should make their way to a designated ‘Refuge’ area, if safe and practical to do so. These are on each landing of the main stairwells in B-wing. People should use the refuge call point to summon assistance. All staff, students or visitors requiring additional mobility support should complete a personal emergency evacuation plan (PEEP). Staff should contact their line manager and students contact Student support office for guidance on developing a PEEP.

Note that the alarm sirens will be tested, in short blasts, weekly during term each Tuesday at 2pm.

4.1. Fire Precautions

- Do not wedge or prop open the smoke doors that safeguard staircases, or the fire separation doors in corridors. Keep access and escape routes clear.
- Know the location of fire alarm call points and fire appliances.
- Report to the FSC, Mr John Liddell John.Liddell@glasgow.ac.uk, any missing, damaged or used fire extinguishers.
- Do not allow wastepaper and combustible materials to accumulate.
- Do not use corridors or under stairways as storage areas.
- Observe the 'No Smoking' rules. The School of Chemistry is a no-smoking area, including e-cigarettes.
- Be aware of any specific fire hazards in your laboratory.

Before fire occurs happens, be familiar with the information on fire prevention and on fire-fighting. At an early opportunity, research workers must attend a training session in fire safety, which are held by SEPS when required:
https://www.gla.ac.uk/myglasgow/seps/training/firesafetytraining/

Learn the location of fire alarms call points, fire blankets and extinguishers, especially in your own laboratory, before commencing work. Be prepared to use the extinguishers for small fires.

Fires in fume cupboards are particularly dangerous as they are fanned by the extractor draught and can easily spread out of reach behind the baffles. They can be tackled in the appropriate way, but switch off the extract fan and close the sash to prevent spread of the blaze. Modern fume cupboards have a built-in dried chemical powder fire extinguisher, activated by a senser in the top of the fume cupboard. You should make yourself familiar with the fume cupboard you are going to use.

4.2.Tackling a fire

First raise the fire alarm. Evacuating safely should be the top priority.

Tackle the fire using extinguishers only if it is safe and you are trained to do so. Do not over assess your ability to cope, and make sure you have a clear escape route. If attempts to extinguish the fire are proving unsuccessful, switch off fume cupboards (if safe to do so), close windows and doors and evacuate:

Use all of the fire extinguisher, if one extinguisher does not put out the fire, do not try a second one, evacuate immediately and wait for emergency services.

There are several types of fire extinguishers available for use in the School; each has different properties.

4.2.1. Carbon Dioxide Extinguisher

A CO_2 extinguisher produces a high-pressure stream of carbon dioxide gas which should be directed at the base of the fire. The gas depletes the fire of oxygen and also cools the source of the fire. It is regarded as the general-purpose extinguisher for use in the laboratory. Don't touch the horn or the base of carbon dioxide extinguisher as this will cause severe cold burns. A CO_2 extinguisher can't be used in confined spaces as it may result in asphyxiation.

4.2.2. Dry Powder Extinguisher

Dry Powder Extinguishers release a stream of dry powder which is used to smother the fire. If you use the powder extinguisher you should seek medical attention as it can cause breathing problems

4.2.3. Sand Bucket (normally red in colour).

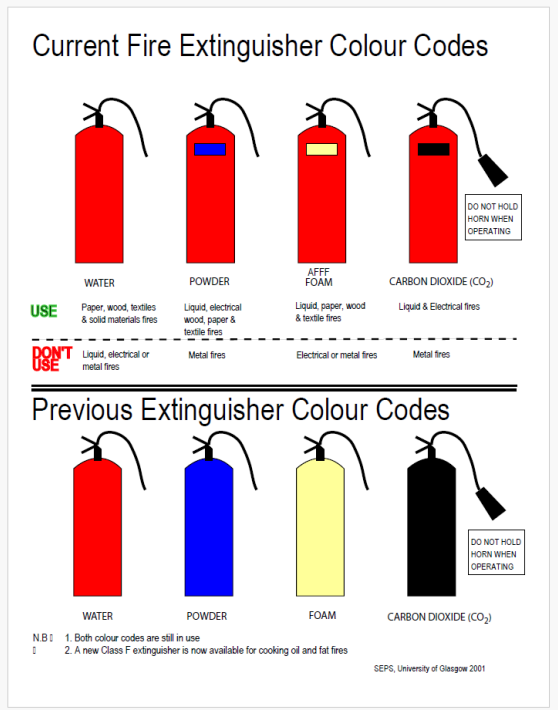
Dry sand is effective at smothering small fires caused by alkali metals or metal hydrides. Common practice is to have a polythene bag filled with sand beside you when there is a risk of this type of fire. When the bag is placed on the fire, the plastic melts thus releasing the sand to smother the fire.

4.2.4. Fire Blanket

Fire blankets are effective in smothering clothing fires.

Fire Extinguishers - Colour Code Chart:
https://www.gla.ac.uk/media/Media_39733_smxx.pdf

Fire Extinguishers - Colours, Classes and Guidance on Use:
https://www.gla.ac.uk/media/Media_185169_smxx.pdf



Fire extinguishers Colour Code Chart

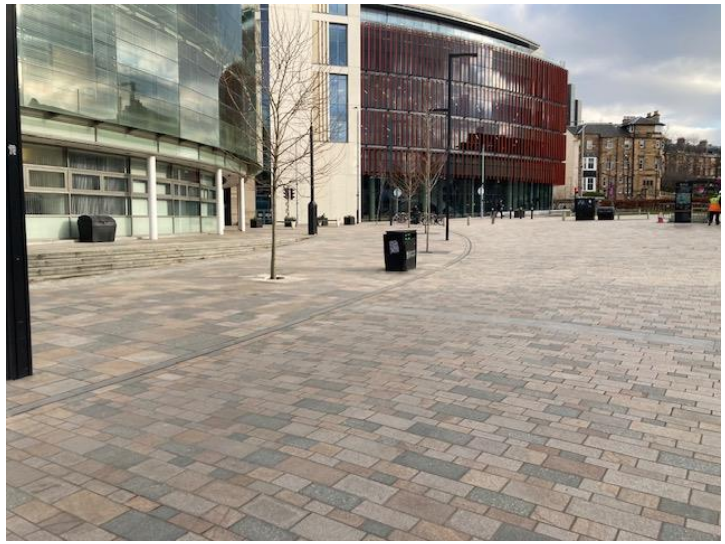
4.3.On discovering a fire which cannot be easily controlled

- Raise the alarm by breaking the glass of the nearest fire alarm call point (normally found at the ends of corridors, close to stairways and exits).
- Call the Fire Service. The fire alarm system automatically sends a signal to the Security Office and the Fire Service is contacted. Nevertheless, if a telephone is within reach, the person discovering the fire should immediately dial 999 and also call the Security Office by dialling 4444 (or 0141 330 4444 on a mobile phone).
- Evacuate the premises by the nearest possible route. Do not use the lifts. All persons evacuated should muster at one of the locations in the image below.

4.4.Fire Wardens

Fire Wardens duties include the following:

- Check "area clear" for the region you are in when the alarm sounds, and report this at the Fire Safety Coordinator at the main door (Janitors' box) or by radio if you have one (channel 2, sub channel 1).
- Insist that evacuees proceed swiftly to the designated muster points. Do not allow loitering in the roadways around the Joseph Black Building to allow the fire service access.
- Do not allow anyone to enter or re-enter the building until the "all clear" has been given by the Fire Officer.



Muster point 1: University Place outside the OTC building

Muster point 2: The Physics car park facing Zoology

Muster point 3: The lane between Physics and the Bower Building

Muster point 4: Courtyard area at the Sir Graeme Davies Building (SGDB)

5. Accidents and Incidents

5.1. First response

First-aid treatment should be given as quickly as practical in a safe area, utilising the nearest first-aid box. Make sure that you know where the First Aid kit closest to your laboratory is situated. Notify your nearest first-aider or emergency first-aider (Appendix 1) immediately.

For more serious cases, contact one of the qualified first-aiders (Appendix 1) who may instruct an ambulance to be called. For very urgent cases (for example, major burns, severe haemorrhage, cyanide poisoning) an ambulance should be called immediately by dialling 999 and then contact Security on 4444. If calling from a mobile phone please use 0141 330 4444. Ensure that you identify yourself and the School/building.

Labs should have appropriate alarms and detectors indicating the presence of toxic gas or vapour above designated limits. If you hear one of these detectors leave the lab immediately. If there is a suspected leak of toxic gas or vapour in your laboratory causing discomfort or danger, evacuate the lab immediately and contact Head of Section or Safety Coordinator.

5.2. Reporting accidents, incidents and near misses

The proper recording of accidents is important. Such records help us to improve our safety arrangements and may be needed in the event of insurance claims or legal proceedings.

All work-related accidents involving injury or damage to property and "near-miss" incidents that did not, but had the potential to cause harm, **MUST** be reported to the Safety and Environmental Protection Service. This includes any incidents that happen while homeworking, but only if these are work-related. SEPS should also be notified immediately by e-mail of any serious incidents. When reporting incidents the PI/Line Manager email address should be specified so that appropriate follow up can be arranged and documentation shared. The School Safety Coordinator email address should be populated automatically.

https://www.gla.ac.uk/myglasgow/seps/reportanincident/

Trivial cuts and burns which can be adequately treated on the spot and do not cause the victim to cease work must still be reported. Written reports are required for **ALL** accidents causing personal injury serious enough to require medical attention.

If the injured person cannot complete the form, the responsibility for reporting accidents lies with the most senior person present and uninjured, or, if there are no witnesses, with the first person to arrive on the scene.

These are submitted directly to SEPS and the Safety Coordinator who will arrange appropriate follow-up.

If you discover such materials as blood or syringes in public places within the University grounds, the advice is that you should take steps to close off the site as far as is reasonable and inform the Security who will detail appropriately trained cleaning staff to attend as soon as possible. Security, who will then contact the relevant personnel.

You should **NOT** attempt to dispose of the materials and clean the site yourself.

6. Lone Working Policy

Working alone in the context of safety is defined as being alone and no-one else being aware of your presence. It is a risk because normal emergency procedures and staff are usually not available under such circumstances. School policy is that this situation is an exception, never a rule, and the following guidelines are minimum requirements to ensure personal safety:

1. **Use the SafeZone App.** The SafeZone App is designed to enable users to log on and off at different locations on University premises. On University premises, and elsewhere, the app also enables them to summon help through a one-touch activation on their mobile 'phone screen. This will connect to the Security and Operational Support 24-hr control room team. The app can also be used to send out notifications to all or selected users about specific problems or hazards - such as a fire situation, impending severe weather warning etc.
2. Make sure that you have signed in and out of the building in the log book at the Janitors box when working out with normal working hours.
3. Do not leave building entry routes unlocked after working hours.
4. Work near a telephone.
5. If you require emergency services dial 999 and then dial extension 4444 (0141 330 4444 from mobile) so that security staff can assist in reaching you.
6. Ensure that the availability and type of aid, and the means of summoning aid are consistent with the nature of the hazard and the degree of exposure as identified by a thorough risk assessment.
7. Risk Assessments involving lone working out with normal hours must be counter-signed by the appropriate Head of Research Area or supervisor/PI and a copy sent to the safety coordinator for record keeping.

For further guidance please use the following link:

https://www.gla.ac.uk/myglasgow/seps/az/loneandoutofhoursactivities/

7. Control Measures

Under the above Regulations, where control equipment is being employed to allow the use of a hazardous material, then the efficiency of the control measure must be monitored.

7.1.Fume Cupboards

This is the main control equipment used by the School; there must be an annual engineering inspection of the cupboards, ducting and fan motors. The cupboards must be inspected by users prior to use.

https://www.gla.ac.uk/media/Media_932358_smxx.docx

7.2. Eye Protection

It is a School policy and requirement to wear eye protection in laboratories. Frequent lab users can obtain safety glasses from Chemistry Store, labs should be able to provide safety glasses for occasional visitors prior to them accessing the lab. Normal prescription glasses do not offer enough protection, and protective over-goggles must be worn with them. These can also be obtained from Chemistry store.

Spectacles should be worn in preference to contact lenses, which could trap chemicals between the lens and the eye. Soft lenes in particular can also absorb solvent vapour.

7.3. Respiratory Protective Equipment

This should not be used in general research laboratories, but may be required following a Risk Assessment when performing tasks such as dispensing solvent from bulk containers etc. It is the duty of the user to determine the properties of the equipment/filter and use it correctly. Prior to first use, each user must have a face fit test carried out to ensure that the face seal is completely effective. Work requiring the use of this equipment must not be done unaccompanied.

7.4. Air Monitoring

The efficiency of a control measure must be tested. Air monitoring might therefore be carried out during laboratory inspections or following a request to do so. SEPS can be contacted to assist with arranging air monitoring.

7.5. Health Surveillance

If the risk assessment identifies a particular hazard that has the potential to cause medium to long-term occupational harm a Health Surveillance Risk Assessment should be completed. Health risks which require health surveillance include but are not limited to:

- noise (https://www.hse.gov.uk/noise/healthsurveillance.htm)
- vibration (https://www.hse.gov.uk/vibration/hav/protect.htm#health-surveillance)
- substances hazardous to health (such as carcinogens): https://www.hse.gov.uk/coshh/basics/surveillance.htm

https://www.gla.ac.uk/myglasgow/seps/az/healthsurveillance/

Health surveillance is not the same as health monitoring, health promotion or health screening. It should only be used for workers who need it; provides feedback about actions you may need to take to prevent further harm and protect others, allows workers to raise concerns about how work affects their health and provides the opportunity to reinforce workers' training and education. On completion of a Health Surveillance Risk Assessment. SEPS and the Occupational Health Service should be consulted to make arrangements to mitigate and control these risks.

7.5.1. Allergies and Dermatitis

Some individuals are sensitive to certain chemicals, which can cause skin rashes, respiratory and other allergic reactions. It is important to avoid contact with such materials. Use of protective gloves might be enough to control the reaction, but in other cases it can be necessary to stop using those chemicals altogether and may even require re-location to a lab which is free of such agents. The Occupational Health Service offer health surveillance to all personnel where respiratory allergy may be an issue:

https://www.gla.ac.uk/myglasgow/seps/az/healthsurveillance/

8. Toxic Hazard Classification

Materials can be classified into one of four toxic hazard categories: Very High (V), High (H), Medium (M), and Low (L). The criteria for classification are outlined below. In some cases, the guidelines are linked to the standard risk phrases used on labels and hazard data sheets. These phrases are shown in bold. In case of difficulty, the Supervisor, Safety Officer or Chemicals Safety Adviser should be consulted for advice. If the resultant Hazard Classification is Very High (V) or High (H), consider reducing the hazard by eliminating a material or by using a substitute. Workplace exposure limits (WELs) for common solvents are provided in Appendix 5.

8.1. Very High Toxic Hazard (VH)

A material which meets any of the following criteria:

- Workplace Exposure Limit (WEL) < 0.1 ppm for vapour or < 0.1 mg/m^3 for dusts
- Is very toxic by acute exposure:-

  - LC50 rat 0.5mg/L/4hr or less - VERY TOXIC BY INHALATION
  - Dermal LD50 rat or rabbit 50mg/kg or less - VERY TOXIC IN CONTACT WITH SKIN
  - Oral LD50 rat 25mg/kg or less - VERY TOXIC IF SWALLOWED
- Sub-acute toxicity with oral no effect level < 0.1 mg/kg/day or equivalent dosage by other routes.
- Proven human carcinogen. See Carcinogens, Mutagens and Teratogens for further guidance.
- Respiratory sensitiser - MAY CAUSE SENSITISATION BY INHALATION
- Substances of unknown toxicity which, after inspection of the structure or other data, are likely to be classified as having an OES below the above limit.
- Substances which have a hazard equivalent to those in the above list in terms of radioactivity.
- Substances which are explosive or are very strong oxidizers.
- Substances which are pyrophoric.

8.2. High Toxic Hazard (H)

- Workplace Exposure Limit (WEL) > 0.1ppm and < 10ppm for vapour or > 0.1mg/m^3 and < 1mg/m^3 for dusts.
- Is toxic by acute exposure:
  - LC50 rat 0.5mg - 2mg/L/4hr - TOXIC BY INHALATION
  - Dermal LD50 rat or rabbit 50mg-400mg/kg - TOXIC IN CONTACT WITH SKIN
  - Oral LD50 rat 25mg-200mg/kg - TOXIC IF SWALLOWED
- Sub-acute toxicity with oral no effect level < 1mg/kg/day or equivalent dosage by other routes.
- Corrosive: CAUSES BURNS/CAUSES SEVERE BURNS
- Extreme skin or eye irritants - RISK OF SERIOUS DAMAGE TO EYES.
- Proven animal carcinogen or materials with suspected carcinogen activity but unknown potency.
- Substances of unknown toxicity which, after inspection of the structure or other data are likely to be classified as having an WEL within the above range.
- Substances which are potentially explosive.
- Substances which are potentially pyrophoric.
- Substances under high pressure in an autoclave or other reaction vessel i.e. hydrogenation.
- Substances which have a hazard equivalent to those in the above list in terms of radioactivity.

8.3. Medium Toxic Hazard (M)

A material which meets any of the following criteria but does not fall into a higher classification.

- Workplace Exposure Limit (WEL) < 500ppm for vapour or < 10mg/m3 for dusts
- Is harmful following acute exposure:
    - LC50 rat 2.0mg-20mg/L/4hr - HARMFUL BY INHALATION
    - Dermal LD50 rat or rabbit 400mg-2000mg/kg - HARMFUL IN CONTACT WITH SKIN
    - Oral LD50 rat 200mg-2000mg/kg - HARMFUL IF SWALLOWED
- Sub-acute toxicity with oral no effect level of 1-50mg/kg/day or equivalent dosage by other routes
- Skin or eye irritants - IRRITATING TO EYES
- Skin Sensitisers - MAY CAUSE SKIN SENSITISATION BY SKIN CONTACT
- Low potency carcinogens
- Substances which have a hazard equivalent to those in the above list in terms of radioactivity.

8.4.Low Hazard (L)

A material which meets any of the following criteria but does not fall into a higher classification:

- Workplace Exposure Limit (WEL) > 500ppm for vapour or > 10mg/m^3 for dusts
- Substances which are non-harmful following acute exposure:
    - LC50 rat > 20mg/L/4hr
    - Dermal LD50 rat or rabbit > 2000mg/kg
    - Oral LD50 rat > 2000mg/kg
- Sub-acute toxicity with oral no effect level of > 50mg/kg/day or equivalent dosage by other routes.
- Non-irritant material
- Non-genotoxic and non-carcinogenic materials
- Materials which are not skin sensitisers (chemicals known or suspected of being absorbed through the skin will have the notation SKIN in their hazard data. Note that the absence of this notation does not guarantee that the material will not be absorbed through the skin).
- Substances which have a hazard equivalent to those in the above list in terms of radioactivity.

8.5. Exposure Potential

The risk presented by working with a material depends on the likelihood of exposure to it as well as the hazard category of the material itself. The following matrix should be used to calculate the exposure potential for each reactant.

	SCORE	**0**	**1**	**2**
EXPOSURE POTENTIAL: key factors	A: Quantity	< 1g	1 – 20 g	20g – 1 kg
		< 1ml	1 – 20 ml	20 ml - 1L
	B: Physical Form	Dense Solids Non-volatile liquids (b.p.>180°C) Dilute Solutions No skin absorption	Dusty Solids Volatile liquids (b.p. 80-180°C) Conc. Solution Low Skin absorption	Gases Highly Volatile liquids (b.p.<80 C) Aerosols High skin absorption
	C: Inherent Character of Unit Operation	- Enclosed System - Low Chance of Mishap	Partly Open System Low Chance of Mishap	Fully Open System Medium/High Chance of Mishap

EXPOSURE POTENTIAL (EP) is the sum of scores for A, B and C i.e. EP = [A] + [B] + [C]

Note that prolonged or repeated exposure may warrant a higher EP category.

TOTAL SCORE	**EP**
≤ 3	LOW
4	MEDIUM
≥ 5	HIGH

8.6.Toxic Hazard Risk Assessment Score

TOXIC HAZARD CATEGORY	LOW	MEDIUM	HIGH
VERY HIGH (V)	4	8	12
HIGH (H)	3	6	9
MEDIUM (M)	2	4	6
LOW (L)	1	2	3

EXPOSURE POTENTIAL

8.7. Location of work for Toxic Hazards

With a risk score of 1, operations on an open bench are appropriate. Scores of 2 or 3 will require use of appropriate control measures. With a risk score of 4 or 5, special facilities such as glove boxes will be necessary, and use of the Special Operations Lab might be considered for some operations.

In summary, to successfully complete a Risk Assessment of an experiment or mini project, it is necessary to consider:

- Hazards associated with the materials and associated operations.
- Suitable control measures (see literature and/or seek safety advice from SEPS/supervisor/safety coordinator
- Emergency Procedures https://www.gla.ac.uk/myglasgow/seps/emergencies/
- Disposal Procedures https://www.gla.ac.uk/myglasgow/seps/specialistwastes/
- Exposure Potential
- Risk Assessment Score
- Training Requirement

These considerations are then formalised in the completion of a COSHH risk assessment form. Copies of the forms adopted by the School of Chemistry for chemical hazards and biological hazards are shown on the next pages, along with the instruction sheets for their successful completion.

Blank forms and instruction notes can be downloaded from the School Safety website at:

https://www.gla.ac.uk/schools/chemistry/informationforcurrentstudentsandstaff/safety/

9. Solvents

Each occupant of a laboratory is allowed a maximum of 2 litres of solvent at their work area provided no one container is greater than 500 cm^3. Direct use of solvent from a 2.5 litre Winchester container is not allowed either in the open laboratory or in a fume cupboard, unless required for a large-scale operation. Prior permission for each such operation must be obtained from the PI. Transfer from a 2.5 litre Winchester to a reagent bottle must be carried out in a fume cupboard.

Do not leave surplus solvents in fume cupboards. Because of the design of the fume cupboard baffles, fires in fume cupboards containing solvents are very difficult to control.

9.1. Flammable Solvents

The maximum volume of flammable solvent (flash point < 32°C) allowed in any one laboratory must never exceed 50 litres. THIS INCLUDES ANY FLAMABLE WASTE stored in the laboratory. 2.5 litre Winchester containers must be stored in a two-hour fire resisting cabinet, which must be kept shut.

9.2. Solvent Spills

Spill kits should be kept in every laboratory, clearly signposted in every lab and their locations included in lab inductions. Where solvents are used appropriate absorbent material should be available so that any spillage can be covered, collected and disposed of as solid contaminated waste.

10. Carcinogens, Mutagens and Teratogens

This section should be read in conjunction with the appropriate section of the University Code of Practice "Working with Carcinogens" which gives an indication of emergency procedures specific for these substances and covers the subject in greater detail.

- Some chemicals (carcinogens) are known or thought to be able to produce cancer in humans at levels that could be reached in working unless proper care

is taken. Others (cancer suspect agents) are merely suspected of this, sometimes on the basis of work involving animals and of massive doses. However, all such substances should be treated with caution.

- Mutagens are substances which can cause mutations. Such substances are often, but not always, more or less carcinogenic and must be regarded as cancer suspect agents in the absence of further information.
- Teratogens are substances that can affect the growing foetus. Because of the foetus' high rate of cell division, this is especially vulnerable to chemical damage. Moreover, harmful chemicals taken before pregnancy is known (or even before conception takes place) could conceivably persist in the body long enough to harm a foetus.

FEMALE WORKERS OF CHILD-BEARING AGE ARE ADVISED TO SHOW THE UTMOST PRUDENCE IN THEIR HANDLING OF ALL CHEMICALS.

Further advice can be obtained from:

http://www.gla.ac.uk/services/seps/az/newandexpectantmothers/

- Carcinogenic activity is often found in the following classes of compounds: polycyclic aromatics, bicyclic or polycyclic aromatic amines and nitro and nitroso compounds, nitrosophenols (but not p-nitrosophenol itself); epoxides; reactive alkyl halides and α-haloethers; aziridines; β-propiolactone; organic sulfates; diazomethane, related species and precursors; nitrogen mustards; other alkylating agents; N-nitrosoamines.
- All suspected carcinogens are suspected teratogens. In addition, mono alkylamides are suspect teratogens.
- A sense of proportion (though not complacency) is in order. The well-publicised chemical tragedies have mostly arisen from prolonged industrial exposure (β - naphthylamine, benzidine, vinyl chloride) or from people actually ingesting the offending compound (thalidomide). Extensive bibliographies on a very large number of substances are listed in the official US Registry of Toxic Chemicals.

11. Waste Disposal

Such is the range of activities carried out in the University that a wide variety of waste is produced, from simple paper to radioactive material.

Please look at the link below to familiarise yourself with the types of waste and the relevant legislation that may govern its disposal.

Finlay Smith, the Stores Manager is the Waste co-ordinator for the School of Chemistry, and any queries should be addressed to him in the first instance.

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/

Printable waste labels:
https://www.gla.ac.uk/myglasgow/seps/specialistwastes/printablewastelabels

The disposal of waste chemicals and solvent can often cost more than the original material. It is important, therefore, when orders are placed for chemicals that only sufficient is ordered for your immediate use.

11.1. General

General waste such as wastepaper in the laboratory may be put into the normal disposal containers. It is important, however, that broken glass or similar material is kept separate.

11.2. Sharps and Broken/Waste Glass Bins

The use of sharps poses inherent risks and should be avoided whenever possible. If not possible, the use of sharps should be carefully risk assessed, and control measures should be implemented including safe disposal of contaminated sharps.

Arrangements should be put in place by line managers/PIs/Supervisors to ensure personnel they are responsible for are trained in the safe handling of sharps and a record of training is maintained.

It is the duty of the user to clean off any chemical which may have adhered to the surface of the glass or sharp objects. Bins are provided in every laboratory for waste glass. These bins are for the disposal of **all waste glass: soda, borosilicate and quartz**. Special yellow bins are also available for “sharps”, i.e. needles and blades and may be obtained from the Chemistry Store. Please ensure that these are used correctly. They are disposed of in different ways. The contents of the “sharps” bins are incinerated. The glass bins must be emptied regularly into the glass disposal bin (lane between Chemistry and the Graham Kerr building). Any problems should be notified to the Stores Manager, Finlay Smith. Filled Sharps (no more than ¾ full) containers should be removed to the store by arrangement with stores personnel.

Needles must not be re-capped unless the risk assessment has identified re-capping is required to prevent a risk.

For further safety information on Sharps and Needles use and their disposal contact Finlay Smith and consult:

https://www.gla.ac.uk/media/Media_649056_smxx.pdf

11.3. Waste Solvent

There are generally three categories of waste solvent: waste flammable solvent, waste non-flammable solvent and waste oils. Each must be kept separate. It is not important to note the quantity of solvent going into the drum, but it is important to note the name.

This should be added to the label attached to the drum. Full drums should be handed into the store with a clearly labelled note showing the different solvents added, the origin of the solvent i.e. the laboratory and an appropriate Hazchem sign attached. The signs can be obtained from the store together with new drums.

- Typical flammable solvents are acetone, diethyl ether, ethyl acetate etc.
- Non-flammable solvent primarily means chlorinated solvents such as chloroform, dichloromethane etc.
- Waste oils in general refers to vacuum pump oil. (If a vacuum pump is to be serviced, it is your responsibility to drain off the waste oil first).

Any acidic or otherwise reactive component of the waste solvent should first be neutralised prior to being poured into the waste drum.

https://www.gla.ac.uk/schools/chemistry/informationforcurrentstudentsandstaff/chemistrystores/

11.4. Waste Chemicals

Disposal of waste chemicals is the responsibility of the user and should be disposed of via Tradebe. Disposal procedure is available on the SEPS page of the University website at: https://www.gla.ac.uk/myglasgow/seps/specialistwastes/chemicals/

Any chemical sent for disposal must be properly labelled showing contents and quantity together with laboratory origin and research group identified. Disposal costs must be met by the waste generator. Although there are costs for waste collection, these can be reduced and shared with others through co-ordination with others within the school (e.g. Chemistry School stores waste solvent uplift). Please contact Safety Coordinator if you require assistance.

Tradebe is the University's approved supplier for the disposal of chemical waste. Information on how to obtain a quotation for disposal and a template form for logging waste for pickup is available here:
https://www.gla.ac.uk/media/Media_818419_smxx.xlsx

If you need to dispose of an 'unknown' chemical you should use the Unknown Chemical Quotation Form (https://www.gla.ac.uk/media/Media_783264_smxx.xlsx) when requesting a quotation of cost for disposal. The less information available about the waste the higher the disposal cost is likely to be and so the purpose of this form is to gather as much information as possible. If you are unsure about safely identifying answers to the questions on the form you should contact the University Chemical Safety Adviser who will provide advice.

In general, Chemicals should not be poured down the drain. A list of chemicals the explicitly cannot be disposed of by drain, and those which may if no other means of

disposal are practical can be found in Appendix 6 or in the following document: https://www.gla.ac.uk/media/Media_783262_smxx.docx

For disposal of 'heavy metal solutions', please contact Finlay Smith, School of Chemistry Stores manager.

11.5. Solid contaminated waste

Solid contaminated waste including contaminated tissues, gloves, and other consumables should not be disposed of in the general waste as this poses a significant risk to facilities staff emptying bins and cleaning labs, Contaminated waste should either be put inside a clip lock blue drum, available from Chemistry stores, or inside bag and securely sealed (e.g., swan neck seal with cable ties), clearly labelled and safely stored prior to waste collection via Tradebe.

11.6. Electronic (WEEE) Waste

This refers to waste electrical, and electronic equipment. This type of waste is housed in the B2-04 corridor opposite lab B2-25 cylinder pound and is uplifted regularly by CCL North. All electrical and equipment waste must be disposed of via this route. The key to the area is available from the store. See the links below:

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/electricalandelectronicequipment/

https://www.gla.ac.uk/myglasgow/sustainability/wasterecyclingreuse/specialwaste

11.7. Biological Waste

Biological waste may have different disposal routes. Please contact Finlay Smith for advice on the disposal of biological material. See the link below:

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/biologicalwaste/

11.8. Other Waste Streams

11.8.1. Office waste

Paper, card etc, should be disposed of in the general recycling boxes (lined with a clear polythene bag). These boxes are also used for plastics (e.g. drinks bottles) and cans. Food waste should be disposed of via the general waste (black polythene bag). These streams are uplifted by cleaning services.

https://www.gla.ac.uk/myglasgow/sustainability/wasterecyclingreuse/

11.8.2. Furniture

Please deposit waste/damaged furniture in the rubbish pound in the lane between Chemistry and the Graham Kerr Building. The key is available from the store. Surplus

furniture may be transferred to the University storage facility for re-use or advertised on Warpit, https://www.warp-it.co.uk (a national waste reduction scheme).

11.8.3. Batteries

Batteries may be recycled in the box at the store, all terminals must be covered with insulating tape prior to disposal.

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/electricalandelectronicequipment/batteries

11.8.4. IT waste

Submit a request to CoSE IT Helpdesk to dispose of IT waste.

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/electricalandelectronicequipment/

11.8.5. Lecture Bottles

Lecture bottles should either be returned to the supplier or to Tradebe for disposal.

https://www.gla.ac.uk/myglasgow/seps/az/compressedgases/

https://www.gla.ac.uk/myglasgow/seps/specialistwastes/chemicals/fluorinatedgasesf-gasandozonedepletingsubstances/

11.8.6. Confidential Waste

For confidential waste, please contact the School admin staff or use the bins provided in room A4-03.

http://www.gla.ac.uk/services/estates/sustainability/recycling/

12. Lab Guardianship and Certificate of Completion

Academic staff being assigned a lab should identify any legacy waste and equipment that they do not require and contact the safety coordinator for advice on waste disposal prior to taking over guardianship of the lab.

As a reminder and aid to promoting good housekeeping practice and, hopefully, to reduce the occurrences of discovery of unlabelled materials, all researchers will be required to sign a “Certificate of Completion” to the effect that, at the completion of experimental work, all their chemicals have been properly disposed of or labelled and handed to their supervisors. The supervisors will also be required to sign these documents. The forms can be obtained from the Student Support Office. These certificates will form part of a student’s post-graduate progress report and will pass through the Student Support Office. **Progress to oral examination and the award of**

PhD will not proceed in the absence of this certificate.
https://www.gla.ac.uk/media/Media_932402_smxx.docx

13. Special Legislation

13.1. Legal Restrictions Imposed by the Chemical Weapons Convention

The UK is a signatory of the Chemical Weapons Convention (CWC) and all Universities are obliged to comply with the Chemical Weapons Act of 1996, which introduced a number of controls on certain chemical substances. In particular if we make, possess or use any so-called Schedule 1 chemicals we need a license from the Chemical Weapons Convention Implementation, National Authority, Department for Business, Energy and Industrial Strategy, Room G39, 3 Whitehall Place, London, SW1A 2AW.

The University of Glasgow holds an Open General License which allows us to work with these chemicals for research purposes. It restricts the University, however, to a maximum of **5g in total** for all the chemicals on the list that are made, held or used in any calendar year. The Open General License also requires that records be maintained about any production or use of such compounds and that these must be open to inspectors from the CWC National Authority. The list of Schedule 1 substances, which includes various organophosphates and 2-chloroethyl derivatives, is given in Appendix 7. You should familiarise yourself with the chemical types listed there and before using any material related to them check that it is not on the list.

If it is necessary to use a compound on the Schedule 1 list, in order to ensure that we continue to comply with the regulations, it is essential that you should inform the Safety Coordinator IN ADVANCE OF OPERATIONS BEGINNING. You should detail its identity, quantity and proposed use. It will also be necessary to keep copies of the relevant sections of lab notebooks for at least three years afterwards for possible inspection. Note that this requirement relates not only to isolated chemicals, but also to reaction intermediates prepared and used in situ.

Permission can be obtained to exceed the 5g p.a. limit if this appears necessary by applying for an Individual Possession and Use License or an Individual Production License. We are assured by the National Authority inspectors that, if necessary, this could be arranged in about two weeks.

13.2. Drug Precursor Legislation 273/2004

The Drug Precursor Legislation regulation came into force on 18th August 2005 and requires that users of chemicals shown in category 1 (Appendix 8) apply for a Home

Office license, while for category 1 and category 2 chemicals a yearly returns form should be completed.

14. Utilities

14.1. Maintenance

All requests for maintenance to services (gas, water, electricity) should be made using the following link:

https://glasgowready.assetworks.cloud/ready/ Please ensure that all room numbers are quoted.

14.2. External service workers or Contractors in the School

14.2.1. Access

Service workers or contractors entering the School should contact the Facility Zone Managers, who will inform the appropriate Laboratory Responsible Persons. Arrangements will then be made to allow workers safe access to the work site. Service workers should identify themselves to the Facilities Assistants whenever they enter the building and inform them of the location of the work. Service workers are not permitted to work in hazardous laboratories without appropriate arrangements being made for the safety of themselves and others.

Access to the roof is by arrangement only, by contacting the Facility Coordinators or Facility Manager. When work is to take place on the roof or in a laboratory, some lab work may have to be postponed. (e.g. shutting down fume cupboards or removing hazardous chemicals from the work area). This may require prior notification or delays, both to repair or installation work and to lab work. All parties should co-operate to minimise any disruption. Typically, notices are now placed on lab doors giving prior notice of upcoming roof work.

14.2.2. Safety of Maintenance Personnel

It is the duty of the research worker to ensure that items to be maintained are in a safe condition for the work to be carried out. If there is any doubt about safety, the maintenance staff must be informed and advised about suitable precautions to take. Advice can be obtained from your supervisor, local technician, safety coordinator or Chemical Safety Adviser, SEPS.

School safety rules must be obeyed when workmen are operating in laboratories. Safety glasses and other PPE as required should be provided for service workers.

14.3. Gas

Natural gas has been removed from the building and is not used for Bunsen burners. The use of portable gas burners for gas appliances such as Bunsen burners should be restricted where possible to fume cupboards. If naked flames are to be used in the open laboratory, the user must ensure the absence of flammable solvents and other similar material and conduct a thorough risk assessment assessing the additional fire hazard as part of the work.

14.4. Water

All water connections must be clipped. Polythene tubing or neoprene rubber tubing should be used for permanent connections. Water flow through condensers should be kept to a sensible minimum and the outflow tube adequately secured. Note that water pressure often rises at night, and it is usually necessary to reduce the flow of water through condensers that have to be left on overnight. Do not allow tissue paper and other rubbish to collect in sinks. Where appropriate the use of water flow indicators is recommended.

14.5. Electricity

To ensure the safe use of electrical appliances and to comply with the law, the following points must be observed:

- All portable appliances must have a valid test certificate (fitted to the plug) before it may be used.
- Appliances must be visually inspected each time prior to use (flex, plug, instrument).
- Faulty equipment should be taken to the electrical workshop for repair at the earliest opportunity. This can be arranged via the IT Helpdesk request system.
- DO NOT replace the fuse with one of a higher rating.
- New equipment should be correctly fused and tested prior to use. Calculate the appropriate fuse value by using the formula:
    - Current = Power/Voltage (See back plate of Instrument)
    - Example: An instrument rated at 1000W, 240V would use a current of 1000/240 = 4.16A, the correct fuse would be the maximum current (i.e. round up) = 5 A fuse.
- Whenever practicable, switch off apparatus at the socket (or remove the plug) last thing at night.

14.5.1. Electrical Testing of Portable Appliances (PAT Testing)

All equipment is to have an electrical test with frequent additional visual examinations. (See table below - for information on item classification).

Risk Factor	Items	Period (months)	
		Visual	PAT
High	Hand-held items - Class I - hot air guns	6	12
Normal	Portable equipment - Class I - stirrer hotplates	24	24
Low	IT, static and double-insulated items Class II - PCs, fridges	36	36

Each item is to be labelled with an identification number, located next to the mains inlet. This code is in three parts, the first part being 124 (the building number), the second is the room number and the third the serial number. (e.g. 124/A432a/001).

Each item is to have a test label, with either "Tested for Electrical Safety" and the date and re-test date, or "Equipment not to be Used". The plug should also have a label of the fuse rating.

Record of PAT testing will be identified during regular inspections of laboratories/areas. Requests for testing are made through the UoG helpdesk and is arranged by CBRE.In each area, the Laboratory Responsible Person should take action over items which fail tests. They will also be responsible for:

- Arranging for repair work or for disposing of the equipment
- Preparing equipment for testing/checking
- Ensuring that staff and students are aware of user checks
- Ensuring that new equipment entering the laboratory is tested, the test details recorded, and a copy sent to the Safety coordinator.

14.5.2. User checks

Plugs: Examine terminals (all terminals must have earth sheaths) and cord grip to ensure that they are in good working order and free of corrosion or contamination.

Cables: Examine flex for cuts, abrasions and signs of overheating and that the outer sheath enters the plug. NO tapes or terminal blocks should be used.

Appliances: Examine items to ensure that they look in good order and free of corrosion or contamination.

14.6. Fume Cupboards

All fume cupboards in the School are of an aerodynamic design approved by the British Standards Institute.

The use of a fume cupboard is a fundamental part of many COSHH Risk Assessments but its function is often not properly understood:

https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/guidancedocuments/

The purpose of a fume cupboard is the **secondary containment** of fumes.

Primary containment must be part of the experimental design, which should allow for the trapping and/or neutralisation of any expected fume release.

The fume cupboards are fitted with alarms that will activate if there is a drop in air flow during medium speed operation.

It is the users' responsibility to check the performance of fume cupboards. Any faults should be reported to the lab supervisor. All fume cupboards are inspected annually and have a test certificate placed on the sash. Contact the lab supervisor if a certificate is not in place.

In a multi-user laboratory a note giving details of the reaction in progress must accompany each experiment. **All materials and apparatus must be cleared up and removed from the fume cupboard on completion of the experiment.**

In the event of failure of an extract system or poor flow rate resulting in continuous, do not continue to work in the fume cupboard until the issue is resolved. Make experiments safe and cease work as soon as possible.

Fume hoods should not be used as a convenient way of disposing of noxious vapours. Such vapours (thiols, etc.) must be trapped and neutralised as far as possible. Do not use fume cupboards for the long-term storage of noxious or hazardous chemicals.

15. Pressurised Systems

Useful links of safety regulations related to the use of pressurised gas cylinders and other pressurised systems can be found here:

- https://www.gla.ac.uk/myglasgow/seps/az/pressuresystems/
- https://www.gla.ac.uk/myglasgow/seps/az/compressedgases/
- https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/guidancedocuments/
- https://www.hse.gov.uk/pressure-systems/pssr.htm

15.1. Gas Cylinders

Large gas cylinders must be handled with care because serious injury can result from a cylinder toppling over and, for example, crushing a foot or breaking the cylinder's main valve leading to an enormous release of energy and turning it into a lethal projectile. **DO NOT ATTEMPT TO MOVE A CYLINDER WITHOUT A CYLINDER TROLLEY**. Gas cylinders are colour coded. Be sure to correctly identify the cylinder you want before using it. The correct reduction valve for the gas must be fitted to the cylinder prior to use. Do not attempt to do this unless training has been given. **Never move a cylinder with its reduction valve still in place, as this greatly increases the chance of snapping the cylinder neck in an accident.** Gas cylinders other than "lecture bottles" must be securely strapped to benches or walls using an approved fitting. They should not be used from mobile trolleys unless specific permission has been given for that. When not in use, cylinders should be **turned off**, not merely at the reduction valve, but **at the main cylinder valve as well** (after which the gas in the reduction valve should be released).

Unless explicitly given permission by the Head of School, handling of cylinders must be conducted in pairs and never alone.

Ensure that there is an appropriate warning label on the external door of the laboratory.

Ensure that the valve and regulator are free of grease.

Note that oxygen supports and intensifies fire, and there is a potential for oxygen cylinders to lead to serious explosions.

The use of Teflon tape (plumbers sealing tape) on the threads of cylinder regulators is prohibited by the PSSR 2000 regulations.

When a gas cylinder is empty, it should be returned to the stores yard as soon as possible (you will be charged for the rental until this is done). The Cylinder Pound has a code for entry and is available from the stores when training is completed.

Note that using nitrogen or argon in confined spaces poses an asphyxiation hazard. An assessment should be made on whether oxygen monitors should be installed in confined spaces containing these gases. Carbon monoxide (CO) is very toxic and H_2 and CO are both flammable and can present an explosion risk.

To comply with Pressure Systems Safety Regulations 2000, compressed gas systems with an operating pressure greater than 0.5 bar must have a “Written Scheme of Examination” (WSE). Such compressed gas systems must have an “Annual Inspection” carried out by a “Competent Person” as defined in the WSE. All “Safety Devices” associated with the compressed gas system are subject to a five yearly maintenance schedule as defined in the Written Scheme of Examination. In practice, maintenance often means replacement of the safety device. Safety devices may comprise the cylinder regulator, pressure relief valve or bursting disc High pressure hoses also require to be replaced five yearly. Users should take responsibility for inspecting cylinder valves visually for debris and checking regulators are in date prior to use:

https://www.gla.ac.uk/media/Media_932362_smxx.docx

15.2. Lecture Bottles

Lecture bottles can contain up to 500g of materials under pressure but do not pose the same mechanical dangers as large cylinders. Many lecture bottles however contain very dangerous substances - toxic, very toxic, corrosive or flammable. Lecture bottles must be stored in an upright or canted position (valve to top), ideally in a vented cabinet, or the valves may suffer from corrosion making it difficult to open them controllably or to close them once open. Depending on the substance in the lecture bottle, take great care to check that the necessary fine control of the valve can be achieved before attaching it to any apparatus. When the gas is toxic or corrosive and is being 'bubbled through' a reaction process, excess gas from the apparatus should be scrubbed with water (e.g. for HBr, HCl) or an alternative suitable reagent before being vented into a fume cupboard.

Whilst the risks and necessary precautions associated with the dangerous substances will be dealt with as part of the normal risk assessment procedure, the additional hazards of using cylinders of these materials (large amounts, high pressure) might not. It is recommended, therefore, that the "Residual Risk and Appropriate Procedures" section of the standard risk assessment forms should be used to identify these possible additional hazards, and the remedial actions to be undertaken in the event of problems (leaking valves, etc.) listed there.

Laboratory Responsible Persons should take an inventory of all lecture bottles and cylinders kept in their laboratories and ensure that incompatible materials are not stored together. Regular inspections of lecture bottles should be made to check against excessive corrosion and to check that identity labels are not becoming obscured.

15.3. Malfunction

Although lecture bottles are provided with suitable valves that should not corrode or malfunction, experience has shown that, from time to time, valves fail to operate smoothly and controllably so that gas is released too fast for the scrubber to absorb it all. Where there is such a risk, a secondary containment mechanism should be available.

Lecture bottles should normally be connected to a vacuum system via a secondary valve and metal connector. Bottles must be always securely clamped. Connections via rubber or plastic hose are seldom satisfactory. On those occasions when gas from a lecture bottle is to be passed through a system at ambient pressure, the operation must be carried out in a fume cupboard and a properly tested scrubber unit must be added.

15.4. Disposal

The cylinders can be disposed of by a commercial organisation. The cost of this operation will have to be met by the research group which owns the cylinders.

16. Pressurised Equipment/Apparatus

The Pressure Systems and transportable Gas Containers Regulations 1989 cover all systems in which gas or vapour is contained at pressures greater than 0.5 bar above atmospheric pressure, including gas pipelines. Equipment with a pressure vessel in which the energy exceeds 250 bar litres must be registered with the University and be subject to periodic examination by an insurance engineering inspector. In addition, equipment covered by the above Regulations must be certified as being suitable for its purpose by a consultant engineer before being used. Equipment built "in house" cannot, therefore, be used until certified.

- Research equipment is exempt provided it exists for less than twelve months.
- Laboratory equipment, including pressure cookers and gas distribution systems, are not exempt.
- For all equipment covered by the Regulations, written information must be available, and the safe operating limits defined.
- The Regulations do not cover vacuum or hydraulic systems.

Useful links are provided below:

Pressure systems safety and you (leaflet): http://www.hse.gov.uk/pubns/indg261.pdf

Safety of Pressure Systems Approved Code of Practice. (L122):
http://www.hse.gov.uk/pubns/priced/l122.pdf

CHEM09 Pressure Systems Safety:
https://www.gla.ac.uk/media/Media_932362_smxx.docx

CHEM19 Compressed Gas Cylinders:

https://www.gla.ac.uk/media/Media_932404_smxx.docx

CHEM19a Design of Compressed Gas Cylinder Stores:

https://www.gla.ac.uk/media/Media_932353_smxx.docx

CHEM21 Statutory Inspections:

https://www.gla.ac.uk/media/Media_982167_smxx.docx

16.1. Gas Reactions

Reactions involving gaseous materials must be in specially designed apparatus and calculations should have been carried out to ensure that any pressure generated can be contained safely within the apparatus (see also sections dealing with sealed tubes and gas cylinders). Gases should not be dried by passing through concentrated sulfuric acid. Blockage of the exit tube can cause pressure build-up and blow-back of acid when the cylinder is disconnected.

16.2. Carius Tubes (or sealed tubes of a similar type)

Preference should be given to use of stainless-steel vessels as they are considered to be safer. For smaller reactions under relatively mild conditions (say less than 5 bar and 150 degrees), purpose-built Pyrex glass tubes should be employed. One of the procedures below, designed to protect you and others nearby, must be followed.

16.2.1. Frequent users.

There should be a group protocol in operation and researchers will probably seal their own tubes. Newcomers should be trained by the glassblower before attempting this.

16.2.2. Occasional users.

The glassblowers must assist. You should complete a requisition form for the "Sealing of Carius Tubes" (forms are available from the Glassblowing Workshop) and give to the glassblower an accurate inventory of everything to be put in the tube. The completed form should be checked by your supervisor, and a copy should be retained in the Glassblowing Workshop. Ensure that your COSHH risk assessment form covers the whole procedure.

You must calculate the maximum pressure likely to be encountered, and the glassblower will select the appropriate grade of glass from which to make the tube. The glassblower will seal the tube, and, after the reaction, assist or advise you on opening it. Take care to de-gas any solvent and to avoid condensing volatiles in the tube if you cool it before sealing. If the tube needs to be sealed under vacuum or nitrogen this can be done at your bench.

Use common sense at the heating stage. Since the tube is small and only moderate conditions apply, an oil bath behind a blast screen in a (preferably dedicated) fume cupboard should offer adequate protection. As a safeguard against a dangerous build up of pressure should accidental overheating occur, you should consider the effects of the solvent converting to its gaseous state. This is probably not appropriate if a significant volume of solvent is involved, however. In these circumstances use of the Clausius-Clapeyron equation is more realistic in determining the pressure contribution from the solvent.

16.3. Manufacture and Sealing

- All tubes (Pyrex glass) must be manufactured by the Glassblowers.
- Wide tubes should normally be sealed by the Glassblowers; constricted tubes prepared by the Glassblowers may be sealed by the individual research worker after appropriate training.
- Take the tubes in a cooling bath to the Glassblowers at a pre-arranged time. Be careful not to condense unwanted moisture or volatiles in the tube. Liquid nitrogen should not be used to cool tubes under circumstances where liquid oxygen could condense in the vessel. It is permissible, however, to cool tubes evacuated under high vacuum using liquid nitrogen.

16.4. Opening

Tubes are usually opened using the 'scratch/hot rod' technique (see Glassblower). No member of technical staff, glassblower or otherwise, should be asked to open sealed tubes. This must be done by the research worker or by the supervisor.

The following procedure must be used:

- Before opening, the tubes must be cooled sufficiently to ensure that no excess pressure within the tube exists at the time of opening.
- Opening is to be done behind a safety screen and preferably in a fume cupboard.
- The tube should preferably be held in a mild steel sheath with only the capillary projecting.
- The steel tube must be directed so that any projectile from it cannot damage personnel.
- A full-face shield is to be worn.
- Heavy industrial gloves are to be worn.

17. Vacuum Systems and Vacuum Distillation

Most vacuum apparatus is constructed of Pyrex glass. When assembling vacuum apparatus, always examine the equipment for stresses and strains and defects. If glassblowing has been carried out on a piece of glassware, it must be properly annealed

and checked by the glassblower before being used for reduced pressure work. As far as possible, vacuum apparatus should be protected against effects of implosion and explosion by the use of PVC tape and safety netting, and shields where appropriate. Safety goggles should be used when operating glass vacuum apparatus.

If using Schlenk lines, inspect and ensure schlenk is secure and not secured by fragile glass, protect again ingestion of materials into pump and into lab. Any accidental impact on schlenk line should be followed by a visual inspection of line to ensure no cracks. Any flasks attached to schlenk line MUST be secured by neck and in a safe location in lab.

Under no circumstances should a trap cooled to liquid nitrogen temperature be left on a line open to the atmosphere. This may result in liquid oxygen condensing inside the line which can give rise to an explosion if either: (1) the line contains an organic material or; (2) the line is closed to the atmosphere and the trap removed. If liquid oxygen is spotted (blue colour) switch off line, remove cold trap and clear area of personnel.

Always operate stopcocks slowly using one hand to support the barrel; never try to force it. Manometers or parts of the apparatus containing quantities of mercury should be moved slowly as the induced pressure shock can cause the line to rupture. Similar precautions apply to vacuum distillations; in general, traps should be cooled in acetone-dry ice rather than liquid nitrogen.

18. Special Hazards

18.1. Lasers

- Accidental misuse can cause eye damage or even blindness.
- Rooms in which lasers are used must be designated as laser hazard areas and admission restricted to duly authorised personnel and, where regulations permit, to others under properly authorised supervision.
- There are regulations about eye protection, screening of sources, and the placing of warnings on doors of rooms where lasers are used. These rules are summarised in the School Local Rules and Systems of Work for the Safe Operation of Laser Products, which are available from the Laser Safety Adviser **(Gordon Hedley)**, and which should be consulted before any work is begun.
- These rules do not apply to equipment operating under Class 1 conditions where the laser beam is contained safely within an enclosure and where the beam cannot come into contact with the user. However, anyone who has to service that equipment or who works with lasers above Class 3a (except for manufacturers' service engineers) must first contact the School Laser Safety Adviser who will determine his/her competence to undertake the work.

More information, advice and training can be accessed via the University's Radiation Protection Service: https://www.gla.ac.uk/myglasgow/radiationprotection/

Laser safety training is provided by RPS and should be completed by users prior to work.

https://www.gla.ac.uk/myglasgow/radiationprotection/lasersafetycourse/

18.2. X-Ray Sources

- Even momentary exposure to intense X-ray beams can cause serious burns, leading to amputations in the worst cases. Long term exposure to lower levels of X-radiation carries increased risk of genetic abnormalities, sickness and death.
- The doors of laboratories in which X-rays are generated are appropriately marked. Interlocked instrument enclosures are primary method of control.
- Entrance to each X-ray laboratory is strictly limited to (i) authorised personnel and (ii) persons under the direct supervision of authorised personnel. The current list of authorised personnel is posted on the door of each X-ray laboratory.
- Supervisors of students and technicians are reminded that formal written application to Joy Farnaby (school radiation adviser) for authorised personnel status is mandatory and that supervised training in safe use of X-ray equipment is required.
- Users of equipment using X-rays should contact the PI/Technician operating the equipment who will provide training information on the X-ray safety awareness course from RPS on Moodle.
- NEW AND EXPECTANT MOTHERS SHOULD NOT WORK WITH X-RAYS.

New students, or members of staff who currently operate x-ray equipment on Campus, are encouraged to complete the X-Ray Awareness Course.

Please note our courses are only open to University of Glasgow staff/students/affiliates/specific RPS Consultancies

https://www.gla.ac.uk/myglasgow/radiationprotection/xrayawareness/#d.en.776580

18.3. Radioactive Chemicals and Substances

- Information sheets are available to members of staff for the most commonly used radionuclides they may encounter within their laboratory or research environment. https://www.gla.ac.uk/myglasgow/radiationprotection/hazardinformationsheets/informationforstaff/
- Radiation safety training can be arranged through the RPS.

- The school has holding and disposal limits and it is imperative that these limits are not exceeded. Before placing an order, the end user must discuss with Joy Farnaby (School Radiation Adviser).
- Radioisotopes will be delivered initially to the RPS for contamination monitoring and the isotope, location and activity will be logged; this procedure is used as a secondary monitoring system.
- All work involving unsealed radioisotopes must be conducted in Supervised or Controlled Radiation Areas.
- All radioisotopes must be stored in a safe and secure manner.
- More information on the University's Radiation safety policy can be found here:

https://www.gla.ac.uk/media/Media_717201_smxx.docx

- Training for radiation protection can be found here:

https://www.gla.ac.uk/myglasgow/radiationprotection/radiationprotectioncourse/

18.4. Biological Hazards

The COSHH Regulations require that risk assessments should cover biological as well as chemical hazards. A risk assessment should therefore be completed whenever experiments involve a 'biological agent' as defined in the COSHH Biological Agents ACOP. This includes bacteria, fungi, viruses, cultured cells and materials likely to contain pathogens, such as human body fluids. Biological agents are categorised into hazard groups according to their potential for causing infection in man, by the Advisory Committee on Dangerous Pathogens. The categorisation is set out in the following publication, available in the library, which also describes the level of containment required for each hazard group:

https://www.hse.gov.uk/pubns/misc208.pdf

Useful practical information on dealing with biohazards is available from the SEPS website at University of Glasgow - MyGlasgow - Safety & Environmental Protection Service - Biological safety

The School Biological Safety Adviser, Adrian Lapthorn or SEPS Biological Safety Adviser, Aude Aumeunier, can provide advice on the legislation and the facilities available for working with biological agents in the School.

Genetically modified (GM) organisms are covered by separate rules administered by ACGM in addition to the COSHH regulations. For experiments involving GM organisms, the School of Chemistry operates within the registered administrative framework established by MVLS. If you think an experiment may fall within this category or if you need to obtain outline approval for the purpose of a grant application, please discuss it

with Adrian Lapthorn, who can provide the forms necessary for GM experiments, help to complete them and channel them to the MVLS GM Committee.

The Scottish Agricultural Science Agency regulates the experimental use of non-indigenous plant pathogens and some plant and soil materials from overseas, under licence. While this legislation is not directly concerned with human health and safety, similar biological containment measures are appropriate, and the same procedures should be used for risk assessment.

19. Visitors

Visitors **must** comply with local safety rules when entering laboratory areas. If they are participating in any experimental work, they must be issued with a copy of the Safety Regulations and are required to read it and sign an appropriate risk assessment form or laboratory form, as well as comply with all the appropriate safety instructions. Each visitor must be known to and working with a member of the School of Chemistry academic staff, and it is the responsibility of that staff member to report the visitor's arrival to the Head of School Secretary. **That staff member will also be responsible for ensuring that the visitor is trained to the appropriate standard of safety before any experimental work commences**.

Outwith normal hours, visitors must have specific permission to be in the School:

https://www.gla.ac.uk/schools/chemistry/informationforcurrentstudentsandstaff/adminresources/

20. Working outwith Normal Hours.

Normal hours of working are: 8.30 – 17.30, Monday – Friday

20.1. Out of hours work

All persons using the buildings after 18.00 hours Monday – Friday, anytime on Saturday or Sunday, or during public holidays should follow the guidance here:

https://www.gla.ac.uk/myglasgow/seps/az/loneandoutofhoursactivities/outofhoursactivity/

- Use of the SafeZone App is strongly recommended.
- Sign in and sign out of the Late Book at the Janitors' Box.
- Practical work (other than routine instrumental work) must only be done with at least one other person present in the laboratory or within easy earshot.
- Very high-risk experiments are forbidden out of hours and experiments in the high-risk categories (as defined by COSHH assessment) should only be attempted out of hours following consultation with and at the discretion of the research supervisor.

- Pyrophoric or highly toxic compounds must not be used outside normal working hours.
- For researchers who need to make short visits to their laboratory (e.g. to top up Dewar flasks or to take readings as part of a long-running experiment) in the small hours or late during the weekend (when the safety requirement of having a second person within earshot may be difficult to arrange), a check in/check out system with Central Security has been arranged as a safety backup. Under these circumstances, it is recommended that the SafeZone app is used to inform security. If this is not possible, researcher should telephone Central Security on Ext. 4282 as soon as they enter to Joseph Black Building to inform them of his/her location in the building and the expected duration of the visit. The researcher should telephone Security again to check out when he/she is about to leave Joseph Black Building. (If you neglect to do this you will initiate a search).

Animals are not allowed in the building without the prior approval of the Head of School.

Children are not allowed into the building without proper supervision. They are only allowed into laboratories for educational visits where they must be issued with protective clothing and must be supervised at all times.

20.2. Overnight Operations

This type of work should be kept to a minimum, but if there is a requirement, the following precautions must be taken:

- The experiment must have a label beside it giving details of the reaction and the chemical risk.
- An “Overnight Experiment” form must be placed on the laboratory door.
- Both labels should be signed and dated by the supervisor or a representative of academic staff of similar status who **must** inspect the apparatus in person before signing.
- For water cooling, use only permanent hose, thick-walled neoprene rubber, or strong plastic tubing, and secure by clips, not wire. (See “Utilities”).
- Enter details of the type of reaction taking place and its location in the Overnight Experiment Book at the Janitors' Box.
- The electricity to experiments not covered by such a form may be **SWITCHED OFF.**
- Redundant or out-of-date overnight cards must be removed.
- Naked flames **MUST NOT** be used for unattended experiments.
- Overnight experiment notes must include contact details, be signed and dated.

University of Glasgow	REQUEST TO LEAVE UNATTENDED OPERATING EQUIPMENT		
Name of Researcher		Contact Telephone	
Name of Supervisor		Contact Telephone	
In the event of an emergency it is safe to switch off?			
Electricity Supply		Water Supply	
Heating Equipment		Compressed Gas	
Actions to take in the event of a leak or spillage?			
Any other special instructions?			

Substance(s) Involved and Reaction Scheme	(tick all hazards that apply)			
	 Flammable		 Corrosive	
	 Oxidiser		 Toxic	
	 Explosive		 Compressed Gas	
	 Biohazard		 Radiation	

Special Hazards:			
CoSHH Assessment Reference			
Location of Experiment			
Signature			
Experiment Start Date		Experiment End Date	

Overnight operations forms similar to the one shown below will be used.

Please Note:

1. Before any equipment is run unattended for an extended period of time, the permission of the appropriate supervisor must be obtained and the appropriate senior member of the technical staff informed.

2. Print the information clearly. Reaction Scheme (Include all Reagents and Specify Hazards)
3. Fasten the notice to equipment or position it where it is obvious to which equipment it refers.
4. All water connections must be clipped on.
5. No guarantee can be given that apparatus will be left running, particularly if the request form is unsigned or dates incorrect.

20.3. Continuous Operations

Equipment continuously supplied with water must have the condition of hoses and pipes checked by a responsible person at least twice a week and a record kept. The location of such equipment must be displayed in a log at the Janitors' Box.

- Equipment in continuous operation must be clearly labelled with the following information: Name and signature of staff member responsible for the apparatus.
- Action to be taken in the event of a malfunction or emergency must be clearly stated for a non-specialist person's understanding (e.g. Security).

20.4. Security

When there is no janitorial presence, DO NOT allow anyone access to the building using your key fob unless you are certain of their identity. If you are the last person to leave a room or laboratory, lock the door behind you. Do not leave valuables in an unsecured place.

21. General Chemical Safety Precautions

21.1. Storage of Chemicals

The SEPS website provides common sense information about the safe storage of chemicals in the laboratory: CHEM04 Safe Chemical Storage (https://www.gla.ac.uk/media/Media_932355_smxx.docx).

For further information please also visit:

https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/guidancedocuments/

Note in particular:

- Store like with like. Incompatible chemicals should be identified as part of your COSHH Risk Assessment. Take precautions to ensure that they can never be inadvertently mixed. Incompatible chemicals list: https://www.gla.ac.uk/media/Media_932357_smxx.docx

- Store only the minimum stock levels of hazardous materials.
- Large, breakable containers, particularly of liquids, should always be kept below shoulder height.

Note: the availability of specialist cabinets such as fire-resistant solvent cabinets and vented cabinets and use them to store the appropriate materials. **Fume cupboards are not to be used as storage units.** Chemicals should not be stored outwith the laboratories.

	Inorganic Acids	Oxidising Acids	Organic Acids	Alkali / Caustic	Oxidising Agents	Inorganic Poisons	Organic Poisons	Water Reactive	Organic Solvents
Inorganic Acids	✓	✓	✗	✗	✓	✗	✗	✗	✗
Oxidising Acids	✓	✓	✗	✗	✓	✗	✗	✗	✗
Organic Acids	✗	✗	✓	✗	✗	✗	✗	✗	✓
Alkali / Caustic	✗	✗	✗	✓	✓	✓	✗	✗	✗
Oxidising Agents	✓	✓	✗	✓	✓	✓	✗	✗	✗
Inorganic Poisons	✗	✗	✗	✓	✓	✓	✗	✗	✗
Organic Poisons	✗	✗	✗	✗	✗	✗	✓	✓	✓
Water Reactive	✗	✗	✗	✗	✗	✗	✓	✓	✓
Organic Solvents	✗	✗	✓	✗	✗	✗	✓	✓	✓

This table can be used to give a general idea of which chemicals can be safely stored together and which should be separated whenever possible. It is not an exhaustive guide and further information (e.g. safety data sheets) should always be consulted when making a final decision on storage methods.

21.2. Spillages

For more information on dealing with chemical spillages please see the SEPS guidance note, below:

https://www.gla.ac.uk/media/Media_932354_smxx.docx

Training on dealing with chemical emergencies is provided through SEPS:
https://www.gla.ac.uk/myglasgow/seps/chemical%20safety%20(revised)/training/

When moving solvents around the building, it is important that the proper equipment is used i.e. Winchester carriers. All labs must have a suitable number of these to meet their needs. Bulk orders of solvents in glass Winchesters from the store may only be moved on the deep trolleys provided for this purpose. The use of shallow trolleys to move Winchesters is prohibited.

21.3. Handling Chemicals

The handling of chemicals must be considered as being potentially harmful. Before working with chemicals, it is essential that a COSHH risk assessment is completed so that the risk can be fully understood prior to work commencing. Be sure that you are aware of the toxic properties of the materials and that all appropriate precautions are taken. Avoid direct contact with chemicals and avoid breathing in vapour from solvents or dust from solids. Beware also of increased vapour concentrations where solvents or other toxic materials come into contact with hot liquids, for example during washing up.

21.4. Acids and Corrosive Materials

These materials will destroy living tissue if it is in contact with them for any time. It should also be remembered that, due to the heat of hydration, acids should be added to water when dilution is taking place, rather than the other way round. When storing hazardous chemicals, flammable takes priority over acids, so glacial acetic acid would be stored in a flammable cabinet rather than an acids cabinet.

21.5. Alkali Metals and Metal Hydrides

Care must be taken when handling these materials due to their vigorous reaction with air and moisture. Where sodium wire or metal hydrides are being used to dry solvents, it is the responsibility of the user to ensure that all of the reagent is destroyed before returning the empty container to the Store. Whenever such a drying agent is introduced into a vessel, a hazard label must be attached. The labels, with the words:

“DANGER. BOTTLE CONTAINS ….. DRYING AGENT”

printed in red on a yellow background, are obtainable from the Chemistry stores. The identity of the drying agent must be written in. Winchesters will not be returned to the stores until the researcher has written a signed statement across this label to the effect that the drying agent has been properly destroyed and the bottle given a final rinse with water.

The destruction of sodium is best achieved using one of the higher alcohols such as iso-propanol. Remember, destruction of the alkali metals produces heat and large quantities of hydrogen gas which may catch fire or explode if the mixture overheats. Similar effects can be seen when using or destroying metal hydrides and related compounds. For this reason, destroy lithium aluminium hydride cautiously with ethyl acetate.

Incomplete hydrolysis of pyrophoric organometallics or hydrides such as $LiAlH_4$ is not uncommon and has led to explosions as well as fires. The problems usually arise because crusts of insoluble material (frequently metal hydroxides) protect pockets of the reagent from the hydrolysing agent, and the turbidity of the mixture prevents

observation of this. When the crust is finally broken and excess hydrolysing agent gets through a violent reaction can result. It is therefore vital to ensure complete mixing during such operations, which must always be done with great care.

Note that a simple, safe and economical method of disposing of larger pieces of sodium or potassium metal is described and illustrated in *Inorganic Chemistry*, 2001, **40**, 6855: https://pubs.acs.org/doi/full/10.1021/ic010594m

21.6. Solvent Purifier System

Two solvent purifier systems have been installed in the School. One is in room C2-03, next to the Chemical Stores, another is in room A3-26b. Note that the systems are fitted with B29 dispensers, adaptors may be required. The following solvents are available: THF, dichloromethane, diethyl ether, acetonitrile, and toluene. Before using the SPS, a person should be trained by Craig Bradley and be familiar with the Instruction Manual.

Importantly! According to Regulations, two people must be present when using the system. Access to these rooms is only granted after training has been signed off. Glassware must be checked for star cracks and only round bottomed flasks should be used. A secondary container (beaker or small box) is also required for transporting the solvent back to the lab. Any questions related to the SPS and SPS training should be directed to Craig Bradley.

21.7. Cooling Baths

Mixtures of salt and ice (1 part to 3) can achieve temperatures down to about –15°C, and a $CaCl_2 6H_2O$ and ice mix (5:4) can reach –50°C. These temperatures are low enough to cause burns, so precautions must be taken to prevent splashing.

21.8. Dry-ice Slush Baths

Beware frostbite; wear insulating gloves. Slowly add small lumps of solid CO_2 to the organic liquid until no more rapid evaporation takes place. Dry-ice/acetone will reach –78°C. Use plastic vessels or Dewar flasks to avoid burns.

21.9. Liquid Nitrogen

Nitrogen is an odourless, asphyxiant gas, and care must be taken when using it in confined spaces. The risk is particularly high when liquid nitrogen is being decanted or used in confined spaces, since one litre of liquid N_2 can rapidly evaporate to about 680 litres of gas. It does not take many litres of liquid N_2 to evaporate in a small room to deplete the percentage of oxygen in the atmosphere to below the level at which it can sustain life. Always ensure that there is sufficient ventilation. Depending on the volume of nitrogen and area of the room it is stored in an oxygen monitoring system may be required. Further hazards of liquid nitrogen include the risk of cryogenic burns, so skin

contact is to be avoided. On standing in air, liquid nitrogen becomes enriched by liquid oxygen, which can present an explosion hazard in contact with organic materials. In order to prevent pressure build-up, containers of liquid nitrogen must never be sealed. Liquid nitrogen should only be stored in appropriate temperature rated dewars or eggs. SEPS Health and Safety Note number 01/024 on the hazards of liquid nitrogen should be consulted: http://www.gla.ac.uk/media/media_173312_en.pdf

When dispensing liquid nitrogen, insulated gloves, a lab coat and a face shield must be worn. This personal protection equipment is available from stores for use when dispensing from the School dewar. The handling of liquid nitrogen should never be done alone so you must have a second person accompany you when dispensing nitrogen form the external pound. Supervisors should have such PPE available when liquid nitrogen is used in their labs.

21.10. Liquid Nitrogen Slush Baths

Use only fresh liquid nitrogen to protect against forming dangerously explosive liquid O_2/organic mixtures. Slowly pour the liquid nitrogen into the organic solvent in a Dewar flask, stirring continuously to prevent formation of a solid crust, until a slush of solid in liquid is obtained. Several organic solvents can be employed: e.g. MeOH down to –98°C, n-pentane down to –131°C.

After use, allow the baths to warm to room temperature in a fume cupboard, then dispose of the solvent.

22. Some Advanced Chemical Safety Precautions

Specialist in depth manuals are available on the safety section of the School website for the following substances: Diazomethane, Hydrogen Peroxide, Pyrophorics, HF, Ammonia, Hydrogenation, Ozone & UV use:

https://www.gla.ac.uk/schools/chemistry/informationforcurrentstudentsandstaff/safety/

More general advice is available from your supervisor, school safety coordinator and SEPS chemical safety advisor.

22.1. Peroxides in Ethers and Other Solvents

When ethers are exposed to sunlight, peroxides form via abstraction of a hydrogen atom from the carbon to the oxygen. The reaction proceeds via a stabilised radical, so those ethers that form stabilised radicals are the most prone to peroxide formation, and di-isopropyl ether is the most common example. Peroxides are also readily formed by tetrahydrofuran (THF), and it is well to assume that any ether will form peroxides on standing. Some other solvents also form peroxides.

Keep ethers and other solvents known to form peroxides in brown glass bottles and out of sunlight.

22.2. Irritants and Lachrymators

These must only be handled in the fume cupboard. Empty containers must be thoroughly washed prior to the removal from the cupboard to ensure that all materials are hydrolysed.

22.3. Thiols and Stenches

In all cases, these materials must only be used in a fume cupboard. If using more than 0.1 mole, consider using the Special Operations Laboratory. Experimental design should ensure that no vapour escapes from the apparatus and that all material is oxidised before apparatus is removed from the fume cupboard for cleaning.

ALL SUCH TOXIC (OR OBNOXIOUS SMELLING) CHEMICALS MUST BE RENDERED SAFE (AND ODOURLESS) PRIOR TO DISPOSAL, AND **ON NO ACCOUNT** MUST SUCH CHEMICALS BE WASHED DOWN SINKS OR PLACED IN WASTE BINS (INSIDE OR OUTSIDE THE CHEMISTRY BUILDING).

For thiols, oxidation with cold aqueous potassium permanganate is adequate; however, **take care that no other easily oxidised compounds are present which could react violently with permanganate**. Even traces of thiols are sufficient to produce the odour of a gas leak. Accordingly, a trap containing aqueous permanganate or bleach should be inserted between a rotary evaporator and its water pump.

22.4. Ozonolysis Reactions

Adhere to the protocol at the ozone generator. The reactions are nearly always carried out at low temperatures (-78°C), at which temperature ozone is blue. Accordingly, when an ozonation is complete the solution becomes blue. It is then necessary to (i) remove the excess ozone (this is done by flushing the reaction vessel with dry nitrogen until the solution becomes colourless), and (ii) decompose the ozonide completely, since ozonides are explosive (this is done by addition of excess Me_2S or other reducing agents such as Me_3N or Ph_3P, and stirring at room temperature overnight; it is imperative to test with starch-iodide paper that all the ozonide has decomposed before proceeding). Further details can be found in “Ozonation”, by P.S.Bailey, Academic Press, 1982 (library, index no. K223), or *Organic Synthesis*, **5**, 489; **52**, 135; **56**, 36; **60**, 63; **64**, 150; **65**, 183; **71**, 214.

22.5. Cyanides (c.f. Schedule 1 poisons)

Anyone working with cyanide MUST have a person trained in oxygen therapy first aid (see Appendix 1) in close proximity to where the work is being carried out and as such

advanced notice needs to be given to the Oxygen Therapy first-aider so that the work can be arranged for a time when they are present. The oxygen resuscitation equipment is kept in a locked cabinet centrally located on level B3, and it will normally be obtained by the trained person prior to work starting. The cabinet is equipped with a key in a break-glass compartment and in emergency this can be used.

Destroy cyanide residues with excess sodium hypochlorite solution by allowing the mixed solution to stand for 24 hours. Collect waste in an appropriate container and arrange for pick up using the University's waste contractor Tradebe. Cyanide Guidance Note: https://www.gla.ac.uk/media/Media_932369_smxx.docx

22.6. Hydrofluoric Acid and Anhydrous Hydrogen Fluoride

A person trained in the administration of first aid treatment for HF burns must be in close proximity to the area where work is in progress. Cold running water should be used to treat any burn until the first-aider, trained in its treatment, takes over. Calcium gluconate gel must be kept both in the laboratory and at home by regular users of HF. Note that HF burns on limbs have resulted in amputations and even death. It is essential that full protective clothing (full length PVC coveralls, face shield, PVC gloves) be worn.

Please consult the school safety coordinator and/or SEPS chemical safety advisor if commencing new work that may use HF.

HF Guidance Note: https://www.gla.ac.uk/media/Media_932364_smxx.docx

22.7. Schedule 1 poisons

The Poisons Act of 1972 places restrictions on access to certain groups of chemicals. The ones of particular importance to this School are those in Schedule 1. To comply with the Act, any chemical in this category may only be ordered by senior members of the academic or technical staff. That person is then responsible for keeping it in a locked cabinet. The person is responsible for ensuring that it is accounted for and used properly. The full list can be found in the Safety Section of the Library, but some of the more important chemicals are:

- Arsenic compounds
- Barium compounds (other than barium sulphate)
- Cyanides capable of producing hydrogen cyanide
- Lead compounds
- Mercuric compounds
- Organo pesticides and insecticides
- Phosphorus compounds

https://www.legislation.gov.uk/uksi/1982/217/schedule/made

22.8. Mercury

Poisonous and expensive Mercury, it should be used with care. Containers must always be sealed and any spillage must be sucked up using a mercury pipette. Small drops may be frozen with pieces of dry ice then collected. The contaminated area of the spillage should then be treated with the mercury spill kit and instructions followed. The resulting material must then be packaged and handed in for disposal by an appropriate waste contractor. Contact the Technician for your area. Mercury spill kits are bought in for each lab. The bulk spill kit is outside of Chemistry Stores and is for communal use.

22.9. Dimethylmercury

This volatile, highly toxic compound attacks the central nervous system. **It readily passes through latex rubber gloves and skin**. A spillage of one drop on a gloved hand has been known to cause coma followed by death.

22.10. Perchlorates and Perchloric Acid

Any trace of perchlorate in contact with organic material constitutes a dangerously explosive mixture, especially if heated. In many cases, alternative materials can be substituted; for example HBF4 can often replace $HClO_4$ as a strong acid, and other non-coordinating anions might be used instead of $[ClO_4]$.

Perchloric Acid Guidance Note:
https://www.gla.ac.uk/media/Media_932390_smxx.docx

22.11. Reduction of Nitro Compounds

The catalytic reduction of nitro compounds is strongly exothermic and should not be carried out on a large scale.

22.12. n-Hexane

This substance is a known neurotoxin and a cancer suspect agent. It would be prudent to replace this where possible - for example petroleum mixtures containing less than 2% of this isomer are available. Where it cannot easily be replaced, for example as a chromatography eluent, the vapour should be avoided.

23. Good Laboratory Practice

23.1. Listening to Music

The use of radios or music players, etc, as background noise in laboratories is at the discretion of the PI and should be at a level that allows normal vocal communication and does not impair situational awareness. The use of headphones in labs or offices is strictly prohibited as this may hinder emergency procedures e.g. Fire Alarm.

23.2. Mobile Phones

- While Mobile Phones are not banned in labs school-wide, there use in labs should be limited as much as possible and they should only be used for urgent and necessary purposes (e.g., using Safe Zone, contacting emergency services, urgent need to contact a colleague).
- Local labs may have stricter measures in place dictate by the risk assessment of the activities in the lab.
- The following general guidance should be followed if you required to have a mobile phone in the lab:
    - Mobile phone use in the lab should be avoided wherever possible.
    - Mobile phones should only be used in the lab as a means of urgent work-related communication (e.g., use of safe-zone app, emergency contacts).
    - No scrolling/messaging while undertaking **any** lab work, no matter how menial or trivial you perceive it to be.
    - No walking through the lab whilst looking at/interacting with your device.
    - Do not leave your phone on workbenches, in fume cupboards, on lab stools etc. as they may become contaminated.
    - Do not touch device screens with gloved hands.

23.3. Housekeeping and General Advice

- Plan ahead. Before commencing an experiment, you should have a clear idea of everything that is to be done from start to finish. Make sure there is adequate bench space and see that the bench is clean and dry and the gangway is clear. Collect any safety equipment such as blast screens or visors that may be required and note the location of the nearest fire extinguisher. If highly flammable substances are being used, check the area for possible sources of ignition such as lighted Bunsen burners, hot plates, heating mantles. Ensure heating mantle has temperature cut off set if available to prevent overheating. In the event of an emergency or unexpected disruption, a plan should be in place to make the experiment safe for other users i.e. quench, switch off cooling

- In erecting apparatus, care must be taken when using bosses and clamps. The boss should be fixed first with the clamp open. If the cork or rubber layers are missing from the clamp, it should be replaced or, alternatively, a piece of similarly resilient material placed between the clamp and the apparatus. Tighten the clamp carefully making sure that the apparatus is not strained in any way. If it is necessary to loosen the boss to do this, do not allow the weight of the boss and clamp to be taken by the apparatus. Make sure that the equipment is adequately supported and is not top heavy. Laboratory jacks are available and are often very useful in supporting parts of the equipment.

- When erecting apparatus requiring the use of heating mantles, oil baths, etc., you should not build from the bench up but place the heat source on a lab-jack or similar platform and build up from there. It is much easier to rapidly lower the source of heat to control an overheating reaction than it is to raise the rest of the apparatus assembly.

- Remember that you are concerned with the safety of others as well as your own.

- If safety (blast) screens are necessary in front of the equipment they will also be necessary at the back if someone is working on the other side of the bench.

- All reaction products should be properly labelled and stored in a safe place. If this is a communal facility, the name of the experimenter should be on the label. Unstoppered vessels, including those containing aqueous solutions, should not be kept in cupboards or refrigerators.

- The stoppers or caps of reagent bottles should be replaced immediately after use, Winchesters of flammable solvents should be returned to the solvent cabinet and the door locked shut.

- Clear up any spillage immediately.

- When using fume cupboards, glove boxes etc. for the secondary containment of dangerous substances, remember to take all necessary precautions before removing contaminated apparatus and “empty” chemical bottles into the open laboratory.

- Remember that the Joseph Black Building is a multi-user building, and its corridors are frequently busy with non-chemists, and even non-science undergraduates who use the lecture theatres. It is essential that no-one is put at risk through the carriage of solvents or dangerous chemicals between laboratories or from the stores. During term time, avoid transporting any such materials at lecture change-over times (between five to and five past the hours). At any times, if the materials would create a hazard if spilt, use a **double containment** method. This can be as simple as having a large, plastic, screw-top jar in which to place the bottles of chemicals.

- Shelf supports in vented cabinets and other cupboards where chemicals are stored should be checked regularly to ensure that they are secure.

23.4. Labelling

- Label all flasks as they are used, including the name of substance / owner, and remove old labels when cleaning apparatus.
- Always renew a label. Never amend an old one.
- Products and by-products should have a permanent label attached. These labels should have the chemical name written (not just a formula) and the name or initials of the person who produced it. The appropriate hazard label should be affixed to the container.
- Labels must be placed beside experiments in fume cupboards of multi-user laboratories giving brief details of the reaction, hazards and risk. Similar labels must also be placed beside experimental work in locations remote from the experimenter's normal workplace.
- Use self-adhesive labels only - never lick a gummed label. (Some self-adhesive labels need to be further secured with a clear tape).

23.5. Best practice and key things to remember

ALL LABCOATS MUST BE 100% COTTON

- It is against the law to eat, chew gum, smoke, drink or apply make-up in the laboratory.
- No one will be allowed to work in laboratories after consuming recreational drugs or any alcohol. Individuals taking medication should carefully consider common side effects (e.g., drowsiness, lack of concentration, tremors) and avoid undertaking lab work until no longer requiring medication or experiencing the side effects. If this is a persistent factor, it should be incorporated into the risk assessment and special arrangements to support lab work.
- Regard all chemicals and solvents as toxic. Trace impurities in apparently "edible" laboratory materials have caused death!
- For the same reasons, smelling chemicals and gases, especially unknown substances, must be avoided.
- Wear safety glasses and protective clothing at all times in the lab. It is a legal requirement that it is enforced under The Personal Protective Equipment at Work Regulations 1992. HSE guidance: https://www.hse.gov.uk/pubns/priced/l25.pdf
- Long hair must be securely held back or covered to avoid contact with flames or chemicals.
- Religious head coverings where possible/practical should be 100% cotton.
- Laboratory coats must be left in the laboratory or in a locker and should not be worn in conference or tea rooms, lecture theatres, toilets or the library.
- Never stand on a laboratory stool or chair. Always use the correct equipment. Do not improvise or use a makeshift arrangement.

- Do not use anything that is knowingly defective. Have it repaired.
- Keep working surfaces and areas clean and tidy.
- Store chemicals and heavy objects below shoulder level in appropriate locations (i.e., vented cabinets, locked cabinets, fire rated cabinets).
- Apparatus not in use should be cleaned and tidied away.
- Inspect all glassware for cracks before use. Broken or chipped bottles or glassware must be taken out of use immediately.
- Lubricate all ground glass joints using suitable lubricant i.e. vacuum safe grease, when so required for reduced pressure work.
- Ensure all flexible tubing is properly connected, in good condition and free from cracks and cuts. If in doubt obtain new flexible tubing can be obtained from Chemistry stores rather than reusing old tubing.
- Treat sharp edges and points and glass tubing with respect. Do not leave sharp implements on a working surface or loose in a drawer - keep them in a box. Sharp pointed objects must not be carried in a pocket.
- Never re-use single use sharps and dispose in a sharps bin immediately after use. Do not reuse needles or put back into sheath.
- Be careful opening drawers and close them after use.
- Do not run in any area of the School.
- Take care when opening or closing laboratory doors.
- Use a carrying basket when moving Winchesters to and from the laboratory. Do not carry Winchester bottles of ether etc. containing sodium wire over wet floors.
- **Always wear suitable footwear. All footwear should be enclosed, i.e., no open toed sandals etc.**
- **Appropriate clothing should be worn, ensure bare legs are covered and minimise the use of synthetic material. Natural fibres offer better protection against flash burns and solvent spills.**
- Place electric cables where they cannot be snagged or cause anyone to trip (including yourself) or pull over the equipment to which they are connected.
- Make sure that cables, hoses etc., are not in contact with the heating surfaces of stirrer hotplates or heating mantles.
- Do not use or operate equipment with which you are not familiar. Seek advice or training. Always follow the manufacturer’s instructions. Always switch off and unplug before cleaning, adjusting or changing parts of a machine or equipment, and when not in use.
- It is an offence to interfere with equipment and devices provided for safety. Make sure all safeguards are in position. Safety devices must be inspected annually and records kept.
- Appropriate protective gloves should be worn when handling dangerous materials or strong cleaning agents.

- Use only proprietary cleaning agents unless directed specifically by your supervisor.
- Solvents must not be used to remove contamination from the hands as some substances can produce toxic effects by skin absorption.
- Dewar vessels must be taped or enclosed, and those used to transport contents to laboratories must be encased.
- Always keep back-up copies of your laboratory notebook and other important data, spectra, etc. in a separate location (preferably not in the building). There is always a risk of loss of valuable data from floods and fires. Lab books should be recorded in an electronic format and stored on university approved programmes/servers only. Please refer to the University policy on Cyber security: (https://www.gla.ac.uk/myglasgow/it/informationsecurity/policies/
- Many chemicals are delivered in bottles inside sealed metal canisters. It should be remembered that any leakage inside the canister might lead to a pressure build-up. In particular, when moisture-sensitive compounds are delivered in sealed canisters, either they should be opened within a few days, or the lid punctured to prevent pressure build up. The initial puncturing of any of these canisters should be done at arm's length, in a fume cupboard, and (of course) wearing safety glasses.
- Be aware of the effects of strong sunlight (even in Glasgow!) on chemicals. For example, some years ago several distillations of diazomethane/ether solutions were successfully carried out by standard procedures in December, but in April with strong sunlight shining directly onto the condenser and receiving flask a violent explosion occurred. (See also the section on peroxides in ethers). Note that a spherical flask of liquid can act as a focussing lens.
- The electrical heating elements in hot air blowers operate above the auto-ignition point of many organic solvents, even when a high airflow is selected. Care must therefore be taken not to use these when organic vapours are around. The use of hot air blowers in fume cupboards and other confined spaces is especially hazardous. Hot air blowers must not be used as a heat source for distillation or re-crystallisation. **Use of heat guns for crystallisation, to dissolve materials or to speed up drying of materials is not allowed as ignition of organic vapours can occur.**
- Take care to avoid getting liquid on heating mantles. Water can create a short circuit and electrocution risk. Organic liquids might inflame as the heating coils warm up. Wet or contaminated heating mantles should be cleaned, dried and electrically tested before use.
- **The wearing of lab gloves in public areas of the building is prohibited. Should PPE/gloves be required, only one hand should be gloved to carry material. If**

two gloves are required then the person must be accompanied by someone to open doors etc.

- **Gloved hands should never be used to open ANY door, should PPE be required a bare hand must be used or alternatively someone must accompany you to open doors.**

24. Manual Handling

24.1. Lifting

When lifting anything heavy, get a good grip, keep your back straight and chin in, bend your knees and have one foot slightly in front of the other, and lift with your leg muscles as you stand up. Move smoothly and do not jerk or twist your body as you lift. Never attempt to move anything that feels too heavy for you or is an awkward shape. If in doubt, get someone to help you. Do not carry a load that obstructs your view or with which you cannot see the stair treads. Further information and advice should be obtained by consulting: https://www.gla.ac.uk/myglasgow/seps/az/manualhandling and guidance therein.

Manual handling training is also provided by SEPS: https://www.gla.ac.uk/myglasgow/seps/training/manualhandlingtraining

24.2. Handling Heavy Loads

Assess the weight - possibly by partly lifting a corner.

- Check that the route for the lift is clear, and if necessary, plan rest stops.
- Face the direction of travel.
- Use mechanical aids when these will help - trolleys, skates etc.
- Bend the knees, not the back. Try to keep on a natural line. Do not over-bend.
- Grasp the load firmly and lift smoothly. Avoid bending and twisting.
- Hold the load close to the centre of body.
- Do not change your grip unless the load is supported.
- Make sure that your vision is not obstructed.
- Unload in a similar manner to loading but avoid trapping fingers.

25. Visual Display Units

The University has published "Safety Standards and Guidance for Visual Display Units" which should be consulted if you work with a VDU on a regular basis. This includes workstations attached to apparatus.

This guidance is at the address below:

https://www.gla.ac.uk/myglasgow/seps/az/computersseealsohomeworking/

Appendix 1 – First-Aiders

First Aider	E-mail	Room	Extension
Julie Alexander	Julie.Alexander@glasgow.ac.uk	A2-32a	0784/5334
Ellen Brown	Ellen.Brown@glasgow.ac.uk	A2-32a	4014
Lorraine Clark	Lorraine.Clark@glasgow.ac.uk	A2-32a	0784/5334
Loraine McDonald	Loraine.McDonald@glasgow.ac.uk	A2-32a	4014/5334
Hazel Tosh	Hazel.Tosh@glasgow.ac.uk	A2-32a	5334
Zoe Michel	Zoe.Michel@glasgow.ac.uk	A3-07	0237
Paul Shields	Paul.Shields@glasgow.ac.uk	A3-07	0237
Lloyd Henry	Lloyd.Henry@glasgow.ac.uk	A3-24	6563
Craig Bradley	Craig.Bradley@glasgow.ac.uk	A3-25d	6570
Euan Stobbs	Euan.Stobbs@glasgow.ac.uk	A3-25d	6570
Chris Kelly	Christopher.Kelly.3@glasgow.ac.uk	A3-29	8106
Connor Fleming	Connor.Fleming@glasgow.ac.uk	A3-29c	XXXX
Giovanni Enrico Rossi	GiovanniEnrico.Rossi@glasgow.ac.uk	A3-29c	XXXX
Margaret Mullin	Margaret.Mullin@glasgow.ac.uk	A3-33a	4893
Rachel Hill	Rachel.Hill.2@glasgow.ac.uk	A4-30	XXXX
Adam Hotson	Adam.Hotson@glasgow.ac.uk	A4-32c	6577
Marcox Pun	Marcox.Pun@glasgow.ac.uk	A4-32c	6577
Harry Miras	Charalampos.Moiras@glasgow.ac.uk	A4-42	4375
Antrea Pallikara	Antrea.Pallikara@glasgow.ac.uk	B2-10	5989
Andy Monaghan	Andrew.Monaghan@glasgow.ac.uk	B2-25	6585
Tang Phattharaphuti	Phitchayapha.Phattharaphuti@glasgow.ac.uk	B3-34	5953
June Southall	June.Southall@glasgow.ac.uk	B4-13	6447
Alec Mungall	Alexander.Mungall@glasgow.ac.uk	C3-03b	6551
Alex Loch	Alex.Loch@glasgow.ac.uk	C3-08	XXXX
Gillian Laidlaw	Gillian.Laidlaw@glasgow.ac.uk	C4-03a	XXXX
Joseph Steel	Joseph.Steel@glasgow.ac.uk	C5-12	7341

Mental Health First Aider	E-mail	Room	Extension
Ellen Brown	Ellen.Brown@glasgow.ac.uk	A2-32a	4014
Euan Stobbs	Euan.Stobbs@glasgow.ac.uk	A3-25d	6570
Frances Docherty	Frances.Docherty@glasgow.ac.uk	A4-15	XXXX
Emily Draper	Emily.Draper@glasgow.ac.uk	A5-13/C3-08	7738
Mario González-Jiménez	Mario.GonzalezJimenez@glasgow.ac.uk	B3-21	7680
June Southall	June.Southall@glasgow.ac.uk	B4-13	6447

Oxygen Therapy First Aider	E-mail	Room	Extension
Craig Bradley	Craig.Bradley@glasgow.ac.uk	A3-25d	6570
Gillian Laidlaw	Gillian.Laidlaw@glasgow.ac.uk	C4-03a	XXXX

To call an extension from a mobile phone, dial **0141 330** then the 4 digit extension code.

First Aid kits are available in all laboratories.

Call **0141 330 4444** (or **4444** on internal landline phones) for Emergency Services.

First Aid assistance can also be accessed (including out of hours) by calling Security on **0141 330 4444** (or **4444** on internal landline phones) or via the **SafeZone** app.

The nearest **AEDs (defibrillators)** are located in the entrance foyer of the Wolfson Medical building and the workmen's courtyard of the Isabella Elder building. Other defibrillator locations can be found in the UofG Life app 'Near Me' section.

Appendix 2 – Laboratory Responsible Persons

To be updated

Appendix 3 – School Safety Committee

Justin Hargreaves – Chair, Head of School

Gordon Hedley – Laser Safety Officer

Stuart Caldwell – Post-doctoral Representative

Marta Kostadinova – Post Graduate Representative

Adrian Lapthorn – Biological Safety Member

De-Liang Long – Complex Chemistry Member

Andrew Monaghan – Technical Services representative

Jessica Walker – Lead Teaching Technician *(Depute Safety Coordinator)*

Drew Thomson – Chemical Biology and Medicinal Chemistry (CBMC) Rep

Joy Farnaby – Radioactive Materials Specialist

John Liddell – Area Fire Officer

Carol-Anne Smith – ARC Technical Operations Manager

Finlay Smith – Chemistry Stores / Waste disposal

Alec Mungall – Unite union representative *(Depute Safety Coordinator)*

Mark Wildman – Technical Services Manager – Research Labs *(Safety Coordinator)*

Ross Slavin – Chemical Safety Advisor - SEPS

Indira Gray – Minutes

Appendix 4 – COSHH Hazard Pictograms

Explosive (Symbol: exploding bomb)

Flammable (Symbol: flame)

Oxidising (Symbol: flame over circle)

Corrosive (Symbol: corrosion)

Acute toxicity (Symbol: skull and crossbones)

Hazardous to the environment (Symbol: environment)

Health hazard/Hazardous to the ozone layer (Symbol: exclamation mark)

Serious health hazard (Symbol: health hazard)

Gas under pressure (Symbol: gas cylinder)

Appendix 5 – Workplace Exposure Limits

These are air quality limit values in workplaces set, in this country, by the Health and Safety Executive from ACTS (Advisory Committee on Toxic Substances). For more guidance please see the link below:

http://www.hse.gov.uk/coshh/basics/exposurelimits.htm

These are usually based on a time weighted average (TWA) atmospheric concentration over an 8 hour period.

Short term exposure limits (STEL) are usually based on a 10 minute exposure period.

Atmospheric concentrations are usually quoted in parts per million for gases and vapours (ppm). At 25°C:

$$\text{mg m}^{-3} = \frac{\text{MW} \times \text{ppm}}{24.44}$$

(MW = molecular weight)

For certain dusts and fibres, particles per cubic foot (ppcf) or fibres per millilitre may be used.

A list of Workplace Exposure Limits and explanatory information is given in The Health and Safety Executive Guidance Note EH40 which is reviewed and updated annually.

Substance	TWA (8h) ppm	STEL (15min) ppm	Primary Hazard(s)
Acetic acid	10	20	Flammable, corrosive
Acetone	500	1500	Flammable, irritant
Acetonitrile	40	60	Flammable, irritant
Benzene	1	-	Flammable, irritant, carcinogenic
Butane-2-one (MEK)	200	300	Flammable, irritant
Carbon tetrachloride	1	5	Toxic, suspected carcinogen
Chloroform	2	-	Toxic, suspected carcinogen
Dichloromethane	100	-	Irritant, suspected carcinogen
Diethyl ether	100	200	Flammable, harmful
Dimethylformamide (DMF)	5	10	Flammable, harmful, reproductive toxin
1,4-dioxane	20	-	Flammable, irritant, suspected carcinogen
Ethanol	1000	-	Flammable, irritant
Ethyl acetate	200	400	Flammable, irritant
Formic acid	5	-	Flammable, corrosive, harmful
n-Hexane	20	-	Flammable, toxic
Methanol	200	250	Flammable, irritant, toxic
Nitromethane	100	150	Flammable, harmful, suspected carcinogen
Pentane	600	-	Flammable, toxic
Petroleum spirits	-	-	Flammable, irritant, toxic
Propan-1-ol	200	250	Flammable, irritant
Propan-2-ol (isopropanol)	400	500	Flammable, irritant
Pyridine	5	10	Flammable, irritant
Tetrahydrofuran (THF)	50	100	Flammable, irritant, suspected carcinogen
Toluene	50	100	Flammable, irritant, reproductive toxin
1,1,1-Trichloroethane	100	200	Irritant, suspected carcinogen
Xylenes	50	100	Flammable, irritant

Appendix 6 – Chemical disposal via drain.

Substances that must not be released to drain*

Certain substances used in research and teaching are likely to cause serious environmental damage or other harmful effects if released into the drainage system. The substances listed below **must not** be released to foul sewers in any quantity under any circumstances.

- Calcium carbide
- Oils, petroleum spirit or any other volatile / flammable organic solvent
- Substances classified as being **priority substances** for control due to their potential to cause serious environmental damage, these substances formerly appeared on the UK Red List of the most dangerous substances for the environment (see appendix 2)
- Any substance listed in the schedule of the Poisons List Order 1982 (Part I)
    - Aluminium phosphide
    - Arsenic and its compounds
    - Barium salts
    - Bromomethane
    - Chloropicrin
    - Fluoroacetic acid and its salts, fluoroacetamide
    - Hydrogen cyanide, metal cyanides (other than ferrocyanides and ferricyanides)
    - Lead acetates
    - Mercury salts and compounds
    - Oxalic acid
    - Phenol and phenols
    - Phosphorus (yellow)
    - Strychnine, salts and quaternary compounds
    - Thallium salts
- Waste likely to cause viscous or solid deposits in any part of the sewerage system (e.g. wax, agar, fats)
- Ethidium bromide solutions (as DNA stain or for other purposes)
- Other DNA stains (without specific approval)
- Mineral , silicon and synthetic oils
- Substances likely to give rise to fumes or strong odours (e.g. mercaptans)
- Halogenated hydrocarbons
- Halogen substituted phenolic compounds
- Thiourea and its derivatives
- Solutions containing any concentration of the following elements:
    - Antimony
    - Arsenic

  - Chromium
  - Selenium
  - Tellurium
- Organohalogen, organophosporus or organonitrogen pesticides, triazine herbicides and any other biocidal compound.
- Metal phosphide compounds (e.g. aluminium phosphide)
- Elemental phosphorus
- Poisonous organosilicon compounds
- Spent photographic solutions
- Picric acid and picrate compounds

Note: This list is not exhaustive, any highly toxic, ecotoxic, flammable / explosive or highly reactive substance should be prevented from entering the drainage system.

List of Priority Substances (including the former UK Red List)

These substances are extremely damaging to the environment and should always be prevented from entering drains, watercourses and other sensitive areas no matter how small the quantity or how high the dilution. It is generally illegal to discharge any of these substances into the environment.

- 1,2-dichloroethane
- Alachlor
- Aldrin, Dieldrin, Endrin
- Anthracene
- Atrazine
- Benzene
- Brominated diphenylether
- Cadmium (and its compounds)
- Carbon tetrachloride
- Chlorfenvinphos
- Chloroalkanes (C10 –C13)
- Chloroform
- DDT (all isomers)
- Dichloromethane
- Dichlorvos
- Dieldrin

- Di(2-ethylhexyl)phthalate
- Diuoron
- Endosulfan
- Fenitrothion
- Gamma-Hexachlorocyclohexane (Lindane)
- Hexachlorobenzene
- Hexachlorobutadiene
- Isoproturon
- Lead (and its compounds)
- Malathion
- Mercury (and its compounds)
- Naphthalene
- Nickel (and its compounds)
- Nonylphenols
- Octylphenols
- Pentachlorobenzene
- Pentachlorophenol (and its compounds)
- Polychlorinated biphenyls
- Simazine
- Tributyltin compounds
- Trichlorobenzene (all isomers)
- Trifluralin
- Triphenyltin compounds

Substances that may be disposed of via drains

While the University of Glasgow is working towards a **"zero to drain"** policy it is recognised that for small quantities (typically 500ml or less) of low-hazard, water soluble substances it may be acceptable to wash waste to drain as long as copious quantities of running water accompany the waste to ensure adequate dilution.

The judgement of what constitutes a low hazard substance or an appropriate amount relies on the professional judgement of the individual bearing in mind that different thresholds may apply to different substances that even some seemingly innocuous chemicals can have adverse effects on the environment. Large quantities or highly concentrated substances should always be disposed of properly via an approved contractor.

The list below gives some guidance as to the classes of chemical which may be disposed of via the drainage system in small quantities with dilution. This list is not intended to be exhaustive but in the event that a substance is not listed then further advice should be sought.

- Dilute acid solutions (not including HF)
- Dilute alkaline solutions (not including ammonia)
- Non-toxic, water soluble alcohols
- Non-toxic, water soluble inorganic salts (e.g. sodium chloride , sodium citrate)
- Small quantities of detergent used for cleaning
- Disinfectant solutions at the working concentration only (i.e. 2% Virkon)
- Hypochlorite (bleach) solutions at the working concentration only
- Dilute, aqueous chemical solutions (below the relevant threshold levels)
- TAE / TBE buffer at the working concentration only (not including stock / concentrated solutions)

Note: Although it may be acceptable to wash small quantities of the above substances to drain with copious quantities of water <u>it is not acceptable to deliberately dilute bulk waste chemicals</u> for the purposes of disposal. Any large quantity of waste should be retained safely for disposal via an approved contractor.

Note: Remember that even dilute solutions of incompatible substances may react violently if they come into contact within the drainage system potentially producing flammable or toxic products (e.g. Virkon will react with bleach to produce toxic chlorine gas). Care should be taken to ensure that the risks are properly assessed before disposing of any substance via the drainage system.

Appendix 7 – Schedule 1 Chemical Warfare Agents

SCHEDULE 1 CHEMICAL WARFARE AGENTS

A. TOXIC CHEMICALS

1 O-Alkyl (≤C_{10}, incl cycloalkyl) alkyl (Me, Et, n-Pr or i-Pr)- phosphonofluoridates

eg Sarin: O-lsopropyl methylphosphonofluoridate

Soman: O-Pinacolyl methylphosphonofluoridate

2. O-Alkyl (≤C_{10}, incl cycloalkyl) N,N-dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidocyanidates

eg Tabun: O-Ethyl N,N-dimethyl phosphoramidocyanidate

3. O-Alkyl (H or ≤C_{10}, incl cycloalkyl) S-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts.

eg VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate

4. Sulfur mustards:

2-Chloroethylchloromethylsulfide

Mustard gas: Bis(2-chloroethyl)sulfide

Bis(2-chloroethylthio)methane

Sesquimustard: 1 ,2-Bis(2-chloroethylthio)ethane

1,3-Bis(2-chloroethylthio)-n-propane

1,4-Bis(2-chloroethylthio)-n-butane

1,5-Bis(2-chloroethylthio)-n-pentane

Bis(2-chlorethylthiomethyl)ether

O-Mustard: Bis(2-chloroethylthioethyl)ether

5. Lewisites:

Lewisite 1: 2-Chlorovinyldichloroarsine

Lewisite 2: Bis(2-chlorovinyl)chloroarsine

Lewisite 3: Tris(2-chlorovinyl)arsine

6. Nitrogen mustards:

HN1: Bis(2-chloroethyl)ethylamine

HN2: Bis(2-chloroethyl)methylamine

HN3: Tris(2-chloroethyl)amine

7. Saxitoxin

8. Ricin

B. Precursors

Legislation requires that an annual return of all purchases of Schedule 1 chemical warfare agents and precursors is made to the Home Office for orders during the period 1st January to 31st December during any calendar year. For this reason, the Safety Coordinator must be informed of any such purchases.

Appendix 8 - Drug Precursor Legislation

CATEGORY 1

Substance	CN designation (if different)	CN code	CAS No ([2])
1-phenyl-2-propanone	Phenylacetone	2914 31 00	103-79-7
N-acetylanthranilic acid	2-acetamidobenzoic acid	2924 23 00	89-52-1
Isosafrol (cis + trans)		2932 91 00	120-58-1
3,4-methylenedioxyphenyl-propan-2-one	1-(1,3-Benzodioxol-5-yl)propan-2-one	2932 92 00	4676-39-5
Piperonal		2932 93 00	120-57-0
Safrole		2932 94 00	94-59-7
Ephedrine		2939 41 00	299-42-3
Pseudoephedrine		2939 42 00	90-82-4
Norephedrine		ex 2939 49 00	14838-15-4
Ergometrine		2939 61 00	60-79-7
Ergotamine		2939 62 00	113-15-5
Lysergic acid		2939 63 00	82-58-6

The stereoisomeric forms of the substances listed in this category not being cathine ([3]), whenever the existence of such forms is possible.

The salts of the substances listed in this category, whenever the existence of such salts is possible and not being the salts of cathine.

([3]) Also named (+)-norpseudoephedrine, CN code 2939 43 00, CAS No 492-39-7.

CATEGORY 2

Substance	CN designation (if different)	CN code ([1])	CAS No ([2])
Acetic anhydride		2915 24 00	108-24-7
Phenylacetic acid		2916 34 00	103-82-2
Anthranilic acid		2922 43 00	118-92-3
Piperidine		2933 32 00	110-89-4
Potassium permanganate		2841 61 00	7722-64-7
The salts of the substances listed in this category, whenever the existence of such salts is possible.			

([1]) OJ L 290, 28.10.2002, p.1.
([2]) The CAS No is the 'chemical abstracts service registry number', which is a unique numeric identifier specific to each substance and its structure. The CAS No is specific to each isomer and to each salt of each isomer. It must be understood that the CAS Nos for the salts of the substances listed above will be different to those given.

Legislation requires that an annual return of all purchases of Category 1 and 2 is made to the Home Office for orders during the period 1st January to 31st December during any calendar year. For this reason, the Safety Coordinator must be informed of any such purchase