Department of Chemistry

Departmental Code of Practice for Health & Safety

Department of Chemistry Safety Handbook November 2023

November 2023

University of Aberdeen
Department of Chemistry
Departmental Code of Practice for Health and Safety
Version November 2023

This document is also available on the Departmental website using this link.

Revised November 2023

Note regarding web links: We have checked that all links in this document are up to date to the best of our ability. Please note that links to documents such as PDF files will not work directly on most browsers, but you can copy and paste them to automatically download the desired document.

Contents

Useful Names and Phone Numbers*

Departmental Safety Adviser

Dr Rainer Ebel - Ext. 2930

School Technical Resources Officer

Brian Paterson Ext. 3804

Head of Health, Safety and Resilience

Garry Fisher Ext. 2783

Senior Health & Safety Adviser

Dr Allan Petrie Ext. 3896

Health & Safety Adviser (in charge of NCS)

Emily Blake Ext. 4786

University Fire Safety Adviser

Mr Willie Tocher Ext. 2515

General Enquiries (to the Central Safety Team)

healthandsafety@abdn.ac.uk

University Radiation Protection Adviser

This service is provided to the University by NHS Grampian Radiation Protection Service. Services include specialist advice and assistance with the use of sources of ionising and non-ionising radiations:

Dr Stephen McCallum, Head of Radiation Protection

Dept Biomedical Physics, NHS Grampian Foresterhill

Aberdeen, AB25 ZD

01224 553109 or 01224-553209

* if dialling from outside the University, add 01224 27 (followed by the stated extension)

Policy Statement

It is the Policy of the School of Natural and Computing Sciences (NCS) to take all practicable steps to safeguard the health, safety and welfare of all staff and students while at work in the School and to protect all others against hazards to health or safety arising out of its activities. The contents of this book set out the details of this policy.

Although ultimate responsibility for Health and Safety within the School lies with the Head of School, the implementation is the role of the Head of Chemistry, in consultation with the Departmental Safety Adviser and the Departmental Health & Safety Committee. Departmental safety inspections will be conducted every 12 months or more frequently if necessary. If issues raised during safety inspections are not addressed in a timely manner, they may be escalated to the School Health & Safety Committee.

The purpose of the Health and Safety at Work Etc., Act 1974, and the regulations and Codes of Practice which follow from it is to provide a legal framework for the promotion of high health and safety standards at work. The intention of the Act is clear. Safety is the responsibility of everyone. We need the co-operation of every member of the Department. Therefore, if the safety policy is to be effective it needs the active support of all staff, students, and visitors.

Breaches of safety procedures or actions, which in any way endanger persons within the Department, will be treated as serious disciplinary offences.

Professor Abbie McLaughlin
Head of Chemistry

Professor David McGloin
Head of School, NCS

November 2023

Part 1: Emergency Procedures

A) Fire

Fire is probably the greatest single safety related threat to the Department and to members of the Department. Even if everyone were to escape safely from the building, a fire could destroy our facilities and all our documents and data. It is important therefore that we do as much as we can to prevent a fire starting. If despite our best efforts a fire should start, a fast and effective response can help save life and property.

Fire prevention

The University's no smoking policy eliminates one of the main ways in which a fire can start. Our systems for inspecting electrical equipment should reduce the chances of faulty electrical equipment being a source of fire. Other important precautions are:

- Comply fully with the Department's procedures for the storage and use of highly flammable liquids.
- Comply fully with the Department's procedures for out of hours running of experiments.
- Avoid large accumulations of material which might easily burn (e.g. waste paper, cardboard, plastics).
- Do not obstruct the ventilation of electrical equipment or place material immediately above or close to electric heaters. Note that the use of private electrical heaters has been banned by the University.
- Do not overload electrical sockets by connecting too many appliances to a single socket.

On hearing the fire alarm

If you hear the fire alarm:

- Leave the building by the **nearest exit** and go to the assembly point shown on the fire notices (**Academic Square in front of Fraser Noble**). It is important to leave sufficient space for fire engines and ambulances to come through – move towards the ramp leading to the Sir Duncan Rice Library, and encourage others to do so as well.
- If you are a member of staff, when alarm sounds retrieve the yellow high-visibility vest from the nearest safety station. If the vest is there you must take on the role of fire warden.
- When acting as fire warden, if safe to do so, check rooms and laboratories in this sector (as designated on the plan displayed at safety station when you collect the yellow high-visibility vest), and ensure all occupants have heard the alarm and get them to leave building, then leave yourself.
- On exiting building fire wardens must report to the fire marshal, who will be wearing an orange high-visibility vest (one at the North and South entrances). They will mark off that sector as having been checked and cleared.
- Anyone teaching or supervising groups of students should ensure that **all the students leave the building by the nearest exit** and go to the assembly point.
- If you have any information about someone who might be still in the building, report to

the fire marshal. They will be identified by an orange high visibility jacket and will be located at the main entrance doors to the Meston Building.

- Report if there are any disabled persons that require assistance.

Note: **Do not re-enter the building until given clearance either from Security or the Fire & Rescue Services**.

Important notes:

Even if you assume it may be a false alarm, you must evacuate the building! Failure to evacuate during a fire alarm may lead to disciplinary action.

The School of NCS and the Chemistry department have dedicated fire safety policies which are updated on a regular basis and published on the Chemistry Safety pages.

Extinguishers and fire blankets

There are three main types of fire extinguishers used in the Chemistry department, **carbon dioxide**, **foam spray** and **dry powder** (sometimes labelled "ABC powder"). They are suitable for different kinds of fire, as detailed below. Note that there are labels summarising their main applications fixed to the wall above each extinguisher (which are also printed on the side of each extinguisher) for quick reference in case of an emergency. It is vital that staff, researchers, visitors and students familiarise themselves with the location of firefighting equipment.

Within the Department, the following firefighting equipment is available:

1) CO_2 extinguishers. These are red with a black marking and are the most widely distributed throughout the Department. In addition to their general usefulness, they can also be used on electrical fires, but not on flammable metal fires. Their main drawbacks are that they require you to get quite close to the fire and, as they have little cooling effect, re-ignition can occur in certain circumstances. Also, they should not be used in small, confined spaces due to the risk of oxygen depletion. Nevertheless, they are the first choice for small laboratory fires. Be aware that they may produce a loud noise when used.

2) Foam spray extinguishers. These are red with a buff marking. While they are good for many types of fire, they must not be used where there is the possibility of contact with electrical equipment or flammable metals. Normal foam is not effective on fires involving alcohols and special types of foam are needed.
3) Dry powder (ABC powder) extinguishers. These are red with a blue marking. They have good blanketing properties and are particularly useful for large solvent fires, live electrical equipment fires, but not for flammable metal fires.
4) Buckets containing sodium bicarbonate have been placed in all teaching laboratories and at other locations in the Department. These may be used on small solvent fires.
5) Fire blankets can be used to extinguish burning clothing. They must not be used for bench fires. Burning clothing may also be extinguished with the water sprays in the laboratories.

Special extinguishers are required for fires involving a burning metal, for example class D powder-based fire extinguishers. The type of extinguisher depends on the metal involved. Note that these extinguishers are not provided on a routine basis, and thus their supply will need to be arranged before work in these areas can start.

All extinguishers are checked every 12 months (by a company contracted by the Estates Section). The date of last inspection is shown on the extinguisher. You must inform the Technical Resources Officer whenever an extinguisher is discharged so that it may be re-filled.

Escape routes

Corridors and escape routes must be kept clear. Combustible materials should not be stored in corridors or on escape routes where they could become a source of fire and smoke.

Furniture and other items should not be placed so they partially block escape routes. Narrowing of escape routes will reduce the rate at which people can leave the building in an emergency. In a corridor filled with smoke, furniture can create a serious obstacle for someone who is trying to find his or her way out.

Fire doors can have a very significant effect in preventing the spread of smoke and fire through a building and make it easier for people to escape. It is extremely important that fire doors are kept closed and not wedged open. (Any door fitted with a door-closing device should be treated as a fire door and should not be wedged open.)

Fire drills and alarm tests

Fire drills are held in the Department at least once each year to enable us to test the efficiency of our fire evacuation arrangements.

The fire alarm for the building is usually tested each week on Wednesday at 7:30 am. The alarm bells ring twice during the test. The building uses a wireless system, so it takes some minutes for the alarm to sound in all areas.

Liaison with the Fire Brigade

The following people have been designated members of staff who will liaise with the Fire Brigade: Brian Paterson, Russell Gray and Dr Rainer Ebel. On hearing the alarm these people should go to the South Entrance. The first to arrive will don a high visibility jacket and become the fire warden of the building. The person in charge will inform the Fire Brigade of any hazards in the building. The necessary plans and lists are in dedicated boxes at both the North (SDRL) and the South (Meston Walk) Entrance; the keys are under these boxes. The Safety Adviser and the Technical Resources Officer will update these as necessary. A dedicated communication system via two-way radios is in place for communication between the different ends of the building and Security,

Duty of Fire Wardens

1) The floor checker for a designated Fire Sector is the staff member who has donned the high visibility vest for that zone (usually the first staff member to have reached the high visibility vest). Yellow vests are located strategically within existing Fire Sector, plans of which are located at the appropriate Fire Sector points.
2) Floor Checkers should check that their designated sectors are completely evacuated and report to the Fire Warden (see above). Floor checkers leaving the building by the North Entrance should not re-enter the building but travel round the outside.
3) Make yourself familiar with the locations of the various vests – if you work in different areas you may need to retrieve a vest from a nearby location.

B) First aid - emergencies

It may take a first aider several minutes to reach the scene of an accident or an accident might happen at a time when there are no first aiders in the building. The actions taken by those on the scene in the seconds and minutes immediately following an incident may be able to significantly limit the extent of the injuries suffered by a casualty. There are First Aid boxes in all teaching laboratories and selected corridor locations.

Initial actions

Contact a qualified first aider or, if unavailable, call the emergency telephone numbers listed below (9-999 or 9-112).

Meston First Aiders

Name	Location	Extension
Alex Brasier	101	3449
Iona Copley	119b	3495
Colin North	109	3459
Carolyn Porter	313	3634
Ross Macpherson	320	2315
Milan Markovic	207	4596
Walter Ritchie	G13	3493
James Sinclair*	G74	2940

* First Aider has been trained in the administration of oxygen and in the treatment of HF burns.

All First Aiders have been trained in the use of a defibrillator. The nearest **defibrillator unit** is located in **Fraser Noble** on the pillar immediately **beside the Porters office** (**2532**) inside a box. The key is inside the red glass break box.

Emergency Telephone Numbers

Fire Brigade	**-**	**9-999 [or 9-112]**
Ambulance	**-**	**9-999 [or 9-112]**
Police	**-**	**9-999 [or 9-112]**
Campus Security (24 h)		**3939**
Accident & Emergency Foresterhill		**(76) 53306**

If an ambulance is required **dial 9-999 (or 9-112) to talk to the emergency services directly**. Only in exceptional cases (for example if only a regular phone without outside connection is available) should you call Campus Security (3939), as this inevitably will lead to a delay. If possible, someone should meet the ambulance at the South entrance. It is important to stay with the patient until medical help arrives. If a patient is sent to hospital either by ambulance or private car, it is helpful if the Accident and Emergency Unit at Foresterhill can be forewarned.

After calling for assistance, a trained first aider should:

- talk to, listen to and reassure the conscious casualty.
- check that there is no further danger to the casualty or yourself.
- check breathing, bleeding and whether conscious.
- if breathing has stopped, clear the airway and start resuscitation.

If **cardiac arrest is suspected**, the following steps should be taken:

- assess the person; open their airways
- shout for help immediately, someone must call 9-999 for an ambulance, stating that they suspect cardiac arrest. Also, they need someone to phone 2532 for the defibrillator or go to collect it
- the nearest **defibrillator unit** is located in **Fraser Noble** on the pillar immediately **beside the Porters office** (**2532**) inside a box. The key is inside the red glass break box
- start CPR. Once the defibrillator arrives, follow the instructions given by the defibrillator. It will need one person to maintain CPR, and one person to operate the defibrillator
- send people to the various entrances of the building to meet the ambulance. Note that based on past experience, ambulances may go to the South end = Meston Walk or to the North entrance = Academic Plaza, or even the shuttle bus stop near the Sir Duncan Rice Library.

Common first aid response to chemical contamination, hot and cold burns

> Common treatment for all these cases involves **immediate application of** cold or lukewarm **running water** for **at least 10 minutes**. Sources of water can either be a safety shower or a simple water tap equipped with a piece of rubber tubing. To prevent or at least reduce the risk of lasting damage, it is important that **this treatment is initiated even before a first aider is called**, or further medical attention be sought.

On discovering a fire

1) Sound the alarm.
2) Get someone to call the fire brigade by dialling 9-999 (alternatively, 9-112).
3) Warn others in the area (Shout "Fire!" and bang on doors - some people do not always respond immediately to fire alarms).
4) Only if you can do so without putting your own safety at risk (and you have received adequate training), attempt to fight the fire with a suitable extinguisher.
5) Otherwise, close the door to the area where the fire is (to contain the fire) and leave the building and await the arrival of the fire brigade.
6) At the assembly point (Academic Square in front of Fraser Noble) report to the fire marshal. An orange high visibility jacket will identify them. Provide them with information about what has happened.

Hot and cold burns

To minimise the effect of burns, speed is essential. The immediate application of cold (but not freezing) for hot burns, or cold or lukewarm (for cold burns) running water for at least 10 minutes (time it properly; it's a lot longer than you would think) can have a dramatic effect in limiting the amount of damaged tissue. Only after running water has been applied for this period, should medical attention be sought.

Large heat burns and scalds should be covered with a dry, sterile dressing as soon as possible. No ointment should be used and no attempt made to clean the damaged area. Get medical help.

Small burns may be covered with a dry dressing after the cold-water treatment.

All dressings must be non-adhesive to avoid them sticking to blistered or burnt skin.

Chemical contamination of the body

1) The immediate inclination on being splashed with a chemical, or seeing someone else being splashed, might be to seek medical help. This could be a mistake. The first step must be to stop the chemical causing further damage to the body. Medical help is required at a later stage to repair any damage, which has been caused.
2) Application of large amounts of running water to the affected area of the body for a period of 10 minutes is the standard initial treatment for all instances of chemical contamination.

It must be commenced immediately. A delay of a few minutes can result in greatly increased damage to the body's tissues. You should time it with a watch or clock, as 10 minutes can seem a very long time.

3) Anyone assisting a casualty should protect themselves with rubber gloves etc. Any dry chemical should quickly and carefully be brushed off. Contaminated clothing and jewellery should be removed and the affected area of the body flooded with running water for 10 minutes. At the end of this period medical attention should be sought. (A copy of the MSDS for the substance concerned should accompany the casualty if they are taken to hospital.)
4) Chemical contamination of the eyes should not occur because the laboratory worker should have been wearing appropriate eye protection. If it does happen, again the treatment is the application of running water for 10 minutes. Use either safety showers or dedicated eyewash stations. In an extreme case, even a piece of flexible tubing fitted to a laboratory tap may be used. The casualty should always be taken to hospital.
5) When suspecting ingestion of poisonous chemicals, give large quantities of water as a mouthwash. Ensure that the mouthwash is not swallowed. If the chemical has been swallowed, do not induce vomiting. If the casualty is vomiting by herself/himself, give large quantities of water as a mouthwash, but do not make them drink water.* Arrange for transport to hospital. Provide information to accompany the casualty on the chemical swallowed (MSDS!) with, if possible, an estimate of the quantity and concentration of the poison consumed.

* Check the respective MSDS, as some chemicals may require administering very small sips of water in case of ingestion– but this should only be done if specifically called for in the MSDS.

Follow-up procedures for dealing with severe cases of chemical burns

Following the immediate treatment with cold or lukewarm running water for at least 10 minutes as detailed above, some cases of chemical burns will require the injured person seeking professional medical help. While it is difficult to foresee all possible scenarios, and the decision what will be appropriate in individual cases remains with the academic supervisor(s), the following suggestions should be taken into account:

1) Medical help is **always advised for severe cases of chemical burns**. Severe cases of chemical burns include the following:

- Any exposure to any chemical by swallowing, ingestion or contact with the eyes.
- Any exposure/skin contact to any chemical that goes **beyond** a first degree burn. First degree burns affect only the superficial skin layer, they appear red without blisters and pain, and typically last around three days.
- Any exposure (even if only suspected) to **very high risk chemicals**, including hydrofluoric acid, cyanides, or phenol – even if no symptoms are visible!

2) Medical help/treatment should be obtained by presenting the injured person (whenever possible, accompanied by another person familiar with the experiment or the chemical in question) to the **Aberdeen Royal Infirmary**, **A&E unit at Foresterhill***.

Procedure to follow:

The following is the agreed procedure between the A&E unit and the Central University Safety

Team:

1) Self-treatment initially as per the instruction relating to the chemical
2) Contact the First Aider for further advice and treatment
3) First Aider to make assessment and give further First Aid treatment relevant to the nature of the chemical
4) If requiring hospital check or treatment and the case does not require ambulance service, First Aider or the Line Manager to contact NHS Aberdeen Royal Infirmary, Accident and Emergency, on 01224-553306 and give the following information:
    - Your name and that you are from the University of Aberdeen
    - That it is a case of Chemical Exposure/ Chemical Burn/Chemical Injury
    - Name of the casualty
5) Arrange for the casualty to be taken to the A&E. If the casualty cannot drive or are unable to then they should be taken by someone or accompanied in a taxi to the A&E.
6) At A&E, the Reception staff will be aware and waiting to receive the casualty and will be treated by Clinical Staff in line with the seriousness of the injury
7) If the case is more serious and requires assistance and transportation by an Ambulance, then skip step 4 and dial 999 and ask for an ambulance

A printout of a recent version of the Material Safety Datasheet (MSDS) should be brought along. We recommend (whenever possible) to obtain this from European suppliers such as Sigma Aldrich, as non- European companies may not list information specific to EU regulations. When in the A&E unit, approach the reception staff, present the MSDS, and kindly ask them to look up the chemical in Toxbase.

*****Full address: Aberdeen Royal Infirmary - Accident & Emergency, Foresterhill, Aberdeen, AB25 2ZN

First aid room

The First Aid Room is located on the lower ground floor Room No. 037. This room including the toilet must not be used for any other purposes (apart from the purposes detailed in the next paragraph), and it should be the decision of a trained first aider whether or not an injured person is to be brought there.

The First Aid Room may be used by expecting and by breastfeeding mothers, and also as a baby changing room.

Special treatments

Hydrofluoric acid and **cyanides**

Work with hydrofluoric acid or cyanides poses an extra level of risk, which needs to be assessed in writing before any work can be undertaken. In particular, the appropriate procedures required for work with these chemicals need to be controlled by **specific standard operating procedures** which, among others, must address specific first aid procedures including requirements for appropriate first aid kits, if applicable. Anyone working with these chemicals **requires full training**, and during any experiments, there always need to be **at least two fully**

trained persons on location. Before any experiments or procedure involving these chemicals are carried out for the first time, the supervisor(s) need(s) to inform the Departmental Safety Advisor in writing.

Given the extremely hazardous nature of these chemicals, they should **never** be handled **out-of-hours**, while it is also strongly advised not to carry out any experiments and procedures involving these chemicals during **the absence of the supervisor(s)** (which normally should be an academic on a permanent contract). Any departure from this needs to be documented in writing. Also, researchers have to confirm in writing that they have informed a first aider and ensured their availability for the days(s) these experiments are carried out.

Work with hydrofluoric acid and cyanides may only be carried out in dedicated labs specifically mentioned in the risk assessments. HF work must not take place if calcium gluconate gels are not available on site or have exceeded their expiry date.

C) Spillages and other uncontrolled releases

Note that the Chemistry department currently no longer maintains a dedicated spillage team equipped with breathing apparatus – this means that in many cases, it may be necessary to bring in help from an external consultant (e.g. Veolia) or the fire brigade. Users should evacuate the affected area, open windows if possible (but obviously, your personal safety takes priority) and contact the Technical Resources Officer or the Safety Adviser, copying in the supervisor.

It is a mandatory part of any risk assessment that consideration should be made of the appropriate procedures for dealing with spillages. There is an Emergency Spillage Guide in the Japp Lab (G92), which gives procedures for a large range of substances and you should consult this before making the risk assessment. In most cases the amounts of spilled material will be small and the worker concerned should be able to clear up the spill without assistance. When large amounts (e.g. a Winchester full) of liquid are spilled, extra procedures are required. Those listed below are for the most commonly used substances; for other chemicals, consult the Emergency Spillage Guide.

If you require assistance, you should provide safety data information to those doing the cleanup. All lab users should make themselves familiar with the locations of dedicated spill kits – this may involve several locations if working in different areas.

Highly flammable liquids

Ensure that there are no sources of ignition (e.g. an open flame or a spark from a thermostat, other electrical equipment, mobile phones, light switches) in the vicinity. Remember that vapours can creep a long way. Open windows for extra ventilation and close doors to prevent spreading through the building. Instruct others in the laboratory to keep a safe distance.

Wear a lab coat, safety glasses and nitrile gloves.

The first step for dealing with minor spills, as long as there is no risk to personal safety, is to contain the spill and then use spill kits if available. For example, small amounts of liquids can be absorbed onto Ecozorb granules, available from the Stores. Then contact the Technical Resources Officer who will arrange their disposal.

In case of larger spills or in particular, if the ventilation is inadequate, ensure that everyone in the affected room leaves and contact the Technical Resources Officer or the Safety Adviser who will arrange for help. Have the relevant information provided in the MSDS available on hand to inform the required steps to adequately deal with the spillage and the disposal of chemicals. Note that some spills may require help from an external consultant (e.g. Veolia) or the fire brigade.

Non inflammable organic liquids.

These are mainly halogenated solvents which produce toxic vapours, so breathing apparatus may well be required. In such a case, contact the Technical Resources Officer or the Safety Adviser. If there is no risk for your personal safety, open windows, if possible, to ensure adequate ventilation. As above, dealing with these kinds of spills may require help from an external consultant (e.g. Veolia) or the fire brigade.

Acids

Concentrated acids can produce toxic vapours. Warn others to keep to a safe distance. Unless the area is well ventilated, contact the Technical Resources Officer or Safety Adviser, who may need bring in help from an external consultant (e.g. Veolia) or the fire brigade. Acid resistant overalls, gloves and boots must be worn. Acids should be neutralised with sodium bicarbonate - take care to limit the rate of heat evolution, and open windows to deal with evolving carbon dioxide where appropriate or necessary. The resulting slurry can be flushed to waste with a large excess of water, provided adequate floor drains are in place and capable of handling the amounts involved.

Gas Cylinders

All gases except oxygen should be treated as asphyxiants. Red on the body or shoulder of the cylinder indicates that the gas is flammable, yellow that it is toxic.

Eliminate sources of ignition and warn others to keep to a safe distance, open windows and close lab doors on the way out.

Leaking CO_2, O_2 and N_2 cylinders can be vented slowly to the outside atmosphere.

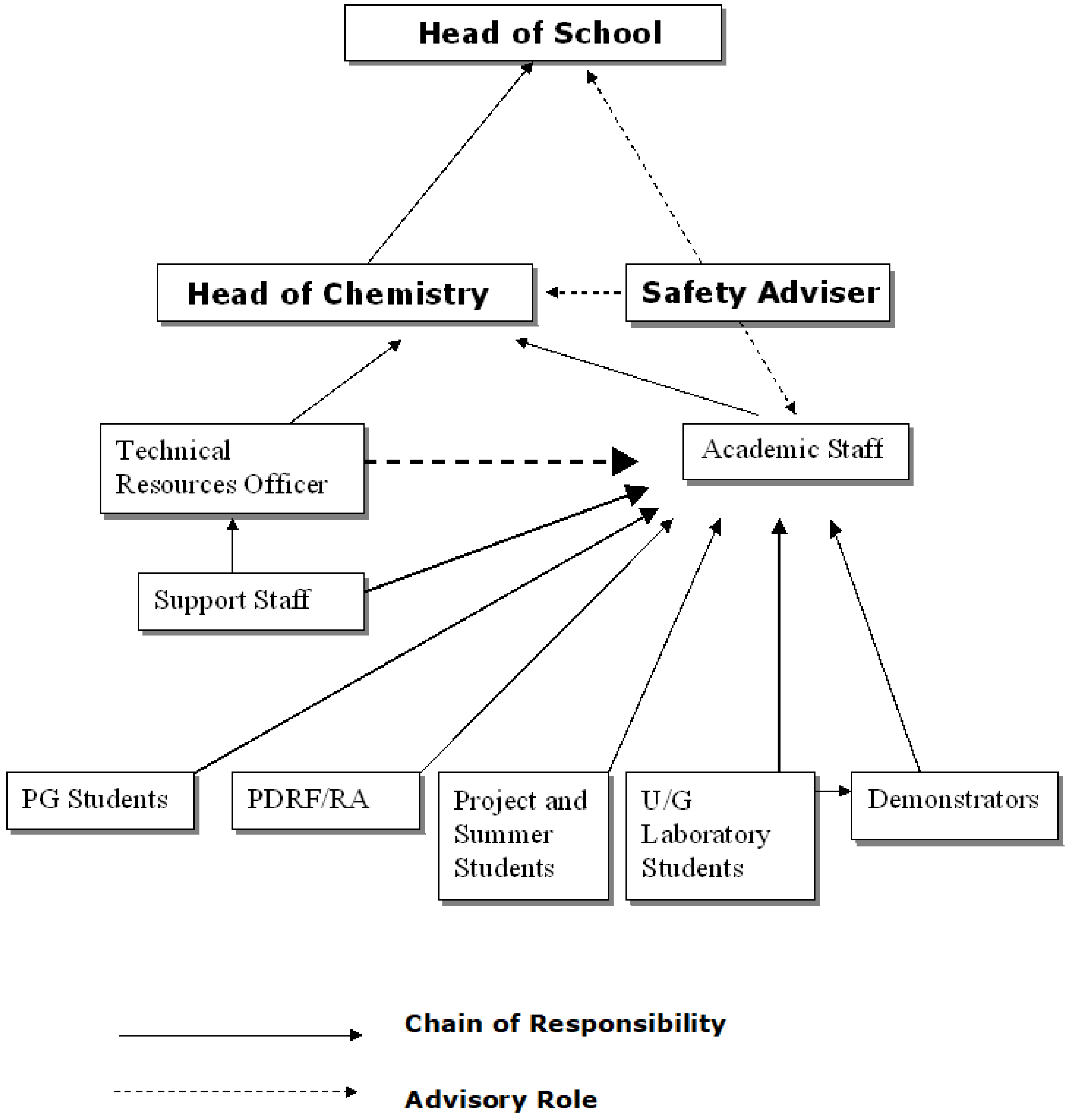
Leaking NH_3, Cl_2, HCl, HBr, HF, H_2S, or H_2 cylinders should be vented slowly into a large volume of running water, preferably in a fume cupboard.

Solids

Wear lab coat, safety glasses and nitrile gloves. The solid should be mixed with sand and placed inside an appropriately labelled container. Inform the Technical Resources Officer who will arrange disposal.

Part 2: Administrative arrangements

A) Organisation and responsibilities for health and safety



Overview

The Head of School has ultimate responsibility for health and safety in the Department but delegates this to the Head of Department. In the Department (as everywhere in the University) health and safety is a line management responsibility. Accordingly, members of the Department with managerial and supervisory duties must take full responsibility for health and safety in all activities under their control. In particular, they must ensure that staff and students under their control are aware of the dangers in the tasks, which they undertake and are able to implement appropriate precautions. They must ensure that staff and students are provided with appropriate training and supervision (see Health & Safety Induction Form).

Note: Health and Safety is not the responsibility of those who have "health" and/or "safety" in their job titles. The Departmental Safety Adviser provides advice and assistance to line managers and supervisors with health and safety matters. He does not however have any direct responsibilities for health and safety in the Department.

Responsibilities of the Head of Department

The Head of Department will:

- provide an effective Health and Safety Policy for the Department
- ensure the provision of resources necessary to enable the policy to be implemented
- commission inspections of the Department annually to monitor whether the Department's health and safety arrangements are being complied with
- commission reviews (at least once per year) of the effectiveness of the Policy and the arrangements to ensure its implementation
- communicate and engage with staff and students about safety matters

Responsibilities of staff

All staff must

- familiarise themselves with and comply with the health and safety arrangements put in place by the Department
- make sure that their activities do not cause harm to others or themselves
- if they see or become aware of something which they believe is unsafe, either take immediate steps to make it safe or alternatively bring it to the attention of the Departmental Safety Advisor or Technical Resources Officer.
- if they become aware of any deficiencies in the Department's health and safety arrangements, bring those deficiencies to the attention of the Departmental Safety Advisor or Technical Resources Officer
- not interfere with, or misuse, anything, which is provided for reasons of health and safety.

Responsibilities of all students

All students must

- familiarise themselves with and comply with the health and safety arrangements put in place by the Department
- make sure that their activities do not cause harm to others or themselves

- if they see or become aware of something which they believe is unsafe, either take immediate steps to make it safe or alternatively bring it to the attention of someone who can do something about it
- if they become aware of any deficiencies in the Department's health and safety arrangements, bring those deficiencies to the attention of their immediate supervisor
- not interfere with, or misuse, anything, which is provided for reasons of health and safety.

Responsibilities of the Departmental Safety Adviser

The Departmental Safety Adviser is Dr Rainer Ebel.

The Departmental Safety Adviser will provide advice to the Head of School, Head of Department and to all members of the Department on health and safety matters. In addition, the Departmental Safety Adviser will liaise with the Fire Brigade, Estates and other outside bodies. He will also initiate action to maintain the highest levels of safety.

Responsibilities of laboratory supervisors

Each laboratory is assigned a custodian whose name is displayed on the laboratory door. The custodian has the authority to ensure that only safe working practices are used. Their principal duties are listed in Part 3, section 18.

Arrangements for dealing with health and safety concerns

It is expected that health and safety problems will be resolved by discussions within the Department, with the assistance of the central Health, Safety and Wellbeing team where appropriate. An individual member of staff or student with a concern about a health and safety matter should discuss it initially with their line manager/supervisor or with the Departmental Safety Adviser. If the matter is not resolved in this way it should be brought to the attention of the Head of Department.

Departmental Health & Safety Committee

The committee has the following membership for 2023:

Rainer Ebel (Convener), Abbie McLaughlin (Chair), Brian Paterson, James Sinclair, Laurent Trembleau, Russell Gray, Alan Gibson.

The remit of the committee is to

1) Keep under review the health and safety arrangements of the Department and make recommendations to the Head of Department on steps to be taken to ensure the effectiveness of the Department's health and safety policy.
2) Formally review the Department's health and safety management system every 12 months and make recommendations for any changes to the Head of Department.
3) Report significant findings to the School Health & Safety Committee.
4) Provide a forum for discussion of health and safety matters raised by members of the committee or raised by staff/students through committee members.
5) Encourage and facilitate two-way communication
6) Meet every 3-4 months or other times as the convenor of the committee deems appropriate. Particular matters that the Committee should consider include

- reports of health and safety inspections of the Department
- reports of all accidents and near misses
- the adequacy of the Department's arrangements for risk assessment
- the health and safety content of training for staff and students
- health and safety information produced for staff and students and how it is communicated

If any student or member of staff has a matter they wish the Committee to discuss they should contact one of the members of the Committee.

B) Review of the safety handbook

Each year (i.e. every 12-15 months) this handbook will be revised (and reissued, if necessary) after the annual review of the Department's health and safety arrangements by the Departmental Health & Safety Committee. Note that due to cost implications, printed versions will be replaced only after major changes. In case of any discrepancies, the online version always takes precedence over the printed version.

A copy of the handbook will be on display in all laboratories and is also available on the Department's web pages under this link. Relevant sections of the handbook will be included in undergraduate course documentation.

C) Risk assessment

Introductory remark: The University has proposed a draft COSHH policy in 2023 which currently is under review and is evaluated by a dedicated Task & Finish group. The following sections may therefore be subject to change once this new policy has been passed. As of November 2023, the need to prepare individual COSHH assessments for each chemical has been (at least temporarily) suspended. Nonetheless, a dedicated COSHH assessment form is available on the Chemistry Safety pages.

Risk assessment is the process of

- identifying where there is significant risk (i.e. danger) in an activity and
- determining how that risk can be reduced as low as is reasonably practical (i.e. working out how the activity can be carried out safely).

The carrying out of risk assessments is fundamental to the effective management of health and safety. If we do not first identify how people might be hurt, we cannot then take steps to prevent them being hurt. The Department is obliged by law to ensure that suitable and sufficient risk assessments are carried out. There is also a legal requirement to record the "significant findings" of risk assessments in writing. The "significant findings" are the precautions which need to be taken when carrying out particular activities.

A good risk assessment is one which concentrates on the main dangers (and does not spend undue time on trivial ones) and records the "significant findings" in a way which will help those involved in the work to carry it out safely, for example by identifying suitable control measures.

The department's approach to risk assessment

We tackle risk assessment in the Department in three different ways:

1) The significant findings of risk assessments for frequently repeated tasks which form part of the routine operation of our laboratories and other facilities are already recorded in this handbook. (See - "Departmental procedures for specific hazards", part 3 of this manual)

2) Where written procedures exist for particular scientific processes, the significant findings of the risk assessments will be recorded as part of those written procedures, e.g.

   - A procedure ('Standard Operating Procedure', SOP) for an analytical process should include details of how the task should be carried out safely if, without those details, the people carrying out the task would not be certain of the health and safety precautions they should take.
   - Procedures/SOP for the operation of a piece of scientific equipment should include details of how to operate the equipment safely if, without those details, the people operating the equipment might not know how to do so safely.
   - Written procedures for undergraduate practical work should always begin by identifying the main dangers associated with the work and the precautions which are to be employed. Details of the precautions should be included at the appropriate stage in the method. If the practical has been devised such that there are no significant dangers associated with it, a statement to that effect should be made at the start of the method.

3) For those activities not covered by 1) or 2) above, a separate risk assessment should be carried out. If it will help those involved in the activity to carry out the work safely, the findings of the assessment should be recorded in writing.
   For research work involving postgraduate students the University Court has said that supervisors must ensure

   "Postgraduate projects are assessed for health and safety risks" and ***"Necessary precautions are agreed with the postgraduate (and in all but the most elementary circumstances are committed to writing)".***

   The University Court has defined that undergraduate Honours projects should be treated in the same way as postgraduate projects.

   It is a Departmental requirement that risk assessments for both postgraduate projects and undergraduate honours projects follow the method described below.

Risk assessment in postgraduate work and undergraduate honours projects

Risk assessments for research work in the laboratory or in the field involving postgraduate or undergraduate students must follow this method for risk assessment. Supervisors of students are responsible for ensuring it is followed. The purpose is to ensure that students

- appreciate where the dangers lie in the work they are about to undertake, and
- understand in sufficient detail the precautions which will need to be taken to ensure that the work is carried out safely.

Supervisors are responsible for deciding to what extent necessary precautions should be committed to writing. (More details will need to be recorded for work to be carried out by a new postgraduate compared with the level of detail which will be needed for similar work which is to be carried out by a third-year postgraduate.)

1) Student and supervisor should meet before the work begins and systematically examine the dangers associated with the work and discuss the techniques available to enable the work to be carried out safely. The Department's checklist for risk assessment (see below) should be used to prompt the discussion. The supervisor should ensure that the student is aware of the sections of this handbook which are relevant to the work as well as any other documents with relevant health and safety content.

2) The student should then be asked to write out a summary of the dangers and the precautions which will be necessary to enable the work to be carried out safely. (This will be the "significant findings" of the risk assessment.) The supervisor should provide guidance on the level of detail required. (e.g., if a relatively inexperienced student is working with a highly flammable liquid, it may be necessary to ask the student to record in some detail how sources of ignition will be excluded from the work area and how the HFL will be stored. With a more experienced student who has performed similar work before and in whom the supervisor has confidence, it will probably not be necessary to record anything about this aspect of the work.)

   The student should be asked to complete the Department's risk assessment form (see below) which is available via Teams

   (Alternatives (e.g. a standard operating procedure, a dedicated COSHH assessment) to these may be used if agreed in advance between supervisor and the Departmental Safety Adviser.)

3) The supervisor should then review the written record of the assessment. The supervisor must sign the record of the assessment before the work can begin.

4) The record of the assessment must be retained by the student for as long as the work to which it relates continues. The record must be produced if required during Departmental health and safety inspections. A copy of the assessment must be stored on a dedicated shared drive in a dedicated risk assessment database. Due to the sometimes transient nature of IT solutions, instructions are posted on the Chemistry department safety pages and are updated as necessary.

5) The student must understand that significant alterations in the agreed procedure must not be introduced without the supervisor's knowledge. From time-to-time student and supervisor should meet to confirm that the risk assessment is still valid. If there are significant changes to the work, the written assessment must be revised and the record of the revised assessment must be reviewed and signed by the supervisor.

6) The relevant risk assessment must be produced when orders for new chemicals are placed. (See also Section H of this handbook - "Postgraduate Students")

Persons under the age of 16

When young persons, for example during school liaison projects, are to do experimental work, the risk assessment must be communicated to their parent or guardian before the work starts.

Purpose of risk assessment

It is important that supervisors of students should not lose sight of the purpose of the risk assessment exercise. Its purpose is not to produce a completed form which then can be placed on one side and forgotten about. It is to reduce the potential for injury in the laboratory and in the field. The work should be discussed in sufficient detail and enough committed to writing to achieve this purpose.

Department of Chemistry Risk Assessment

READ THIS FIRST

The risk assessment should be made after discussion with your supervisor and **before** experimental work begins. You must revise the assessment if there is a change in the work or environment. The assessment must also be reviewed at yearly intervals. Keep a copy (printout) in your lab book. An electronic copy of the assessment must be stored on a dedicated shared drive in a dedicated risk assessment database. Due to the sometimes transient nature of IT solutions, instructions are posted on the Chemistry department safety pages and are updated as necessary.

Anticipate circumstances that could give rise to danger. What will be done to prevent them arising?

The aim is to produce a list of control measures that must then be implemented.

Consider all parts of the work: e.g. storage and handling of starting materials, processing of materials, analytical operations, storage of end products, storage and disposal of waste.

Note: the points below are only some of those that will need to be considered.

1) **Hazards to Health**

- List all substances to be used or produced.
- Obtain Hazard Data Sheets (MSDS) for all substances to be used. If you do not have hazard data sheets, you can often obtain the data from the websites listed in the Department Home Page. The Sigma-Aldrich site is very useful. A Google search is also a fast way of obtaining MSDS data.
- Identify categories of danger: (e.g., carcinogenic, mutagenic, toxic for reproduction, very toxic, toxic, harmful, corrosive, irritant, sensitising).
- Look for more detail in the risk phrases on the data sheets.

Consider possible exposure routes (e.g., inhalation, skin absorption or direct skin contact, inoculation by sharps, ingestion).

Consider exposure potential and consequences (e.g., amount used, physical form, volatility, concentration, primary barriers and chances of mishaps, frequency and duration of work).

Decide secondary containment regimes for the various stages of the work:

- none required (open bench)
- general containment (fume cupboard)

- special facilities (need to specify what is required)

Decide if any protective equipment is needed (e.g., glasses, goggles, face shield, gloves (what type?), respiratory protection, other). Do you need to ensure other workers in the vicinity are not at risk from your activities (e.g., exposure to dust - if you need a mask those close by may also need one)?

Consider where stricter control regimes might be required (e.g., for work with carcinogens - rules are in the Departmental Safety Handbook).

2) Reactive Chemical Hazards

Where is there potential for loss of control (e.g., highly reactive substances, unstable substances, production of undesired substances)? There is a list of common reactive hazards in the Departmental Safety Handbook

- How will control be maintained?
- What contingency arrangements are there to cover loss of control? (e.g., screening, relief venting).

3) Flammable Hazards

Approximate flash point and autoignition temperature should be found for all flammable substances used or produced.

Identify potential sources of ignition (e.g., flames, hot surfaces, friction, electricity, static).

Decide how sources of ignition will be eliminated or separation from sources of ignition will be maintained.

Determine what limits will be placed on amounts of flammable substances permitted in the work location. Note the general cumulative 50 L limit for any type of highly flammable liquids in a single lab as specified by the HSE.

4) Pressure/Vacuum Hazards

Identify where high or low pressures will be created. What controls are required to prevent explosion or implosion?

5) Other Hazards

Consider for example, radiation (ionising and non-ionising), lasers, high and low temperatures, electricity, mechanical hazards (e.g., machinery), levels of noise, etc – note that this list is not meant to be comprehensive, but it is up to the individual researcher to identify the relevant hazards.

Is it safe (and necessary) to permit unattended operation of equipment? (e.g., overnight running).

6) Spillages

Plan how you will deal with spillages or other accidental releases. There is a clean-up guide in the Organic Laboratory

7) Supervision

Identify under what circumstances those carrying out the work will need to refer to their supervisor.

8) Training

Determine whether particular training is required.

The current version of the risk assessment form is provided on the following pages. The document can be downloaded under on the Chemistry Safety pages, both as Word and as PDF file.

School of Natural and Computing Sciences | Risk Assessment - CHEMISTRY | Page 1 of 3

Risk Assessment

PROCEDURE:

- Complete risk assessment in consultation with PI/Supervisor and technical staff as appropriate.
- Risk assessment checked and signed by PI/Supervisor
- A copy or scan of the signed document to be given to the lab technician, School Safety Adviser and PI/Supervisor.

NOTES:

- No laboratory work is to commence without a risk assessment signed by the PI/Supervisor.
- The risk assessment must be reviewed when any changes are made to the equipment, materials, procedure or personnel.
- Technical staff can stop work if no risk assessment is in place or if, in their opinion, there is a risk to safety.

Project name:			
Location of work:			
Principal Investigator/Supervisor:		Signed:	Date:
Assessment Prepared by:		Signed:	Date:
Outline description of the work:			
Names of persons carrying out the work:			
Intended start date			

Risk Assessment form Chemistry September 2023

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to manage this risk?	Action by whom?	Action by when?	Done

Will particular training be required?	
How will spillages or other uncontrolled releases be dealt with?	
How will the products and waste be disposed of?	
Which first aid measures are required in case of accidents including exposure to chemicals involved in this experiment?	

D) Health and safety training

Health and safety training will be provided for staff and students as follows:

1) All postgraduate students carrying out laboratory-based research work will receive guidance in laboratory safety during a Safety Induction Lecture given by the Departmental Safety Adviser at the beginning of each session. For students starting projects at other times of the year, a video is available on the website which must be viewed as part of the induction process. Records of postgraduate health and safety and other training will be kept in the student's personal log.
2) Attendance at the Safety Induction Lecture (or viewing of the video) is a prerequisite for working in the Department's laboratories. Students must be familiar with all safety issues surrounding their activities, normally achieved in discussion with supervisors.
3) Other health and safety training (eLearning) will be provided from time to time for staff and students.

E) Safety inspections

1) The Head of Department will commission health and safety inspections of the Department's activities at least once per year. The purpose of the inspections is to ascertain the extent of compliance by the Department with the health and safety arrangements described in this handbook.
2) Each inspection will be carried out by a team headed by the Departmental Safety Adviser. The other members of the team will normally be the members of the Department Safety Committee.
3) The inspection team will be guided by a checklist based on the health and safety arrangements described in this handbook. Matters to be examined during the inspection will include (but will not be limited to):
   - Compliance with departmental procedures for specific hazards
   - Adequacy of documented risk assessments (particularly for work undertaken by undergraduate and postgraduate students)
   - Completeness of health and safety training records
   - Emergency response arrangements
   - Arrangements for inspection and maintenance of premises, plant and equipment and completeness of records of inspection and maintenance.
4) The inspection team will produce a report which is circulated to include Head of Department and Head of School. The report will include:
   - positive findings, as well as details of the location and significance of any failings discovered
   - recommendations for remedial action (including timescale and priorities)
   - suggestions as to who should carry out particular remedial actions.

   (The reporting process should not delay remedial measures or prevent immediate action during the inspection if there is a risk of serious injury or ill health.) The Head of

Department will confirm the suggested remedial action.

5) A follow up inspection(s) will be arranged specifically to ensure that any necessary remedial action has been taken and is effective. A report on the follow up inspection will be made to the Head of Department but where attitudes towards safety policy are unsatisfactory, lab closure may be necessary.

6) If requested by the Head of School, inspection reports and laboratory supervisor responses may be collated and presented to the Head of School via the School Health & Safety Committee.

F) Undergraduate students

The University Health and Safety Policy says:

1) Initially undergraduate students will be assumed to be untrained in all matters of health and safety.

2) Each department should provide undergraduates with the training and supervision necessary to ensure their health and safety
   - while working in University premises
   - on University organised fieldwork
   - during University work elsewhere.

3) Hazardous substances and equipment will not be introduced into undergraduate practical work until the risks associated with their use have been assessed and adequate safeguards provided.

4) Written instructions to undergraduates about practical work must always draw attention to
   - the hazards of substances and equipment and
   - the safeguards that are provided.
   - Undergraduates will also be provided with appropriate training before practical work begins.

5) Any independent work (e.g. as part of an "honours project") should be subject to at least the standards of supervision applied to postgraduate work (see below).

6) [Staff and] Students working in laboratories are responsible for:
   - Complying with all procedures and instructions including, the wearing of the correct personal protective equipment where advised and in accordance with the procedures separating and segregating waste for safe disposal.
   - Immediately reporting any malfunction or failure in any controls.
   - Immediately reporting to their supervisor or Laboratory Manager any incident

An undergraduate's perception of risk in a given situation may be very different from that of a member of staff. Staff will have learnt (often by direct personal experience) what the dangers are and what the consequences can be of not taking necessary precautions. Undergraduates might not even recognise the presence of a health and safety hazard, and even if they do, they are very likely to underestimate its potential to cause harm.

Those involved with undergraduate practicals should never assume that an undergraduate will have developed competence in health and safety matters before coming to the University. The assumption must be that new undergraduates are **completely** untrained in health and safety matters. It is the task of the department to assist them develop skills that will enable them to work safely and to provide an appropriate level of supervision while this development is taking place.

Practical work

1) The health and safety aspects of practical work should be incorporated into the academic instruction and not be treated as a separate topic.
2) Written instructions describing how to carry out a piece of practical work must contain any necessary health and safety information. Written procedures should always begin by identifying the main dangers associated with the work and the precautions which are to be employed. More details of the precautions should be described at the appropriate stage in the method.
3) If academic staff believe that there is no significant residual risk which requires the students to take special precautions, a statement to that effect must be made at the start of the method. The absence of significant risks should be mentioned and the way the practical was designed to bring this about could be explained. The purpose is to get students used to a routine in which health and safety is always addressed before any practical work commences.
4) Health and safety must always be discussed in pre-practical talks.

Independent work

Undergraduate students carry out independent practical work as part of their Honours year. While carrying out this work they must be supervised to at least the same extent as new postgraduates. In some circumstances much higher levels of supervision may be necessary. The preparation and agreement with the supervisor of an adequate risk assessment before any independent work begins is critical. (see section G - "Postgraduate students" below). On completion of practical projects, work areas must be cleared. Students must include a standard declaration form (Health and Safety Induction Form available from the web) signed by supervising staff that this has been completed in their submitted project reports.

G) Postgraduate students

The University Health and Safety Policy says:

1) Each department must make arrangements to provide postgraduate students with such supervision as is necessary to ensure their health and safety.
2) The duty to supervise postgraduates is delegated by the University to the Head of Department and thence to the member of staff directly responsible for the postgraduate.
3) New postgraduates will be trained in departmental health and safety policies and procedures.
4) Supervisors must not discharge their duty to supervise by relying solely upon a postgraduate's status or apparent competence. They must be able to demonstrate that they have exercised an active supervisory role.

5) Active supervision does not usually mean constant attendance. Supervisors must ensure

   - postgraduate projects are assessed for health and safety risks
   - necessary precautions are agreed with the postgraduate (and in all but the most elementary circumstances are committed to writing)
   - regular checks are carried out to ensure that the postgraduate is working to the agreed procedures
   - postgraduates understand that significant alterations in agreed procedures must not be introduced without the supervisor's knowledge.

6) Each department must make formal arrangements to cover for the temporary absence of a postgraduate's normal supervisor.

7) [Staff and] Students working in laboratories are responsible for:

   - complying with all procedures and instructions including, the wearing of the correct personal protective equipment where advised and in accordance with the procedures separating and segregating waste for safe disposal.
   - immediately reporting any malfunction or failure in any controls.
   - immediately reporting to their supervisor or Laboratory Manager any incident.

The relationship between supervisor and student is a critical factor in ensuring safety in postgraduate research. Supervisors must ensure that students are competent to carry out practical work safely and students must work in accordance with procedures agreed with their supervisors.

Some postgraduate students will have completed a first degree at Aberdeen and may already have demonstrated competence in health and safety matters to staff in the department. However staff will initially know very little about the abilities of students coming to Aberdeen from other institutions. These students will need to receive training in the department's health and safety procedures and be under close supervision during the early stages of postgraduate study. (See also Section E in this handbook - "Health and Safety Training".)

1) Supervisors must ensure that postgraduate students appreciate the dangers in the work they are to carry out and understand the precautions which should be taken. **It is mandatory that supervisors require postgraduate students to produce written risk assessments for any laboratory work.** The assessment must be approved by the supervisor before the work may begin. (See section C - "Risk Assessment".)

2) Students must be made aware that unauthorised initiatives are not permitted. Students must at all times work within the scope of the risk assessment agreed with their supervisor and refer to their supervisor before making any significant changes.

3) Supervisors must tell their students where help and advice can be obtained when the supervisor is not available.

4) Whenever a supervisor will be absent from the Department for more than two working days, a replacement supervisor (normally the second or deputy supervisor, but other arrangements can be made if appropriate) must be appointed for the period of absence, and the students supervised by the absent member of staff must be informed of the arrangement.

5) On completion of practical projects, work areas must be cleared. Students must include a sign-off form available from the web, signed by supervising staff that this has been completed before a viva-voce examination can be arranged.

H) Pregnancy – laboratory workers

The University's Maternity Policy can be found under the following link.

In certain circumstances, where there could be a potential risk to your unborn child (for example from exposure to certain pathogens, chemicals or radiation in the laboratory), it will be important that the School is informed as soon as possible to enable us to carry out a review of your laboratory work and, where necessary, ensure that measures are taken for your health and safety and that of your child.

Students should contact the Student Advice & Support Office who will contact the School on your behalf to ask that a specific risk assessment be undertaken.

Members of staff should contact their Human Resources Adviser who will then inform the School on your behalf.

The University provides guidance to Schools on health and safety issues for new and expectant mothers.

Once the School has been informed, we will arrange to carry out a risk assessment with you to identify any relevant risks associated with your laboratory and to manage these risks for your protection. The School may also consult the University's Health & Safety Adviser when completing the risk assessment.

I) Accident investigation and reporting

Staff and students must report accidents, and near misses, as soon as possible to their immediate supervisor. The following must be reported:

- Any incident in which anyone is hurt (regardless of how minor the injury might appear at the time and regardless of whether they need medical treatment) must be submitted as an **accident report**.
- Any incident in which someone could have been hurt (but in which perhaps chance or "good luck" prevented injury) must be submitted as a **near miss report**.

There are several reasons for reporting accidents. The most important is to enable us to take action to prevent a similar accident happening in the future (perhaps with more severe consequences). We may also need to report the incident to the Health and Safety Executive or to our insurers.

Procedure:

1) An online accident report and near miss report form is available through the net. Note that the University is currently planning to move this system to the BeOnline interface – this will be communicated as soon as this move has been completed.
2) The form should be completed and signed by the immediate supervisor of the injured person or the person in charge of the area where the incident happened (and not by the injured person).

3) Completed forms must be sent to the University Safety Adviser **within 48 hours of the accident**. A copy must also be sent to the Departmental Safety Adviser. Note that this will occur automatically if his email address (r.ebel@abdn.ac.uk) is entered into the respective field.

4) Serious accidents must be reported immediately to the University Safety Adviser by telephone (Extension 3894). The University Safety Adviser will ensure that the Health and Safety Executive and our insurers are notified if this is necessary. Any accident involving ionising radiation must be reported by telephone to the University's Radiation Protection Adviser. This is provided to the University by NHS Grampian Radiation Protection Service. Services include specialist advice and assistance with the use of sources of ionising and non-ionising radiations: Biomedical Physics Building, Foresterhill Telephone 01224-553109 or 01224-553209

5) The member of staff responsible for the injured person should initiate an investigation into the accident to discover its cause. They should contact the Departmental Safety Adviser for assistance if required.

6) If the accident is reportable to the Health and Safety Executive (the University Safety Adviser will inform the Department if it is), the Head of Department must receive a copy of the accident report and the results of the investigation into the accident.

J) First aid arrangements

First aid arrangements in the Department are co-ordinated by the Departmental Health & Safety Advisor, who will

- ensure there are an adequate number of qualified first aiders among the staff in the Department and that notices are posted stating who they are
- ensure there are adequate first aid materials available throughout the Department

Emergency procedures are given in Part 1.

K) Inspection and maintenance of premises, plant and equipment

The following equipment in the Department requires periodic inspection and maintenance if it is not to become a source of danger to staff, students and members of the public. The Technical Resources Officer is responsible for ensuring that inspection and maintenance is carried out and that appropriate records are maintained. Further details are given elsewhere in this handbook.

- Local exhaust ventilation (i.e., fume cupboards)
- Centrifuges
- Autoclaves
- Clean benches
- Electrical equipment

L) Ionising and non-ionising radiation

1) Radiochemical experiments

The Department is no longer licensed for work with radioactive isotopes, and no such work can be undertaken within the Department.

2) X-ray equipment

For the powder X-ray equipment permission must be sought from Prof A. McLaughlin. Only trained personnel may use the equipment. Training may be obtained from Prof A. McLaughlin.

Access to the X-ray laboratories is restricted to trained users. Logbooks must always be signed legibly.

The X-ray equipment is provided with shielding and interlocks to prevent accidental exposure. It is forbidden to disable or tamper with them.

3) Lasers

Persons working with, or about to work with, lasers other than Class 1 must obtain a copy of the Laser Code of Practice from the Departmental safety adviser and make themselves familiar with its contents. All lasers must be registered with the University Radiation Protection Adviser (Biomedical Physics Building, Foresterhill, Telephone 01224-553109 or 01224-553209)

4) UV radiation

Ultra-violet (UV) radiation lies in the wavelength range 100-400 nm. The action of UV radiation on the eye is acute and it is absorbed in the outer layers of the eye, the cornea and the conjunctiva. Conjunctivitis results 3-12 h post-exposure and lasts for several days. Suitable eye protection must always be worn whenever there is a possibility of direct exposure to UV radiation.

- UV radiation occurs in welding operations, glass blowing with silica, photochemical experiments, chromatography, etc. In each case the source must be properly shielded.
- Where protective screens are fitted, they must not be removed.
- Note that sun-glasses are not sufficient protection for eyes. Long term skin effects can also result from severe exposure leading to cancerous conditions. Additionally, in the short term, irradiation of the skin of the face, hands and forearms can cause erythema (reddening of the skin). This is most easily prevented by use of a face shield, protective gloves and wrist/arm protection if direct exposure is likely.
- Attention must be paid to the danger of ozone production. Its TLV (threshold limit value) is low (0.1 ppm or 0.2 mg m^{-3}) and the gas is readily detected by its characteristic odour. Efficient ventilation and/or continuous flushing of the optical path with nitrogen will remove this hazard.
- Warning signs must be used at every UV installation.

Part 3: Departmental procedures for specific hazards

1) Access to the department and its facilities

Access to the Department

The North and South Entrances are open from 08.00 to 18.00 hours Monday to Friday. Access outwith these periods is by swipe card access. Exceptions to this rule are made for evening and weekend lectures and social events. The building may be left through any emergency exit (there are currently no alarmed exits in the Meston building), but everyone is required to ensure that the doors have properly closed before leaving the premises, in particular out of hours. Note that in winter, the main exits areas are prioritised for gritting, so other emergency exits routes are more likely to be slippery.

Working Hours and out-of-hours work

The normal working hours of the Department are defined as being between 07.00 and 20.00 hours, Monday to Friday (but note the "core hours" statement in the following section). Work in the Department outwith these hours ("**out-of-hours work**") is subject to the following condition:

1) Each person enters in the log books (located at the desks in the South and the North entrance) their time of arrival, principal location and time of departure. Anyone already in the building and intending to stay after 20.00 hours must also sign the book. Note that every member of the Chemistry department engaged in lab work, regardless of the location, must use the log book at the South entrance, not the one at the North entrance.
2) Experimental work may be performed only if there is at least one other research worker within earshot.
3) Operations must be well-tried and not especially hazardous. Examples are routine use of spectrometers and other instruments, titrations with dilute solutions, recrystallisations.
4) Switching off the apparatus is always the responsibility of the user. A thorough check must be made on gas, electricity and water supplies. Windows must be closed and all unnecessary lights switched off.

Provided that the relevant member of staff accepts responsibility in advance, some relaxation of Rule 2 is allowable in respect of operations such as routine use of spectrometers and other measuring equipment.

"Core hours" statement (jointly published by the Heads of Schools of NCS and Engineering in 03/16)

"We believe that safest and most effective manner of working for those involved in experimental research is to conduct experiments during core working hours. (These hours are defined as between 9.00 and 17:00, Monday to Friday). This statement is based on a desire to maximise the probability of ensuring access and availability of staff including supervisor and support staff, and on minimising the probably that an activity becomes classified as lone working (which is not permitted without further permission) due to the absence of other researchers in close proximity."

It is understood that occasionally experiments extend beyond these hours, however, in such cases it is essential that strict compliance with of out of hours working procedures is met including

- Signing in to a building or area
- Written permission from supervisor/head of section is attained
- A dedicated out-of-hours form signed by both the supervisor and the HoD or Head of Research has been **filed before** the out-of-hours work is started

You are not allowed to let a regular experiment continue into the out-of-hours period, and an oral permission by the supervisor to do so is not sufficient.

Visitors

A Chemistry Department contains many hazards and it follows that unnecessary visitors should be discouraged. In view of our legal responsibilities, it is advisable to keep visitors away from laboratories and other hazardous areas whenever possible. Unaccompanied visitors with no personal connection to the Department must leave the Meston building outside the regular working hours (see above).

Normally, children under 16 years of age must be supervised by an adult at all times during any visit to the Department and may only enter the following areas:

- Entrance halls, corridors and common rooms
- Lecture theatres and lecture rooms
- Offices, excluding those containing potentially dangerous chemicals or equipment
- Toilets.

Exceptions to the above restrictions are made for supervised educational visits. Cats, dogs (apart from guide dogs) etc. may not be brought into the Department.

Contractors

All contractors and their operatives must comply with "Contractors - General Code of Practice" issued by the Estates Section of the University of Aberdeen. The Chemistry Department is a hazardous area and contractors must advise the Technical Resources Officer before any work is commenced (see section 8).

Lectures and demonstrations

Any member of staff intending to use a lecture demonstration should consult the Departmental Safety Adviser to ascertain the suitability of the experiment before carrying out the demonstration. Safety spectacles and shields must be used at the appropriate times.

2) Access to heights

Storage above head height

Every year, several people in the University are injured after falling while using an unsuitable means of access to reach storage above head height. The "unsuitable means of access" is often a chair or a table. It is particularly important in a laboratory, where the consequences of a fall can be severe, that a suitable means of access is used. Access to storage above head height should normally be by a step ladder or a "kick stool". Chairs (and particularly swivel chairs) must never be used.

3) Building works

The fabric of the building occupied by the Department and the installed services (electricity, water, gas etc.) are the responsibility of the Estates Section.

1) Anyone who notices any parts of the building which are unsafe and need to be repaired should contact the Technical Resources Officer, who will contact Estates. For minor non-emergency issues, you can also use the Estates fault reporting system.

   Any urgent matters should be notified directly to Estates on their 24 hour emergency telephone number (27)3939.

2) Any alterations to the building or to the installed services must be carried out by Estates. This is essential to ensure:

- compliance with building regulations and fire regulations
- installed services are not disturbed
- any asbestos in the building is not disturbed (Many buildings in the University contain asbestos - it is perfectly safe as long as it is not disturbed)

Anyone wishing to carry out any work which might affect the fabric of the building (e.g. running cables, fixing items to the walls) should contact the Technical Resources Officer who will then contact Estates and discuss how best to proceed.

4) Centrifuges

The major hazards associated with centrifuges are:

- physical contact between the operator and the rotating head
- mechanical breakage of rotors caused by corrosion or use in excess of manufacturer's recommended limits
- severe vibration caused by an unbalanced rotor.

A rotor can be subject to the same stresses that occur in high-speed aircraft. The periphery of a 10 cm rotor travelling at 50,000 rpm is travelling at over 1,100 miles per hour. The rotor is stressed by every acceleration / deceleration cycle and undergoes measurable stretching each time it accelerates. Mechanical breakage of unbalanced rotors and the vibration resulting from an unbalanced rotor can cause extensive and expensive damage as well as having potential to cause severe injury to anyone in the same room as the centrifuge.

To prevent injury centrifuges should be

- Used in the correct manner and
- Regularly inspected and maintained.

Correct use of centrifuges

1) Except for small, benchtop models, centrifuges may be operated only by people authorised by the academic in charge of the instrument.
2) The centrifuge lid must be closed whenever the rotor is in motion and must be interlocked so it cannot be opened when the rotor is in motion.

3) Do not stop the rotor by hand or indirectly by the application of an implement to the rotor. Stop the centrifuge by returning the control to zero, not by switching off the power supply.
4) If there is any indication of malfunction, stop the machine immediately and contact the Technical Resources Officer.
5) Follow the manufacturer's instructions, particularly regarding balancing tolerances and operating speeds for different rotors. Note that balancing by volume is not suitable for dense solutions (e.g. sucrose must not be balanced with the same volume of water).
6) Before starting a run, inspect the rotor and tube caps for signs of corrosion or cracks. Never use faulty parts.
7) Ensure that the outsides of containers are clear and free of drops of liquid before placing them into the rotors (the drops of liquid could be a cause of corrosion). If any liquid is spilt into a centrifuge or onto a rotor it is crucial that it is removed immediately, and the equipment is cleaned using an appropriate method.
8) Never leave a centrifuge while it is accelerating. Many faults occur during the acceleration phase of a run. If you are present, you can immediately turn the machine off.
9) Always clean and dry the rotor and the centrifuge carefully after use. It is important to remove all traces of materials that could promote corrosion or stress cracking. Mild detergent (e.g. Tepol), possibly with gentle brushing, is all that is required for cleaning. Avoid scratching a rotor.
10) Always leave the lid "ajar" when the centrifuge is not in use.
11) If you are unfamiliar with the operation of any machine, seek assistance.

Inspection and maintenance of centrifuges

The Technical Resources Officer has overall responsibility for coordinating the regular inspection and maintenance of the centrifuges in the department.

5) Chemical safety

Introductory remark: The University has proposed a draft COSHH policy in 2023 which currently is under review and is evaluated by a dedicated Task & Finish group. The following sections may therefore be subject to change once this new policy has been passed. As of November 2023, the need to prepare individual COSHH assessments for each chemical has been (at least temporarily) suspended. Nonetheless, a dedicated COSHH assessment form is available on the Chemistry Safety pages.

Anyone working with chemicals of any sort must ensure before the work commences that they:

- understand the hazards associated with the chemicals
- know what precautions should be taken

The main hazards of chemicals are:

- the toxic effects of chemicals if they enter the body
- the corrosive effects of some chemicals if they come into contact with human tissue
- long-term health effects
- the flammable nature of some chemicals

- the reactive nature of some chemicals - often when incompatible chemicals come together
- environmental damage

These hazards need to be considered during:

- storage of chemicals
- use of chemicals
- disposal of chemical waste

Consider also what will be done if there is a spillage (or other uncontrolled release) of a chemical.

Material Safety Data Sheets

It is a legal requirement that the supplier of a chemical must provide a material safety data (MSDS or SDS) sheet to the purchaser of the chemical. If you have purchased a chemical and do not have the hazard data sheet, contact the supplier and request one. The Department's Home Page has links to a number of safety databases, the most useful being the Sigma-Aldrich website. A Google search is also a good way of finding safety data. Safety and first aid manuals are also available in the Organic Laboratory. Some specific hazards are listed in Appendices 2-4 of this manual.

It is essential that for work with any given chemical, the material safety data sheet must be obtained, and to familiarise oneself with the information provided. Supervisors must ensure that their students consult material safety data sheets as part of the process of carrying out proper risk assessments including COSHH assessments.

Risk assessment

Risk assessments must always take account of the risks created by any chemicals which are used. (See section C - "Risk assessment" for details of how risk assessments should be carried out.) Risk assessments must always address

- storage of chemicals
- use of chemicals - toxic and reactive hazards
- disposal of waste
- actions to be taken in event of a spillage.

The wide range of chemicals which are used in the Department means that it is not possible in this handbook to provide anything other than very general guidance on precautions which should be taken. Supervisors of those using chemicals are responsible for ensuring that hazards are identified and that necessary precautions are taken. The principle that it is those controlling the work who should determine how it is carried out safely is well established in law.

The Department's Laboratory Risk Assessment Form (see Part 2, section D - "Risk assessment") identifies matters which should be considered in determining how chemicals should be used safely.

Storage of chemicals

1) All chemicals (either in the stores or in the laboratory) must be correctly labelled. Materials purchased from suppliers should already be correctly labelled. When solutions are prepared in the laboratory or when chemicals are dispensed or repacked, they must be clearly labelled, and any hazards indicated with appropriate hazard symbol labels.
    - Correct chemical names are required (e.g., labelling a bottle only as "solution A" is

unacceptable. What would happen if the bottle leaked or was knocked over when the person who made up the solution was away from the Department?)

- Durable labels are required (e.g., felt pen on glass is not acceptable).
- Where exact identity of contents is unknown, container should be labelled with list of major constituents.
- Hazard symbol labels are available from the Stores.

2) When storing chemicals consider the effects of two chemicals coming into contact if there was a spillage or a leak. With some incompatible chemicals violent reactions can occur if they combine under uncontrolled conditions. With other chemicals uncontrolled mixing can result in the production of highly toxic gases or fumes. Chemicals must be stored so that they cannot possibly accidentally come into contact with incompatible chemicals, which in many cases may require using separate cabinets. A list of incompatible chemicals is given in Appendices 3 and 4.
3) Bottles containing liquids must always be placed in bottle carriers when being transported to/from storage areas which are outside the laboratory.
4) For storage of highly flammable liquids see the separate section in this handbook.

Benzene

Apart from exceptional cases which must be sanctioned by the Head of the Chemistry, **the use of benzene in teaching laboratories is banned**. It is no longer held as a stock chemical in Stores. Its use in research laboratories should be avoided as far as possible and all operations involving its use must be carried out in accordance with the regulations on carcinogens. Research students and other research staff must obtain the permission of their supervisors before using benzene.

Mercury

The high and cumulative nature of the toxicity of mercury vapour and its wide use justify its separate mention here. Unless essential, it should not be left in open vessels. Wherever possible, trays should be used to contain spillages. Contaminated mercury awaiting purification should be kept under dilute sulfuric acid. In case of spillage, immediate action must be taken to recover as much mercury as possible by mechanical means. Any droplets collected in cracks in benches and floors should then be treated with the "**Mercurisorb Kit**" (obtainable from the main store) or should be amalgamated with zinc dust. The spill must be reported as an accident or near miss.

Cold traps must always be used when mercury-vapour diffusion pumps are installed in high vacuum equipment.

Carcinogens

The procedures in this section are mandatory for work with Category 1 and Category 2 carcinogens.

Carcinogens are divided into three categories.

Category 1: These are substances known to be carcinogenic to man. There is sufficient evidence to establish a causal association between human exposure to a substance and the development of cancer. If purchased from a supplier, they will be marked:

- T; R45 May cause cancer, or

- T; R49 May cause cancer by inhalation.

Category 2: These are substances which should be regarded as if they are carcinogenic to man. There is sufficient evidence to provide a strong presumption that human exposure to a substance may result in the development of cancer, generally on the basis of appropriate long-term animal studies and other relevant information. If purchased from a supplier, they will be marked:

- T; R45 May cause cancer, or
- T; R49 May cause cancer by inhalation.

Category 3: These are substances which cause concern for humans owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment. There is some evidence from appropriate animal studies, but this is insufficient to place the substance in Category 2. If purchased from a supplier, they will be marked:

- X_n; R40 Possible risk of irreversible effects

1) Carcinogenic chemicals should not be used for purposes for which a satisfactory non-carcinogenic substitute is available.
2) The use of carcinogens for teaching purposes should be avoided. If it is considered that their use in a teaching procedure is unavoidable, the need for their use and the conditions of use must be reviewed annually. The written permission of the Head of Department must be obtained before first use of any carcinogen for teaching and each year thereafter.
3) Work with carcinogens must be conducted in accordance with **written** procedures which are derived from the risk assessment for the work. Risk assessments for work with carcinogens should always consider:
   - processes which can produce aerosols or vapour containing a carcinogen
   - manipulation of carcinogens likely to result in dust formation
   - storage and manipulation of carcinogenic gases, volatile carcinogens and compounds which decompose spontaneously, evolving carcinogens
   - weighing of carcinogens and the preparation of solutions containing them
   - the possible effects of static electricity during handling of powders
   - changing traps and exhaust filters
   - response to a spillage or other uncontrolled release of a carcinogen
   - decontamination of work areas and equipment
   - disposal of waste
4) Carcinogens should be handled only in suitable designated areas with adequate equipment for their containment.
   - designated areas should be marked clearly
   - access to designated areas should be restricted to those carrying out the work
   - the numbers of those involved in the work and entering the designated areas should be kept as low as possible

- effective methods must be devised to ensure people not involved in the work do not enter designated areas

5) If small samples of carcinogenic materials need to be taken to non-designated areas (e.g. for specialised analysis), samples should be clearly marked as carcinogens and be carried in robust sealed containers. The same stringent precautions as are required in designated areas should be observed in non- designated areas.

6) Carcinogens should be kept segregated from all other chemicals in a locked cupboard clearly labelled "Chemical carcinogens".

7) Protective clothing required should be specified and be worn at all times.

   - Protective clothing must be disposable and must be disposed of in the same manner as the carcinogen itself.
   - Contaminated clothing must not be sent for laundering. (**Any procedure which causes contamination of protective clothing is unsatisfactory and must be improved**.)
   - Protective clothing which has been worn in a designated area is potentially contaminated and must not leave the designated area except for disposal.

8) Standards of personal hygiene in any laboratory should always be high. When working with carcinogens it is particularly important to ensure that the highest standards are maintained

   - No eating, drinking, or applying of cosmetics is permitted in the laboratory
   - Mouth pipetting is strictly prohibited.
   - Any exposed cut or abrasion of the skin must be covered with an appropriate surgical dressing before commencing work or putting on protective clothing
   - Hands must be washed and dried with disposable towels before leaving the laboratory

9) Decontamination methods for experimental residues and laboratory equipment should ensure complete chemical conversion into non-carcinogenic substances. Written instructions for cleaning and decontamination of equipment must be prepared. Decontamination and cleaning of equipment should be carried out in the designated area.

10) Written procedures for disposal of waste must be prepared. Contaminated material which cannot be decontaminated should be double bagged in sealed plastic bags, clearly labelled with contents and carcinogenic nature of hazardous substances and then passed to the Technical Resources Officer who will arrange disposal by licensed waste contractors.

11) Any sharps (e.g., needles, broken glass) must be placed in plastic sharps containers and passed to the Technical Resources Officer (Meston G29) for disposal by incineration.

The following classes of compounds contain known carcinogens:

1) **Polycyclic aromatic hydrocarbons**, in particular: 3,4-benzpyrene, 1,2-benzanthracene, 1,2,5,6- dibenzanthracene, 1,2- and 3,4-benzacridines.

2) **Some aromatic amines and related compounds**: Category 1 carcinogens 2-naphthylamine, benzidine, 4-aminobiphenyl, 4-nitrobiphenyl and their salts. Category 2 carcinogens include 1- naphthylamine, toluidines, di-*m*-anisidine (3,3'-dimethoxybenzidine), dichlorobenzidine, and their salts.

3) **N-nitroso compounds**: All compounds of the type R.N.(NO)R' are potential carcinogens and should be handled as such.

4) **Biological alkylating agents**: Examples are β-propiolactone, nitrogen mustards, ethyleneimine and compounds containing aziridine groups, and methyliodide.

Ethers and formation of organic peroxides

1) Certain chemicals form explosive peroxides when allowed limited access to air and exposure to light. They should therefore be stored in dark bottles with the air space above the liquid kept to a minimum. Bottles containing these chemicals should not be topped up as this can lead to the accumulation of peroxides in the bottle. A list of common peroxide forming chemicals and their risks is given in Appendix 5.

2) Do not attempt to distil the low boiling point aliphatic ethers nearly to dryness because this concentrates the peroxides and can cause dangerous detonation.

3) Opened bottles should be tested before use and at least at 6-monthly intervals. Test strips to enable testing for peroxides can be obtained from the Stores.

Date and result of tests must be recorded on a label on the bottle along with the name of the person carrying out the test.

Date of opening of a new bottle should be recorded on a label on the bottle.

1) Peroxide can be removed from ether by washing with acidified ferrous sulphate, or by passing the ether over alumina. It should be noted that on prolonged storage of ethers the peroxides, mainly hydroperoxides, which are initially formed may be converted into secondary products, such as dialkyl peroxides. These products (also explosive) are difficult to detect.

2) **Di-isopropyl ether** presents an extremely severe peroxide hazard. Its structure is such that peroxidation is very rapid and the hydroperoxide settles out as a readily detonated crystalline solid. The maximum permissible storage time is one month unopened and one week opened. A crystalline deposit near the stopper is a danger sign. If this is seen do not attempt to open the bottle, but consult the Technical Resources Officer about disposal.

6) Computer workstations

Those working with keyboards and computer display screens for prolonged periods as a significant part of their normal work, can be exposed to a number of health hazards. The principal hazard relates to the arms. The problems, which can develop, are referred to as WRULDs (Work related upper limb disorders). They were previously referred to as RSI (Repetitive strain injuries). Applying ergonomic principles to the design, selection and installation of computer equipment, the design of the workplace, and the organisation of the task can readily control the risks.

The risk is only significant for those who use computer workstations intensively for a large part of each working day. Staff and students who are identified as being in this category, or who feel they may be at risk will have their workstations assessed for compliance with workstation standards. They will also receive instruction on how to use their workstations correctly.

The Technical Resources Officer has been appointed workstation assessor for the Department and will determine whose workstations need to be assessed and will then carry out the assessments.

Further information including the University's policy on the use of Display Screen Equipment (DSE) can be found under this link. Note that there are also mandatory training modules offered by the University through BeOnline.

7) Compressed gases

The main hazards associated with cylinders of compressed gas are:

- those related to the explosive release of energy stored in a cylinder in event of an uncontrolled discharge (cylinders can become jet propelled).
- those related to the mass of the cylinder (cylinders are tall, thin and heavy; they can inflict damage and injury if they fall over).
- those related to the properties of the gas stored in the cylinder (e.g., flammable, asphyxiating, toxic, corrosive, oxidant).

Storage of cylinders

1) All cylinders not in use (i.e., not connected to equipment) should be stored outside the building in the cylinder store in Meston Quad.
2) The Technical Resources Officer is responsible for the cylinder store who will ensure that:
    - access to the store is controlled and that it is kept locked when access is not required
    - cylinders in the store are correctly secured in a vertical position (acetylene and propane in particular should never under any circumstances be placed horizontally either in storage or in use)
    - cylinders in the store are segregated in accordance with industry guidelines (to help limit the consequences in event of a leak of gas or a fire)
    - stock is rotated so that oldest stock is used first
    - nothing other than cylinders is kept in the cylinder store.

Movement of cylinders

1) Cylinders must be transported only when secured vertically in a cylinder trolley, and only by a designated member of the technical staff who has received dedicated training.
2) Within the cylinder store and in the laboratory, cylinders should be "milk churned" to get them into position. Cylinders must never be rolled along the ground.
3) Cylinders should not be transported with the pressure regulator attached unless on a trolley specifically designed for this purpose.
4) While moving cylinders out of the store or into position in the laboratory, always keep unsecured vertical cylinders under your direct control - never turn your back on a free-standing cylinder. The consequences of it falling over can be severe.
5) Anyone handling gas cylinders should wear protective footwear (steel toes) and industrial gloves.
6) Cylinders must always travel unaccompanied in lifts. The transport of cylinders in lifts ideally requires two people, one to load the cylinder into the lift car, the other to summon the lift to its destination. A sign prohibiting entry to the lift must be displayed prominently on the cylinder while it is in transit, in case someone at another floor also summons the

lift.

A leak in any type of cylinder could cause the air in a lift car to become unbreathable. If this were to happen while a lift was stuck between floors, the consequences could be fatal. Anyone who has seen the bursting disc of a carbon dioxide cylinder fail (and it can happen without warning) will know how rapidly carbon dioxide can flood out of a cylinder and would not want to have been in a confined space with the cylinder with no immediate means of escape.

Use of cylinders

1) All cylinders in a laboratory must be mounted vertically on a stand or secured to the bench or to the wall. Acetylene and propane must never be used or stored in a horizontal position.
2) Cylinders should be fitted with a regulator valve of the correct type (e.g. it is not safe to fit a nitrogen regulator to an oxygen cylinder). The cylinder key should be secured to the gauge, so it is always available to enable an emergency cut off.
3) Regulators must be replaced according to the following policy (note that this may be subject to change, so make sure you follow current University guidelines):
   - low pressure regulators (up to 0-5 bar) must be replaced after 5 years
   - high pressure regulators (0-10 bar and above) must be replaced in the middle of year five of usage
4) Do not use excessive force on valves and gauges. If a cylinder valve cannot be opened readily, it should be returned to the supplier.
5) Never use oil or grease on any part of a valve or regulator. Do not use PTFE tape on any part of a compressed gas system. If a gas tight seal cannot be obtained, change the fittings.
6) Always open valves slowly. Rapid opening may result in an explosion.
7) Check your equipment regularly for leaks. Always use the proprietary liquids which are intended for detecting leaks. (Do not get into the habit of using soap and water. Some soaps contain fats which react violently with oxygen.)
8) Regulator valves are not intended for use with low flow rates and low back pressures. Always use a needle valve to control gas flow from the low-pressure side. These can be obtained from BOC as "fine control valves", the thread depending on the gas to be controlled.
9) All connections should be secure; a "jubilee" clip is ideal. A safety valve of some form is advisable to prevent high pressure being applied to your apparatus.
10) Gas supplies feeding a source of ignition (e.g. a welding or glass working torch) must be fitted with non-return valves or explosion preventers.
11) After use, always shut off the gas at the cylinder valve, and release the pressure in the gauges before finally shutting all valves. Do not rely on the regulator to stop the gas flow for more than brief periods.
12) Understand the hazardous properties of the compressed gases you are using (e.g. flammability, toxicity).
13) Cylinders containing flammable gases have some part painted red.

14) Cylinders containing flammable gases should not be used within 2 m of any source of ignition.

15) There should be no unprotected electrical equipment within a cone rising at an angle of 25° to the vertical from the connections of any hydrogen cylinder in use.

16) Acetylene cylinders must always be kept vertical and upright. Any acetylene cylinder that has been lying horizontally must be stored vertically and upright for 24 hours before use. Flashback arrestors must be used with acetylene. The maximum recommended pressure of acetylene in rubber hose is 15 psi. Copper fittings or tubing must **never** be used for acetylene.

8) Contractors

Any staff member planning to bring contractors into the Department should contact the Technical Resources Officer in advance to agree any precautions which might be required.

In particular, contractors must never be allowed to undertake <u>any</u> work in the Department without consulting the Technical Resources Officer.

This is to ensure that

- contractors' staff do not endanger their own health and safety by entering laboratories without taking necessary precautions and
- contractors do not endanger the health and safety of Departmental staff and students by carrying out works in an inappropriate manner.

This applies both to contractors working directly for the Department and to contractors brought in by Estates to carry out works on the fabric of the building.

9) Cryogenic fluids

The hazards arising from the use of low temperature liquefied gases (cryogenic fluids) are:

- asphyxiation from oxygen deficient atmospheres (This is a problem particularly in poorly ventilated confined spaces)
- fire in oxygen enriched atmospheres (While obviously a problem with liquid oxygen, it can also be a problem with liquid nitrogen and liquid helium. Near the surface of liquid nitrogen or liquid helium it is possible for oxygen to be condensed from the atmosphere causing localised oxygen enrichment.)
- cold burns from the intense cold (The damage to the skin is similar to that caused by heat burns. The eyes are particularly vulnerable to damage.)
- over pressurisation from the large volume expansion ratio from liquid to gas on evaporation.
- the effects of very low temperatures on materials. (e.g. normally ductile materials can become brittle, methods of jointing need careful consideration because of possible differential rates of contraction.)

Storage of bulk stocks of cryogenic fluids

1) Bulk stock of liquid nitrogen is stored in Loading Bay No 1.

2) The Technical Resources Officer is responsible for ensuring that
   - the storage area is maintained in a satisfactory condition
   - necessary personal protective equipment is available
   - appropriate warning notices are posted
   - equipment used for storage is suitable for purpose and is maintained in good condition

Transport of cryogenic fluids within the department

Cryogenic fluids must never be transported in lifts accompanied by people. A lift cage is a confined space. If the lift were to become trapped between floors for a period, it is possible that evaporation of the fluid could cause the air to become unbreathable. Warning notices to this effect are posted in the lifts in the Department.

The transport of large vessels in lifts requires two people, one to load the vessel into the cage, the other to summon the lift to its destination. An additional sign prohibiting entry to the lift must be displayed prominently on the vessel while it is in transit, in case someone at another floor also summons the lift.

Use of cryogenic fluids

1) No one should work with cryogenic fluids until they have been thoroughly instructed and trained in the nature of the hazards and the precautions to be taken. The hazards associated with cryogenic fluids will not be readily apparent to someone who has not received appropriate training.

   Those working with cryogenic fluids must be aware of the first aid treatment for cold burns. The numbing effect of very low temperatures makes it possible for someone to suffer a burn without noticing, for example by touching a cold metal surface.

2) If contact with the cryogenic fluid is possible, eye protection (or preferably a full-face visor) must be worn. Other protective clothing, e.g., thermal gloves, should be worn depending on the risk associated with the work. Clothing should be non-absorbent and not have features which could trap a spillage of fluid (e.g., open pockets, turnups on trousers). Watches and jewellery which could trap cryogenic fluid close to the skin should not be worn.

   If small volumes of cryogenic liquids are to be used, it is better not to wear gloves, unless there is the possibility of contact with very cold surfaces. In such cases the gloves should ideally be "Cryo-gloves". (These are gloves which are specially designed for low temperature work.) If other gloves are used, they should be non-absorbent leather gloves and they should be a loose fit so they can easily be removed if fluid should splash into them. Gauntlet gloves should not be used as they increase the likelihood of a spillage going into the glove. Rubber gloves must never be worn. If a conscious decision is made that a certain procedure involving handling of cryogenic liquids is safer to be carried out without gloves, suitable gloves should still be kept within arm's reach to be able to deal with unforeseen events such as spillages.

3) If liquid oxygen is to be used, equipment must be scrupulously clean as dirt, oil or grease can pose a serious fire or explosion hazard. Any jointing materials must also be oxygen-compatible.

   With other cryogenic fluids it is also good practice to use oxygen-compatible materials.

4) Materials used in experiments involving cryogenic fluids must be chosen with care. The most significant considerations are those of brittle fracture and ensuring that joints are suitable for the temperatures which will be established.

5) Avoid situations where oxygen can condense in liquid nitrogen. Open Dewars which are topped up with liquid nitrogen over prolonged periods should be emptied out weekly. Cold traps in vacuum lines must be under vacuum before being cooled with liquid nitrogen. Avoid flow of air through cold traps.

6) Always ensure that lids or stoppers are loose enough to prevent the build-up of pressure. Note that in the past, there has been at least one serious explosion when a cold bath liquid containing remnants of dry ice, solid carbon dioxide, was poured into a bottle that was then sealed, whilst still cold and full of dissolved gases.

10) Electrical equipment

Note that the University has a dedicated policy on electrical safety that can be found using this link.

The main hazards arising from the use of electrical equipment are:

- electric shock
- fire caused by overheated conductors
- explosion due to a spark in a flammable atmosphere

To prevent electricity becoming a source of harm, electrical equipment should be

- installed correctly and be suitable for the application
- used correctly
- maintained in good condition

Selection and installation of electrical equipment

1) The electrical installation in the building up to and including the electrical sockets or other point of supply is the responsibility of the University’s Estates Section. No one other than Estates electricians or their contractors should interfere with the electrical installation or attempt to carry out repairs.

   Anyone who needs changes made to the installation or believes part of it may be faulty should contact the Technical Resources Officer.

2) Electrical equipment must be suitable for the area in which it will be used. Particular care is needed when selecting equipment for use
   - outdoors
   - in areas where there is water
   - in places where electrolytes or saline solutions are used
   - in cold rooms
   - in places of high humidity
   - in places where flammable atmospheres might develop

It is unlikely that "normal" electrical equipment will be suitable for any of these conditions. Anyone wanting to use electrical equipment in one of the above environments or any other hazardous environment should contact the Faculty Electronic Workshop for advice on the selection and installation of suitable equipment.

3) Any electrical equipment brought into the Department must be tested for electrical safety before being put into use. This includes equipment brought from home as well as equipment received from other University departments. Contact the Technical Resources Officer to arrange testing. Note that University specifically **prohibits the use of any personally provided electric heaters**, and that this includes offices and similar rooms. If there is a problem with heating in your area, please report this to the fault desk (x3333) in the first instance, and the Estates section will seek to rectify this. If Estates are unable to do so, a heater will be provided until a long-term solution can be found.
4) Three pin plugs and other electrical connections should be fitted only by competent persons. (If you are in any doubt as to whether you are a competent person, then you are not!) Contact the Technical Resources Officer if you need assistance with the fitting of plugs and other connections.

Correct use of electrical equipment

1) Carry out a visual inspection of any electrical equipment before connecting it to the electrical supply. (Look for any obvious damage such as frayed cables and damaged plugs.)
2) If any equipment is faulty, disconnect it from the supply and take steps to prevent anyone else using it. (Place a notice on both the equipment and on the plug.) Where appropriate, consider making arrangements to have the equipment repaired by the electronics workshop. You will need to obtain a form from the Technical Resources Officer.
3) Always replace a blown fuse by a fuse of the correct rating. (A 13 Amp fuse will be too large for most items of equipment.) If the replacement fuse should blow, the equipment should be regarded as faulty and not reconnected to the power supply until the fault has been repaired
4) Do not use multiway plug-in adapters with electrical equipment. They can lead to overloading of sockets. Power only one piece of equipment from each socket. If there are not enough sockets available, arrange to get some more installed.
5) Only attempt to repair electrical equipment if you are competent to do so. When carrying out repairs always disconnect the equipment from the supply by pulling out the plug. Take steps to prevent anyone plugging it in again while you are carrying out the repair.

Maintenance of electrical equipment (portable appliance testing, PAT)

1) Individual lab custodians are responsible for ensuring that small electronic devices within their laboratories are subjected to portable appliance testing (PAT) on a regular basis. The current policy is that in lab environments, inspection and testing of electrical equipment should occur once every three years. For PAT, lab custodians should contact the Technical Resources Officer to arrange for a trained laboratory technician to carry out the testing. Equipment passing the test is marked with a green and white sticker to indicate that it has been inspected or tested. The date of the test must be marked on the sticker. Equipment failing the test must not be used until it has been repaired by a competent person (normally in the electronics workshop).
2) Exemptions are acceptable for large (non-portable) pieces of equipment or instruments, in

particular if they are subject to a service contract or to a regular inspection protocol that include an assessment of electrical safety.

3) For office or non-laboratory environments, inspection and testing of electrical equipment should occur once every year and is arranged centrally. The Technical Resources Officer will ensure that inspection and test is carried out at the specified intervals.

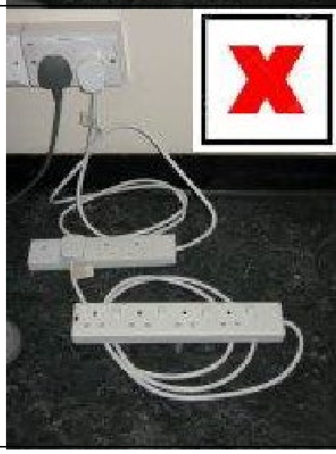
Mains electrical safety - extension leads and block adapters

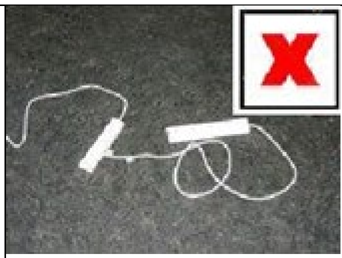
1) **Daisy chaining** of mains extension leads (i.e., plugging a second extension lead into another) is sometimes used to provide additional sockets or to extend the length of a cable so that it can reach the equipment being powered. Daisy chaining of extension leads risk creating a trip hazard and overloading or overheating conditions and **is prohibited** in the University.
2) **Block mains adapters are prohibited** by the University because of their potential for overloading the socket outlet and for overheating. Where found they should be removed and replaced by an approved method.

What should you do?

1) If you see a daisy chained extension lead or a block adapter you should contact the Technical Resources Officer or Safety Adviser who will liaise with the user in the introduction of suitable alternatives.
2) If you require additional sockets or a longer lead you should contact the Technical Resources Officer or Engineering's Electronics Workshop.

Examples of correct and incorrect arrangements

Correct: • Only one extension is plugged into a socket outlet.	
Incorrect: • One extension is plugged into another. • Daisy chaining is prohibited by the University.	

Incorrect: • One extension is plugged into another and trailing across the floor. • Daisy chaining is prohibited by the University. Pathways should be kept clear of trip hazards.	
Incorrect: • Block adapters are prohibited by the University as they can introduce overloading or overheating.	

11) Explosive substances

The formation of peroxides in ethers is mentioned elsewhere. General precautions to be taken when handling potentially explosive materials are:

1) Avoid handling the material in the dry state.
2) Avoid friction, blows and hard tools (use wood or soft metals).
3) Do not store in glass-stoppered bottles.
4) Use only small quantities of material.
5) Avoid heating them alone or with easily oxidised substances or materials which are themselves inflammable.
6) Suitable precautions such as the use of goggles, gloves, screens, neck wrappings etc., must be taken.

12) Fume cupboards

Fume cupboards are intended to keep harmful substances away from the person using fume cupboard and away from other users of the laboratory. The cupboard will do this effectively only if:

- it is used in the correct manner
- it is regularly maintained

Use of a fume cupboard

1) Fume cupboards should be used only for experimental work and not as storage areas. Use for storage will interfere with the air flow within the cupboard and will increase the likelihood of harmful substances being released from the cupboard into the laboratory. If there were to be an accident, the presence of stored chemicals in the cupboard would increase the risks.

No one should carry out an experiment in a fume cupboard that is being used as a store.

2) Do not set up equipment close to the front edge of the fume cupboard. This will increase the likelihood of turbulent flow in the air stream being drawn in at the front of the cupboard. Turbulent flow can result in "eddies" in the air stream with a consequently greater risk of harmful substances being released into the laboratory. As general guide, equipment should be set back at least 150mm from the plane of the sash.

   Equipment should not be put so far back that it obstructs the extract slot at the bottom of the back of the cupboard (or so far back that the operator has to put their head in the fume cupboard to operate the equipment!).

3) Avoid unnecessary clutter. Large objects such as safety screens, ovens, trays etc. will all cause turbulence in the air being drawn across the base of the cupboard. The effect can be minimised by raising all large objects about 50mm above the base of the cupboard with blocks.

4) Avoid rapid movements in front of and within the fume cupboard. Any sudden movement is liable to disturb the air flow and allow harmful substances to escape

Maintenance of fume cupboards

The best designed and engineered installation will cease to perform effectively if not maintained on a regular basis. It is a legal requirement that all fume cupboards are maintained and that their performance is measured at least every 14 months. Inspection and maintenance is carried out in accordance with British Standard BS 7258: (1994). A permit must be obtained from the Technical Resources Officer before work on a fume cupboard is undertaken.

1) The Estates Section is responsible for ensuring that
   - fume cupboards in the Department are inspected and maintained
   - records are kept of inspection and maintenance and certificates provided by maintenance contractors are kept on file
   - face velocities are marked on the cupboards. (Face velocity is the speed at which air is drawn in through the front of the fume cupboard.)
   - any fume cupboard which is not inspected on schedule or which fails its inspection is taken out of use.
2) Every 6 months contractors arranged by Estates will
   - where necessary, carry out a thorough wash-down of the interior of the fume cupboard (including the area behind the baffle)
   - inspect the sash mechanism for corrosion and damage and inspect the fan for correct running (a certificate of inspection will be provided and kept on file).
3) Every 12 months contractors arranged by Estates will
   - check the condition of services to the fume cupboard and the functioning of any alarms and controls
   - carry out a face velocity test and record the face velocity and the date of measurement on a label on the outside of the fume cupboard.
   - carry out a detailed check on the condition of the fan

- check the stability and condition of the discharge stack
- check and clean duct work as is necessary
- check that the make-up air into the laboratory is satisfactory
- provide a certificate of inspection

"Do not use" signs

Whenever a fume cupboard is marked with a sign which says "Do not use" under no circumstances should the fume cupboard be turned on or anything placed in the fume cupboard. Someone will very likely be carrying out maintenance on the fume extract system. Any attempt to use the fume cupboard will expose the maintenance worker to hazardous gases or fumes.

13) Furnaces

Furnaces may operate at very high temperatures and the main hazards are burns, the effects of UV and the possibility of igniting benches, paper etc.

1) Always use the tongs and gloves provided.
2) Ensure that all solvents have been removed before placing a sample in the furnace.
3) Hot crucibles must be placed on a refractory surface and allowed to cool before being handled.
4) Use UV goggles when the furnace temperature is above 1000 °C.
5) Keep papers and other flammable materials away from furnaces.
6) Consider what you will do if you drop a hot crucible onto the floor.

14) Glassware

Accidents with glassware are a common source of injury in the University. On occasions accidents with glassware have been very serious.

1) Before using any glassware check that it is sound. Cracked or chipped glassware is dangerous and must be repaired or thrown away. If it is possible that it could be salvaged from the bin, carefully break the object into the bin to prevent reuse. Even scratches and star cracks can cause failure of glass in vacuum systems.
2) All glass must be properly supported. It is bad practice to clamp vessels of more than 500 mL by the neck alone.
3) **Never** pick up Winchesters by the neck as the weight of the contents can be enough to shatter the bottle.
4) When carrying glass objects take care not to harm yourself or any other person. Always carry glass tubes vertically. Carry NMR tubes or similar breakable glass containers in a box or suitable secondary container -never carry these types of glass objects in your pockets.
5) Always protect your hands with a cloth when cutting glass tube, or when inserting glass objects through bungs. A cork borer is a valuable aid to inserting glass through a bung. A lubricant such as glycerol or industrial alcohol will also help.
6) Take care when fitting pipettes into pipetting devices. The pipette should be grasped near

the top and pressed gently but firmly into the device with a twisting motion and avoid leverage. (A cloth can be used to protect the hands.) Pipettes should be removed in a similar way.

7) Fire polish the ends of glass tubes.

8) Take care when putting flexible tubes, e.g. rubber or PVC tube on to glass objects. When removing flexible tubing from glass do not struggle with a stuck tube. Cut it off; flexible tube isn't expensive.

9) Never store glass on the floor.

10) Glass is often used for vacuum and occasionally under low positive pressures. To prevent bursting or collapse provide a protective screen, cage, or tape the apparatus with self-adhesive tape. Cling film is very useful in this respect. Never apply vacuum or pressure suddenly, as damage may result. Never use scratched, stained or damaged glassware. Always use the smallest suitable container; it is less likely to come to harm and with vacuum systems is easier to exhaust.

11) If heating glassware apply the heat slowly and ensure that the glassware is vented to avoid a pressure developing. Even glass coming from a cold room to the laboratory can develop pressure sufficient to cause damage. If the heating is required as part of glass blowing, check that the glassware is dry and free of all solvent vapours.

12) Never cut towards yourself. Always keep cutting tools sharp.

13) Finally, if you have an accident any broken glass must be cleaned up at once. Avoid walking on areas where broken glass is scattered. Every laboratory should have a small brush and dustpan. Take care not to cut yourself. A piece of plasticine is useful for collecting small slivers of glass. Take particular care to remove broken glass from sinks; wet, broken glass is almost invisible. If a liquid spill is involved in the accident, take care that the cleaning cloths do not collect broken glass, it’s too easy to cut yourself while handling cleaning cloths. Broken glass must be put into specially marked bins, never into ordinary wastebaskets as this could injure cleaners.

14) When dealing with spills or breakages, consult risk assessment / MSDS / COSHH form for specific measures required to deal with chemical hazards of the chemicals involved.

15) Heat guns

A heat gun is similar in appearance to a standard hairdryer but is operated and used in a vastly different manner. Both are constructed with a motor-driven fan that blows air over an electrically heated filament. The heating element in a heat gun typically becomes red-hot during use. Heat guns are *very* hot, some will give temperatures in excess of 400 °C, and 600 °C is not uncommon. With these temperatures, it is very easy to stress glass, if the gun is not moved about enough to avoid localised hot spots. Also, the temperature of the gun is often past the autoignition point of many solvents. The gun should be treated as one would treat a Bunsen burner, and thus not used to apply heat to heat a flammable solvent. They are ideal for warming glassware, but very inefficient in heating quantities of liquid – in most cases, an indirect heating bath or heating block (for small volumes, a water bath connected to a rotary evaporator may be sufficient) is by far the safer option. Heat guns are often used as an easily available heat source, and indeed they can be invaluable in the laboratory to prevent solidification on distillation of low melting solids. However, several incidents have been seen where they have been used to heat flasks of flammable liquids;

in these cases, the flask has cracked, and the spilled liquid has ignited with the heat of the gun. The resulting fire can lead to disastrous consequences, and at least one person has been known to be killed (not at this University).

Therefore, heat guns should **not** be used for any of the following:

- heating flammable liquids
- heating sealed glass containers
- as heat sources for reactions, as the temperature inside a reaction vessel is difficult to control. There is a risk of forming hot spots, which may be a potential cause for explosions

Given the temperatures that may be achieved, always make sure to have the appropriate equipment (e.g., thermal gloves, heat resistant ceramic tiles, etc.) available on site before working with heat guns. If heat guns are used for heating glassware, the latter should be clamped or otherwise immobilised, but do not attempt to hold it in your hand, even when wearing thermal gloves.

16) Highly flammable liquids

Highly flammable liquids (HFLs) should be treated carefully so

- they do not become a source of fire
- they do not fuel an existing fire

A HFL is a liquid with a **flash point** below 32 °C. (The flash point of a liquid is the lowest temperature at which the liquid gives off vapour in sufficient concentration to form a combustible mixture with air near the surface of the liquid.) The flash points of common laboratory solvents and other liquids are listed in Appendix 3.

As the flash points of all these liquids are below room temperature the liquids will always constitute a major fire and explosion hazard. For example, acetone, diethyl ether or carbon disulphide have flash points below the temperatures which may be found in a refrigerator or freezer and will therefore constitute an explosion hazard even when in cold storage.

Bulk stocks

1) Bulk stocks of HFLs must be kept in the solvent store outside the Main Stores.
2) Entry to the store is restricted to keyholders authorised by the Stores Technician
3) Bottles of HFLs will only be issued to people with sealed bottle carriers capable of containing the contents of the bottle in event of spillage. The bottle carriers must be used to transport the HFLs to the laboratory. Wire bottle carries are not acceptable alternatives.
4) Note that HFLs, like other chemicals, must always travel unaccompanied in lifts.

Dispensing highly flammable liquids

When HFLs are dispensed from metal containers larger than 5 litres, the operator and the container must be connected by an earthing strap to prevent static discharges which might ignite the HFL.

Laboratory stocks

1) The total volume of HFLs in any laboratory or room in the department (other than the designated bulk solvent store) must be kept as low as possible and **under no**

circumstances must it exceed 50 litres. (The 50 litre limit is set by legislation.). Note that his figure includes waste solvents.

2) All HFLs in a laboratory must be stored in specially designed and approved fire resisting cabinets. (Ordinary metal storage cabinets are not acceptable.) Cabinets should be located away from exits from the laboratory. Cabinets must be conspicuously marked with the approved labels to indicate that they contain HFLs. **Cabinets should be used only for solvents and never for oxidants, acids, alkalis or other materials which could react with the solvents or cause corrosion of the cabinets**. **HFLs should not be stored on the open bench or in fume cupboards**.

3) Bottles of HFLs temporarily removed from their storage cabinets should not be left on the open bench in direct sunlight. (Even in Aberdeen during the winter a relatively short period in sunlight can be enough to break a bottle through the build-up of pressure caused by the heating effect of the sunlight.)

For storage of HFLs in refrigerators and cold rooms, see section 26.

Empty bottles

Empty bottles which once contained HFLs should be handled and stored as carefully as full bottles as they may contain explosive vapours. Do not accumulate large numbers of empty solvent bottles; empty bottles should be rinsed or dried, as appropriate, and disposed of in the appropriate waste container in Meston Quad (red bins, after being placed inside a black bag).

Work with highly flammable liquids

1) Those working with HFLs must be aware of the flash points of the liquids and must take care to exclude ignition sources from the work area. The risk assessment for the work must address how this will be done.

2) In deciding what might be a possible source of ignition, note must be taken of the **autoignition temperature** of the HFL. (The autoignition temperature is the minimum temperature required to initiate combustion.) It is not only sparks and naked flames which can be a source of ignition. If the vapour of the HFL comes into contact with a surface at a temperature in excess of the autoignition temperature, the vapour can ignite. For example, the autoignition temperature of diethyl ether is 160 °C. The temperature of the element of a heating mantle or the surface of a hot plate can be higher than the autoignition temperature of diethyl ether.

17) Housekeeping and good laboratory practice

The following should be instinctive practices for anyone who works in a laboratory. They make the laboratory a safer place for everyone, but they are only of any value if everyone in the laboratory takes an active interest.

1) Corridors, fire exits and passageways forming means of escape through working areas must be kept free of obstruction.

2) Floor surfaces must be kept clean and in good condition

3) Any spillages and breakages should be cleaned up immediately.

4) Benches should be kept tidy and gangways kept clear.

5) **All** bottles must be clearly labelled with their contents and, where possible marked with

the appropriate warning symbol. Marking a bottle with nothing more than “Sample 1” is not acceptable.

6) Wash bottles containing anything other than water must be marked in a highly visible and distinctive manner.

7) Do not set up apparatus in front of service controls or in a way which blocks exit routes.

8) If any apparatus has to be set up above head height, ensure that a suitable means of access is available. (A suitable means of access will be a kick stool or a step ladder. Climbing on a bench, chair or laboratory stool is not acceptable.)

9) Eating and drinking are forbidden in all laboratories.

10) Do not apply cosmetics or chew on pencils and pens in a laboratory.

11) Mouth pipetting (even of harmless substances) is strictly prohibited.

12) When wearing gloves do not touch anything which someone else without gloves might touch (e.g. telephone, computer keyboard, door handle).

13) Always wash your hands thoroughly after handling hazardous substances and when leaving the laboratory.

14) Wear your lab coat fastened with the sleeves down and remove it when you leave the laboratory or laboratory suite. Lab coats must not be worn in the Conference Room or other areas where eating and drinking are permitted

15) Long hair must be tied back.

16) Do not wear open-toed shoes or sandals.

17) Do not allow electric flexes to trail untidily.

18) Avoid taking or making mobile phone calls while inside labs, but rather, aim to do so from other areas where disturbance can be kept at a minimum.

19) Avoid using headphones while inside labs.

18) Laboratory supervisors

Laboratory Supervisors (or laboratory custodians) are responsible for the safe and orderly running of laboratories and are authorised to enforce compliance with safety regulations. The name of the custodian is posted prominently at the entrance to each laboratory. The principal duties are:

- Ensuring that there are formal risk assessments of the laboratories under their control that amongst other things, address control of access, the safe cleaning of the laboratories and the safe disposal of wastes from the laboratories, the safe running of experiments.
- Ensuring that staff / students, including visiting researchers, are adequately informed and where appropriate trained and competent to follow the procedures for the cleaning and the disposal of waste from the laboratories as well as the safe running of experiments.
- Providing supervision to their staff / students proportionate to the risks involved to maintain a safe working environment.
- Ensuring that the laboratories are safe for access, cleaning and removal of wastes.
- Providing relevant information in writing to Estates maintenance and cleaning staff and

their managers on hazards and risks in the laboratories that are to be accessed or cleaned.

- Ensuring that the appropriate signs and warnings are in place to inform anyone entering the laboratory of potential risks. The system of signs for access as identified in Appendix 7 is applicable for all laboratories.
- Ensuring that other relevant signage including hazard labels are up to date.
- Dealing with any reported infringements of the procedures and to have the infringements rectified.
- Reporting any incidents, including near miss incidents involving these procedures.
- Enforcing wearing of lab coats and safety glasses.
- Ensuring there is no eating and drinking in laboratories.
- Ensuring overnight permits are in place and up to date.
- Maintaining laboratories in a tidy, safe condition and foster good laboratory practice.
- Reporting defects to the Technical Resources Officer.
- Enforcing rules on carcinogens.
- Enforcing 50 litre limit per room of highly flammable liquids, including solvent waste and small bottles.
- Ensuring proper storage of highly flammable liquids, i.e. highly flammable liquids are only to be kept in the designated cabinets, not on the open bench or in fume cupboards.
- Ensuring highly flammable liquids are not kept in non-spark-proofed refrigerators.
- Rectifying deficiencies noted during safety inspections.
- Notifying the Technical Resources Officer and/or local safety coordinator of significant changes to the use of a laboratory in a timely manner.

19) Lone working

'Lone working' is where a member of staff or student is working without a second person nearby who would immediately be aware if the first person were to get into difficulties of any sort. (It is important than any second person is not only present near the work area but also knows how to provide an effective response to any emergency.)

'Lone working' is distinct from 'Out-of-hours' working, i.e. it is possible to be alone in an area of the department during the working day. The assessment of risk must recognise this and indicate appropriate procedures for minimising risks to individuals.

Department procedures for 'Lone Working' are:

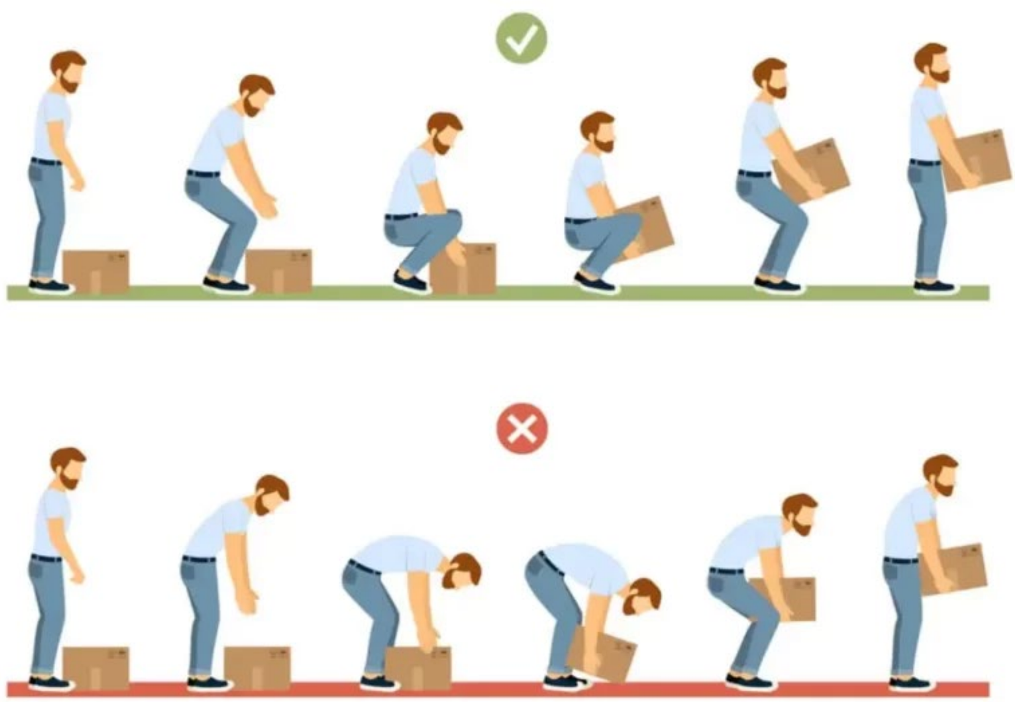
- individuals and supervisors must ensure that risk assessments of work to be undertaken in remote environments (even within the Department) where lone working is necessary, contain details of appropriate procedures for minimising risks to individuals; no special arrangements for logging of those risk assessments is necessary (normal procedures apply) and it is not necessary to make entries into the 'out-of-hours' activity log.
- individuals who must work in isolation must identify a colleague who will periodically check on them if they have not themselves checked in.

20) Manual handling

Back injury resulting from manual handling is a common cause of lost time accidents. Injury to the lower back, caused by a momentary lapse of good practice, may never recover fully and can be prone to relapse. It is not only injuries to the back which can result from manual handling operations. Cuts, bruising of hands and feet are injuries which can occur when manual handling is not done correctly.

1) Members of the Department with supervisory responsibilities must ensure that people under their control are not expected to carry out manual handling operations which are likely to cause injuries. Note that the University can be contacted to provide assistance when moving very heavy equipment.
2) Before attempting to lift anything, size up the job. Do not hesitate to seek help with heavy or awkwardly shaped loads. Always look at the possibility of moving the load in an easier way (e.g. by using a trolley or some other form of mechanical assistance).
3) Anyone with any doubts about their ability to lift or carry a particular item, should discuss it with their immediate supervisor. It will usually be possible to work out a different way to move the load.

How to lift



- Relax or unlock the knees and move one foot either forward, backwards or sideways. This lowers your centre of gravity, gives a wider base and gives greater stability.
- Relax your back to allow you to take hold of the load. There is nothing wrong with bending, provided you have done the previous moves. Keeping your back straight forces you off balance and increases the risk of injury.
- Take a comfortable handhold, using the palm or surface of your hand and fingers,

distributing the weight over the palms and forearms wherever possible.

- **Do not lift the load with the back bent**. This is where the head plays a vital role in protecting the spine. You should lead the lift with your head by moving it in a forwards and upwards direction. This brings the natural curve back into the lower spine and protects it from damage.
- Throughout the lift, hold the load as close to you as possible. Always lift towards yourself, never away.
- Do not twist and bend at the same time. Moving your feet instead of your upper body can help balance the load.
- Do not jerk but use rhythm and timing with rocking movements.

21) Magnetic fields: NMR spectrometers

These rules apply to the NMR facilities in the Marine Biodiscovery Centre (spectroscopy lab, MT 082, 400 & 600 MHz NMR). Note that each user must receive appropriate training by our NMR technician, Russell Gray, before they can use the NMR systems.

NMR instrumentation uses a very strong magnet and radio-waves to analyse chemical compounds. **This may be dangerous for some people**. This information is to make you aware of the risks of entering rooms containing such equipment. Casual visitors must be accompanied by a qualified user. Due to the increased shielding of modern magnets, note that the 5 Gauss zones are actually inside the magnets of both NMR systems.

Briefly stated the **risk factors** (including specific **medical conditions**) that may prevent someone from getting close to the NMR systems include the following:

- Pacemakers, cardiac defibrillators or nerve stimulators
- Having had brain or heart surgery
- Metal implants in your body (e.g. aneurysm clip, artificial limbs, metal joints, metal plates/screws, middle ear implant, hydrocephalus shunt, coil, stent or catheter)
- A false eye/metal fragments in your eye
- A hearing aid
- Body piercing or jewellery
- Pregnancy

In addition, if you have had previous operations, you should record this on the screening form before you are trained as a user.

If there is any doubt that it may not be safe for you to approach the NMR spectrometers, please notify Russell Gray or Dr Rainer Ebel so we can seek advice from the Radiation Protection Officer at Aberdeen Royal Infirmary.

Magnetic fields may damage other objects such as mobile phones, watches, credit cards, USB drives, portable disk drives, MP3 players, computers and any other electronic devices, or those relying on magnetic materials. Therefore, avoid bringing these objects close to the magnets.

22) Out of hours running of unattended experiments and equipment

Overnight experiments

Equipment should not be left to run overnight unless absolutely necessary. When it is unavoidable, all reasonable precautions must be taken to prevent fire, flood, explosion or the emission of toxic materials. In particular, the following points should be noted:

1) Gas heating or gas burners must **not** be used overnight.
2) All experiments must be labelled with an **overnight running permit**. These permits are issued by the Technical Resources Officer and must be completed. The permit must give the supervisor's name. No instructions on turning off equipment etc. may be given to security staff or other untrained personnel.
3) Experiments must have been running for at least one hour before they are left unattended. They must be designed such that a failure of the water, electrical or compressed air supplies does not generate any danger.

Water supplies

1) **It is absolutely essential** that water supplies to any equipment or experimental apparatus are properly connected. The consequences of leaks out of hours can be devastating. Not only have the costs of the damage caused been very high, the disruption to the departments affected has been very significant. Keep in mind that water leaks may not only affect the laboratory housing the equipment, but also laboratories and offices on floors below.
2) Water supplies must be connected using pressure resistant tubing and hose clips at all connections (e.g. Jubilee clips). Wiring on of tubing is never acceptable. If the wire is tight enough to secure the tubing it is also very likely to cut the tubing. If equipment will run over several days or weeks, connections should be checked every day.
3) Waste lines must be put well down into drains and secured so they cannot jump out. Water flow must be kept as low as possible. Remember that water pressure can rise (especially outside normal working hours when the demand for water in the area may drop).
4) Wherever and whenever practical, consider using recirculating chillers instead of running water for cooling purposes.

Experiments and equipment left on overnight and not carrying a running permit will be reported by the security staff.

Responsibilities for equipment

1) Anyone leaving an experiment or equipment running unattended out of hours must recognise that they have full responsibility for it. They are responsible for ensuring that it does not cause harm to anyone or cause any damage to the building and the equipment, data and records which are contained in the building.
2) Remember that outside normal working hours the building is still a place of work for some groups of staff. (e.g. cleaners who will come into the laboratories early in the morning and security staff who will visit laboratories periodically through the night and at weekends.) Their safety must be considered when a decision is made to leave experiments and

equipment running through the night.

23) Out-of-hours working

1) Definition

For the purposes of these guidelines, Out-of-Hours is defined as **before 7.00 am and after 8.00 pm** Mondays to Fridays and **all day Saturday, Sunday** and declared public holidays.

2) Logbook

The regular working hours in the Chemistry department are from 7:00 until 20:00 on weekdays. Every person associated with the Chemistry department (academic and technical staff, PhD students, postdoctoral researchers, visiting scientists, etc.) must fill out the logbook at the South end of the Meston building if they are present outside these hours or at any time on the weekend. Note that the requirement to sign the logbook includes non-chemical work such as office work.

3) Work in chemical laboratories

Supervisors are expected be aware at all times of the work being undertaken by their students and postdoctoral researchers and it is only with supervisor approval that out-of-hours working can be undertaken. It is the supervisor's responsibility to ensure that the planned work is safe to be undertaken out-of-hours.

Any work in a chemical laboratory within the Meston building outside the hours stated above (before 7:00 or after 20:00, or at any time on the weekend) will only be permitted provided that the following conditions are met:

- An electronic form must be filled out and submitted by the student or researcher via the Department's Teams site ("Chemistry PGR student group") and signed electronically by the supervisor. Special arrangements need to be in place in case of the supervisor's absence due to travel – there is an expectation that at least one of the supervisors should be in Aberdeen when out-of-hours work is taking place.
- This form must contain a written description of the nature of the proposed out-of-hours laboratory work intended, complete with full risk assessment including the reference number assigned. Details of dates and times, agreed emergency actions and periodic check-in arrangements (to security or supervisor), robust arrangements to prevent lone working ["Names of others involved"] must be clearly stated on the forms.
- Out of hours work on weekends must be seen as an exception, and it is the Department's policy to only allow work on either a Saturday or a Sunday on any given weekend. If in exceptional cases, out of hours work is required for both days, separate forms must be submitted and signed electronically.
- In addition to the supervisor, the form must be electronically signed by the Head of Department (or their nominated replacement in case of absence). It is the student's/researcher's responsibility to submit the request in a timely fashion to allow for the required approvals.

4) Notes

- Individuals should be aware that undertaking work in a chemical laboratory without the required permission as detailed in this section **will incur disciplinary action**.

- Even a valid out-of-hours permit **does not qualify for lone working** activities!
- Out-of-hours forms are not required for office work or exclusively computer-based work (e.g. processing of experimental data or spectra), as long this occurs exclusively outside any chemistry lab.

24) Personal protective equipment

Eye Protection

1) Eye protection must be worn whenever there is a likelihood of material of any kind entering the eyes.
2) Normal spectacles are not an effective or acceptable form of eye protection.
3) Where the risk of injury to the eyes is high, goggles or full-face visors will be required.
4) Eye protection must be worn at all times in chemical laboratories. The only exceptions are when there is only a minimal risk, for example when using a microscope, computer or an analytical balance in a side room.
5) UV protection is required when using UV lamps and high temperature furnaces.

Respiratory Protection

Staff and researchers are advised that the Department no longer maintains a self-contained breathing apparatus. Any incident in a lab, e.g., chemical spill that need to be dealt with using a self-contained breathing apparatus therefore will require bringing in an external contractor (e.g., Veolia) or the fire brigade.

Protective lab coats

1) Lab coats are intended to collect small spillages and to protect the person and their clothing. They should always be worn fastened up and with the sleeves down. They provide much reduced protection if they are not fastened.
2) The contamination which accumulates on a lab coat should remain in the laboratory and not be transported around the building. The lab coat should therefore not be taken outside the laboratory (or laboratory suite) and in particular it should not be taken into libraries, write up areas or places set aside for eating and drinking. A failure to follow this very basic precaution can result in others in the building (as well as the wearer) being exposed to the contamination.
3) Note: It is almost certain that someone who does not wear a lab coat in the laboratory will take contaminants out of the laboratory on their clothing.
4) Laboratory coats fastened by press studs are much better than those fastened by buttons as the former can be removed much more quickly in event of a spillage on the coat.
5) If there is a likelihood of splashing liquids, a thick rubber or plastic apron should be worn over the normal lab coat.

Hand protection

Gloves are essential in laboratories and should be worn whenever there is a likelihood of the hand coming onto contact with substances which could damage the skin or with toxic substances which could be absorbed through the skin (or through cuts and abrasions on the skin).

Catalogues of gloves suitable for laboratory use contain a very large range of different gloves made of different materials. A large range is essential as materials used have differing resistances to the different types of chemicals used in the laboratory. Some chemicals will go through the material of some gloves almost immediately. This is particularly true in the case of ordinary rubber (i.e. latex) gloves such as Marigolds. **It is vital to pick the correct glove to provide the right level of protection against the substances with which you are working.**

A broad classification of the barrier effectiveness of the different materials from which chemically resistant gloves are made is given below. This is a guide only. **Before using a glove to protect against a particular chemical it is essential to refer to the specification produced by the manufacturer of that glove.**

Chemical Groups	Natural Latex	Nitrile	Neoprene	PVC	PVA
Solvents	**X**	☐	☐	**X**	**X**
Ketones	☐	**X**	☐	**X**	☐
Caustics	☐	☐	☐	☐	**X**
Acids	☐	☐	☐	☐	**X**
Hydrocarbons	**X**	☐	☐	**X**	☐
Oils	**X**	☐	☐	☐	☐
Fats	**X**	☐	☐	☐	**X**
Organic Solvents	**X**	☐	☐	**X**	☐

☐**=** may be suitable (check manufacturer's specification)**X**= not suitable

Many gloves will burn readily. It is preferable not to wear them near naked flames. If they must be worn, great care is needed to keep them clear of the flame.

Protective gloves must be removed when touching anything that someone else might touch without gloves, e.g. door handles, phones, computer keyboards, light switches, papers, etc. In order to carry anything between laboratories, at least one glove must be removed, while the glove-free hand is then used to open doors en route.

Know how to remove disposable gloves without touching contaminated surfaces with your hands by turning the gloves inside out.

Do not use when handling liquefied gases.

Liquid Nitrogen

Wearing disposable laboratory gloves while handling liquid nitrogen is hazardous because of the risk of trapping liquid between the gloves and the skin. Insulated gloves and eye protection should be worn however while dispensing liquid nitrogen from the central storage dewar.

Allergy to latex gloves and resulting dermatitis

The proteins which can be found in some cheaper latex gloves can cause an allergic reaction to develop on the skin of the hands with resulting dermatitis. In severe cases this can be so bad as to completely prevent an individual continuing with their normal job. All those who are long term glove users should be aware that they are at greater risk than short term wearers. Only non-allergenic, powder free gloves are permitted as the standard latex glove for the laboratory.

Note: It is a common misconception that glove powder is the offending allergen. It is not. The powder can cause mechanical irritation or chemical damage to the skin. This is a completely different effect on the skin to the allergic reaction produced by the proteins in the rubber of some cheaper gloves.

Safety footwear

Safety footwear (with steel toe caps) should be used where it is necessary to move heavy equipment.

Proper laboratory clothing

When working in a laboratory, in addition to the personal protective equipment detailed above (i.e., at least safety specs and lab coat), you should wear a shirt or a similar piece of clothing that covers the stomach and lower back as well as the upper arms, long pants, and shoes that completely cover the foot. (An acceptable, but not recommended, alternative is to wear shorts, a skirt, or a lab coat such that your knees are covered when you are sitting down.) Tank tops or cropped shirts, mesh shirts, shorts or skirts that do not cover your knees when you are sitting, Sandals, flip-flops, or other shoes that do not completely cover your feet are not considered appropriate attire.

25) Pressure systems

Maintenance

1) All pressure equipment and systems should be properly maintained. There should be a maintenance programme for the system as a whole.
2) A written system of examination is required for pressure systems
   - if the system has at least one pressure vessel and operates at a pressure of 0.5 bar above atmospheric (and if the product of the pressure times volume is greater than 250 bar × litres): or
   - if the system contains steam.
3) If a written scheme of examination is required, the insurance company contracted by Estates to carry out inspections can assist with its preparation. The system must be inspected at the intervals prescribed by the written scheme of examination. The insurance company contracted by Estates must be used to carry out the inspection. They will provide certificates of inspection which must be retained on file.

26) Refrigerators and cold rooms

1) Standard refrigerators and freezers are not equipped with spark proofed electrical equipment and therefore must never be used to store highly flammable liquids (even if the HFL is in a sealed container). In the past there have been major explosions and fires in many Universities (including the University of Aberdeen) because of a failure to use purpose designed spark proof equipment.
2) All refrigerators, freezers and cold rooms which are not spark proofed must be labelled with a sign indicating that they are not suitable for storage of any HFL (in either open or closed containers). Even if the flash point of the liquid is above that of the working temperature inside the refrigerator, storage is still not permitted. If the cooling system were to fail, the temperature could rise above the flash point and an explosive atmosphere could result.

Warning – Explosion hazard

This apparatus is **not** spark proof and must **not** be used to store any source of fumes of highly flammable liquids.

Typical sources of potentially explosive fumes are open or closed vessels containing common solvents, e.g., MeOH, EtOH, EtOAc, acetone, toluene, diethyl ether.

3) **If it is necessary to place HFLs in a refrigerator or freezer it is essential that a special refrigerator / freezer is used.** It must be spark-proofed and protected against an explosion. Even a very small amount of HFL in an ordinary refrigerator or freezer can create an explosive atmosphere which can then be ignited by a very low energy spark (e.g. from a thermostat). The consequences can be devastating. It is very likely that the resulting explosion will, at the very least, completely destroy the laboratory containing the refrigerator or freezer. Even in a protected refrigerator the HFLs must be kept in closed containers impervious to the solvent concerned. (Many plastics are not suitable.)
4) Before storing any material in a refrigerator, it must be clearly labelled with the owner's name, the name of the substance, hazard information and the date on which it was stored. Labels must be firmly fixed so that they are not lost or obscured during storage. In the case of items which can become reactive at room temperature, precautions must be taken against the interruption of the electricity supply.

27) Sharps, needles etc.

In general, re-sheathing of needles should be avoided wherever practical. Syringes dedicated for manual injection into chromatographic systems (e.g., HPLC, GC) should normally be equipped with blunt tips, also to avoid damage to injection valves.

A special situation may arise with devices required for injecting chemicals, for example through stoppers meant to seal an apparatus. In this case, re-using these needles (which normally will have sharp tips) may be required as a matter of cost – re-sheathing should then be carried out by placing both the needle and the sheath on a flat surface, and holding down the sheath as far away from the opening as possible. Users not familiar with this technique should receive an appropriate induction by other, more experienced users.

28) Toxic, harmful and irritant chemicals

Experiments involving the use or generation of these must be carried out in a fume cupboard and efforts should be made to reduce the amounts of material escaping into the fume cupboard by the use of suitable traps.

Flow rates in all fume cupboards are checked periodically and lists are kept by the Technical Resources Officer. Except for small quantities of highly toxic volatile materials, fume cupboards must not be used for storage purposes.

In general, four points should be considered before starting any experiment involving a toxic chemical:

1) the nature and level of the toxicity.
2) the appropriate antidote.
3) suitable protective clothing and safety measures in general.
4) safe ways of waste disposal at the conclusion of the experiment.

29) Vacuum systems

1) The danger of implosion in a vacuum system depends on the absolute pressure difference between the inside and the outside of the system. This means that a soft vacuum or even a water-pump vacuum is as dangerous as a high vacuum of similar dimensions and the same precautions must be taken.
2) Eye protection is mandatory when operating glass vacuum apparatus.
3) When assembling vacuum equipment, examine it for stresses and strains, both before and after filling. Reagents can produce severe strains in glass apparatus. Use metal or plastic tubing wherever possible and include flexible couplings.
4) To visualise areas of strain, view a piece of glassware placed between two crossed Polaroid sheets in front of a lamp; areas of strain will show some birefringence. These are available from the glassblower, Mrs Paula Craib in Room 027.
5) Whenever practical, vacuum apparatus should be screened. Wide bore tubing, bulbs and items up to 1 litre capacity should be strapped with tape, clingfilm, or enclosed in plastic mesh (available from Stores). Larger items should be encased in stout metal mesh cages.
6) Vacuum pumps must be serviced in accordance with manufacturer's recommendations. The Technical Resources Officer is responsible for ensuring that all vacuum pumps in the department are serviced.
7) Ensure that rubber bungs are large enough to avoid being sucked into an evacuated vessel.
8) Ensure that stopcocks are properly lubricated and never try to force one. Always operate stopcocks slowly, supporting the barrel at the same time to prevent strain in other parts of the line.

30) Waste disposal

Note: The latest version of the University waste streams is provided on the following page, while the current waste disposal procedure for NCS is provided in Appendix 6.

1) Nearly all processes in the Department will generate waste of some sort. Some of the waste will be hazardous in nature. We have a duty to ensure that hazardous waste

- **does not harm those who have to handle it** between the point in the Department where it is generated and the point of ultimate disposal (Consider, for example, cleaners, porters, staff of waste disposal contractors)
- **does not harm those who might come into contact with the waste** at its point of ultimate disposal (e.g. chemicals sent by mistake to a landfill site for domestic waste could harm workers at the site as well as children who might play there and people who live near the site)

2) We separate waste into separate "waste streams" at the point of generation. Each waste stream is stored separately and goes through a separate route to separate points of ultimate disposal.

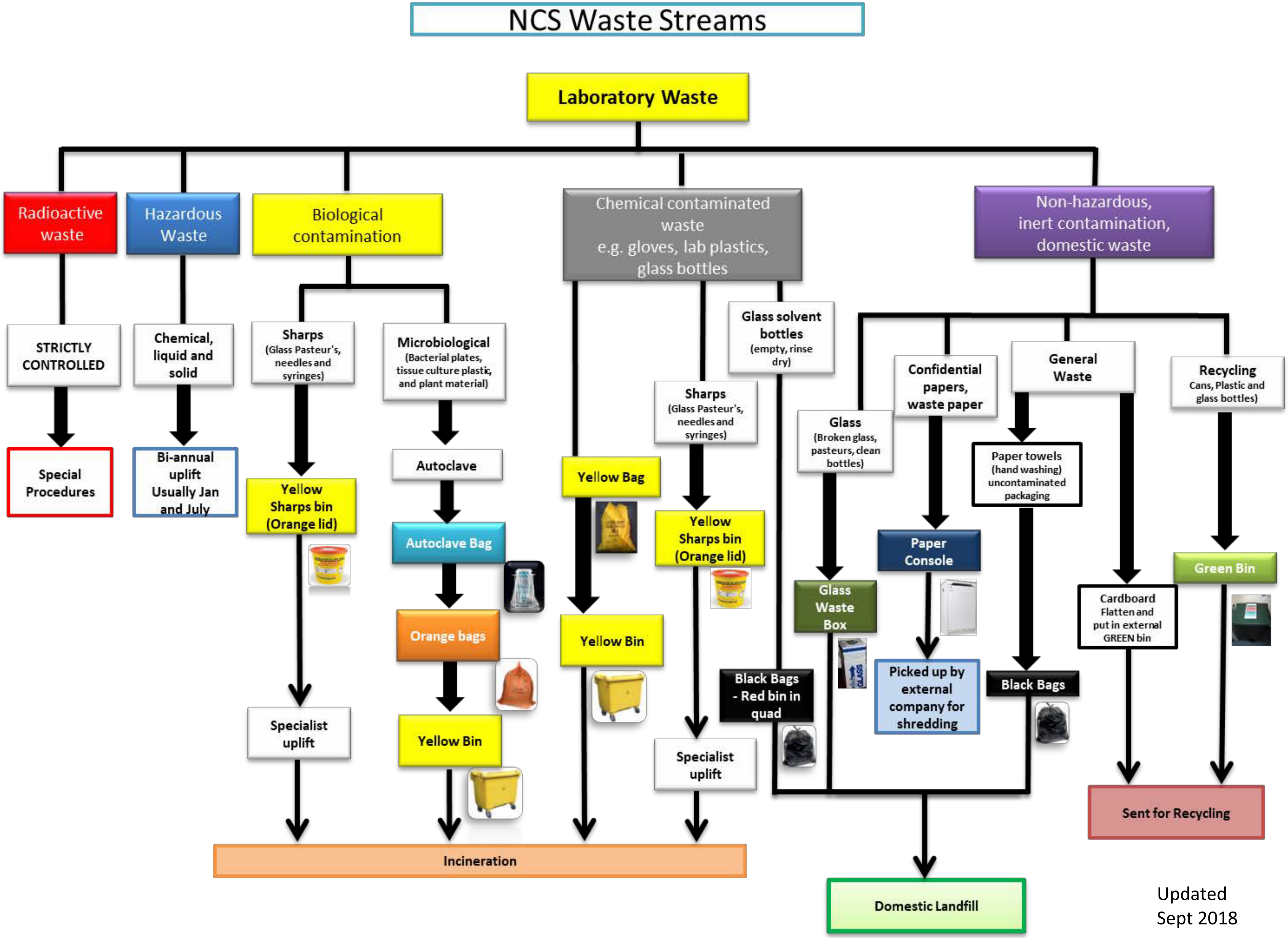
3) The safe disposal of any kind of waste is only possible when the nature of the waste is known. All materials must be kept in labelled containers at all times.

4) It is essential that research students and other personnel arrange for the disposal of all chemicals in their charge before they leave the Department. Supervisors must accept responsibility for this.

5) Never allow waste to accumulate over long periods of time.

Everyone must

- be aware of the different waste streams which go out from the School,
- ensure they know into which stream all the different types of waste which they generate must go,
- know where in the building to place waste for each of the waste streams.


NCS Waste Streams
Laboratory Waste
Radioactive waste
Hazardous Waste
Biological contamination
Chemical contaminated waste e.g. gloves, lab plastics, glass bottles
Non-hazardous, inert contamination, domestic waste
STRICTLY CONTROLLED
Chemical, liquid and solid
Sharps (Glass Pasteur's, needles and syringes)
Microbiological (Bacterial plates, tissue culture plastic, and plant material)
Glass solvent bottles (empty, rinse dry)
Sharps (Glass Pasteur's, needles and syringes)
Glass (Broken glass, pasteurs, clean bottles)
Confidential papers, waste paper
General Waste
Recycling Cans, Plastic and glass bottles)
Special Procedures
Bi-annual uplift Usually Jan and July
Yellow Sharps bin (Orange lid)
Autoclave
Autoclave Bag
Orange bags
Yellow Bin
Yellow Bag
Yellow Bin
Yellow Sharps bin (Orange lid)
Specialist uplift
Specialist uplift
Black Bags - Red bin in quad
Glass Waste Box
Paper Console
Picked up by external company for shredding
Paper towels (hand washing) uncontaminated packaging
Black Bags
Cardboard Flatten and put in external GREEN bin
Green Bin
Incineration
Domestic Landfill
Sent for Recycling
Updated Sept 2018

Appendices

Appendix 1: Partial list of incompatible chemicals (reactive hazards)

Substances in the left-hand column should be stored and handled so they cannot possibly accidentally contact corresponding substances in the right-hand column under uncontrolled conditions, when violent reactions may occur. Note that many metals which are thought of as inert are very reactive when finely divided, e.g. Ni and Mo.

Note that this list is not meant to be comprehensive but should only be used as a guide.

Alkali and alkaline earth metals together with magnesium powdered aluminium	Carbon dioxide, carbon tetrachloride and other chlorinated hydrocarbons, and water
Acetic acid	Chromic acid, nitric acid, ethylene, glycol perchloric acid, peroxides and permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures, Chloroform + bases
Acetylene	Chlorine, bromine, fluorine, copper, silver and mercury
Ammonia (anhyd.)	Mercury, chlorine, calcium hypo chlorite, iodine, bromine and hydrogen fluoride
Ammonium nitrate	Acetic acid, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organics or combustibles
Aniline	Nitric acid, hydrogen peroxide
Azides	Acids
Bromine	Ammonia, acetylene, butadiene, butane and other petroleum gases, sodium carbide, turpentine, benzene, and finely divided metals
Calcium oxide	Water
Carbon activated	Calcium hypochlorite
Copper	Acetylene, hydrogen peroxide
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organics or combustibles

Chromic acid and chromium trioxide	Acetic acid, naphthalene, glycerol, turpentine, alcohol and other flammable liquids
Chlorine	Ammonia, acetylene, butadiene, butane and other petroleum gases, hydrogen, sodium carbide, turpentine, benzene and finely divided metals
Chlorine dioxide	Ammonia, methane, phosphine and hydrogen sulphide
Fluorine	Isolate from everything
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidant
Hydrocyanic acid	Nitric acid, alkalis
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane
Hydrofluoric acid, anhydrous; Hydrogen fluoride	Ammonia, aqueous or anhydrous
Hydrogen sulphide	Fuming nitric acid, oxidizing gases
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, peroxides, nitric acid
Iodine	Acetylene, ammonia (anhydrous or aqueous)
Mercury	Acetylene, fulminic acid*, ammonia
Nitric acid (conc.)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, and nitratable substances
Nitroparaffins (nitroalkanes)	Inorganic bases
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Oxalic acid	Silver, mercury
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils and many other organic materials

Peroxides, organic	Acids (organic and mineral), many organic substances
Phosphorus (white)	Air, oxygen, chlorates
Potassium chlorate	Acids (see also chlorates)
Potassium perchlorate	Acids (see also perchloric acid)
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Silver	Acetylene, oxalic acid, tartaric acid, fulminic acid*, ammonium compounds
Sodium	See alkali metals
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulphide, glycerol, ethylene glycol, ethyl acetate, methyl acetate and furfural
Sulfuric acid	Chlorates, perchlorates, permanganates

*produced in nitric acid-ethanol mixtures.

Appendix 2: Partial list of incompatible chemicals (toxic hazards)

Substances in the left-hand column should be stored and handled so that they cannot possibly accidentally contact corresponding substances in the centre column, because toxic materials (right-hand column) would be produced.

Note that this list is not meant to be comprehensive but should only be used as a guide.

Antimony	Reducing agents	Stibine
Arsenical materials	Any reducing agent*	Arsine
Azides	Acids	Hydrazoic acid
Cyanides	Acids	Hydrogen cyanide
Hypochlorites	Acids	Chlorine or hypochlorous acid
Nitric acid	Copper, brass any heavy metals	Nitrogen dioxide (nitrous fumes)
Nitrites	Acids	Nitrous fumes
Nitrates	Sulfuric acid	Nitrogen dioxide
Phosphorus	Caustic alkalis or reducing agents	Phosphine
Selenides	Reducing agents	Hydrogen selenide
Sulphides	Acids	Hydrogen sulphide
Tellurides	Reducing agents	Hydrogen telluride

***Arsine has been produced by putting an arsenical alloy into a wet galvanised bucket.**

Appendix 3: Flash points of common laboratory solvents and other liquids

(All are "closed cup" values in °C and are taken from "Hazards in the Chemical Laboratory")

Flash point less than 23 °C	
Acetaldehyde	−40
Acetone	−17
Acetonitrile	5
Benzene	−11
Butan-2-one	−3
Carbon disulphide	−30
Chloromethane	below 0
Crotonaldehyde	8
Cyclohexane	−18
Cyclohexene	−12
1,2-Dichloroethylene	6
Diethylamine	−28
Diethyl ether	−40
Dioxane	12 - 15
Ethanol	12
Ethyl acetate	−3
Ethyl formate	−19
Heptane	−1
Methanol	9.7
Methyl acetate	−9
Methyl formate	−26

Flash point less than 23 °C	
Methyl methacrylate	10
Pentane	−49
Pentan-2-one	7
Piperidine	4
Propan-2-ol	11
Propyl acetate	14
Pyridine	20
Tetrahydrofuran	−17
Toluene	4

Flash point between 23 and 35 °C	
Chloroacetone	27
Dibutyl ether	25
Butan-1-ol	24 - 29
Butan-2-ol	24 - 29
Chlorobenzene	23
Propan-1-ol	25
o-Xylene	32
m- and *p*-Xylenes	25

Appendix 4: Common peroxide forming chemicals

1) Severe peroxide hazard on storage with exposure to air

Test within 3 months of opening

Diisopropyl ether (isopropyl ether)
Divinylacetylene (DVA)
Potassium amide
Potassium metal
Sodium Amide
Vinylidene chloride (1,1 dichloroethylene

2) Test for presence of peroxides before distillation or evaporation

Discard or test for peroxides 6 months after opening

Acetaldehyde diethyl acetal (acetal)	Ethylene glycol dimethyl ether acetates
Cumene (isopropyl benzene)	Ethylene glycol ether acetates
Cyclohexene	Furan
Cyclopentane	Methylacetylene
Decalin (decahydronaphthalene)	Methylcyclopentane
Diacetylene (butadiene)	Methyl isobutyl ketone
Dicyclopentadiene	bis-2-methoxy ethyl ether
1,2-dimethoxy ethane	Tetrahydrofuran (THF)
Diethyl ether	Tetralin (tetrahydronaphthalene)
Dioxane	Vinyl ethers
Ether anhydrous	

3) Hazard of rapid polymerisation initiated by internally formed peroxides

Normal liquids – Discard or test for peroxides 6 months after opening

Chloroprene (2-chloro-1,3-butadiene)
Styrene
Vinyl Acetate
Vinylpyridine

Normal gases – Test for peroxides or discard 12 months after opening

Butadiene
Tetrafluoroethylene (TFE)
Vinylacetylene (MVA)
Vinyl chloride

Appendix 5: Safety inspection report form Department of Chemistry

Room: Date:

Lab supervisor: Inspected by:

specific issues	OK*	not OK	specific comments (please fill out if ticked not OK)**
outside labelling (e.g. lab supervisor, out-of-hours running permits)			
housekeeping			
storage of chemicals			
labelling of chemicals			
safety-relevant documentation (e.g. SOPs)			
compressed gas cylinders			
safety awareness of researchers in the lab			
safety-relevant equipment (e.g. PPE, fire extinguishers, spill kits)			
PAT labels/PAT testing			
electrical safety (cables, extension cords etc)			
any other issues			

* insert **n/a** if not applicable, **nt** if not tested

** please use back of this page or additional paper if not sufficient space

Appendix 6: Laboratory waste management

1) Introduction

Different activities in the University generate different types of waste. Some of the waste is hazardous in nature and requires special arrangement for storage, handling and transportation. All waste should be separated and packed in such a way that it does not harm anyone likely to handle it. This includes:

- Those who handle it between the point where it is generated in the laboratory and the point of storage for collection at the University (e.g. cleaners, porters, laboratory personnel);
- Those who may come into contact with the waste when they handle and transport (waste disposal contractors) the waste from the University; and
- Those at the site of ultimate disposal

Waste should be separated into "waste streams" at the point of generation in line with the guidance and standards of the University (see p. 60). Each waste stream should be stored appropriately.

The safe disposal of any kind of waste is only possible when the nature of the waste is known. All materials must be kept in labelled containers at all times. Waste should not be allowed to accumulate over long periods of time.

It is essential that supervisors ensure that research students and other personnel arrange for the disposal of all chemicals in their charge before they leave the School.

The waste streams expected from the University laboratories and the segregation and the route of disposal of the waste is as follows:

2) Solid waste

Chemical contaminated waste, e.g. gloves, lab plastics, paper towels used to clean up small chemical spills

- The waste **must not be disposed of in black bags**, but goes into **yellow** bags in yellow bins or hoops.
- The **yellow** bags are transferred by lab staff into the **yellow** storage bins in the cage in the Meston Quad. The key is held in Chemistry Stores.
- The disposal of the bags is arranged through the Estates Department
- Bags are uplifted for disposal by a specialist company for incineration.

Biohazardous waste, e.g. bacterial plates, tissue culture, plastic, plant material

- The waste **must not be disposed of** in black bags, but is inactivated by either chemical (e.g. appropriate detergents) or physical means (e.g. autoclaving)
- Inactivated waste goes into **orange** bags.
- The **orange** bags are transferred by lab staff into the **yellow** storage bins in the cage in the Meston Quad. The key is held in Chemistry Stores.
- The disposal of the bags is arranged through the Estates Department.

- Bags are uplifted for disposal by a specialist company for incineration.

Glass pipettes, sharps and biohazard contaminated sharps, e.g. needles, syringes, scalpel blades

- The waste **must not be disposed of** in black bags, autoclave bags, yellow or orange bags, but goes into special cardboard boxes and sharps bins (also known as "cin bins", yellow with red lid).
- When bin is full, close it (it seals shut, and can't be reopened) and take it to the Chemistry Stores.
- The disposal is arranged through the Estates Department
- Sharps bins are uplifted for disposal by a specialist company for incineration
- Re-sheathing of needles must be avoided where possible.

Asbestos

It is not expected that Laboratories will generate asbestos waste or waste containing asbestos or contaminated with asbestos. All asbestos waste is handled through Estates Health and Safety Manager and can only be uplifted by specialist companies. Labs should contact their Technical Resources Officer in first instance.

Radioactive waste (strictly controlled)

- The waste **must not be disposed of** in black bags, autoclave bags, yellow or orange bags, but is kept in allocated radiation-controlled area and disposal arranged through the Radiation Protection Supervisor (RPS). Radioactive waste requires special procedures; advice is provided to the University by NHS Grampian Radiation Protection Service. In first instance contact Local RPS and seek advice from the University Radiation Protection Adviser.

University radiation protection adviser:	Dr Stephen McCallum, s.mccallum@abdn.ac.uk
Geosciences local radiation supervisor:	Dr Steve Bowden, s.a.bowden@abdn.ac.uk
Chemistry local radiation supervisor:	Prof Abbie McLaughlin, a.c.mclaughlin@abdn.ac.uk

Uncontaminated broken glass

- Uncontaminated broken glass **must not be disposed of** in black bags, autoclave bags, yellow or orange bags, but is placed in puncture-proof containers (e.g. cardboard box, available from Stores). Full containers are sealed and labelled as broken glass and are disposed of in main bins by the laboratory staff.
- Contaminated broken glass, where safe to do so, should be rinsed and then placed in cardboard boxes.
- **Note:** Larger unbroken glass containers, most notably empty solvent bottles, should be rinsed, placed inside a black bag and then disposed of through the red storage bins in the Meston Quad.

Electrical equipment (WEEE) and metal

- Electrical equipment for disposal (WEEE) is disposed of monthly. All equipment must be certified as decontaminated, all hazard labels removed, and labels detached.
- Metal **must not be disposed of** in black bags, autoclave bags, yellow or orange bags, contact the Technical Resources Officer for advice.
- Disposal of computers and peripherals is arranged through IT services, servicedesk@abdn.ac.uk.

General non-hazardous, inert contamination, domestic waste, e.g. paper towels used for drying hands

- Waste goes into **black** bags.
- **Cleaners** remove the **black** bags from the laboratories.
- Black bags with domestic waste stream to landfill.

3) Liquid waste

- Solvent waste should be kept in clearly labelled bottles. Two types exist, i.e. **organic solvent waste** (for **non-halogenated solvents**), and **halogenated solvent waste**. Mixtures of both – but see below! – must be disposed of as **halogenated solvent waste**.
- Each solvent in the waste must be listed. Note that **no abbreviations** (e.g. MeOH, DCM) must be used, but **full names** (e.g. methanol, dichloromethane) must be used instead. This is a condition of the University's contract with the contractor which collects and disposes of this waste. When full, these should be taken immediately to the **Waste Solvent Store** outside the Meston building. **Waste solvent bottles must not be left tightly stoppered, a vented cap** (provided by Stores) **must be used instead**.
- The containers are inspected by chemistry stores. Obtain the key from Stores and sign form, then place waste container in the waste solvent store outside the Meston building.
- **Important note:** Never mix chlorinated (e.g. chloroform, trichloroethylene) and non-chlorinated waste (e.g. acetone, diethyl ether) liquids for disposal. This is a condition of the University's contract with the contractor which collects and disposes of this waste.
- Persons drying solvents with sodium wire have the responsibility of (a) attaching warning labels to bottles containing such solvents and (b) disposing of the sodium wire as follows: Sodium wire can be safely quenched by first adding to the bottle sufficient propan-2-ol to cover the wire. Leave in a fume cupboard until no more evolution of gas is visible. Slowly add small portions of methylated spirits until all the sodium has completely dissolved.

4) Other types of waste and general guidelines

- For practical reasons, this list can never meant to be exhaustive. It is in the responsibility of each individual to appropriately deal with and safely dispose of any waste not covered by the categories listed above.
- Larger unbroken glass containers, most notably empty solvent bottles, should be rinsed, placed inside a black bag and then disposed of through the red bins in the Meston Quad.
- Some chemicals can be safely disposed of down drains using copious amounts of water, but note this is only acceptable if explicitly stated in the MSDS. If in doubt, contact the

Transport and Waste Manager.

- Before purchasing chemicals consider how it will be disposed of.
- Significant quantities of unwanted chemicals should not be allowed to accumulate.
- If you have unwanted chemicals that cannot be discharged to the drains, contact the Department Safety Adviser, the Technical Resources Officer or the Transport & Waste Manager (Chris Osbeck). Where possible, dangerous wastes should be rendered innocuous by suitable chemical treatment.

5) Recycling

Confidential waste and waste paper

The waste goes into the waste paper consoles.

Consoles are emptied weekly, if there is a large amount of paper waste, e.g. from an office clear out, then use white bags instead, available from the Environment Office - environment@abdn.ac.uk, or the Technical Resources Officer.

Cans, Plastic and glass bottles

The waste goes into green bins available in various locations.

Cardboard

Remove all plastic (this is deemed general waste and should be disposed of in normal bins), flatten and take to the green bin in the Meston Quad.

6) Autoclaves

These are often used to treat waste from biological laboratories. It is well established that a cycle of 121 °C for 20 minutes is sufficient to render most materials sterile. It is important however to ensure that all parts of the load are raised to the required temperature for the required time. The timing of the cycle should commence only when all parts of the load have achieved the required temperature. It can take a considerable time for the centre of some loads to achieve the same temperature as the outside of the load.

Internal temperature probes

If the autoclave has an internal "wandering" temperature probe which can be placed in the centre of the load you can programme the autoclave to time the cycle from the moment the probe indicates that the centre of the load is at the required temperature. If possible, the load probe should be connected to a chart recorder so that a record of each cycle can be created and retained. You should check that the internal probe is reading the correct temperature by comparing the readings with those of independent calibrated thermocouples placed alongside the internal probe during the annual testing and service of the autoclave.

Alternative methods

If the autoclave does not have an internal temperature probe that can be placed inside the load there should be an alternative means of ensuring that waste is subjected to the required temperature for the required time. At annual service, thermocouples should be placed inside a worst-case load and the time taken for all parts of the load to reach the required temperature recorded. (This service is provided by external contractors). **In addition, the first load of waste each week should have an autoclave indicator strip placed in the centre of the load.**

Records should be kept. The strip will change colour if the strip (and therefore the load) is subjected to the required temperature for the required time. Indicator strips are inexpensive and can be obtained for various temperatures and exposure periods. It is important to select the correct type of strip.

Additional information

Autoclave tape indicates only that the required temperature was reached, not that it was held for the required time. Autoclave tape does not therefore demonstrate that the load was subjected to the required conditions. Tape can be useful however to identify material which has been placed in the autoclave and differentiate it from material which is waiting to be autoclaved.

Any questions can be directed to the Local Safety Coordinators:

- Chemistry: **Dr Rainer Ebel**
- Computing Science, Mathematics, Physics and Geosciences: **TBC**
- Engineering: **Grant Cordiner**

Appendix 7: Access to laboratories

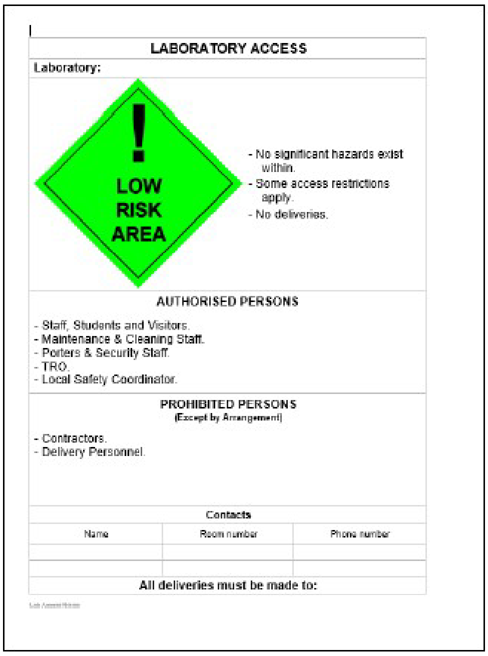
Access to laboratories should be controlled based on risk assessment of the laboratory and the work carried out. The risk assessment should lead to the classification of the area into either low, medium or high-risk category. The risk category will determine who has authorised access to the laboratory and who does not.

The following is provided as a standard to follow:

Risk Category	Authorised	Not Authorised (except by arrangement)
Low – No significant hazards 	• Staff, students • Maintenance and cleaning staff • Porters and security staff • Technical Resource staff • Local safety coordinator	• Contractors • Delivery personnel • Visitors
Medium – Possible significant hazards 	• Staff and Students explicitly authorised by a responsible person. • Cleaning Staff authorised for specific tasks. • Technical resource staff. • Local Safety Coordinator.	• Maintenance staff. • Porters and security staff. • Contractors. • Delivery personnel. • Visitors.
High – Significant hazards exist 	• Staff and Students explicitly authorised by a responsible person. • Technical resource staff. • Local safety coordinator	• Maintenance and cleaning Staff. • Porters and security staff. • Contractors. • Delivery personnel. • Visitors.

Those authorised or given access to the laboratories should be briefed on hazards and risks and controls in place including the use of Personal Protective Equipment (PPE).

Along with other hazard warning signs, the following template signs for the categories should be affixed to the laboratory access doors to control access:



LABORATORY ACCESS

Laboratory:

LOW RISK AREA

- No significant hazards exist within.
- Some access restrictions apply.
- No deliveries.

AUTHORISED PERSONS

- Staff, Students and Visitors.
- Maintenance & Cleaning Staff.
- Porters & Security Staff.
- TRO.
- Local Safety Coordinator.

PROHIBITED PERSONS
(Except by Arrangement)

- Contractors.
- Delivery Personnel.

Contacts

Name	Room number	Phone number

All deliveries must be made to:

LABORATORY ACCESS

Laboratory:

MEDIUM RISK AREA

- Potentially significant hazards may exist.
- Access restricted to authorised persons only.
- All authorised persons must have a safety induction.
- All visitors and contractors must be accompanied by an authorised person at all times.
- No deliveries.

AUTHORISED PERSONS

- Staff and Students explicitly authorised by a responsible person.
- Cleaning Staff.
- TRO.
- Local Safety Coordinator.

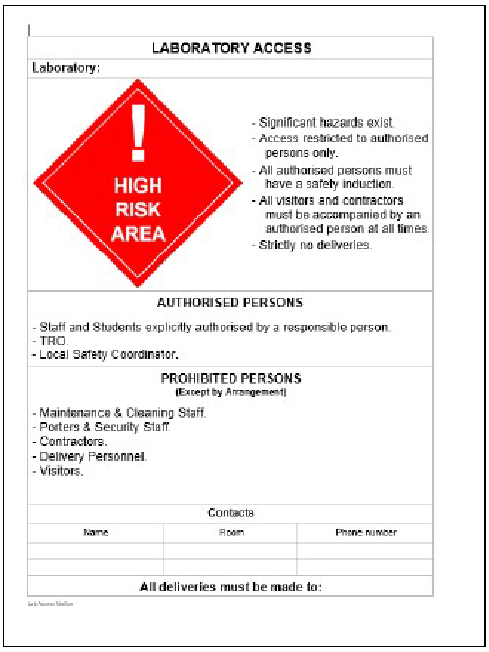
PROHIBITED PERSONS
(Except by Arrangement)

- Maintenance Staff.
- Porters & Security Staff.
- Contractors.
- Delivery Personnel.
- Visitors.

Contacts

Name	Room number	Phone number

All deliveries must be made to:



LABORATORY ACCESS

Laboratory:

HIGH RISK AREA

- Significant hazards exist.
- Access restricted to authorised persons only.
- All authorised persons must have a safety induction.
- All visitors and contractors must be accompanied by an authorised person at all times.
- Strictly no deliveries.

AUTHORISED PERSONS

- Staff and Students explicitly authorised by a responsible person.
- TRO.
- Local Safety Coordinator.

PROHIBITED PERSONS
(Except by Arrangement)

- Maintenance & Cleaning Staff.
- Porters & Security Staff.
- Contractors.
- Delivery Personnel.
- Visitors.

Contacts

Name	Room	Phone number

All deliveries must be made to:

Appendix 8: Guidance for the cleaning of laboratories

The cleaning and maintenance of laboratories is an essential part of running of the laboratories. The Estates staff provide the basic cleaning service and maintenance service. Cleaning activities entail cleaning of hand wash basins, mopping of floors and removal of black bag waste. There is a range and complexity of hazards and potential risks which require careful consideration and an informed risk assessment by the laboratory managers. The University expects there to be a collaborative approach between Schools and Estates to ensure that no one comes to any harm when carrying out maintenance or cleaning or removal of wastes. That includes sharing of information on potential risks and ensuring that information is conveyed to the staff performing the cleaning and waste removal duties.

Guidance for Laboratory Managers and Laboratory Supervisors

The cleaners will clean laboratory floors, hand wash basins and replenish soap and paper dispensers. Any other cleaning required, for example cleaning of the laboratory sinks must be agreed with the cleaning supervisor or their manager. The cleaners must be informed as to the basic precautions to follow while in the lab environment. Specific arrangements will be required for the cleaning of the biological containment laboratories and laboratories where radioactive materials are handled.

Laboratory managers should ensure that areas are safe for cleaners to gain access and safe for them to carry out their work. The cleaning staff work at a time when laboratory staff have left or are not there at the end of a normal working day. The communication should be such that the cleaning staff are not put in a position to make decisions for themselves as to whether an area or a laboratory is safe to clean or not, therefore adequate and agreed signs and notices should be used to inform the cleaners on whether an area is safe for them to enter and do their job.

The laboratory workers should also be instructed and trained to check, each day, before they finish work that no hazardous items have been left in areas where there is the potential for cleaners to come into contact with them and put their health or safety at risk. In particular:

- Where cleaners are expected to clean laboratory sinks, both the draining board area and the sink should be free of any glass ware and other items.
- Chemicals should never be stored on the floors but always stored in the suitable chemical store cupboards, of construction appropriate to the hazard(s). Hazardous liquids should be stored on drip trays. Equally, vacuum pumps should be placed on drip trays to avoid oil leaking on the floor. Flasks containing biological agents should be placed in some type of secondary containment to prevent them from being knocked or damaged during the cleaning and routine laboratory work.
- Small amounts of chemicals that may be within the open laboratory should be securely closed and labelled with the name of the chemical and a hazard warning label where appropriate on the container. Such chemical containers should be placed to the rear of the bench each evening.
- Where experiments are left running overnight, risk assessment should determine whether cleaners should be excluded from the laboratory by locking the access door and placing a warning sign outside the laboratory. An exception to this rule may be, subject to risk assessment, if the experiment is wholly confined within a fume cupboard with the sash fully closed.

- All experiments left running overnight must be clearly marked informing of action to be taken and the person to be contacted in the event of an accident involving the equipment.
- Cleaners should not clean laboratory benches. Where deep cleaning is carried out of benches by internal staff or by contractors, a specific risk assessment should be prepared to devise appropriate control measures.
- All pressurised gas cylinders must be securely fastened, in an upright position, using purpose made clamps, brackets and chains/belts.
- Hazard warning signs should be fixed to containers, cupboards and apparatus containing hazardous chemicals.
- Hazard warning signs and instructions for specific immediate hazard to anyone entering the laboratory or room should be fixed to the door in circumstances such as the presence of strong magnetic field that could be of risk to someone with a pacemaker or where there are regulatory requirements such as in the case of biological or radiation hazards.
- Access to laboratories should be controlled using a traffic light system as detailed in Appendix 7.