

Department of Materials

Laboratory Safety Manual

October 2018

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Departmental Information

		<i>Telephone</i>
Acting Departmental Safety Officer:	Paul Bagot	73711
Deputy Departmental Safety Officer:	Paul Bagot	73711
Departmental Fire Officer:	Les Chorley	73681 Mobile 07799438942
Senior Radiation Protection Supervisor:	Chris Grovenor	73737 Home (01865) 27041
Departmental Laser Supervisor:	Clara Barker	73793
Chemical Safety & Hazardous Waste:	Christina Foldbjerg Holdway	73721
Qualified First Aiders:	Holder - Diana Passmore (coordinator)	73658/83205
	Holder - Graham Wyatt	83229
	12/13 PR - Kyriakos Porfyraakis	73724
	Hume-Rothery - Jayne Shaw	73710
	Hume-Rothery - Kiri Holmes	73706
	21 BR - Francis Dunleavey	83222
	21 BR - Christina Foldbjerg Holdway	73721
	Rex Rich. - Nadia Abdul-Karim	83996
	Rex Rich.- Kate Sidwick	73752
	Rex Rich. - Zsofia Lazar	12761
	Begbroke - Kerstin Jurkschat	83746
	Begbroke - Nicola Flanagan	83752
Accident Report Book Location:	Main Site: Hume-Rothery Reception Begbroke: Christian Building Reception	

Useful Telephone Numbers

Emergency Services Dial 999 or 112 from any telephone
 Accident Service, John Radcliffe Hospital (9) 220208 or 741166
 Eye Casualty, John Radcliffe Hospital (9) 234800
 Area Safety Officer (Linda Curson) 83331
 University Radiation Protection Office 70802
 University Safety Office 70810
 Thames Valley Police - Oxford (9) 0845 8505505
 Thames Water (9) 0845 920 0800 (24 hour)

Introduction

A research laboratory is a potentially dangerous environment, where without care and attention accidents can occur, many with serious consequences and most are avoidable. Rules therefore must be followed when working in the lab. **The actions required from you are straightforward and are in your interest**, however the consequences of not following protocols and thoughtless behaviour mean that you put yourself and colleagues in danger. **You therefore have a moral and legal responsibility for your safety and the safety of others.** You are required to declare acceptance of the Safety Code of Conduct, as set out on page 19 of this document. If you do not comply you may be banned from lab work, as stated in the Departmental Safety Policy (page 15).

Laboratory Standards

Laboratory Supervisor's safety responsibility

- 1 The routine administration of the departmental rules governing laboratories is the responsibility of each Laboratory Supervisor. Laboratory risk assessments and COSHH assessments must be made and displayed (see Departmental Safety Policy page 10).
- 2 The Laboratory Supervisor must ensure that his laboratories are properly organised and operated; that proper instructions and training is given in the use of specialist equipment and that staff, students and visitors conduct themselves in a safe and sensible manner when using the facilities.
- 3 The Laboratory Supervisor must ensure that the Department's Laboratory Safety Policy (page 15 in the Departmental Safety Policy), the Hazardous Waste Policy (page 14 and appendices B and C) in Departmental Safety Policy), the University Policy Statements on laboratory safety and the Standards and Code of Conduct set in the Laboratory Safety Manual are properly applied and understood by everyone using laboratories under their control. In particular, where there is a risk of exposure to hazardous chemicals, laboratory safety rules must be posted in accordance with University Policy Statement S3/01.

Individual's safety responsibility

- 4 Anyone using a laboratory must first obtain the Laboratory Supervisor's permission; ask for and obtain suitable training in the use of specialist equipment; use only those items of equipment on which they have been trained and obey all safety instructions.
- 5 Before starting any proposed work, researchers must discuss the safety implications with their supervisor, group head or laboratory supervisor, as appropriate. Together they should complete a risk assessment form (page 10) and a signed copy should be forwarded to the DSO. Researchers should also be shown a copy of the appropriate laboratory risk assessments. If the work will involve the use of hazardous materials of any kind a COSHH assessment must also be made (see page 13).
- 6 If in the course of laboratory work researchers change procedures or identify an unexpected hazard they should warn their supervisor and complete a new risk assessment and COSHH forms as appropriate. If anyone is in any doubt about the safety of any procedure, he or she should seek expert advice from his/her supervisor or the DSO who will initiate contacts with professional safety staff.
- 7 All laboratory users making an October start must attend the lecture on laboratory safety which is usually held on the first Tuesday of Michaelmas Term. Part II students will receive safety instruction on their induction day in mid-September. Safety lectures are repeated in Hilary and Trinity terms. Those who arrive at other times in the year should contact the DSO for instructions and normally attend the next scheduled safety lecture.
- 8 A record shall be kept at each Fume Cupboard or Fume Hood of the chemicals used in it. Users must check this list and add the names of new chemicals when brought into use.
- 9 Researchers are encouraged to attend a course of first aid training, which will be arranged by the Department.
- 10 Additional individual responsibility are set out in the Department Safety Policy, appendix A. You must adhere to these, as you have a duty of care in relation to yourselves and others who may be affected by your actions.

General lab safety

Basic information

- Before starting an experiment, make sure you are familiar with all the known hazards of the starting materials and expected products and with necessary exposure controls. Appropriate safeguards and remedies should be planned in advance.
- If anything unexpected occurs during your experiment, or if you are in any doubt, consult your supervisor immediately.

Housekeeping

Untidiness leads to unsafe working conditions and inefficient working (for example, wasted time and money from looking for haphazardly placed items, and ordering duplicates because you **can't find them amongst the mess**). **Whereas good housekeeping will create clean, tidy and organised labs that are safe, pleasant and efficient to work in.**

- The work bench must always be kept clean and tidy. This means clearing up as you go along, at the end of an experiment and at end of day. Put everything back in its place.
- Storage cupboards and shelves must be kept orderly and free from spillage.
- Hazardous wastes must be disposed regularly through the University Safety Office
- The laboratory floor should be free of obstruction. Reagent bottles and apparatus left on the floor can cause accidents.
- Any incidental spillage of chemicals on the bench or floor must be cleaned up immediately using the spillage kit provided in each laboratory and disposed of safely.
- Wear hand protection to pick up/sweep broken glass and dispose in correct designated bin (consult waste disposal guide for correct glass bins to use)

Laboratory safety rules

Every laboratory work space, including workshops, must have local laboratory rules clearly defined to protect those who may be exposed to the hazards within that work space. It is the responsibility of Laboratory Supervisors to set and enforce adherence to these rules, and to enforce compliance with all departmental rules as set out in the Safety Code of Conduct. Examples of areas to consider when devising local laboratory rules are provided in Lab Management Guideline, found page 8 in this document.

All laboratory users must comply with the defined local laboratory rules, and abide to departmental rules as set out in the Safety Code of Conduct.

Use of Personal Protective Equipment

- Laboratory overalls protect you and your clothing from contamination by chemicals. Wear them properly fastened.
- You must wear suitable eye protection when handling chemicals, or in the vicinity of chemicals being used.
- Emergency eye wash facilities are available in all laboratories - know where they are and how to use them.
- Wear protective gloves to handle hazardous chemicals. There are various types of protective gloves: be familiar with the best type suited to each particular job.
- Remove contaminated gloves to handle cupboard doors, water taps, etc.

- Inhalation of chemicals should be avoided either by handling technique or the use of air extraction (e.g. a fume cupboard). Appropriate respiratory protection should be used as back-up protection or where no other means of avoiding inhalation is practicable.
- Rubber or PVC protective aprons should be worn when large quantities of corrosive or dangerous chemicals are being handled.

Unattended operations

- Never leave a laboratory experiment unattended without consulting your supervisor, and leaving a reaction card with brief details of the hazards, what to do in emergencies, your name and contact telephone.
- In considering whether an experiment should be left overnight, you should take into account the nature of the materials involved, the scale of the experiment, previous experience with the experiment type, and the level of supervision that is available, and **use equipment that have fail safe designs**. You must also undertake a risk assessment and get your supervisor's permission.
- If experiments must be left unattended, place an 'unattended work' notice next to the experimental set up, indicating the chemicals involved, major hazards, your name and telephone number where you may be reached in case of an emergency.

Apparatus

- Use a cloth for protection when inserting glass tubing, rods or thermometers into rubber tubing or threaded adaptors; use a lubricant where necessary.
- Damaged, cracked or badly etched glassware should not be used - inspect it before use.
- Great care should be taken in the disposal of broken glass, pipettes, syringe needles, scalpel blades, etc. All such hazardous waste should be put in a designated 'sharps bin'.
- Always carry out chemical reactions and distillations in fume cupboards when there is any possibility of a hazard.
- Operations such as grinding solids, sieving powders or using chemical aerosol sprays should be carried out in fume cupboards where there are risks of significant exposure.
- Compressed gas cylinders should always be supported with a chain to prevent their falling and placed in a safe location (i.e. do not place flammable gas near hot plates).
- Never tamper with compressed gas cylinders in any way.
- Never connect a gas cylinder directly to a reaction vessel; always interpose a surge vessel and a system of traps.
- Always turn off a gas cylinder at the main valve after use and release any excess pressure in the regulator.
- Always move large gas cylinders on an approved cylinder trolley. Never manhandle a cylinder into position by the valve.
- Always use compressed air at the minimum workable pressure – regulators should be restricted to 2 bar. A risk assessment must be completed.
- Cryogenic liquids (e.g. liquid nitrogen) present special hazards, and their use require risk assessments incorporating the following precautions:
 - 1) Before using them you must have received training in the recommended handling precautions or be under the direct supervision of an experienced person.
 - 2) To decant liquid nitrogen from the large dewar, you must obtain training from Mr Graham Wyatt (if at Oxford main site) and Mr Greg Cook (if at Begbroke site).
 - 3) Always wear appropriate protective clothing.

4) Prolonged inhalation of cold vapour or gas should be avoided. The possibility of oxygen deficiency must be considered with the risk assessment.

5) Never transport them in a passenger lift because of the risk of asphyxia.

Oxidation experiments and other reactions involving explosion risks

- Operatives should know the flammable limits of gaseous mixtures and, if possible, should aim to work well outside the flammable or explosive range. A COSHH assessment must be completed for these types of experiment.

Fire prevention

- Be aware of the Department's Fire Orders – see the Departmental Safety Policy.
- Never place hot plates or other heating devices against walls or close to bench partitions.
- Gas burners should be isolated from the bench by heat-resistant material.
- Inspect gas tubing regularly and reject any that shows hardening or cracking.
- Use open flames only after carefully considering adjacent apparatus and experiments.
- A hot-air gun can often be used as a convenient way of heating small experiments; but remember it can also be a source of ignition of flammable liquids and vapours.
- Flammable liquids should be stored in the safety cabinets supplied. Ensure that limits specified for laboratories and storerooms are not exceeded.
- Turn off all heating devices when they are not being used. Remember that an aerated bunsen burner is often invisible in daylight.

Working hours

<p>The department's normal working hours are 08:00 – 17:00 Monday to Friday. Safety support (first aiders for example) are not available outside these hours.</p>

- The supervisor has the responsibility for ensuring that research workers within their groups are aware of and conform to the Department Policy on lone working. (see page 28 of Dept. Safety Policy)
- No researcher worker is permitted to perform experimental work alone in any laboratory outside normal working hours without suitable and sufficient risk assessment and the risks involved must be suitably low and controlled.
- The assessment must be authorised by the supervisor before work commences.

If significant risks are identified during the risk assessment process, authorisation from the relevant head of section and safety officer must be obtained before the work can precede.

Lab Management Guidelines

Laboratory Supervisor and individual responsibilities are clearly defined on page 4 in the Laboratories Standards section of this document and pages 6 and 15 in the Departmental Safety Policy. It is worth reiterating and summarising here how they translate in the everyday management of a lab.

1) Laboratory Supervisors (LSs) are responsible for ensuring safety policies are properly applied and understood by everyone using laboratories under their controls, and that their labs are properly organised and operated as stated in the Departmental Safety Policy.

This means that LS need to clearly define rules for their labs, and ensure that everyone who works within these areas is made aware and adhere to them.

These are the key areas to consider when setting lab rules:

- Housekeeping – it may be useful to issue general guidelines and designate certain tasks to key individuals or groups, or set up a rota to distribute tasks evenly.
- Define work practices, for example:
 - i) Behaviour (no running or fooling about in laboratories, tying long hair, removing jewellery and tie to prevent entanglement in moving equipment and trailing on contaminated work surfaces).
 - ii) Personal hygiene (washing hands regularly, especially before eating and visits to toilets, not applying cosmetics in a laboratory, avoid contacts between your fingers and mouth, such as biting fingernails).
 - iii) Use of personal protective equipment (this includes wearing sensible footwear that offers protection against injuries).
- Waste disposal – chemical and general waste. Designate key individuals or groups to ensure this is managed correctly and regularly.
- Communal equipment.
- Safety data and information. Maintain up to date records of chemicals stored and used in the lab, and where appropriate records of maintenance services
- Chemical safety management – this includes procurement procedure, maintenance of chemical inventory, distribution and storage.
- End of day/shut down procedures.
- Reporting failures/breakdowns in services.
- Non-compliance and disciplinary procedures.
- Training, including laboratory induction and laboratory specific safety procedures.
- It may be useful to set regular lab clean outs, and lab management meetings to ensure problems are corrected and systems improved.

2) All lab members have duty of care to ensure their own and others safety. This means that all lab members are responsible for housekeeping of the lab, waste disposal etc as listed below. Although services such as emptying bins and vacuuming floors are provided, the everyday upkeep and cleaning of the lab must be done by all lab members and is an integral part of everyday lab work.

Housekeeping – General Guidelines

When housekeeping standards fall, accidents are more likely to occur and safety performance inevitably deteriorates. The work area must be kept clean, and chemicals and equipment must be properly labelled and stored.

Housekeeping is the responsibility of all laboratory workers and principally includes:

- Returning reagents to their designated storage area after use.
- Returning items of equipment not in use to storage.
- Cleaning and putting away glassware.
- Tidying and cleaning of benches, fume cupboards and communal areas. Cleaning up should follow the completion of any operation and at the end of each day.
- It may be useful to produce a written cleaning schedule for communal areas.
- Removal of out-of-date chemicals and cleaning of bottles. The maintenance of a chemical inventory will help with stock control & regular reviews.
- Labelling of reagents in secondary containers e.g. beakers and the replacement of deteriorated labels.
- Discarding disposables into appropriate containers.
- Collection of waste in designated areas within the laboratory and the regular collection and removal of the same.
- Maintenance of means of access to and egress from the laboratory.

Appendix 5, a checklist is available that may be used to check your labs comply with safety.

Hazardous Substances Standards

Effective chemical safety management requires that care **MUST** always be taken when working with chemicals and, that **the whole life cycle of the chemical must be considered**, from the point of introducing the chemical into the lab, its storage, use and right through to disposal.

The following is a minimum set of standards that **must be complied with**

- 1 Prior to introducing a chemical to the lab, the hazards, effective risk control including use of engineering controls must be considered (for example, can a safer alternative be used, are there safe storage facilities?).
- 2 Read hazard warning labels on containers, consult safety data sheets and follow their advice.
- 3 When using hazardous substances, always complete a COSHH assessment addressing the hazards, exposure and identifying appropriate risk controls in accordance with the hierarchy of control as required by the Control of Substances Hazardous to Health regulations.
- 4 No experiment involving poison should be started without knowing what to do if something goes wrong and without having the antidotes at hand.
- 5 Scheduled poisons and substances of high toxicity must be kept in a locked cupboard or store and checked regularly.
- 6 **The quantity of hazardous chemicals acquired, kept and used must actively be minimised.** So, only buy or prepare the minimum quantities of hazardous chemicals required, and dispose of any left-over solutions immediately via the departmental waste disposal procedures.
- 7 **All chemicals**, even those temporarily stored and non-hazardous, **must be clearly and fully labelled** showing their identity and hazards, the owners' identity, date prepared or date received/opened.
- 8 Hazardous **chemicals are stored and segregated to prevent adverse reactions** that give off dangerous fumes or cause fire or explosion on accidental breakage. This includes using compatible containers, that containers are securely closed, and where appropriate has enough head space and use of vented caps to avoid over-pressurisation.
- 9 All hazardous waste must be labelled as described above, stored and segregated according to compatibility, and disposed of regularly and in accordance with Departmental policy. **Do not allow for excessive prolonged storage & accumulation of wastes.**
- 10 Keep an inventory of hazardous materials, **inspect stock regularly** to ensure that chemicals are kept in good condition (not leaking, container not damaged etc), that surplus unwanted and expired chemicals including wastes are regularly disposed.
- 11 Where appropriate, hazardous chemicals are stored in secondary containers to minimise impact of spillage.
- 12 The transportation of hazardous substances must be undertaken in a safe manner. For example, Winchester containers should be transported only in proper carriers and never by the neck alone.

Also, hazardous chemicals may not be carried in any vehicle, departmental or private, without the written approval of the DSO or ASO.

- 13 Where appropriate, especially when handling chemicals where there's risk of exposure by inhalation, **work in an adequately ventilated fume cupboard**; use safety screens. Fill log books with chemicals used in the fume cupboard.
- 14 Always wear protective clothing and Protective Personal Equipment (PPE) in accordance with local risk assessments and lab rules; and most essentially **always wear eye protection** when working in 'wet labs' (labs that use chemicals).
- 15 When working with flammable substances, keep the correct fire extinguisher nearby at all times.
- 16 Electrical switches inside refrigerators may cause sparks which could ignite flammable vapours. Therefore, flammable liquids should be placed only in special laboratory refrigerators which are internally sparkproof. On no account must food or drink be kept in laboratory refrigerators.
- 17 Use and storage of cryogenic liquids, asphyxiating and toxic gases must be risk assessed with implemented risk controls.
- 18 Chemical spill procedures are established, ensure suitable chemical spill kit are available and to clean up small incidental spills immediately.

Chemical storage

Consequences of improper storage:

- Dangerous unwanted reactions from accidental mixing of incompatibles, which can lead to injuries, fire and explosions.
- Escalation of small incidents as a result of others hazardous materials stored in the vicinity. E.g. small fires may be controlled quite easily, but would quickly intensify and become more difficult to deal with if strong oxidants in the vicinity become involved in the fire.

Always:

- Minimise or restrict the volume stored. Over ordering is unsafe & is a false economy.
- Segregate, use suitable hazardous storage cabinets and secondary containment to minimise impact of spillage.
- Safe packaging – that means using compatible and sturdy containers, keeping caps well sealed and allowing for head space to prevent explosion from over pressurisation, and of course labelling.
- After use, always return reagents to the appropriate storage cabinet.

Never:

- Do not allow for prolonged storage – some chemicals decompose into dangerous compounds on extended storage (for example diethyl ether), and prolonged storage risk old containers breaking and resulting in a major spill.
- Do not leave hazardous materials on open benches – this is unacceptable.
- Do not store hazardous substances above eye level

Segregation of incompatibles

Every effort must be taken to ensure adequate segregation wherever chemicals are stored and handled.

Guidance on segregation:

- Brief guidance for segregation of chemicals commonly found in the department:

1) Keep **acids away from alkali** (caustics, base)

2) Keep **flammable organic solvents away from chlorinated solvent**

For example, acetone (organic flammable solvent) away for dichloromethane (chlorinated)

3) Keep **oxidants away from flammables and all organic combustible materials**

Nitric acid/perchloric acid away from acetone (flammable organic liquid) and from acetic acid

Nitric acid/perchloric acid away from wood, paper

4) Keep **oxidants away from dehydrating agents**

Nitric acid/Perchloric acid away from sulfuric acid

- A matrix showing basic segregation guidance may be found in Appendix 3
- A list of incompatible chemicals may be found in Appendix 4

Safe handling of chemicals

The following are general advice when handling chemicals

- Add acids to water, and not vice versa, when diluting strong acids.
- Keep reaction well mixed to avoid pockets of overheating.
- Keep reaction mixtures as cool as possible, to minimise risks.

Completing COSHH

Completing COSHH is not just for the fulfilment of legal obligations. It is an integral part of planning your experimental work; so that you think through the whole experiment procedure from start to finish, finding out for yourself and fully appreciating the dangers. This will help you determine what you need to do to manage the risks. Consequently, **your work in the laboratory should be safer and you will be better prepared to act correctly should an accident occur.**

When is a COSHH assessment required?

A COSHH assessment should **always** be made **before the start of any work involving a hazardous substance**. Some standard procedures involve the use of a limited range of substances and well tried techniques. **If** appropriate safety features are included in the Area Risk Assessment, then no separate written COSHH assessment is required.

- (i) Copies of all COSHH must be sent to Christina Holdway and copies must be available in the laboratories where the work is undertaken.
- (ii) The availability of COSHH will be checked in the annual safety inspection. If suitable assessments have not been made, the work will be halted.

It is **ALWAYS** necessary to carry out **full detailed written assessments** for substances presenting an extreme hazard. In such cases use of the standard COSHH proforma is unlikely to be suitable, and a full experimental protocol should be written. Substances presenting an extreme hazard are defined in general terms as follows:

1. Known human carcinogens e.g. benzidine
2. Very toxic e.g. cyanides
3. Highly corrosive/irritant e.g. HF, Br, Cl
4. Explosive substances e.g. perchlorates
5. Large scale reactions, >1 mole
6. Pyrophoric substances

The list above is not intended to be fully inclusive. It would be impossible to list every substance and usage that would require a full written COSHH assessment to be completed. Each case must be considered on its own merits. **Seek advice** - If you have any doubts concerning the requirement for COSHH assessments contact Christina Holdway for further advice.

Methodology - How to make a COSHH assessment:

A step by step guide on how to complete a COSHH assessment can be found in appendix 1.

The main principles:

- 1) Consult SDS (available online from suppliers such as Sigma Aldrich) to find out as much as possible about the concerned chemicals and by-products from published sources.
- 2) **Consideration should be made of the type of hazard, quantity of substance used, quantity handled, time of exposure, frequency of exposure.**
- 3) **Every aspect of the experiment from start to finish must be considered, not just the particular chemical of concern and not just the core activity.** For example when combining substances, consider if there are any dangerous reactions or formation of unstable intermediates? For example, bis-chloromethyl ether (a powerful carcinogen at very low concentration if inhaled continuously) can be formed spontaneously from the vapours of formaldehyde and hydrochloric acid under the conditions of temperature and humidity which commonly occur in laboratories.

Hazardous Waste Disposal

Waste disposal is considered as part of COSHH – **Do not start an experiment before knowing exactly how to deal with the wastes that will be generated.** This is because waste disposal can be difficult. Without careful planning, experiments may generate problematic wastes with no acceptable disposal options.

Responsibility

The department operates a scheme for the onward disposal of waste chemicals. Remember though, that **it is your responsibility to ensure that the wastes are properly packaged in the correct containers, containers properly labelled and are safe for transport.**

Using the department's waste disposal scheme

For instructions to use this service, consult the Department Safety Policy, page 14, appendices B and C. The principles are:

- 1) Ensure that the wastes are packaged safely and fully labelled. **Any wastes presented not conforming to instructions as explained in DSP will be rejected.**
- 2) Complete a waste disposal form, fully describing the wastes. Pay attention to the instructions, as **incorrect forms will be returned to the sender.**
- 3) Email the completed form to Christina Holdway. She will schedule a time for you to bring the wastes to the chemical wastes building.

Waste management

Effective waste management must be devised to **ensure the correct and regular disposal of hazardous wastes.** This is part of the Hazardous Substances Standards that must be complied with, and include not allowing generation of unknowns. This is because **unknowns will not be accepted by Safety Office, and as a consequence become incredibly difficult and expensive to dispose.**

Principles for preventing the generation of unknowns:

- Always label chemicals and wastes.
- Use good quality labels (waste labels are available in stores); do not use pen that easily smear
- **Do not allow prolonged storage** and for the labels to deteriorate.

Less is better – reduce long term liabilities for disposal

Every effort must be made incorporate the principles of waste minimisation into experimental design. **Do not make multiple purchases thinking it'll save money.** This is false economy. It is always easier to order additional chemicals, but disposal costs can be difficult and far exceed the cost of the chemical, not to mention the cost of injury and down times as a consequence of multiple purchases that are allowed to deteriorate.

Principles for waste minimisation:

- Design experiments to generate as little waste as possible
- Buy pre-prepared aliquots wherever possible
- Use a 'first in first out' system, to prevent unnecessary expiration
- Avoid duplicate orders by checking the stock & asking your lab mates before ordering

Fume Cupboard Use

(Taken from University Policy Statement S7/01)

The performance of any fume cupboard can be severely degraded by incorrect use, in particular by anything that disturbs the laminar flow of air into the enclosure.

Any of the following could cause interference to airflow and cause fumes from within the enclosure to enter the worker's breathing zone:

- a) External draughts (caused by the user's sudden movements, by people walking quickly past the front of the fume cupboard, by opening doors situated too close to it, by air conditioning units or by other fans)
- b) The use of naked flames, hot air guns, ovens, hotplates, fans or centrifuges, all of which may cause turbulence
- c) Large items placed too close to the front opening, or too close to the back baffle - the back baffle should be kept clear of ALL obstructions (e.g. bottles, equipment, or tissues) which could obstruct the airflow.
- d) The sash should be kept closed as much as possible in order to maximise containment. In any event, during the experiment it should not be raised above 0.5 m. Before raising the sash at the end of an experiment, the fan should be allowed to run for a while to clear any fumes.
- e) Fume cupboards are working areas, so those used for experimental work should not also be used for the storage of chemicals or apparatus. Besides the effect on airflow described above, there is the possibility that a minor incident could involve these stored materials and escalate into a more serious one.
- f) No chemicals may be disposed of via the fume cupboard sinks (see Departmental policy at www.materials.ox.ac.uk/local).
- g) Spilt chemicals should not be allowed to go down the fume cupboard sink unless collection puts the user at risk. If in doubt contact the ASO, DSO or the Chemicals Safety Advisor.

Spills Procedures

First of all, **before handling chemicals**, make sure you **fully understand the actions to take in an emergency, consult SDS, COSHH & risk assessments and ensure all safety equipment and first aids are available, working and unobstructed** (eyewash/safety shower, spill kit, first aid kits).

Small, low toxicity and incidental spills:

Laboratory workers are qualified to clean up small and incidental spills. This is because lab workers are **expected to be familiar with the hazards of the chemicals they routinely** handle during an ‘average’ workday. Lab Supervisors must provide training for dealing with small/incidental spills promptly and thoroughly.

Small, low toxicity and incidental spills are those which do not pose a significant safety or health hazard to people in the immediate vicinity nor does it have the potential to become an emergency within a short time frame.

e.g. 5ml of concentrated acid inside fumehood. Although concentrated, the volume is small and being in the fumehood means low risk of inhalation.

1 – If there are injuries, isolate affected person, apply first aid as instructed in COSHH, SDS or other instructions and call first aiders. If necessary, seek medical help or call for an ambulance (999).

2 - Put on PPE before attempting to clean up spill

3 - Use absorbent pads/pillows from the pink spill kit to absorb spills and stop it from spreading. Place these also to **stop spill from entering sinks/drains**

4 - Warn others, stick DO NOT ENTER sign on door.

5 – Evaluate hazards to decide if evacuation or additional help is required.

6 – Place used absorbents and used gloves in hazardous spill bag (found in spill kit)

7 – Neutralise residuals using suitable agent if appropriate

8 – Scoop up neutralised wastes and place in hazardous spill bag

9 – Decontaminate area by washing with detergent and plenty of water and dry

10 - Double bag the hazardous spill bag, secure, label and arrange for disposal of hazardous wastes.

11 – Report incident in accident/incident book (kept in reception)

DO NOT:

- neutralise concentrated acids or alkalis

- Switch on/off electrical equipment when cleaning up flammables

Major spills:

These are spills that exceed the exposure one would expect during the normal course of work, spills that generates a lot of harmful fumes and have truly become emergency situations in that laboratory workers are overwhelmed beyond their level of training, and that their response capability is compromised by the magnitude of the incident.

e.g. Spill of a 2.5L winchester of concentrated acid, or the uncontrolled release of toxic gas in a poorly ventilated area

RESPONSE PROCEDURE

1 – Consider the immediate dangers to persons. **If there are injuries, isolate affected person, apply first aid as instructed in COSHH, SDS or other instructions and call first aiders. If necessary, seek medical help or call for an ambulance (999).**

2 – If applicable, pull the fume hood sash down

3 – If safe to do so, place absorbent pads/pillows over spills to at least contain spills & stop it from spreading.

4 – Evacuate yourself and others, and prevent others from entering (post up NO ENTRY sign)

6 – Remain nearby to provide information when help arrives

7 – Call 999

9 - Notify the Lab Manager/Supervisor, Paul Bagot (73711) and Christina Holdway (73721), or via reception (73777) who will notify these members of staff.

10 – Clean up once safe to do so, put on PPE before attempting clean up and arrange for disposal of hazardous wastes.

Safety Code of Conduct

Research workers in the Department are required to declare acceptance of these obligations.

- 1 I will never work in any way that endangers myself, or my colleagues, and will always work in accordance with the University Policy Statements and other relevant safety documents.
- 2 I will abide by local lab safety rules set by the Laboratory Supervisor of the laboratory I am working in. When working in labs outside the department of Materials, I will provide risk assessments for this and abide by local rules of the host departments.
- 3 I will comply with the Laboratory Safety Policy as set out in the Department Safety Policy, the Lab Standards and Hazardous Substances Standards as explained and set out in the Laboratories Safety Manual.
- 4 I will provide approved COSHH and risk assessments for all experiments BEFORE starting, and work strictly in accordance with these documents.
- 5 I will always clean up after myself. This means when a lab session is finished, the work space must be cleaned and returned to its original condition.
- 6 I will at all times while working in 'wet labs' (labs that use chemicals), wear correct personal protective equipment and appropriate dress and sensible footwear: safety glasses must be worn, properly fastened lab coat, clothes covering legs and arms, shoes that enclose the foot and are not porous. When working in other types of labs, I will adhere to the local lab rules.
- 7 I will never store or consume food and drink in laboratories.
- 8 I will not wear headphones / earphones when working in a lab of any type.
- 9 I will consult my supervisor whenever I have doubts about procedures.
- 10 If I am pregnant I will inform my supervisor as soon as possible so that the risk of possible exposure to teratogens can be assessed and eliminated. Early action is vital because the foetus is most at risk in the first three months of pregnancy.
- 11 I will report all accidents or potentially dangerous incidents in the accident book, and all equipment failures/faults to the appropriate people.
- 12 If I need to leave my work space for a time, I will leave an overnight equipment form and unattended experiment card with my name, contact number, date and duration of use.
- 13 When I leave the lab/s, I will ensure that my experiment set up is left in a safe state and I will comply with end of day procedures to ensure the lab/s are left in a safe condition at night.
- 14 To keep good records of procedures and safety considerations.

Communications

Key contacts:

These may be found on page 2. Generally, regarding safety and reporting faults, contact the following staff. If unsure, you may contact any one of us and we will point you in the right direction.

Name	Role	Contact for
Dr. Paul Bagot	Acting Department Safety Officer (DSO)	<ul style="list-style-type: none"> • All safety concerns • Risks & COSHH assessment • Accidents/incidents reporting
Mrs Linda Curson	Area Safety Officer (ASO)	<ul style="list-style-type: none"> • All safety concerns • Risk assessments • Display screen assessments • Respirator fittings
Dr Clara Barker	Departmental Laser Supervisor of Laser Safety	<ul style="list-style-type: none"> • Laser Safety • Laser Risk Assessments
Mr Leslie Chorley	Building & Facilities Manager	<ul style="list-style-type: none"> • Report facilities' faults e.g. if eye wash is not working
Prof C R M Grovenor	Senior Radiation Protection Supervisor	Radiation protection arrangements
Mrs Christina Holdway	Chemicals Safety Advisor	<ul style="list-style-type: none"> • Chemical safety • COSHH assessments • Hazardous waste disposal

Accidents/incidents reporting

The log book to record this may be found at reception in Hume-Rothery and the Christian Building at Begbroke. Please report all accidents/incidents and near misses by completing the book and report immediately to Paul Bagot.

The purpose of reporting accidents and near misses is for the department help prevent future occurrences, and ensure prompt reporting to the University Safety Office.

Safety drop-in sessions

This is an informal opportunity for all members of the department to meet and discuss safety issues.

Drop-in sessions are held once a month, usually the last Wednesday of the month.

Appendix 1 - Step by step guide to completing COSHH

1) File reference, location of work, date, persons involved

This is self-explanatory

2) Description of procedure

I.e. what are you using and doing? **Describe the whole process** from start to finish. I.e. from preparation stage right to disposal of wastes, and consider every aspects of the process, for example:

- **Will the materials react with other chemicals in the process**, how? Is it a highly energetic reaction?
- Will the procedure itself enhance the hazards – i.e. will you be heating? Will this add further dangers?
- Does the substance have **incompatible materials** that must be avoided?

3) Substance used, quantity used, quantity handled, frequency, concentration, hazards identified, exposure route

Substance use – List all the chemicals used

Quantity & concentration used – this will help evaluate the risks & decide sensible control measures

Quantity handled – this is the maximum that you will be exposed to

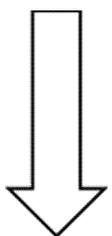
Frequency of use – this will help evaluate the risks & decide sensible control measures

Hazards & exposure routes identified – use MSDS as guidance to help with this

4) Can a less hazardous substance (or form of the substance) be used instead?

OUTCOME DESIRED: The point of doing risk assessments and that include COSHH, is to **enable implementation of effective controls to prevent or significantly reduce the chance of injury or illness due to exposure.**

As such, when assessing the risk of working with hazardous materials, always consider in the following order:

<p>MOST EFFECTIVE</p>  <p>LEAST EFFECTIVE</p>	<p><u>HIEARCHY OF CONTROLS</u></p> <p>i) ELIMINATE - First of all, could you not use this substance at all? The most effective control measure is elimination/substitution – i.e. not use the material at all in the first place will prevent exposure. Every effort MUST seriously be made to consider this.</p> <p>ii) SUBSTITUTE - Secondly, can you substitute for a less risky option? If you must use the substance, can a safer form be used? For example, use a less toxic material, a lower concentration, or in pellet form instead of fine powder?</p> <p>iii) PROCEDURE/MANAGEMENT - Thirdly, can you prevent access to the hazard/organise the work to reduce exposure to the hazards? I.e. can you make changes to the actual procedure to reduce exposure to the hazards? For example, restricting access, or not allowing lone working.</p> <p>iv) PERSONAL PROTECTIVE EQUIPMENT (PPE) - The last resort would be to issue personal protective equipment (PPE). This is the least effective control, because it doesn't actually remove the hazards, it simply prevents direct contact.</p>
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5) Justify not using a less hazardous substance (or form of the substance)

If elimination/substitution cannot be implemented, you must justify the reason/s, and apply appropriate controls. **Stating it is how it has always been done, or simply because this is as described in the literature ARE NOT justifications.**

6) Control measures

Having identified the hazards, exposure routes and whether you can eliminate/substitute, now describe the steps and precautions you need to take to prevent/minimise exposure to these hazards, and assign actions to adequately control and reduce the risks to as low a level as possible. Control measures include what you must do and equally important, what you **MUST NOT** do as well.



1) The FIRST RESORT is always engineering control. I.e. use inside fume hood, glove box or local exhaust ventilation system.

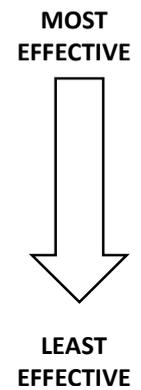
This is because they **remove/eliminate the hazards** away from you and will protect not only yourself, but others around you. **Every effort MUST be made to implement this control measure.**

2) Then consider procedural & management measures.

For examples important procedural measures such as adding acid to water and not vice versa, and management measures such as restricting access and working hours is also useful.

3) The last resort is PPE.

This is because PPE only protect the wearer and not others around them, and effectiveness will depend on correct selection and fit.



7) Checks on control measures

Reaction temp: This may need monitoring if the reaction is energetic, i.e. release a lot of heat

Reaction time: This may need monitoring if the reaction needs to go on for prolonged period

Integrity of PPE: It is important to check these regularly, to ensure PPE continue to offer protection

Fume hood: It is important to check this works properly

8) Emergency procedures

If you treat this as a copy and paste exercise, remember that should an accident occur, the first person who will be exposed to the hazards is you. So **it is in your interest to be prepared, because this will lead to effective emergency responses** and subsequently reduce injuries to yourself and others.

First aid: Describe actions to take to treat injuries, and how to call for help if needed.

Spillage: Describe exactly how you will deal with each type of spill. So starting work, make sure you have the correct and sufficient spill kit, PPE etc to deal with spills.

Large scale:

Can you safely contain the spills, can you safely clean up the spills? Will you need to call for help, how will you do this? How will you make the area safe?

Small scale:

These result from the quantity used in the experiment. You are expected to be able to deal with these.

Fire & explosion: You must describe the control measures, for example using lower quantity of flammables. Actions to take in a fire – the main consideration is to evacuate everyone out safely, raise the alarm & follow evacuation procedures. Only attempt to tackle a fire if there is the correct fire extinguisher, that the fire is small & you are confident there is no risk of it spreading, and that your means of escape is not obstructed.

9) Actions to take at the end of the experiment

Storage: If there are materials/samples left at the end of experiment that you want to keep and re-use, you must describe how these may be stored safely, including labelling.

Waste disposal: Before starting work, it is important to ensure correct disposal of wastes that will be generated. Incorrect disposals lead to significant difficulties, hazards and cost. Describe how to collect & package the wastes, how & where to store until disposal and how to arrange for disposal.

10) Approval

You must sign the form, and if you are a student you must obtain signature from your supervisor. All members must then send the form to Christina Holdway for approval. If at a later date, other researchers wish to conduct a currently risk assessed experiment, they need to sign the declaration part of the COSHH form, and obtain the supervisor's signature if they are students.

Appendix 2 – List of hazardous substances

The following guidance provides general advice and information on hazardous substances:

- ◇ **Unstable compounds**
 - * Inorganic and organic azides, chlorates, perchlorates and peroxides are in many instances highly unstable and can decompose explosively.
 - * Many organic nitro compounds are potentially explosive. Do not carry out drying or grinding operations with unstable compounds, as this could cause detonation.
 - * Low molecular weight acetylene derivatives, particularly those of copper or silver, should also be treated with extreme caution. In the dry state, these substances are known to detonate if subjected to only slight mechanical shock or friction.
 - * Avoid carrying out azide reactions in halogenated solvents: explosions have occurred.
- ◇ **Strong acids**
 - * Take care when using or handling concentrated sulphuric acid, nitric acid and hydrochloric acid. Hydrofluoric acid, chlorosulphonic acid, chromic acid and oleum are even more hazardous and corrosive. All these acids cause dangerous burns on contact with the skin. Organic acids such as acetic acid, formic acid and chloroacetic acid also cause burns to the skin.
 - * Never add water to a concentrated acid; always add the acid (carefully) to the water.
- ◇ **Strong alkalis**
 - * Sodium hydroxide, potassium hydroxide, calcium hydroxide and ammonia, either in solution or undiluted, can all rapidly affect the skin and cause painful burns.
 - * There is often a pressure build up inside concentrated ammonia bottles: open with care.
- ◇ **Alkali metals (Potassium, sodium, lithium)**
 - * Alkali metals are dangerous because they react so rapidly with water or moist air. Care should be taken with storing them (always under paraffin or light petroleum).
 - * Alkali metals also react violently with many organo-halogen compounds, especially carbon tetrachloride.
 - * Potassium requires extreme care in handling, use and disposal. Expert advice should be obtained before using this metal.

 - * Sodium, though not so violently reactive as potassium, should be handled and used with care. Lumps of sodium should be cut with a metal knife in a dish containing enough petroleum ether to cover the metal.
 - * When sodium is used for drying solvents, bottles to which sodium has been added must be clearly labelled. All sodium residues in solvent bottles must be completely removed (together with the label) before the bottle is washed or discarded.
 - * Lithium, although less reactive than sodium, should still be treated with similar care.
- ◇ **Asbestos**
 - * Asbestos dust is a serious hazard to health. The handling and removal of asbestos are subject to regulatory controls and should only be carried out by an accredited asbestos contractor. Contact Les Chorley.
 - * For high temperature lagging, a flexible non-asbestos mineral wool should be used.
- ◇ **Benzene**
 - * Benzene should not be used if other solvents (for example toluene) can replace it. As well as presenting a fire risk, benzene is extremely toxic, both by inhalation and contact with the skin. If you can smell it, you are breathing in dangerous quantities.
 - * Benzene should not be stored or kept as a bench reagent in the open laboratory.
 - * Experiments requiring the use of benzene should be carried out in a fume cupboard.
- ◇ **Carbon disulphide**
 - * Carbon disulphide may be ignited by a hot steam pipe or electric light bulb; it has a flash point of -30°C and is extremely poisonous. Carbon disulphide should be used only in isolation or in noxious laboratory facilities.
- ◇ **Chlorinated hydrocarbons**

- * Chlorinated hydrocarbons are generally toxic and some are highly toxic. Exposure to vapour or liquid should always be avoided. All handling of chlorinated hydrocarbons should be confined to fume cupboards. Chloroform and trichloroethylene, in particular, are suspected to be serious health hazards.
- ◇ **Cyanides (HCN, alkali cyanides, NaCN)**
 - * Special precautions need to be taken before undertaking any operation involving the use of cyanide, and the Safety Officer must be consulted.
 - * Cyanide solutions may be used only in special fume cupboards reserved exclusively for them, and never anywhere else.
 - * Acids must never be introduced into fume cupboards reserved for use with cyanide.
- ◇ **Diazomethane**
 - * Diazomethane is highly toxic and can decompose vigorously. Its preparation usually involves hazardous nitroso intermediates. All operations involving diazomethane and its intermediates must be carried out with great care.
- ◇ **Diethyl ether**
 - * Diethyl ether is a dangerous fire risk and can be ignited by an electrically heated hot plate or a sparking electric motor.
- ◇ **Halogens (bromine, chlorine, fluorine)**
 - * Glass bottles containing bromine can fracture because of the mobility of bromine coupled with its high density. The vapour and the liquid cause burns.
 - * Chlorine is usually encountered in gas cylinders, and like bromine is corrosive and toxic. Chlorine and bromine should always be handled in fume cupboards.
 - * Fluorine is extremely corrosive and poisonous. Special facilities are required for its use.
- ◇ **Hydrogen fluoride**
 - * Hydrogen fluoride/hydrofluoric acid is an extremely hazardous substance. Specialist advice should be obtained before considering its use. Contact with living tissue can be destructive and irreversible. Medical facilities capable of administering antidote treatment for HF must be on hand if it is to be used.
- ◇ **Hydrogen peroxide**
 - * Concentrated solutions (50 volumes and over) of hydrogen peroxide should be handled with extreme caution. The presence of trace amounts of metal can cause rapid decomposition. Hydrogen peroxide rapidly attacks exposed skin and tissue.
 - * Sunlight will cause decomposition of hydrogen peroxide and organic peroxides. Store in dark coloured bottles in a dark place.
- ◇ **Hydrogen sulphide and hydrogen selenide**
 - * Hydrogen sulphide and hydrogen selenide are almost as toxic as hydrogen cyanide. Always conduct experiments in fume cupboards.
- ◇ **Mercury**
 - * Mercury is a cumulative poison; it has an appreciable vapour pressure at room temperature and should never be allowed to stand exposed in a laboratory. Any spillage of mercury should be collected immediately using a fine capillary tube connected to a filter flask and water pump.
 - * Surfaces affected by tiny droplets of mercury in a spillage should be decontaminated by pasting with a slurry of slaked lime and flowers of sulphur mixed with a little water. The slurry should be allowed to dry and about 24 hours later it should be removed with clean water and the surfaces again allowed to dry.
 - * After spilled mercury has been cleaned up sprinkle the area liberally with zinc dust and contact the Safety Officer who will monitor the area for mercury vapour.
 - * Do not allow mercury to run down a drain.
- ◇ **Nitroso derivatives**
 - * Many organic nitroso compounds are suspected of having carcinogenic properties and should always be handled with extreme care. Thoroughly decontaminate the work area and equipment after work is completed.

- ◇ **Nitrous fumes**
 - * The oxides of nitrogen are very toxic and the intensity of colour does not indicate the degree of danger. Never release nitrous fumes into the open laboratory.
- ◇ **Perchloric acid**
 - * Perchloric acid is dangerously corrosive and readily forms explosive mixtures. Appropriate PPE should be worn at all times when handling and a risk assessment for the storage of both reagents and waste containing perchloric acid should be made.
- ◇ **Phenol, cresol, xylene**
 - * Phenols, including cresol and xylene, burn the skin quickly and are highly toxic. Wear protective gloves and a face visor when handling them.
- ◇ **Phosphorus halides**
 - * Phosphorus trichloride and phosphorus oxychloride are dangerous irritants. On no account breathe the vapour. If spilt onto the skin, wash the affected part immediately.
- ◇ **Thionyl chloride**
 - * Thionyl chloride has an irritant vapour and is corrosive. It reacts vigorously with water, liberating hydrochloric acid and sulphur dioxide fumes.

Appendix 3 - Incompatible matrix

Safe storage can be achieved by separation based on chemical properties. This **requires planning and will involve an inventory list, accurate labelling, an appreciation of the chemical incompatibilities and a range of suitable containers and storage facilities**

Figure 1 shows general guidance on how to isolate chemicals into their basic hazard property

	FLAMMABLES	OXIDISING ACIDS	NON-OXIDISING ACIDS	ORGANIC ACIDS	ALKALIS (BASES)	OXIDISING AGENTS	AIR/WATER REACTIVES, PYROPHORICS, REDUCING AGENTS	TOXICS	UNSTABLE/SHOCK SENSITIVES
	<p>Examples: Acetone, methanol, ethanol, toluene, *diethyl ether*, *tetrahydrofuran*</p> <p>* Special attention:</p>	<p>Examples: Perchloric acid, nitric acid</p> <p>Special attention:</p>	<p>Examples: Hydrochloric acid, phosphoric acid, hydrofluoric acid, sulfuric acid</p> <p>Special attention:</p>	<p>Examples: Acetic acid</p> <p>Special attention:</p>	<p>Examples: Sodium hydroxide</p>	<p>Examples: Lithium nitrate</p>	<p>Examples: Potassium, sodium, magnesium, metal dust/fine powder, metal sulphide, titanium tetrachloride, diethyl zinc, Lithium aluminium hydride, thionyl chloride</p> <p>Special attention:</p>	<p>Examples: Cyanides, Lead, mercury, cadmium, phenol, chromates, chlorinated solvents, fluorine, hydrofluoric acid, benzene, carbon disulfide</p>	<p>Examples: Picric acid (trinitrophenol),, nitro/nitroso compounds, azo, diazo or azide chemicals, perchlorates, fulminates, potassium oxide, potassium superoxide (from oxidation of potassium metal), perchloric acid</p>
	Prolonged storage of ethers such as diethyl ether and tetrahydrofuran may lead to formation of explosive peroxides	<input type="checkbox"/> Segregate from strong dehydrating agents such as sulfuric acid. <input type="checkbox"/> Readily form explosive mixtures	<input type="checkbox"/> Hydrofluoric acid is highly toxic, and is best stored by itself <input type="checkbox"/> Sulfuric acid is also a strong dehydrating agent. Do not store with perchloric/nitric acid	These are also flammable. Best placed inside a flammable storage cabinet, inside a secondary container			Must be handled & stored under dry and inert atmosphere. Residual unwanted materials require careful quenching (destroying).		
Flammables	I	X	X	I	X	X	X	X	X
Oxidising acids	X	I	I	X	X	I	X	X	X
Non-oxidising acids	X	I	I	I	X	X	X	X	X
Organic acids	I	X	I	I	X	X	X	X	X
Alkali (bases)	X	X	X	X	I	X	X	X	X
Oxidising agents	X	I	X	X	X	I	X	X	X
Air/water reactives, pyrophorics, reducing agent	X	X	X	X	X	X	I	X	X
Toxics	X	X	X	X	X	X	X	I	X
Unstable/shock sensitive	X	X	X	X	X	X	X	X	I

I = may be stored together X = may not be stored together

Appendix 4 - List of incompatible chemicals (not an exhaustive list)

Substances in the left hand column should be stored and handled so that they cannot accidentally come into contact with the corresponding substances in the right hand column under uncontrolled conditions (where violent reactions may occur).

Acetic acid	Chromic acid, nitric acid, hydroxyl containing compounds, ethylene glycol, perchloric acid, peroxides, sodium peroxide, permanganates (see acids)
Acids	Azides, cyanide, hypochlorites, sulphides, nitrites, peroxides, potassium chlorate, potassium perchlorate, sulphides
Acetone	Concentrated nitric and sulphuric acids
Acetic anhydride	Perchloric acid, sodium peroxide
Acetylene	Chlorine, bromine, copper, silver, fluorine, mercury
Alcohol	Chromic acid, chromium trioxide, perchloric acid
Alkali and alkaline earth metals	Carbon dioxide, carbon tetrachloride and other chlorinated hydrocarbons
Aluminium lithium hydride	Water
Aluminium (powdered)	See alkali and alkaline earth metals
Amines	Nitroparaffins
Ammonia (anhyd)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrogen fluoride
Ammonium compounds	Silver
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulphur, finely divided organics or combustibles.
Aniline	Nitric acid, hydrogen peroxide
Arsenic	Any reducing agent
Azides	Acids
Benzene	Bromine
Benzaldehyde	Sodium peroxide
Bromine	Ammonia, acetylene, butadiene, butane and other petroleum gases, sodium carbide, turpentine, benzene and finely divided metals
Butane/Butadiene	Bromine see hydrocarbons
Calcium	See alkali metals
Calcium oxide	Water
Calcium hypochlorite	Carbon (activated)
Carbon (activated)	Calcium hypochlorite
Camphor	Chromic acid
Carbon disulphide	Sodium peroxide
Chlorates	Ammonium salts, acids, metal powders, sulphur, finely divided organics or combustibles
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol and other hydrocarbons, turpentine, alcohol and other flammable liquids
Chlorine	As bromine, plus oxygen
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulphide
Copper	Acetylene, hydrogen peroxide
Cyanide	Acids
Ethylene glycol	Sodium peroxide, potassium permanganate
Flammable liquids	Nitric acid, oxygen

Fluorine	Isolate from all other chemicals
Gasoline	See hydrocarbons
Hydrazine	Hydrogen peroxide, nitric acid, other oxidants
Hydrocarbons (benzene, butane, propane, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, peroxide
Hydrocyanic acid, nitric acid, alkaline	(see acids)
Hydrofluoric acid (anhyd)	Ammonia, aqueous or anhydrous
Hydrogen peroxide	Copper, chromium iron, many metals and their salts, flammable liquids, combustible materials, aniline, nitromethane
Hydrogen sulphide	Nitric acid (fuming), oxidising gases
Hypochlorates	Acids
Iodine	Acetylene ammonia (anhyd or aqueous)
Magnesium	See alkali metals
Mercury	Acetylene, nitric acid-ethanol mixtures, ammonia, oxalic acid
Nitric acid (conc.)	Acetic acid, acetone, alcohol, aniline, brass, copper, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gasses, nitratable substances, perchloric acid
Nitrites	Acids
Nitroparaffins	Amines, inorganic bases
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammables
Perchloric acid	Acetic acid, acid anhydride, alcohol, carbon, cellulose, dehydrating agents, ether, glycol, nitric acid, pyridine, paper, etc.
Peroxides (organic)	Acids
Phosphorus	Caustic alkalis or reducing agents
Potassium	see alkali metals
Potassium chlorate	Acids (see also chlorates)
Potassium perchlorate	Acids (see also perchloric acid)
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, fulminic acid (in nitric acid-ethanol mixtures), ammonium compounds
Sodium	see alkali metals
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Any oxidisable substance, e.g. ethanol, acetic acid, acetic anhydride, carbon disulphide, glycerol, ethylene glycol, ethyl acetate
Sulphuric acid	Chlorates, perchlorates, permanganates
Sulphides	Acids
Telluride	Reducing agents

Appendix 5 - Lab general safety checklist

Use this checklist to regularly monitor and ensure your labs comply with safety requirement.

1)Waste	Waste packaged, labelled and stored correctly Dispose regularly, do not allow build up.
2)Chemical storage	<ul style="list-style-type: none"> - Must be correctly labelled, dated & hazards identified - Must be stored correctly, use secondary containers & be in good conditions - Must ensure segregations of incompatibles * take care with water reactive, pyrophoric, oxidisers, toxics, peroxide forming chemicals. - Flammables, less than 50L
3)gas cylinders	Must be secured with chains to wall or bench, and located in safe place. Regulators with test pass labels, and flashback arrestors where necessary. Any tubings must be clear of kinks/twist
4)Water/effluent	Tubings secured to avoid flooding, sink and sink area kept clear and unblocked
5)Electrical	All equipment with PAT test
6)Fumehood/glove boxes	<ul style="list-style-type: none"> - Kept clean and clear of debris, unwanted equipment and avoid clutter. - Fill log books with chemicals used - Clear procedure for removing items from glove box
7)Fire extinguishers/blankets	Keep clear and report use
8)General housekeeping	Keep work surfaces clean and tidy, keep lab unobstructed, lab duties assigned and delegated?
9)Safety specs/lab coat	Provide supply available by door, and dirty lab coat sent for laundry
10) Risk & COSHH assessments	Must be provided. Evidence of training?
11) Equipment service records	Service records, for example centrifuges
12) Awareness of procedures	Lab members aware of procedures and their responsibilities?
13) Clear shut down procedures	Clear instruction, unattended forms in use, all unused equipment switched off?
14) Emergency preparedness	Are spill kit, eyewash, antidote, extinguishers available & in good condition. Are procedures available & workers trained?