UNIVERSITY OF ST ANDREWS

University
of
St Andrews

SCHOOL OF CHEMISTRY

SAFETY HANDBOOK

September 2011

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SAFETY PERSONNEL
and contact details

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Deputy School Safety Coordinator			
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School Biological Hazards Officer			
Dr T. K. Smith	3.17(BMS)	3412	tks1
School Laser Safety Officer			
Dr M. Buck	101b	7232	mb45
School Radiation Protection Officer (Radiochemicals)			
Dr C.-J. Dong	228	7282	cd26
School Radiation Protection Officer (Ionising Radiation)			
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This School Safety Document replaces all previously issued safety documents and directives

1. *Policy Statement*

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

It is the policy of the School of Chemistry not only to comply fully with the Health and Safety at Work etc. Act as required by law, but to act positively to prevent injury, ill-health, damage and loss arising from work carried out within its precincts. This policy is a supplement to the University's Health and Safety policy and is applicable in the Purdie, Biomolecular Sciences and Medical School Buildings.

It considers the promotion of the safety and health of all persons working in the School to be an essential part of the academic staff's duties for which they are accountable at all levels. The School will seek to encourage all members of the School to participate in and contribute to the establishment and observance of safe working practices. However, the School expects all persons working within its precincts to recognise that equally there is a clear duty on them to exercise self-discipline and accept responsibility to do everything they can to prevent injury to themselves and others and loss to the School.

Current legislation applies in full to all work carried out in the School. The School expects all personnel to co-operate fully in carrying out the procedures required by these Regulations and in obeying the School safety rules arising from them, which are given in Section 9 of this booklet.
The School and University take Health and Safety very seriously. Non compliance with safety policies is a disciplinary matter which can ultimately result in dismissal for both staff and students.

In accord with the above policy the School of Chemistry will:

(i) Employ and provide proper resources to ensure competent advice on safety and health matters.

(ii) Continue to develop and implement procedures and codes of safe working practice.

(iii) Maintain systems for exchange of information with other chemistry Schools for reporting and controlling safety performance and for monitoring and assessing health at work.

(iv) Provide training in safe working methods.

(v) Maintain an appropriate framework for consultation on effective measures for promoting safety and health at work including a School Safety Committee.

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J. D. Woollins **(Date)**
Head of School

2. *Organisation and Arrangements*

To give effect to the above statement of policy the School of Chemistry has made the following arrangements.

2.1 Head of School

The Head of School is responsible for ensuring, so far as it is reasonably practicable, that the operations in the School do not constitute a hazard to safety and health; and, in particular, that any rules made by the University and the School are understood and observed by all persons working in the School.

He is responsible for making suitable arrangements for consultation between himself, the staff and representatives of the School for the purpose of reviewing existing safety practices and, in particular, for the introduction of new safety measures.

2.2 Members of the Academic Staff

Members of the academic staff are responsible, under the direction of the Head of School, for:-

(i) Instructing members of their research groups and technicians under their supervision in safe working practices.

(ii) Ensuring safe working practice, adherence of equipment to safety standards (e.g. Electricity at Work Regulations) and good housekeeping in laboratories and workshops designated as their particular responsibility.

(iii) Arranging for a colleague to be responsible for their research group if they are to be absent for more than three days, and notifying this arrangement to the Head of School's office.

(iv) Requiring that School safety rules are obeyed.

(v) Ensuring that the necessary safety equipment is available and used.

(vi) Demonstrating their personal concern with health and safety at work.

(vii) Engaging the interest and commitment of all persons under their supervision to healthy and safe working practices.

Part-time Postgraduate Demonstrators
Part-time demonstrators will have the responsibilities listed in 2.2 (iv)-(vii) above for members of staff whilst they are demonstrating.

2.3 All Employees of the University, Postgraduate and Undergraduate Students

All employees of the University and students have a responsibility to themselves and to others to:-

(i) Carry out their work in a safe manner and with due regard to health.

(ii) Adhere to the University and School safety rules.

(iii) Inform themselves of the safety and health hazards of the equipment and materials with which they are concerned, in so far as these hazards may reasonably be foreseen.

(iv) Bring to the notice of supervisors any potential hazard to safety and health of which they know or learn of whether in routine work or arising from faults in equipment.

2.4 School Safety Coordinator

The Head of School has appointed **Dr P. Wormald** as the Health and Safety Coordinator for Chemistry in the Purdie, Biomolecular Sciences and Medical School Buildings. He is to advise the Head of School and to act on his behalf in any matters affecting the personal safety of individuals and equipment. This is not, however, a delegation of responsibility, which resides in the Head of School. The School Safety Coordinator is advised, as necessary, by the University Safety Adviser. Note that members of the School should refer all safety matters to the School Safety Coordinator in the first instance who will then consult the University Safety Adviser as necessary.

A function of the Safety Coordinator is to keep under review the measures taken to ensure health and safety at work, and to promote the effective co-operation of all members of the School at all levels in such measures.

The School Safety Coordinator is responsible for Safety Audit within the School of Chemistry. He will therefore arrange for the inspection of all laboratories on a regular basis and present a written report to the member of staff responsible for each laboratory indicating any matters which are in contravention of the School's safety rules. The staff member responsible should then ensure that the necessary improvements are made and confirm this fact to the School Safety Coordinator. Finally the School Safety Coordinator will present a brief summary of the results of the inspection to the University Safety Adviser.

2.5 Jurisdiction

Members of the School of Chemistry are located in the Purdie Building, the Medical School Building (MSB) and the Biomolecular Sciences Building (BMS), these buildings are also partly occupied by members of other Schools. The provisions in this Handbook apply to all members of the School of Chemistry regardless of which building they normally work in. It should be noted however that in some matters (e.g. emergency evacuation procedure) different provisions may apply according to where personnel are located.

Students on Placements with external organisations will normally be subject to the Health and Safety policies of those organisations. It is the policy of the University of St Andrews that students only undertake placements in organisations making an appropriate and adequate provision of Health and Safety care.

All other academic activities undertaken outwith the School of Chemistry must be subjected, in advance, to appropriate risk assessment.

2.6 **Electronic Mail**

It is convenient and efficient to circulate urgent safety information by electronic mail. For this reason all permanent employees, research workers and postgraduate students are **required** to obtain a University e-mail account and to inform the General Office of their e-mail code. In this way the School Safety Coordinator can ensure that essential safety information can be rapidly disseminated to all personnel using the e-mail address list 'chem-all'.

2.7 **Survey of Hazards**

A systematic survey of the hazards present in the School has been performed and this indicates that the major types of hazard are as follows:

Fire – a major risk due to the large amounts of highly flammable materials in use. The relevant regulations are contained in sections **4.** and **8.**

Chemical – again major due to the large number of substances in use many of which are toxic, irritant, corrosive, potentially explosive, carcinogenic and so on. The relevant regulations are contained in sections **6.**, **9.** and **10.**

Radiation – this only involves a few personnel and is strictly controlled. See section **19.**

Biological Hazards – again only a few personnel are involved and the hazards are relatively minor. See section **18**.

Physical and mechanical – this group includes personal injuries such as burns, cuts, sprains etc. which may be caused by falling, equipment failure and incorrect manual handling (see section **20.**) or unsatisfactory use of Display Screen Equipment (see section **21.**).

Noise – only a few pieces of equipment generate a noise level which requires ear protection. See section **6.10**.

Flood – a widespread and major hazard due to the large number of experiments and pieces of equipment using water, many on a continuous basis. See sections **7.7** and **12.7**.

Electrical – major due to the large amount of electrical equipment in use, some of it operating at high voltage. See section **13**.

3. *Access to the School and Security*

The School is open from 8.00 am to 6.00 pm Monday to Friday. When the School is closed access may only be gained through the after-hours access doors on Level 1 of Purdie or BMS. Members of staff, research workers and certain undergraduate students are issued with keys or swipe cards to these doors by the School Office/ID Cards.

3.1 **All persons entering the buildings outside normal hours must sign the book at the door by which they enter**. This is to enable the Emergency Services to immediately ascertain the number and location of persons in the buildings. In the event of an emergency occurring outside normal hours, lives

could depend on these books having been signed. Persons intending to remain in the buildings after 6 pm must also sign the books at that time. All persons should "sign out" when leaving the buildings.

3.2 No person should attempt to travel in the Purdie goods lift outside normal working hours. Goods can be moved by loading the items into the lift, then proceeding via the stairs to the destination Level and calling the lift from there. **Please note you should never enter the lift if Cardice, gas cylinders or Nitrogen dewars are in the lift**

3.3 All key-holders are responsible for ensuring the security of the buildings outside normal hours. To leave the doors unlocked or pass a key to, or otherwise allow admission to, any unauthorised person is a serious breach of the School Safety Regulations. The designated emergency exit doors at the bottom of the stair-wells are for emergency use only and should not be used to exit the buildings under normal circumstances since they cannot be properly closed from the outside and may therefore compromise the security of the buildings.

3.4 Undergraduate students are provided with a different key which only affords access to the library area of the Purdie Building. They are not permitted to enter the laboratory block outside normal hours and research personnel must ensure that the doors at the south end of the common room and in front of the lift on level 2 remain locked.

No mobile phones or headphones are allowed in the laboratories or corridors in the Purdie Building.

4. *Emergency Procedures*

Emergencies are classed as minor, which can be dealt with locally, and major, requiring evacuation of the buildings and signaled by the sounding of the fire alarm. The buildings must be evacuated whenever the alarm sounds continuously.

There are smoke detectors in selected rooms but it may be that the system will have to be activated manually from a break-glass button. If a major emergency arises, sound the fire alarm from the nearest break-glass unit if it has not gone off automatically. (See 4.2)

The CO_2 system of the Purdie Building overnight rooms 339 and 438 is permanently armed. Before entering an overnight room, read carefully the instructions outside the door. In particular, if a continuous bell sounds while you are in an overnight room, CO_2 discharge is imminent: leave the room immediately and close the door**.**

4.1 Minor Emergencies

Small Fires

(i) Raise the alarm locally (e.g. within your own laboratory) by voice.

(ii) Attack the fire immediately using a CO_2 extinguisher or other suitable method. Do not take any personal risk, and ensure that you have a safe exit route at all times.

(iii) If the fire cannot be extinguished quickly using a maximum of two small CO_2 extinguishers, immediately sound the fire alarm using the nearest break-glass point, and follow the evacuation procedure set out in Section 4.2 below.

If at any stage the fire-alarm siren sounds, immediately break off fire-fighting activity and leave the building under the usual evacuation procedure.

(iv) If the fire can be rapidly extinguished quickly, check at intervals thereafter to ensure that the fire has not re-ignited

(v) On no account return any fire extinguisher which has been used to its normal position. Contact the School Safety Coordinator to obtain a full replacement.

(vi) Make a report on the fire as soon as possible to the Safety Coordinator (see Section 5 below).

Small Fires in a Fume Cupboard
If a fire occurs in a fume cupboard the draught may make the normal fire-extinguishing methods ineffective. If safe to do so, close the sash and immediately switch off the fume cupboard. Then tackle the fire as normal using CO_2, dry powder or sand.

Personal injury
(i) Keep calm and give immediate First Aid.

(ii) Summon a qualified First Aid Worker (see p.1) or if the injured person requires hospital treatment, first call for an ambulance (dial 9 999 from any telephone) and then summon a First Aid worker. Arrange for someone to receive the ambulance and repeat the emergency call if help does not arrive within 10 minutes. Personnel should note carefully the location of First Aid workers in the building in which they normally work and when necessary summon the closest one regardless of which School they might belong to. It should be noted however that all accident reports should be sent to the School Safety Coordinator

4.2 Major Emergencies

Both buildings are equipped with an automatic fire alarm system activated by smoke detectors. Any incident which threatens the safety of persons in the buildings calls for sounding of the alarm and immediate evacuation. This includes fires, explosion, and major accidental release of poisonous gas or vapour. If a major emergency arises, sound the fire alarm using a break-glass button if it has not already gone off automatically.

When the alarm sounds continuously

Switch off all gas taps and electrical heating sources. If for any reason you have not been able to do this and have, for example, left a distillation in progress, report this immediately to the School Safety Coordinator at the relevant assembly point (see below). Make other equipment safe if this can be done quickly and without risk.

Leave the building by the nearest safe exit and proceed to the car park in front of the level 2 entrance if exiting from the Purdie Building **or** on the grass across the road from the main entrance of the BMS Building if exiting from that building. Thereafter, and if it safe so to do, all occupants of these buildings should proceed to the point at which they would normally assemble (Purdie Building occupants at the level 2 car park and BMS occupants on the grass opposite the main entrance of that building).

Because of the physical proximity of the Purdie and BMS buildings, a major emergency in one calls for evacuation of the other and the fire alarm will then be activated and evacuation should proceed in the normal way.
When the alarm sounds in the building where you are, you should leave by the nearest signposted exit. Note that this should never involve going through the passages connecting the two buildings. The only exception is if the normal exit route from the BMS building is blocked by fire or smoke, it may be easier to cross into the Purdie building and use the fire escape at the end of the NE or NW wing rather than go to the other end of the BMS building.
It is emphasised that you must evacuate the building by the shortest safe route and not the route you may normally use to come in and out of the building. The main stair-wells are "fire protected escape routes". In particular, once you enter a stair-well go right down to the bottom and out the exit door. Never leave a stair-well to go back into a corridor on a lower level.

DO	check that your room is empty of personnel; close doors behind you;
DO NOT	run (except in a life-threatening situation); stop to collect personal belongings; use lifts; enter a smoke-filled stairwell: use an alternative exit; re-enter the building until it has been declared safe.

The importance of closing all doors on evacuation of the buildings is emphasised. All laboratory doors must be kept closed outside normal working hours. The automatic extinguishing system of the overnight rooms is completely ineffective if the doors are propped open. The doors to the overnight rooms must be kept closed at all times.

The School has a carefully planned Major Incidents Procedure which goes into action whenever the fire alarm sounds. Those who have specific duties under this have been given detailed written instructions. Anyone having detailed

knowledge of the incident which has caused an alarm should exit the building as normal but then report to the appropriate Incident Post.

In order to test various aspects of the fire alarm systems, the alarm will sound for not more than thirty seconds every Wednesday at 4.00 pm.

Members of the Academic Staff conducting a class when the fire alarm sounds should ensure the immediate and safe evacuation of all persons in the class.

When the buildings have been evacuated it is strictly forbidden to re-enter them for any reason unless authorised to do so either by a senior Fire Officer, the Head of School or the School Safety Coordinator. Unauthorised re-entry to a building while it is under the control of the Fire Service is a criminal offence and offenders are liable to arrest for obstruction.

Note: When instructed, re-entry by Chemistry personnel to the Buildings is ONLY permitted via the following doors:

Personnel working in the Purdie Building: Level 2 entrance.
Personnel working in the BMS Building: Level 1 BMS entrance.

In the event of any serious accident, for example a major spillage of harmful chemicals, the School Safety Coordinator should immediately be called and will assume control of the situation. He will arrange to secure the affected area, assess the risks involved and organise appropriate clean-up measures. In controlling access to the affected area the School Safety Coordinator acts for the Head of School and has absolute authority. No person may enter such a closed off area for any reason.

At all times the alarms are connected to the fire-station and the fire brigade will automatically respond if they are set off. If the alarm sounds **outside normal hours** any person in the buildings should:

If a small fire in your laboratory has caused the alarm, extinguish it in the normal way, but only if this can be done without any personal risk.

Immediately leave the building and assemble at the after-hours access door (Level 1). Do not touch the alarm control panel.

Go immediately to the reception area of New Hall and call the Fire Brigade by dialling 9-999 in case the automatic link from the alarm system has failed.

Provide as much information as possible to the emergency services upon their arrival (e.g. nature and location of fire, persons still in the building, etc.).

Only re-enter the building when informed by the Fire Service that it is safe to do so.

4.3 First Aid Equipment

(i) A full set of First Aid equipment is maintained by each qualified First-Aid worker.

(ii) One set of First-Aid equipment is available outside Room 343 on Level 3 for use out-of-hours.

(iii) In accordance with School policy, First Aid boxes must not be provided in laboratories. A trained First Aid worker should be called to each incident.

4.4 Fire Fighting Equipment and Fire Safety Measures

(i) All research workers and all staff must have attended a training session on Fire Safety, provided by the University Fire Safety Adviser, Mr. R. D. Adams. These sessions will be arranged as required and a record of attendance kept.

(ii) Fire extinguishers, sand buckets and asbestos blankets are provided throughout the buildings. Make yourself familiar with the location of these in rooms in which you work.

(iii) Improper use or wilful damage of any fire-fighting equipment is a criminal offence. The use of extinguishers or sand buckets to prop open doors or of sand buckets as rubbish bins is strictly forbidden.

(iv) The connecting doors provided between some rooms are designed to afford an alternative means of escape if the main door is blocked by fire or smoke. These doors, as well as all fire exits, must be kept completely clear and unobstructed at all times.

(v) The access doors to all stairwells in the building are designated as smoke doors and must never be propped open at any time.

(vi) The provision of clear glass windows in the doors of certain rooms allows a fire or dangerous situation within the room to be seen without opening the door and makes it easy to ensure that all the occupants have left. The hanging of such items as posters or laboratory coats so as to obscure the view through such windows is strictly forbidden.

(vii) All laboratory doors should be kept closed when not in use. It is essential that all laboratory doors are closed outside working hours as this will prevent the spread of fire.

(viii) Under current legislation strict rules apply to the positioning and use of notice boards and combustible materials in corridors. The notice boards have been carefully positioned to comply with these regulations and no-one is permitted to move them or erect a new notice board without the permission of the School Safety Coordinator. All notices and posters must be firmly attached to a board by all four corners. Attachment of notices or other combustible materials to the corridor walls or doors is prohibited. Any notices posted in violation of these rules are liable to be removed without warning at any time and disposed of. Combustible materials such as papers which need to be stored in corridors must be inside a metal cabinet.

(ix) The Purdie, MSB and BMS buildings have convenient bicycle racks provided outside. **It is forbidden to bring or store bicycles inside either building.** In addition, the passage to and from the Purdie Building central courtyard adjacent to the out of hours access door is a fire escape route and must never be blocked by bicycles, motorcycles or other items.

(x) The area at the foot of the central stair-well is the main fire escape route for the Purdie Building and must remain unobstructed at all times. This has been marked out with red tape and it is strictly forbidden to leave trolleys or any other items within the marked off area at any time. Once personnel have left by this exit they are to make their way out through the passage beside the out of hours access door. This designated fire escape route must not be obstructed at any time. Any items found there including bicycles will be removed and impounded.

4.5 Major Power Failures

In the event of a widespread power failure within the School all members of the School should make safe their work places, in particular by switching off electrical and/or water supplies to experimental equipment, computers, etc. Fume-cupboard sashes should be closed. As far as possible electrical equipment should be switched off to reduce potential damage caused by possible surges when the power supply is restored.

If power has not been restored after an hour, individuals who do not have designated responsibility to restart critical equipment such as freezers, etc. may leave.

5. *Reporting of Accidents*

Under current legislation, the University Safety Adviser is legally obliged to report certain classes of accidents occurring within the University to the Health and Safety Executive. Since complex rules govern exactly which accidents must be reported, School Safety Coordinators are required to report all accidents to the University Safety Office.

With the exception of minor cuts, abrasions and burns, all accidents within the School must be reported. This includes:

- fires of any kind, no matter how minor;
- explosions;
- cases of poisoning;
- cases of chemicals entering the eye;
- incidents requiring outside medical attention;
- significant spillage of a class 5 material.

The report should be made, if possible by the person concerned, to the School Safety Coordinator (or in his absence to the Head of School's Office), as soon as possible and **in any case not later than the next working day**. In addition you are asked to report any dangerous situation or "near miss" which you experience. Besides fulfilling the legal obligation, the reporting of accidents is essential to allow the review and possible revision of the existing Safety Regulations.

Your report of an accident or near miss could prevent death or serious injury to others.

6. *Personal Protective Equipment*

Personal Protective Equipment (PPE) should be properly used whenever it has been identified as a requirement in a risk assessment. PPE relevant to this School includes such items as eye protection, hand protection, respiratory protection, as well as hearing protection, etc. Workers in any doubt about the appropriate form of PPE should consult their supervisors in the first instance, failing whom the School Safety Coordinator. Further detailed guidance is available at

http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/

Current legislation places a statutory requirement on the School to ensure that all persons within its precincts have their eyes adequately protected.

6.1 Undergraduate Laboratories (MSB)

In all laboratories the wearing of eye protection is mandatory at all times. All other persons must wear safety glasses. This includes students not engaged in experimental work and visitors. Laboratory supervisors are instructed to exclude from their laboratory any person who refuses to wear eye protection.

No mobile phones or headphones are allowed in the laboratories or corridors in the Purdie Building.

Proper shoes giving full coverage should be worn.

6.2 Research Laboratories

The wearing of eye protection is mandatory for all persons in any laboratory where any chemicals, vacuum systems or high pressure systems are in use and also in any laboratory marked with an eye protection sign on the door. The protection must conform to B.S. 2092. Normal glasses are not sufficient and must be fitted with toughened glass. All workmen and visitors must be provided with suitable eye protection before entering such laboratories.

6.3 Contact Lenses

Contact lenses present a serious hazard in the laboratory since any chemical entering the eye may penetrate behind the lens and be impossible to wash out. **The wearing of contact lenses in laboratories is strongly discouraged.** Anyone who wears contact lenses must inform the School Safety Coordinator. A list of wearers is given to each First Aid Worker so that appropriate action can be taken in an emergency.

6.4 Workshops

Suitable eye protection must be worn for all operations involving any reasonably foreseeable risk of eye damage. This includes, for example, welding, and cutting or grinding metal or ceramics.
The workshops have their own procedures that all University staff and visitors should be aware of and follow.

6.5 Lasers

No laser equipment may be operated in the School without the knowledge of Dr M. Buck. Laser equipment may only be operated in full accordance with the *University Local Rules for Work with Lasers*. Suitable eye protection must be worn at all times.

6.6 Visors

Full-face visors provide protection against splashing of corrosive chemicals on the face and should be worn whenever there is a significant risk of this (as for example during preparation of chromic acid).

Other Protective Equipment

For each of the following items of protective equipment the precise type chosen for a particular task must be of suitable design. Personnel should note that, in addition to the types available at the main store, a great variety of such equipment is available from different sources and they should ensure that the type used is the most suitable, if necessary taking expert advice on this from their supervisor or the School Safety Coordinator. A copy of the British Standard giving guidance on the suitability of various types of gloves, eye protection and respiratory protection for different tasks is available at the Store.

6.7 Safety Shields

A safety shield must be placed around any experiment involving a reasonably foreseeable risk of explosion. Safety shields, obtainable from the Store, are more effective when weighted at the base. A special shield may be borrowed from the Store for use when such experiments are being undertaken in "double" fume cupboards. See 7.3.

6.8 Gloves

Various types of gloves are available from the store as follows:

(i) Rubber and heavy PVC gloves: for handling toxic chemicals. These should be discarded when punctured or perished.

(ii) Disposable gloves: although sometimes useful for handling toxic chemicals these are too thin to provide adequate protection in many cases.

(iii) Thick insulating gloves: used for handling hot equipment and also useful to avoid cuts, for example when freeing stuck glass joints.

(iv) Kevlar gloves and "Whizard" armguards and handguards may be borrowed from the Store for use where possibly hazardous manipulations must be carried out - e.g. in a fume cupboard with the sash lowered.

Further guidance on the correct selection of gloves is given at
http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/

Further guidance on the correct use of gloves is given in Section 7.4.

NB It is University policy that the type of gloves required in any operation **must** be specified in the relevant risk assessment.

Gloves should be worn, as required, in laboratories, but in no other parts of the School. It is extremely bad practice to walk around the building, opening and closing doors, using banisters and so on, while wearing laboratory gloves, as this simply spreads far and wide any chemical contamination present on the gloves (see also Section 7.4). Before leaving a laboratory, take off any protective gloves.

6.9 Dust Masks

These should be worn when handling fine powders such as TLC grade silica and alumina which can cause serious lung damage. There is now an HSE requirement for fit-testing of all face masks: consult the School Safety Coordinator.

6.10 Ear Defenders

As required under the Noise at Work Regulations, the noise level has been evaluated throughout the School. All persons using the ultrasound probe sited in BMS Room 4.11 must wear the ear defenders provided. Anyone who is concerned about a high noise level should inform the School Safety Coordinator so that an assessment can be carried out.

7. *General Laboratory Practice*

Previous inspections of the School by the Health and Safety Executive have highlighted the very poor standard of "housekeeping" and working practices in some laboratories. In addition, it should be noted that slips, trips and falls are major causes of accidents in the workplace.

7.1 Tidiness

All work areas must be kept clean and tidy as possible. Benches and fume cupboards must be cleared and cleaned on a regular basis. In the event of an accident, the presence of large quantities of chemicals, solvents and apparatus seriously aggravates the hazard. All items should be returned to safe storage after use. Laboratory floors must be kept as clear as possible.

The storage of items above head height is dangerous and is to be avoided. Where such storage does exist, an appropriate safe means of access must be used, for example a step-ladder with hand rail and not a stool or chair.

All laboratory sinks should be fitted with a filter in the drain which prevents solid objects falling down it. This must be kept in place and on no account be removed and thrown away. Frequently cases of blocked drains have been caused by items being routinely washed down unprotected drains. The filters must be kept in place on all drains.

No alteration to the fabric or fittings of laboratories is permitted without the permission of the Head of School. If any fitting is defective it should immediately be entered in the repairs book at the Purdie Building front entrance so that repair or replacement can be arranged.

7.2 Chemicals

All chemicals must be stored in an appropriate safe place. Old bottles of chemicals which have deteriorated or decomposed should be re-purified or immediately disposed of (see 11). All corrosive or hazardous chemicals must be periodically inspected for signs of leakage or deterioration. Any labels which have deteriorated or fallen off must be replaced immediately.

The need to keep the quantity of chemicals held in the School, and in particular those stored in laboratories, to the minimum is emphasised. The School has extensive stocks of many chemicals at the Main and Research Chemical Stores and these should be used whenever possible rather than ordering up new materials. Always check whether a material you need is already available here before ordering up new stocks. This may be conveniently done using the list in file "AllChem.doc" located in the Safety folder on the School of Chemistry server. All excess chemicals which will not be used for some time should be placed in the appropriate store. Consult the AllChem list to find which store an item belongs in and then return it to the Storekeeper (M) or Mr Iain Patterson (R).

7.3 Fume Cupboards

Fume cupboards are essential for much experimental work involving toxic or hazardous chemicals. Indeed, when space allows, it is advisable to handle all volatile chemicals in a fume cupboard. However fume cupboards which are filled with bottles of dangerous and corrosive chemicals are not suitable for experimental work. Fume cupboards used for experimental work must be cleared of all unnecessary items including bottles of dangerous chemicals**.** In particular the storage of highly toxic or corrosive chemicals along the back of such fume cupboards is forbidden. Where chemicals need to be stored in a fume cupboard they should be placed in one set aside for storage in which experimental work is not allowed. The vented cupboards available in some laboratories are ideal for this purpose. However these must be kept in good order and cleaned out regularly. This valuable space should not be wasted for storage of non-volatile materials and the storage of highly reactive non-volatile chemicals such as sodium or lithium metals or sodium hydride in these facilities is forbidden. Containers used for the collection of highly toxic waste for disposal must on no account be stored in a fume cupboard where experimental work takes place. While being filled they should be kept in a separate fume cupboard set aside for that purpose or in a closed wooden cupboard. Once full they should be disposed of immediately by arrangement with the School Safety Coordinator.

The performance of all fume cupboards is tested on an annual basis and the flow rates achieved recorded on the notice on the front. Please ensure that this notice remains legible and in place and report any problems with fume cupboard performance immediately to the School Safety Coordinator.

Certain fume cupboards within the School have been identified as being partly constructed of flammable materials. No operation involving any pyrophoric material is allowed within these fume cupboards. The pyrophoric materials covered by this regulation are those with hazard classification 5F and include all organozinc and organoaluminium compounds and t-butyllithium (but not other alkyllithiums), potassium metal and sodium acetylide. The cupboards concerned have been marked accordingly.

The ventilation systems in the BMS building and in the recently-refurbished areas of Purdie are centralised. This means that each section is only served by one large motor with one standby motor. If any section of fume cupboards fails (as indicated by the sounding of the alarms) during normal hours, you should IMMEDIATELY contact EITHER Dr John Smith OR Estates. Outside normal hours it should be treated as all other emergencies and be reported to the Call centre.

Experiments involving a foreseeable risk of explosion should be carried out within a fume cupboard and also surrounded by safety shields. Such experiments should preferably be carried out using a "single" fume cupboard. When potentially hazardous work of this nature is to be undertaken in a "double" fume cupboard, a special shield must be borrowed from the Store and fitted.

NB It may be necessary from time to time to call a halt, at short notice, to all discharges from fume-cupboard stacks, because of maintenance or similar work being carried out on the roof, or on roof-mounted facilities.

7.4 Personal Hygiene, Cleanliness and Good Laboratory Practice

Eating and drinking are strictly forbidden in all laboratories. In accordance with University policy, smoking is forbidden anywhere within the buildings. **The use of headphones of any kind in the corridors or laboratories is strictly forbidden. These must be removed when entering the building. These may be used in an office or write up area only**

No area in either the Purdie or BMS buildings is designed or properly equipped to allow the preparation of food under safe and hygienic conditions. **Accordingly the preparation or cooking of food is forbidden.** Specifically the installation or use of conventional or microwave ovens for cooking or heating food is not allowed, and items such as toasters and sandwich makers are also forbidden. Only the heating of water for the preparation of hot drinks is permitted.

Good practice requires that, after carrying out any experimental work, you should wash your hands thoroughly and move to a suitable clean area before eating or drinking. Consumption of food and drinks is only permitted in offices, writing up rooms where no chemicals are present, and in the Common Room. Eating and drinking in the corridors or in lecture theatres presents an unacceptable hygiene and litter problem and is not allowed. Storage of food and drinks is not allowed in any laboratory. The filing cabinets located in some corridors have been provided, at great expense, for the safe storage of research records and documents and are on no account to be used for storage of foodstuffs or clothing. These should instead be stored in a locker, which will be allocated on request by Mrs H. A. Williamson (MSB Chemistry teaching laboratory).

Experimental work in chemistry requires a degree of concentration and alertness, which is incompatible with excessive background noise. For this reason the playing of music is permitted subject to the following condition.

It must be with the agreement of all persons in the room and the volume must be controlled such that it is not audible outside the room.

Also, the use of headphones in the Purdie building is not permitted this includes, all laboratories, rooms and corridors.

The electrical safety of private electrical appliances is the responsibility of the owners and they may be held responsible for any damage or loss to the School arising, for example, from a fire started by a faulty appliance.

All personal electrical equipment must be tested for electrical safety when it is introduced into the School, and it must be regularly tested thereafter.

Care should be exercised in the use of gloves so that clean areas are not inadvertently contaminated. Gloves which have been in contact with toxic chemicals should be decontaminated or discarded as soon as possible. In particular they should not be allowed to come into contact with taps, door handles, telephone receivers, computer keyboards or books. It is interesting to note that experienced chemists handling dangerous chemicals prefer in many cases not to wear gloves on the grounds that this forces them to be careful and that any contamination which does occur is immediately noticed and can be dealt with rather than going unnoticed and being spread round the laboratory.

Library books are very expensive and in some cases irreplaceable and should not be taken into the high risk environment of a chemical laboratory except when this is really necessary. Where possible they should be consulted in the library or in awriting up room. Only when actually in use should they be taken into a laboratory. If it is essential to store regularly used library books in a laboratory they should placed inside a cupboard or drawer and not left out on an open bench, shelf or window-sill.

7.5 Laboratory Coats

All persons are strongly urged to adopt the correct use of laboratory coats. These provide a useful means of confining the dangers of toxic chemicals to certain areas within the building. Laboratory coats should be worn for all work with toxic chemicals and should then be taken off before leaving the laboratory area.
The wearing of laboratory coats in lecture theatres, common rooms and the library is strictly forbidden.

7.6 Freezers for General Use

(i) All items placed in these facilities must be labeled to indicate who is responsible for them. Where a research group or individual requires to put several items in these, it is sufficient for a compartment or shelf to be labeled rather than each item. No-one else should then put items in such a reserved space.

(ii) All containers placed in freezers must be securely closed. No open vessels are allowed.

(iii) All unlabelled items found in these facilities are liable to be removed and disposed of without warning at any time.

(iv) Freezers must be defrosted and cleaned out on a regular basis.

7.7 Rubber Tubing

To avoid flooding it is essential that rubber tubing carrying water is inspected regularly and replaced at the first sign of deterioration. For permanently running equipment plastic tubing is more durable. The use of wire to secure water tubing connections is not allowed under any circumstances. All water tubing connections must be secured if left unattended at any time. This must

be done using metal hose clips, high performance nylon hose clips or, for thin walled tubing only, plastic tension straps. Floods are often caused by the water flow being too hard or a free end of tubing coming out of a sink. Never put the water on any harder than necessary (remember the water pressure increases significantly at night) and secure water outlet tubes firmly in sinks. If rubber tubing has adhered to glassware, it is best removed by being cut away rather than being pulled or otherwise forced, in order to minimise the risk of breakage.

8. *Fire and Explosion Hazards*

Many substances used in the School are highly flammable or explosive. Stringent precautions are required to minimise the risk of accidents.

8.1 Flammable Solvents

Many organic solvents are highly flammable and their vapour forms explosive mixtures with air. The following rules are to be strictly observed:

(i) Stocks of flammable solvents stored in laboratories are to be kept to a minimum. As a rough guide, the stock should never exceed one Winchester bottle of each solvent per two research workers (specially dried or purified solvents may be counted separately).

(ii) Flammable solvents must never be disposed of by pouring down drains. This includes water miscible solvents such as methanol and acetone. For the correct disposal procedure see 11.2.

(iii) Winchester bottles of flammable solvents must be kept in the marked fire-resistant storage cupboards in each laboratory at all times except when being dispensed. Winchester bottles of flammable solvents must never be left on the floor, on benches or in direct sunlight.

(iv) Wherever possible flammable solvents should be heated electrically. The use of open flames for heating flammable solvents is forbidden.

NB Electrical heating mantles should only be used under reflux conditions, **never** for flask to flask distillation, when an oil-bath or steam bath should be used. Heating baths maintain a constant temperature, whereas heating mantles deliver a constant heat flow, leading to the possibility of dangerous overheating in flask to flask operations. Similarly, insulating materials such as glass wool or aluminium foil must **never** be wrapped around flasks being heating in electric heating mantles as, again, this can lead to dangerous overheating.

Safe use of Metal heating blocks (E.g. Drysyn).

As the use of metal heating block becomes more prevalent, it is important to use these correctly and be familiar with the manufacturers instructions. (a) Large round-bottom flasks (>1000 mL) can become

stuck or broken if they are allowed to cool in a heating block, solvent stills are therefore vulnerable. When heating a flask with a metal block, the heating assembly should be mounted on a laboratory jack, this allows the heating block/hotplate assembly to be lowered immediately after the operation is complete. (b) The heating block should NOT be heated beyond that stated in thespecifications (normally 250 C is the maximum).

(v) Wherever possible flammable solvents should be used in a fume cupboard. Before using a flammable solvent make sure there is no open flame or other source of ignition in the vicinity.

(vi) Any experiment, including redistillation, involving the heating of more than 1 litre of a flammable solvent must be carried out in an overnight room (see 12).

(vii) Distillation of solvents using a dangerous set-up in which flammable vapour can escape through the collection port without passing through the condenser is forbidden.

(viii) Chromatography supports (silica and alumina) covered with flammable solvents must not under any circumstances be placed directly in a waste bin. For correct disposal procedure see 11.3.

Arrangements for the supply of solvents

To increase the efficiency of distribution of solvents from the Main Store, a locked solvent storage bin has been constructed adjacent to the external solvent Store. At some times, persons requesting a solvent at the Main Store may be given the key to this bin and asked to take the solvent themselves. Those issued with the key in this way must take only the solvents they have signed for at the Store, ensure that the bin is securely relocked, and return the key immediately to the Main Store hatch.

8.2 Other Fire Hazards

Certain substances may ignite spontaneously on contact with air or water. These must be handled and disposed of with great care.

(i) ***Hydrogenation catalysts*** - including palladium/charcoal and Raney nickel may ignite spontaneously in air. Under no circumstances are these to be placed in a waste bin. They should be made safe and the residues either washed down the sink with copious water (Pd/C), or retained for special disposal (Ni).

(ii) ***Reactive metals*** - Finely divided magnesium, aluminium and zinc may ignite spontaneously. These must not be placed in a waste bin but should be fully dissolved in dilute acid and the residues then washed down the sink with excess water.

(iii) ***Organometallic reagents*** - Many commonly used solutions of organolithium compounds, Grignard reagents and other organometallics in organic solvents may ignite spontaneously in moist air. These should be handled under nitrogen and disposed of as detailed in the following Section.

8.3 Disposal of Pyrophoric Reagents

The following detailed procedure for the safe disposal of used bottles of pyrophoric organometallic reagents must be strictly followed. This regulation applies to commercial bottles of methyllithium, butyllithium (all isomers), phenyllithium, Grignard reagents and also to stocks of such reagents prepared in house.

a. The quantities of such reagents for disposal must be minimised by keeping bottles in good order, properly sealed and not allowing moisture or oxygen to enter. If the concentration of such a solution has dropped, carry out a titration to find the current concentration and wherever possible use the remaining reagent, do not simply order up a new bottle. Once the contents of a bottle are of no further use, they must be disposed of immediately using the procedure below and on no account stored for prolonged periods.

b. The disposal of pyrophoric materials must only be carried out in the fume-cupboard of an overnight room (Room 339 or 438). This is a potentially dangerous operation:— expect a fire and plan in advance exactly what action will be taken in that event. On no account carry out this operation outside normal working hours or over lunch time (1–2 pm).

c. No other materials and in particular no flammable materials must be present while the fume cupboard is being used for such an operation. A dry powder fire-extinguisher should be placed in readiness beside the disposal site.

d. Carefully remove the top from the bottle and place it inside a large fire-clay trough behind a safety shield at the back of the fume cupboard. With great care, add all at once 100 ml of isopropanol or ethyl acetate. Particularly in the case of methyllithium, ethyl acetate is recommended for this operation. While it has a lower flash point than isopropanol (–3 ˚C vs. 22 ˚C) the reaction is less exothermic, and of particular importance in the case of methyllithium, no flammable gas is evolved since an addition rather than hydrolysis reaction is involved.

e. After waiting for 30 min., any visible crust of solid must be carefully broken up using a glass or metal rod before pouring out the contents of the bottle, behind the safety shield, into a large fire-clay trough half full of water. After pouring out the contents, the bottle should be rinsed out with ethyl acetate or isopropanol first into the trough and only then with water. After allowing to stand for a further 30 min the contents of the trough should be washed down the sink with plenty water.

f. If a fire breaks out, proceed immediately as above under *Small Fires in a Fume Cupboard*. If the fire is not immediately extinguished, leave the overnight room, close the door and activate the extinguisher system using the yellow panel to the left of the door.

8.3 Explosive Hazards

All experiments involving potentially explosive substances must be carried out in a fume cupboard, **behind a safety shield**. Except under special circumstances explosive substances should not be heated and must never be subjected to grinding or mechanical shock.

The following materials are explosive:

(i) All azides, organic and inorganic (except sodium azide).

(ii) Certain acetylenes including dimethyl- and diethyl acetylenedicarboxylate which explode on distillation, All metal acetylides.

(iii) All diazo compounds.

(iv) All diazonium salts - (aryl diazonium fluoroborates are marginally safer).

(v) Hydrazine.

(vi) All perchlorates, organic and inorganic - (see 8.4 (ii)).

(vii) Ammonium nitrate.

(viii) All peroxides - (see 8.5).

(ix) Many nitro compounds including polynitroalkanes and polynitro-aromatics such as trinitrobenzene, trinitrotoluene, trinitrophenol (picric acid), metal picrates, trinitrochlorobenzene (picryl chloride), all o-nitrobenzoyl chlorides and metal salts of nitrophenols.

(x) Some poly-nitrogen heterocycles such as tetrazoles and tetrazines.

8.4 Oxidising Agents

Certain strong oxidising agents are themselves stable, but react with any organic material to cause fire or explosion. These include:

(i) Fuming nitric acid and concentrated nitric acid - Operations involving these should be performed on as small a scale as possible. Special care is required when using conc. nitric acid for cleaning purposes: Nitric acid should only be used as a last resort for removal of metal residues

not for organic dirt. The apparatus must be thoroughly washed with water before and after use of nitric acid. The mixing of nitric acid with organic solvents such as ethanol or acetone for cleaning purposes is extremely dangerous and is prohibited.

(ii) Perchloric acid - Steps should be taken to avoid accidental contact of perchloric acid with any other material. Several very serious accidents have occurred after a spillage of perchloric acid reacted with organic material (e.g. a wooden floor). There was often no immediate effect but friction or spillage of another chemical many years later resulted in explosions and fires. Any spillage of perchloric acid must be reported immediately to the School Safety Coordinator. Never mix perchloric acid with dehydrating agents such as acetic anhydride or sulfuric acid.

(iii) Hydrogen Peroxide - While normal concentrations of hydrogen peroxide up to 30% ("100 volume") do not present a serious hazard, stronger solutions may cause spontaneous ignition of any organic material. Solutions stronger than 50% and particularly 90% "anhydrous" H_2O_2 require special precautions and may not be used without the permission of the School Safety Coordinator.

(iv) Liquid Oxygen - Because nitrogen has a lower boiling point than oxygen, cooling any vessel in liquid nitrogen while it is open to the air results in the condensation of a liquid rich in liquid oxygen. This may cause a violent explosion in contact with any organic material. This situation most often arises through forgetting to remove the liquid nitrogen flask from a trap in a vacuum system after it is opened to the air. If this does occur allow the liquid oxygen to evaporate behind a safety shield in a fume cupboard.

Another case where this may occur is in the cooling of a glass tube of reagents for sealing. Sealed tubes must be flushed out with nitrogen before sealing. Do not apply a positive pressure of nitrogen since this will condense liquid nitrogen inside the tube and it will explode on warming.

8.5 Ether Peroxides

Many commonly used ether solvents form explosive peroxides on storage. These include: diethyl ether, tetrahydrofuran, 1,4-dioxane, all ethers of ethylene glycol and higher ether diols (including glyme, diglyme, etc.), all aliphatic ethers such as di-n-butyl ether and diisopropyl ether which peroxidises particularly easily.

(i) Most of these solvents are now supplied containing an inhibitor to prevent peroxide formation. This will be removed by distillation. Do not redistill these solvents unnecessarily and if distillation is necessary the distilled solvent should be used immediately. Never store quantities of ethers which have had the inhibitor removed by distillation.

(ii) Note that the inhibitors used only prevent peroxide formation. Once peroxides have formed the inhibitor will not destroy them.

(iii) All ether peroxides are less volatile than the corresponding ethers and evaporation will concentrate them leading to a violent explosion. Never evaporate an ether solution which may contain peroxides.

(iv) All redistilled ethers and older bottles of ethers must be tested for peroxides before use and peroxides if present must be removed (test and removal procedure - Vogel, p.272).

(v) For disposal of ethers found to be badly peroxidised or containing crystalline deposits of peroxide consult the School Safety Coordinator.

8.6 Sodium and Potassium Metal

Because of their extreme reactivity sodium and potassium present a serious fire and explosion hazard.

(i) The sodium presses (room 438 and 322) used to produce sodium wire for drying solvents should be kept clean and tidy. Excess sodium on the press and die should be destroyed with ethanol or methylated spirit immediately after use (see also 11.6).

(ii) On no account try to dry any chlorinated solvent with sodium - a violent explosion will result.

(iii) The oxide coating on old potassium may catch fire or explode on touching (e.g. on cutting up). Potassium should always be cut up under oil. Oxidised potassium should be disposed of with great care.

(iv) *Disposal Procedures* - Disposal of alkali metals, which involves addition to a flammable solvent and liberation of large quantities of hydrogen, is a serious fire hazard. Always carry this out in a fume cupboard away from sources of ignition and anticipate a fire. Alkali metals are disposed of by careful addition of small pieces to an excess of an alcohol: for sodium and lithium use ethanol or methylated spirit; for potassium use isopropanol. When the reaction is complete wash the solution down the sink with plenty of water. On no account are sodium or potassium, even in small quantities, to be disposed of by addition to water.

(v) Fires involving sodium or potassium should never be tackled using water or CO_2 extinguishers. Use only dry sand or a dry powder extinguisher. Small fires during disposal of these metals may be quickly extinguished by covering the vessel with a glass plate.

8.7 Carbon Disulfide

Besides being highly toxic (LTEL* 10 ppm), carbon disulfide presents a very serious fire and explosion hazard due to its extreme volatility, low flash point (–30 ^{o}C) and low autoignition temperature (102 ^{o}C). The latter means that its vapour can ignite spontaneously even in contact with steam-heated equipment. (* for definition of LTEL see section 9.1).

9. *Chemical Hazards*

The chemical, physical and toxicological properties of the majority of substances purchased by the School, and all the subsequent research chemicals derived therefrom, have not been fully investigated. Their handling and usage may be hazardous. Working practices should be adopted which minimise the exposure of yourself and others to contact with all chemicals**.**

Current legislation requires among other things that :

(i) All substances and biological organisms in use in the School must have been assessed for their potential hazard to health and a record of such assessment kept, subject to inspection by the Health and Safety Executive.

(ii) Based on the hazard assessments each operation involving a hazardous material must be assessed with regard to the degree of risk involved and (a) the risk assessment recorded on a Risk Assessment Form again subject to external inspection (b) the appropriate control measures and precautions instituted to safeguard the health of those involved.

(iii) Control equipment such as fume cupboards and biological safety cabinets must be tested for efficiency at least every 14 months and a written record kept of the results.

Hazard Assessment involves an informed judgement of the degree of hazard posed by a substance in the light of available safety information including where appropriate its Occupational Exposure Limit (see Section 9.1) contained in the most recent edition of Guidance Note EH/40 and its classification under current legislation.

The result of the Hazard Assessment will be expressed as a hazard rating according to the following five point scale:

5 = highly hazardous
4 = hazardous
3 = moderate hazard
2 = low hazard
1 = no significant hazard

The nature of the hazard(s) involved will be indicated by adding letters as follows:

A = corrosive or irritant	C = carcinogenic
F = flammable	O = oxidising agent
T = toxic	X = explosive
M = mutagenic	R = radioactive

When ordering chemicals, all research workers must look up and mark the Hazard Assessment Code of all materials ordered on the order form. This can

be found by consulting the University's Chemical Hazard Risk Management (CHARM) System available at http://charm.st-andrews.ac.uk/COSH/. If a material does not appear on this system, consult the University Chemicals Hazards Adviser, Dr R. A. Aitken, who will assign a code and inform you of it as soon as possible. Orders without a code will not be sent out.

It should also be noted that chemicals and biological organisms obtained other than by conventional ordering (e.g. as a gift from a company or collaborator outside St Andrews) must also be assigned a hazard code. Only commercially available chemicals are assigned a hazard code. "Home-made" substances should be typed in manually on the form and the hazard code column left blank. The hazards of such materials must however be fully considered in the course of the risk assessment

No operation involving any chemicals or biological organisms may be started unless a Risk Assessment Form has been completed and signed by the School Safety Coordinator (for any operation involving a Class 5 chemical) or by your supervisor (in other cases).

A detailed record is kept of the number of Risk Assessment Forms current for all personnel. All workers must ensure that they have properly completed and signed forms in place for all aspects of their work. You are reminded that persistent refusal to abide by legally required Health and Safety procedures would constitute valid grounds for termination of studies for research students and dismissal for post-doctoral workers and other employees.

Risk assessments must be displayed outside each laboratory, in the document holder provided, for all chemical operations in progress within that laboratory. It is the responsibility of all research workers to ensure that the displayed risk assessments are current and complete, with no redundant or obsolete assessments.

A. Carrying out a Risk Assessment

To consider the possible dangers of a given operation and to plan in advance what action would be needed in the event of any mishap is clearly the duty of any responsible and professional research worker. Although most people have probably been doing this informally for some time, it is now required that this be carried out in a more formal and systematic way with written records being kept.

For every operation you intend to undertake you must carefully consider and assess all possible risks, decide how to minimise these and how you would deal with any foreseeable consequence of anything going wrong. If you have any doubts about what some of the risks may be, you must ask your supervisor for advice. Your supervisor has copies of the University publication "Guidance on Risk Assessments" which contains valuable information on the risk assessment procedure in general and can also obtain more specific information in the form of the manufacturers Material Safety Data Sheet for any substance you intend to use if required. It is up to you, in consultation with your supervisor, to obtain all the necessary information to conduct a

thorough risk assessment. Having assessed the risks associated with the operation, complete a Risk Assessment Form as described below.

When a risk assessment has been completed, it is essential that all safety measures identified in the assessment must be in place throughout the operations covered by the assessment, without exception.

B. Filling in a Risk Assessment Form

This must be done using the CHARM system referred to above. All users of this system are recommended to consult both the System User Notes and the COSHH Guidance Notes, both available via links on the CHARM from page.

The system is designed to be largely self-explanatory and you should follow the instructions given at each stage. If you have problems consult the System User Notes or in the last resort consult the School Safety Coordinator. Any malfunction should be reported to the School Safety Coordinator immediately giving as much detail as possible about the nature of the problem.

Note in particular the following points:

a. All workers must fill in their own forms.

b. The forms apply to individual work activities, such as a preparative experiment, a particular type of measurement etc. and also such operations as washing-up using a flammable solvent. Forms are not required for storage of chemicals or equipment, nor for purely physical activities involving no chemicals, such as drying of equipment. Wherever possible you should try to combine closely related operations on a single form. For example if you are carrying out a particular reaction on a series of similar starting materials, only one form is required. In filling in the forms, be sure to include all stages of the operation from beginning to end. For a preparative experiment. for example, you must include preparation of reagents and extraction, purification and processing of the product as well as the actual reaction. The operation of **dry solvent stills**, by which is meant not only setting up and maintaining them but obtaining solvents from them, requires a separate risk assessment form.

c. Begin by typing in the name of each chemical or biological organism to be used. In doing this, relegate all numbers, letters and brackets which describe isomers to the end and be careful as to what should be a separate word. If you are unsure exactly how to spell a name, simply entering the first few letters followed by 'return' will give all names containing this fragment from which you can select the right one. In accordance with the 1990 decision of IUPAC, sulfur, aluminium and caesium and all derived names should be spelled as such. Examples:

ethyl acetate but ethylbenzene dipropylphenol 2,4- -iso-
cytosine glucopyranoside 1-alpha-D-
ethyl chlorophenylacetate (±)- alpha-
bis(diphenylphosphino)butane 1,4-

If after trying all possible alternative names and spellings the system does not find a chemical, obtain a code for it from the University Chemicals Hazards Adviser, Dr R. A. Aitken, before proceeding.

Once you have obtained the code for all the chemicals and organisms, proceed with the system which will create a form automatically. Note that the system is designed to automatically fill in the substances used together with their official hazard codes. When you find a substance of interest do not note down the code, simply click on the substance and it is thereby collected to appear on the form. For class 5 materials, exposure limits, where they are known should be entered with the appropriate concentration units: exposure limits can be obtained from http://www.hse.gov.uk/coshh/index.htm, and all users of the CHARM system are recommended to obtain this listing.

d. In the box marked assessor, enter your e-mail address.

e. In filling in the Procedure section describe briefly what is involved within the space provided, **but carefully drawing attention to any potential hazards and what precautions are required.** Similarly in the Procedures for Disposal section, draw particular attention to the hazards involved and the resulting precautions needed.

f. After you have indicated the major risks involved by clicking the appropriate boxes, choose the emergency action needed from the pull-down menus. Fill in the section on disposal again using the pull-down menus.

C. Processing of Forms

When you are satisfied with the form, add your electronic signature. **Each form must be signed by all users named in it.** Print a copy for your own use,; the system will notify your supervisor & request his/her approval: where class 5 materials are involved, the system will then notify the School Safety Coordinator for his approval. Forms not approved by the School Safety Coordinator will be returned via the system with a detailed explanation of the reasons for rejection, and a description of the modifications required.

Notes

a. If your supervisor or the School Safety Coordinator is away for any period, you should submit forms for signing to the nominated deputy.

b. **The requirement to complete a form for each potentially hazardous operation has been introduced in direct response to the report of the Health and Safety Executive and an Improvement Notice which is a legally binding directive. Any person who carried out an operation without having completed the required form and having had it properly signed would deprive themselves and/or their supervisor of a means of defence in the event of a criminal prosecution.**

c. Supervisors are reminded of their clear legal responsibility for ensuring not only that risk assessments are in place for each operation carried out by those under their control, but also that these are thorough and complete (to use the legal term 'suitable and sufficient') and that the procedures contained within them are followed.

9.1 Poisons

Whilst all chemicals should be regarded as potentially toxic, certain substances used within the School are known to be very severe poisons. In handling these all possible precautions must be taken to completely avoid contact with the body or release to the environment. An attempt has been made to quantify the toxic hazard of many chemicals by the introduction of certain limits.
Many materials have been assigned a Workplace Exposure Limit (WEL). For each material one or both of two limits may exist: the Long Term Exposure Limit (LTEL) is the concentration to which it is believed nearly all persons can be repeatedly exposed without adverse effect and it has an 8-hour reference period; the Short Term Exposure Limit (STEL) is a higher concentration which should not be exceeded even for a short time, and it has a 15-minute reference period. In the absence of further information it is reasonable to assume the STEL is about two-three times the LTEL.

Schedule 1 Poisons - Substances listed in Schedule 1 of the Poisons Rules, 1968, are subject to strict legal control. The common Schedule 1 poisons are listed below, together with other poisons of comparable or even greater toxicity which do not appear in Schedule 1 only because they are not in common industrial use. **These substances must be stored in a LOCKED CUPBOARD** and excess quantities returned to the Store as soon as possible. **These materials all have classification 5T and will only be issued from the Store on production of the appropriate Risk Assessment Form.**

(i) Compounds of arsenic (LTEL 0.1 mg/m^3).

(ii) Alkaloids and dangerous drugs including strychnine, brucine, morphine, codeine, atropine and many others.

(iii) Compounds of barium (LTEL 0.5 mg/m^3) except barium sulfate.

(iv) Bismuth iodide.

(v) All bis(2-chloroethyl)amines ("nitrogen mustards", see also section 23).

(vi) Compounds of cadmium (LTEL 0.025 mg/m^3)

(vii) Sodium and potassium cyanides (see 9.7), all other metal cyanides and hydrogen cyanide (but not ferrocyanides or ferricyanides).

(viii) Fluoroacetic acid and its salts, fluoroacetamide, fluoroacetanilide and fluorocitric acid.

(ix) Lead tetra-acetate and organolead compounds.

(x) Methyl bromide.

(xi) Compounds of mercury (LTEL 0.025 mg/m^3).

(xii) All nitro- and dinitro-phenols, -naphthols, -cresols and -thymols, p-nitrobenzyl cyanide.

(xiii) Osmium tetroxide (LTEL 0.0002 ppm).

(xiv) Paraquat and derivatives.

(xv) Fluorophosphate and fluorophosphonate nerve gases and similar compounds (see also section 23).

(xvi) Metal phosphides.

(xvii) Compounds of selenium (LTEL 0.1 mg/m^3).

(xviii) Componds of tellurium (LTEL 0.1 mg/m^3).

(xix) Compounds of thallium (LTEL 0.1 mg/m^3).

(xx) Organo-tin compounds (LTEL 0.1 mg/m^3) (readily absorbed through the skin).

Other highly poisonous substances - The following substances, many in common use, are highly toxic. These have classification 5T or 4T.

(i) Volatile and unsaturated aldehydes and ketones including acetaldehyde (LTEL 20 ppm), acrolein (LTEL 0.1 ppm), crotonaldehyde, glutaraldehyde (LTEL 0.05 ppm) and methyl vinyl ketone.

(ii) amyl nitrite - a powerful heart stimulant.

(iii) Simple aliphatic amines including methylamine (LTEL 2 ppm), ethylamine (LTEL 2 ppm), dimethylamine (LTEL 2 ppm), diethylamine (LTEL 5 ppm), trimethylamine, triethylamine (LTEL 2 ppm), diisopropylamine (LTEL 5 ppm), 1,2-diaminoethane.

(iv) Aromatic amines including aniline (LTEL 1 ppm) and all substituted anilines such as anisidines, 2-aminopyridine, N-methylaniline (LTEL 0.5 ppm), o-toluidine, p-phenylenediamine. (Highly toxic by skin absorption).

(v) Volatile organic azides and sodium azide (LTEL 0.1 mg/m^3).

(vi) Benzene (LTEL 1 ppm) - see 9.3.

(vii) Volatile metal carbonyls including nickel carbonyl (STEL 0.1 ppm) and iron pentacarbonyl (LTEL 0.01 ppm).

(viii) Dimethyl and diethyl sulfate (LTEL 0.05 ppm) - rapidly absorbed through the skin (antidote - conc. ammonia), also carcinogenic.

(ix) Halogenated solvents and other halogenated compounds including carbon tetrachloride (LTEL 2 ppm) and chloroform (LTEL 2 ppm) (see 9.5), and bromoform, carbon tetrabromide, 1,2-dichloroethane (ethylene dichloride, LTEL 5 ppm), benzyl chloride (LTEL 0.5 ppm), 1,2,4-trichlorobenzene (LTEL 1 ppm), hexachlorocyclopentadiene,

iodoform (LTEL 0.6 ppm), methyl iodide (LTEL 2 ppm), 1,1,2,2-tetrachloroethane.

(x) All compounds of many transition metals and heavy metals including chromium (LTEL 0.5 mg/m^3 for Cr^{II} and Cr^{III} and 0.05 mg/m^3 for Cr^{VI}), cobalt (LTEL 0.1 mg/m^3), manganese (LTEL 0.5 mg/m^3), nickel (LTEL 0.1 mg/m^3), platinum (LTEL for soluble salts 0.002 mg/m^3), rhodium (LTEL for soluble salts 0.001 mg/m^3), ruthenium, silver (LTEL for soluble salts 0.01 mg/m^3, for metal 0.1 mg/m^3), tin (LTEL for inorganic compounds 2 mg/m^3), molybdenum, tantalum and zirconium (all LTEL 5 mg/m^3), vanadium pentoxide (LTEL 0.05 mg/m^3).

(xi) All organic isocyanates (LTEL 0.02 mg/m^3).

(xii) Nitrobenzene (LTEL 1 ppm) and all substituted nitrobenzenes.

(xiii) Oxalic acid (LTEL 1 mg/m^3) and its salts.

(xiv) Phenol (LTEL 5 ppm) and all substituted phenols including cresols (LTEL 5 ppm) and picric acid (LTEL 0.1 mg/m^3). (Highly toxic by skin absorption).

(xv) Pyridine (LTEL 5 ppm) and substituted pyridines.

(xvi) Thiophenol and all substituted thiophenols.

9.2 Carcinogens

These substances present a very serious hazard since slight exposure, even on a single occasion, may result in serious irreversible effects producing cancer. In handling these compounds all possible steps must be taken to completely avoid contact with the body or release to the environment. The following list of carcinogens, many of which are subject to statutory control under the Carcinogenic Substances Regulations, 1967, must not be taken as comprehensive. Most of these materials have classification 5T,C.

(i) Certain aromatic nitrogen compounds including:

α- and β-Naphthylamine, nitronaphthalenes.
All amino and nitrobiphenyls, including benzidines, tolidines, dianisidines, aminobiphenyls, nitrobiphenyls.
All amino and nitro stilbenes.
o-Toluidine.
3-Amino-1,2,4-triazole and related compounds.
Nitroquinoline N-oxides and similar compounds.

(ii) Certain polycyclic aromatic hydrocarbons, notably "bay region" compounds such as benzo[*a*]pyrene, and heterocyclic analogues such as benzacridine.

(iii) All N-nitroso compounds including

Nitrosamines such as dimethylnitrosamine.

Nitrosamides, including the diazomethane precursors N-methyl-N-nitrosourea, N-methyl-N-nitrosoguanidine and N-methyl-N-nitroso-p-toluenesulfonamide ("Diazald").

(iv) All diazo-compounds including ethyl diazoacetate and diazomethane (see 10.3).

(v) Alkylating agents including:

All epoxides and aziridines.
Dimethyl and diethyl sulfate (LTEL 0.05 ppm).
Trimethyl- and triethyloxonium fluoroborate ("Meerwein reagents").
All alkyl halides, particularly more volatile and reactive ones such as methyl iodide (LTEL 2 ppm) and ethyl bromide.
Methyl fluorosulfonate ("Magic methyl") - see 9.10.
Acylating agents such as β-propiolactone, β-butyrolactone and 1,3-propanesultone.

(vi) All hydrazines and simple derivatives thereof, e.g. 1,1- or 1,2-dimethylhydrazine, methylhydrazine, hydrazine (LTEL 0.02 ppm).

(vii) Vinyl halides including vinyl chloride monomer (LTEL 3 ppm), vinyl bromide and acrylonitrile (LTEL 2 ppm).

(vii) Haloalkane solvents including carbon tetrachloride (LTEL 2 ppm), chloroform (LTEL 2 ppm), 1,2-dibromoethane (ethylene dibromide) (LTEL 0.5 ppm), hexachlorobutadiene and trichloroethylene.

(viii) Benzene (LTEL 1 ppm) - see 9.3.

(ix) Hexamethylphosphoramide - see 9.8.

(x) Chloromethyl methyl ether and bis(chloromethyl) ether (LTEL 0.001 ppm) - see 9.6.

(xi) Certain compounds of arsenic, beryllium, cadmium, cobalt, nickel and chromium(VI) including nickel sulfide, lead and zinc chromates, chromic acid (see 9.13).

(xii) All radiochemicals.

(xiii) All forms of asbestos.

(xiv) Miscellaneous compounds including ethyl carbamate (urethane), thioacetamide, and thiourea.

Use of Asbestos Items

The use of items containing asbestos must be avoided wherever possible. In particular such items as asbestos gloves, tape, string and wire gauzes are not allowed and these should be replaced by safer substitutes. The smooth compressed asbestos/cement boards may be used but not older style rough boards. Any items containing asbestos, or which are suspected of containing asbestos should all be passed to Dr J. S. G. Smith for approved disposal.

9.3 **Benzene**

Although commonly used for many years, benzene is now known to be so dangerous that it must not be used except when there is no possible alternative. Benzene is rapidly absorbed both by inhalation and skin contact to produce very serious irreversible effects leading to leukaemia. The LTEL is 1 ppm, and the level at which it can be detected by smell is already well above this. Benzene must only be handled in an efficient fume cupboard and wearing heavy gloves. For most purposes toluene is a safer substitute (LTEL 50 ppm).

9.4 **Beryllium**

Beryllium (LTEL 0.002 mg/m^3) and all its compounds are extremely toxic and also carcinogenic. No compound of beryllium may be used without the permission of the School Safety Coordinator.

9.5 **Carbon tetrachloride and Chloroform**

Carbon tetrachloride (LTEL 2 ppm) and chloroform (LTEL 2 ppm) are both highly toxic, accumulating in the liver and kidneys to produce very serious irreversible effects including cancer.

In addition, recent EU legislation on ozone-depleting substances requires stringent control measures to prevent any escape of carbon tetrachloride into the environment: the use of this substance as a solvent is forbidden except in circumstances where it can be demonstrated that no practical alternative exists.

Similarly, chloroform must not be used except where there is no possible alternative (an exception is the use of deuteriochloroform as an NMR solvent, which should nevertheless be handled with adequate precautions). Work with these solvents must only be carried out in an efficient fume cupboard and wearing heavy gloves. Dichloromethane (LTEL 100 ppm) is a much safer substitute in most applications and, where a higher boiling solvent is required, 1,1,2-trichloro-1,2,2-trifluoroethane ("Arklone", LTEL 1000 ppm) may be used.

9.6 **Chloromethyl methyl ether and bis(chloromethyl) ether**

Commercial samples of chloromethyl methyl ether contain a significant impurity of bis(chloromethyl) ether (LTEL 0.001 ppm) which is an extremely

powerful carcinogen. Cancer has been caused in experimental animals at concentrations as low as 0.1 ppm. Neither of these substances may be used without the permission of the School Safety Coordinator. Bis(chloromethyl) ether is also formed at room temperature when formaldehyde and HCl vapours mix and in Friedel-Crafts reactions involving formaldehyde. All personnel should consider very carefully whether this compound might be formed fortuitously in the course of any operations (for example washing up) and take adequate precautions.

9.7 Cyanides

Because of the extremely rapid and potentially fatal consequences of cyanide poisoning the following rules must be strictly observed for all experiments involving inorganic cyanides or hydrogen cyanide.

(i) All experiments involving significant quantities of cyanides must be carried out in the fume cupboard of the Level 4 overnight room in the BMS Building (Room 4.03). The fume cupboard should be posted with warning notices clearly indicating that cyanide is in use.

(ii) Experiments using cyanides are only permitted in normal working hours. While a reaction may for example be left overnight, any steps involving manipulations (for example, setting up the experiment, taking it off and extracting the product) must be done during normal working hours. In the event of poisoning the required treatment is rapid administration of oxygen and transport to hospital. To allow this a specific First Aid Worker who has had the necessary training must be identified before the work begins and they must be on call. Any person using cyanides must be accompanied by another at all times who can quickly summon the First Aid Worker if required.

(iii) Before any work with cyanide commences, a special form (available from the School Safety Coordinator) must be completed to indicate the precise date(s) and times of the planned manipulations, who will be the other person accompanying the worker at all times, and which first aid worker will be on call. This must be signed by the School Safety Coordinator together with the Risk Assessment Form before the work begins. Note that a special form must be completed and signed each time a cyanide experiment is planned.

(iv) *Disposal Procedure*. The disposal of solutions containing cyanides directly down the drain or of solids contaminated with cyanides directly into a solid waste container is strictly forbidden**.** All cyanide wastes, solid or liquid, must first be made safe by addition to a strong solution of sodium hypochlorite. After at least 24 hours or when a Prussian Blue test shows cyanide to be absent, solids should be removed, washed with water, and placed in a controlled waste bin and the solution poured down the sink in a fume cupboard. Gloves and apparatus may be decontaminated in a similar way. Solids which have been made safe should not be sent for special disposal.

(v) The solution of sodium or potassium cyanide in dimethyl sulfoxide, sometimes required in organic synthesis, is immediately fatal on contact with the skin and may not be used without the permission of the School Safety Coordinator.

(vi) As Schedule 1 poisons, cyanides must be stored in a locked cupboard at all times. Research groups using cyanides on a regular basis are not allowed to return opened bottles of cyanide to the store. The existing stock should be used up or, if it has deteriorated, safely destroyed as in (iv) above. Only then may a new bottle be issued from the store.

9.8 Hexamethylphosphoric triamide (HMPA, HMPT)

Hexamethylphosphoramide has long been known to be highly toxic but it has recently been reported that it is also very strongly carcinogenic, producing cancer in experimental animals at concentrations as low as 0.4 ppm. The most stringent precautions must be taken in its handling and disposal.

9.9 Hydrofluoric acid

In contact with the skin hydrofluoric acid produces very severe burns which may take some time to become apparent. Several cases of serious HF burns have been followed by death from systemic fluoride poisoning. Anyone intending to use hydrofluoric acid must first obtain the treatment for burns, calcium gluconate jelly from the store. Anyone suffering skin contact with HF should apply this treatment and then get immediate medical attention.

9.10 Methyl Fluorosulfonate ("Magic methyl")

Some time ago a research student in the Netherlands died after accidentally inhaling the vapour of "magic methyl". Commercial production of this compound has now been stopped and in view of its high volatility and extreme potency as an alkylating agent, its preparation or use in the School is strictly forbidden without the permission of the School Safety Coordinator.

9.11 Mercury

Mercury vapour is extremely toxic and stringent precautions must be taken to avoid its inhalation. Although the vapour pressure of mercury at room temperature is low, evaporation may be rapid if it is finely divided or on heating. In the absence of ventilation the concentration may ultimately reach 20 mg/m^3 in a confined space. The LTEL for mercury vapour is 0.025 mg/m^3 and even brief exposure to 1 mg/m^3 will result in serious poisoning.

(i) An exposed surface of mercury must never be left open to the air in any laboratory. All mercury stored in bottles or in manometers open to the air should be covered with a layer of water. Mercury should always be handled in a fume cupboard.

(ii) The exhaust from all vacuum systems containing mercury must be vented to a fume cupboard or out a window. All possible precautions must be taken to prevent mercury being sucked into oil pumps: the hot oil will cause a dangerous release of mercury vapour.

(iii) The release of mercury vapour resulting from fracture of a hot mercury diffusion pump is likely to cause serious poisoning or death to all persons in the vicinity. These pumps should not be used unless absolutely essential and must be inspected periodically for cracks.

(iv) Any spillage of mercury should be treated as follows:
pick up all large drops by suction using a pipette connected *via* a trap to the water pump. Cover the affected area with a paste of sulfur and lime in water (this is more effective than sulfur alone). When the mercury has been absorbed (several hours) sweep up the mixture, place it in a bottle and give it to the School Safety Coordinator for special disposal.

(v) Items contaminated with finely divided mercury should be submitted for special disposal.

9.12 Thiols and Sulfides

Because of their extremely strong and unpleasant smell, it is imperative that stocks of low molecular weight thiols and sulfides are kept to the minimum and stored under appropriate conditions. Thiols or sulfides with five carbon atoms or less **may not be ordered up** and the School Purchasing Officer has been given instructions to this effect. Instead they must be obtained from the School Safety Coordinator who keeps the stock of such substances under his personal control. The substances involved are:
methanethiol, ethanethiol, propane-1- and -2-thiol, butane-1-thiol, 2-methylpropane-1- and -2-thiol, pentane-1-thiol and 3-methylbutane-1-thiol, ethane-1,2-dithiol, propane-1,3-dithiol, butane-1,4-dithiol, thioacetic acid, methyl thioglycolate (methyl mercaptoacetate), dimethyl sulfide, dimethyl disulfide, diethyl sulfide, diethyl disulfide, methyl allyl sulfide and tetrahydrothiophene.

9.13 Chromic Acid

The mixture of sulfuric acid and chromic acid formerly in common use for cleaning glassware is highly dangerous. Apart from the obvious corrosive nature of the acid, solutions of Cr^{VI} are highly toxic (LTEL 0.05 mg/m^3) and there is strong evidence that it is also carcinogenic. A particular danger exists in the preparation of chromic acid which involves a highly exothermic reaction and in some cases has resulted in an explosion with disastrous consequences. For these reasons chromic acid must not be used unless there is no possible alternative. In many cases modern detergents (Decon 90", "Micro", etc.) are an efficient and safe alternative for cleaning. Where chromic acid must be used the following precautions must be strictly observed:

(i) The preparation of chromic acid must only be carried out by experienced personnel. Thick rubber gloves and face mask must be worn.

(ii) Baths of chromic acid must be covered by a glass plate at all times.

(iii) Tongs and/or thick rubber gloves should be used to put items in and out of chromic acid. Skin contact must be avoided.

(iv) Many nitrogen compounds react in chromic acid to release highly toxic nitrogen dioxide fumes. Where this is likely to occur the bath must be sited in a fume cupboard.

(v) Chromic acid should be made up in the minimum quantity required and disposed of as soon as it is depleted or no longer required. In no circumstances is chromic acid to be stored in closed bottles.

10. *Gases*

In the event of a fire or serious accident the presence of large numbers of compressed gas cylinders in the building presents a serious additional hazard. The need to keep the quantity of compressed gas cylinders in all laboratories to the absolute minimum is emphasised. All gas cylinders should be returned to the appropriate Cylinder Store immediately after use and when empty.

Access to the cylinder stores is by key obtainable from the Main Store.

Access to the non-flammable gas store may be gained outside normal hours since the keys are placed beside the Main Store hatch, but the key for the flammable gas store may only be obtained from the Storekeeper since toxic gases requiring a class 5 risk assessment form are stored there. In all cases, personnel must complete an inventory control tag for the cylinder removed and deposit it at the Store and also ensure that the cylinder stores are kept locked, that cylinders are chained up at all times and that the cylinder trolleys are returned to the stores immediately after use.

10.1 **General Precautions**

(i) Supplies of natural gas are provided in most laboratories. Gas taps should be firmly closed after use and any leaks reported immediately to the Building Officer.

(ii) Because of their weight, large gas cylinders may cause very serious injury if they fall over. It is also possible that the force of falling may be enough to shear off the regulator with disastrous results. All gas cylinders must be firmly anchored to prevent falling over. Large cylinders must be fixed to a wall or bench using an approved clamp or

placed in a topple-proof support stand. A cylinder trolley does not provide sufficient support.

(iii) Always ensure that the regulator or control valve is closed before opening the main cylinder valve. Always close the main cylinder valve after use.

(iv) Under no circumstances are oil or grease to be applied to any regulator or cylinder head.

(v) All systems connected to a gas cylinder must incorporate a trap to prevent suck back of chemicals into the cylinder.

(vi) All acetylene cylinders must be fitted with a flash back arrester.

10.2 **Toxic Gases**

(i) All toxic gas should be used with great care. No operation involving such gases must be carried out by anyone working in a laboratory on their own or outside normal working hours. The following are some of the most commonly used:

	LTEL (or STEL*) (ppm)	
Phosgene	0.02	(danger to life after 1/2-1 hr at 50 ppm)
Hydrogen selenide	0.02	
Diazomethane	(see 10.3)	
Bromine	0.1	(danger to life after 1/2-1 hr at 10 ppm)
Ozone	0.2*	(danger to life after 1/2-1 hr at 50 ppm)
Chlorine	0.5	(danger to life after 1/2-1 hr at 14 ppm)
Fluorine	1	
Hydrogen chloride	1	
Hydrogen fluoride	1.8	
Sulfur dioxide		(danger to life after 1/2-1 hr at 150 ppm)
Hydrogen bromide	3*	
Nitrogen dioxide		(danger to life after 1/2-1 hr at 25 ppm)
Hydrogen cyanide	10*	
Hydrogen sulfide	5	(immediate danger to life at 700 ppm)
Ammonia	25	
Carbon monoxide	30	(colourless and odourless)

(ii) All toxic gas cylinders must be used with a secondary control valve. The dispensing of any toxic gas from a cylinder by means of the main cylinder valve alone is strictly forbidden.

(iii) Before using any toxic gas cylinder all persons should plan exactly what action will be taken if an uncontrolled escape of gas occurs, e.g. by the cylinder valve sticking open. In all such cases, immediately signal evacuation of the building by activating the nearest fire alarm

button. Any malfunction of the valve of a toxic gas cylinder should be reported to the School Safety Coordinator immediately.

(iv) The direct venting of significant quantities of toxic gases to the atmosphere is not allowed. Wherever possible excess gas should be absorbed in a suitable solution.

(v) The stock of toxic gas cylinders in the School should be kept to a minimum. Before ordering any new gases please ensure that any existing stocks are used up.

10.3 **Diazomethane**

As well as being extremely toxic and a suspected carcinogen, diazomethane is dangerously explosive in contact with rough surfaces. It should only be prepared and handled in dilute ether or methanol solution behind a safety shield in an efficient fume cupboard. Apparatus with ground glass joints or other rough surfaces must on no account be used. Diazomethane is safely destroyed by addition of acetic acid.

11. *Disposal Procedures*

It is the clear responsibility of all research workers to ensure the safe and correct disposal of all wastes produced in the course of their work. Improper and irresponsible disposal of chemical wastes down drains, to the Local Authority refuse collection or into the atmosphere is forbidden by law**.** The Aldrich Handbook provides a useful summary of the correct disposal procedure for most chemicals. Due to new legislation, increasingly strict environmental controls and the escalating costs of disposal, it is essential that the appropriate disposal procedures given below are strictly adhered to. All waste should be disposed of in the proper way as detailed in 11.1–11.9 below. No waste materials may be left in the corridors.

11.1 **Wash down drains with excess water**

- concentrated and dilute acids and alkalis;
- harmless soluble inorganic salts (including all drying agents such as $CaCl_2$, $MgSO_4$, Na_2SO_4, P_2O_5);
- alcohols containing salts (e.g. from destroying sodium);
- hypochlorite solutions from destroying cyanides, phosphines, etc;
- fine (tlc grade) silica and alumina.

It should be noted in particular that no material on the "Red List" should ever be washed down a drain. This list is as follows:

- compounds of the following elements – antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, tellurium, thallium, tin, titanium, uranium, vanadium and zinc.
- organohalogen, organophosphorus or organonitrogen pesticides, triazine herbicides, any other biocides.
- cyanides (see 9.7).
- mineral oils and hydrocarbons.
- poisonous organosilicon compounds, metal phosphides and phosphorus element.
- fluorides and nitrites.

11.2 **Incineration** (Solvent Waste disposal)

- all organic solvents including water miscible ones;
- soluble organic waste including most organic solids;
- paraffin and mineral oil (from oil baths and pumps).

Because of the differing availability of fire-protected and ventilated storage space in various areas of the Buildings two different procedures apply:

A Purdie Building levels 2, 3 and 4.

1. Each laboratory should collect waste solvents in Winchester bottles, separating halogenated and non-halogenated ones.
2. As soon as any bottle is full, it should be immediately taken by the research worker concerned to the nearest Overnight Room (Room 339 or 438) and carefully decanted into the correct 25 litre plastic container which is situated in the single full-length fume cupboard there. It is especially important in doing this that reactive compounds (for example thionyl chloride, triethylamine) have been properly neutralised before addition to the waste. An unexpected vigorous reaction or major evolution of fumes during this operation is a reportable incident – stop the addition immediately and report the circumstances to the School Safety Coordinator.
3. Use a funnel to avoid spillages and be sure that the plastic containers are perfectly clean on the outside and not overfilled (each will contain 10 Winchesters of solvent). As soon as a plastic container is full, screw the cap on firmly (**NB** do not put the cap on until it is full – it cannot be taken off again without breaking the seal), carefully lift it onto a flat-bed trolley or sack barrow and take it to the Main Store. Care is needed in doing this since the containers may weigh 20–30 kg and if you are not confident of being able to lift this weigh safely you should obtain assistance from a colleague.

4. At the Main Store a new empty container will be issued which should be returned to the Overnight Room. If you find that a container is full when the Store is closed (e.g. outside normal working hours) retain the Winchester in the laboratory until the Store is next open. There must never be more than two plastic containers in an Overnight Room at any time.

B BMS and the MSB Buildings.

1. Each laboratory should collect waste solvents in 5 l plastic drums, separating halogenated and non-halogenated ones. These must be stored at all times under one or two particular under fume-cupboard ventilated cupboards per laboratory. These are to be identified by a flammable solvent warning notice, nothing else is to be stored in them, and the doors are to be kept closed at all times. The shelf should be removed so that the container can be filled without being removed from the ventilated space. The plastic containers must not be kept out on bench tops, beside sinks or in a fume cupboard being used for experimental work.

2. Workers may wish to collect waste solvents in Winchester bottles prior to emptying these into the plastic container. Use a funnel to avoid spillages and be sure that the containers are perfectly clean on the outside and not overfilled. As soon as a plastic container is full, screw the cap on firmly and take it to the Main Store and obtain a new container, the cost of which will be charged to your research group budget. If you find that a container is full when the Store is closed (e.g. outside normal working hours) retain it in the laboratory until the Store is next open. Full containers are never to be hoarded up – they must be immediately taken to the Store when full and an empty replacement obtained.

3. In MSB there should be only two containers out per laboratory at any one time. Full containers are temporarily stored in the designated area to await pick up for disposal . For the Surface science group – a single pair of containers should be located in a suitable ventilated space where experimental work is not in progress.

<u>Further Notes</u>

The plastic containers must be labelled to indicate halogenated or non-halogenated and the laboratory or area they have come from (labels from Store).The cost of disposal for partly halogenated solvent waste is three times that for non-halogenated waste and the quantity of halogenated waste must be kept to the minimum.

Note that insoluble solids (silica, molecular sieves etc.) should not be placed in the waste solvent containers – for the proper disposal method, see Safety Handbook Section 11.3.

It is forbidden to hoard up waste solvents in a laboratory – there should be the minimum possible number of Winchesters and they must be emptied out as soon as they are full. Except for the small number of Winchesters used for collecting waste, no empty Winchesters should

now be stored in laboratories. It is the responsibility of all research workers to promptly return all empty Winchesters to the Main Store. It is forbidden to store any Winchester bottles on a laboratory floor.

11.3 Laboratory waste bins and controlled waste

All waste suitable for the Local Authority refuse collection, except recyclable paper and glass is termed 'controlled waste'. Items in this category which includes dirty paper, plastic, rubber and wood, should generally be placed in the waste bins available in each laboratory and it will be collected by the cleaners. In no circumstances must any item of glass, sharp metal or fine powder ever be put in a normal laboratory waste bin: for glass, sharps and fine powders see below, sections 11.5 - 11.7. The cleaners are under strict instructions not to touch any such item and to report the circumstances immediately to the School Safety Coordinator.

Personnel in the BMS building handling biologically hazardous waste must dispose of this in strict accordance with the procedures in force in that building. Further details may be obtained from Mr B. L. Precious.

11.4 Waste for special disposal

This is a troublesome and expensive method of disposal and the quantity of special waste must be kept to an absolute minimum. Only the following items should be disposed of in this way:

(i) Schedule 1 poisons (but not cyanides - see 9.7) and other highly toxic chemicals.

(ii) Materials heavily contaminated with substances in (i).

(iii) Materials contaminated with mercury (see 9.11).

(iv) Carcinogenic solids including asbestos.

Special waste must be collected in a separate labelled bottle or jar for disposal. On no account must different types of waste be mixed. Advice should be sought from the School Safety Coordinator before beginning any work which will produce waste requiring special disposal in order to ensure (a) that the waste can be disposed of, (b) that it is collected in the most suitable form so as to minimise the cost involved, and (c) that it will be stored under suitable conditions.

The importance of handing waste for special disposal to the School Safety Coordinator immediately the container is full or the work is finished is emphasised. The hoarding up of hazardous waste in laboratories is strictly forbidden. All workers must also ensure that waste produced in the course of their work is safely disposed of before they leave the School.

11.5 Glass recycling

For environmental reasons the recycling of glass is encouraged, but only certain items of waste glass produced within the School are acceptable for recycling.

Winchesters which cannot be returned to the suppliers must be disposed of as follows: the plastic cap must be removed and discarded in the normal waste bin, the original contents must be completely removed, and then the bottle must be thoroughly washed with excess water to remove all traces of chemicals. The clean bottle must then be placed in the large container marked "Brown glass bottles and jars" situated in the waste disposal enclosure in the Level 1 car park. NO other material may be placed in this container, which must be kept free of all chemical contamination.

For the disposal of all other glassware, each laboratory should keep at least one of the special glass bins obtainable from the Purdie main store. All glassware for disposal, other than Winchesters, should be made free of significant chemical contamination and then placed in the designated glass bin: these bins must not be allowed to overflow, but when nearly full should be closed and then placed in one the white skips, labelled "Commercial Waste" in the Level 1 car park. Note that no syringes or needles, or loose powders, must be placed in these skips.

11.6 Fine powders

Finely divided waste materials such as charcoal, silica and alumina must NOT be disposed of in loose form. Such materials, free from significant chemical contamination, must be placed in plastic tubs, (the 5 litre size is recommended) with the lids then replaced, and marked as "non-hazardous waste" before being placed in one of the while "Commercial Waste " skips.

NB Fife Council have a Duty of Care to their employees, including the crews of the vehicles which remove our waste and the staff of the landfill site where it is deposited. Chemical contamination of the waste material in any of the skips, including the presence of loose powders, has in the past led to suspensions of waste collection by Fife Council, and any further occurrence will again lead to a suspension of collection.

11.7 Biohazard / Sharps Disposal and Syringes and Needles

"Sharps" contaminated with biologically hazardous materials must be collected in special containers to be sent for incineration. These should be obtained from and returned to the Purdie Main Store. It is also required, at the request of Fife Council, that **all syringes and needles of any type** should be disposed of by the same route. Research groups who do not have their own container for this should take the items to the main store where a container will be available. No syringes or needles must ever be put in a laboratory waste bin or controlled waste container. **Note that this expensive route must not be used for Pasteur pipettes or other sharp items unless contaminated with a biohazard**.

11.8 **Waste paper recycling**

All clean waste paper should be placed in one of the specially designated containers. No plastic materials, acetates, used toner cartridges etc. must be put in the paper recycling containers: these should instead be put in the nearest controlled waste container.

11.9 **Large-scale waste**

Any person having large items or large quantities of waste to be disposed of should immediately consult the School Buildings Officer, Dr J. S. G. Smith.

From time to time a large builders' skip may be placed outside the building. This is under the control of Estates and is required in association with building work in progress in the School. No person from the School of Chemistry is allowed to deposit any kind of waste in these skips without proper authorisation.

12. *Work Outside Normal Hours and Overnight Experiments*

Policy on Lone Working and Work outside Normal Hours
The School accepts that due to the large size of the buildings, the continuous nature of some experimental procedures and the need to maximise use of resources such as spectrometers, personnel may often find themselves working alone in a particular room. When this is outside normal hours without the benefit of First Aid cover and personnel nearby to assist in the event of any incident the risks involved are a particular concern. All personnel should plan to carry out the bulk of experimental work within normal working hours. As noted in 12.1 below, potentially hazardous operations must never be carried out outside normal hours. Even when it may be necessary to carry out a less hazardous experiment outside normal hours, personnel should make contact with someone else in a nearby room who will check regularly on their safety.
Any accompanying persons who are present for safety purposes must be either members of staff or matriculated post-graduate students. Examples of activities which may and may not be carried out outside normal hours are as follows:

<u>Allowed</u>
reading, writing and library work;
use of computers, spectrometers and other instruments;
simple physical operations such as sample preparation, recrystallisation, distillation, filtration and chromatography.

<u>Not Allowed</u>
use of pyrophoric, highly toxic or potentially explosive substances;
use of poisonous gases.

12.1 Never carry out any work involving a significant risk of fire, explosion or any other hazard outside normal hours.

12.2 No experiment may be left running overnight without the explicit permission of the research supervisor or his staff deputy. All overnight experiments must be accompanied by a signed permit giving details of the likely hazards and action to be taken in an emergency.

12.3 Overnight permits, which certify that the experiment has been checked and found to be safe, may only be signed by a member of the Academic Staff. Where no member of the Academic Staff is available, postdoctoral workers are also authorised to sign overnight permits, but are reminded that in doing so they assume full responsibility for the safety of experiments. Research workers intending to put on an overnight experiment must plan ahead and ensure that the experiment has been set up and stabilised, seen by their supervisor, and the overnight form signed before 6 pm.

12.4 The overnight permit must be clearly displayed beside the experiment, in a position such that it will not be destroyed in the event of an accident. Thus one copy should be displayed outside the laboratory, and a second copy should be attached to the sash of the fume-cupboard housing the experiment.

12.5 A clear indication must be given on the permit of what action is to be taken in an emergency. Where such actions have to be carried out in a specific order this must be clearly stated. Any overnight experiments discovered without the required permit are liable to be switched off.

12.6 All overnight experiments involving the heating or mechanical stirring of any organic material or any other potential hazard may only be carried out in an Overnight Room (Purdie room 438, BMS room 3.03, 4.03) or in a fume cupboard equipped with automatic fire protection (certain areas in BMS levels 3 and 4). The Overnight Rooms must be kept clean and tidy. All materials must be removed immediately after use. Any equipment which appears to be abandoned in an Overnight Room may be confiscated by the School Safety Coordinator at any time without warning. The use of gas burners for overnight experiments is forbidden.

12.7 Particular care must be taken to avoid floods outside normal hours. All water tubing on overnight experiments must be in good condition and firmly fixed on with an approved clip or tension strap at each connection. The outlet end of tubing should be firmly clamped to keep it in the drain and the water flow should not be too hard. Water pumps must not be left running overnight.

13. *Electricity*

Current legislation requires that all electrical items should be tested regularly for safety and a record kept of the results. Personnel should ensure that all equipment they use has been tested as required (as indicated by a sticker), that new items are tested before being brought into use (by arrangement with Mr D Waddell, Room 215d, ext: 3898), and that the test number of any items being disposed of are notified to the School Safety Coordinator so that they can be removed from the record.

In addition to the dangers of electrocution, faulty or unsafe electrical installations may result in fires and explosions.

13.1 All electrical equipment must be properly earthed. Under no circumstances must an earth connection ever be made to a gas pipe.

13.2 All electrical cables and connections must be properly insulated. Insulation must be replaced at the first sign of deterioration.

13.3 Contact of water or any chemicals with electrical connections must be avoided.

13.4 The use of round-pin mains plugs, open coil variable transformers, radiant bar electric fires, two and three way mains plug adapters and "varistat" bimetallic strip controls for water baths is prohibited. Personnel should consult Mr Brian Walker, Electronic Workshop for advice on construction or purchase of suitable safe replacements.

13.5 Personal electrical equipment may only be introduced into the School's precincts if it is considered essential and may not be used until its electrical safety has been tested (see 13.1).

14. *Vacuum Systems*

14.1 All vacuum desiccators taken below atmospheric pressure must be enclosed in a wire guard. In this context there is little practical difference between water-pump vacuum and high vacuum (a pressure difference of 740 mmHg versus 760 mmHg).

14.2 All bulbs on vacuum lines must be protected to confine fragments in the event of an implosion. This should be done by covering with a network of adhesive tape such that no area larger than one square inch is left clear.

14.3 The exhaust from pumps connected to systems containing toxic chemicals (including mercury - see 9.11) should not be discharged into the laboratory. It should be vented into a suitable trap or preferably ducted into a fume-cupboard or out a window.

14.4 The vapour of corrosive or toxic chemicals must never be allowed to enter an oil-pump. Always use a suitable cold-trap.

15. *Sealed tubes and High Pressure Equipment*

15.1 Reactions involving the heating of sealed tubes or other fragile pressure vessels must be conducted in the roof laboratory (Room 502). The heating of steel "bombs" is permitted in other laboratories but they must be of approved strong construction and have been pressure tested.

15.2 Sealed tubes must be enclosed in a steel tube before heating and should not be removed until completely cold.

15.3 Tubes should be cooled before sealing or opening. Care must be taken to avoid condensing liquid oxygen (see 8.4(iv)) and cracking a tube by cooling too quickly.

16. *Use of High Temperature Furnaces and Ovens*

16.1 Safety glasses, and, normally, laboratory coat should be worn when removing or inserting samples into a furnace. If the furnace temperature is above 1100 ºC then UV glasses must be worn. Long tongs should normally be used and heat resistant gloves may be used if appropriate. Particular care should be taken to ensure the tongs do not touch the elements of the furnace in case the door safety cut off is ineffective.

16.2 All samples entering the furnace should be entered in the log book giving details of user, sample and heating profile.

16.3 The area around the furnace should be kept clean and dry with no flammable materials within the vicinity. Always ensure there is a clear, safe and heat resistant surface for your sample when removing it from the furnace.

16.4 Samples should normally be placed in alumina, platinum or gold crucibles depending on the sample and the conditions being used.

16.5 Consider the chemical hazards of the samples that are being placed into the furnace and ensure that they are safe to heat to the required temperature in air or the atmosphere applied if in a controlled atmosphere.

16.6 Never attempt or inspect for repairs when the power is still on. For most repairs you should contact the appropriate person within the department.

16.7 Always ensure that there is a clear, safe and heat resistant surface for your sample when removing it from the furnace.

16.8 All samples removed from the surface at high temperature should be kept near the furnace until they have cooled down, preferably clearly labeled to alert others of the high temperature hazard.

16.9 For rapid heating furnace types, in particular where the exterior can be fairly hot, it is essential to ensure that sources of explosion such as compressed gas cylinders are kept at least 1.5 metres away. Considerable care should be taken that gas cylinders are not kept in small rooms containing furnaces.

16.10 When removing dust or similar particles from the furnace a dust mask should be worn and the furnace should be isolated from the mains by removing the plug or, in the case of fixed installations, turning off. Similar caution should be taken when using tube furnaces and vacuum furnaces although furnaces

will be cooled down before removing the samples to avoid sudden shock damaging the tube. Particular care should be taken when removing dust or other contaminants from the tube, again wearing a mask and taking care of others in the immediate environment.

16.11 Ovens are lower temperature furnaces generally not exceeding 300 ºC. Care must be taken to avoid burns from picking up hot objects that are cooling down outside the furnace.

16.12 Hydrothermal reactions are normally performed in sealed vessels that contain high pressure fluid at high temperature. Therefore care should be taken to work within the safe operational limits for seal and vessel. For hydrothermal systems (i.e. water based) the pressure is determined by the working temperature, however, for solvothermal or solvent based systems all the solvent may well evaporate and the expected pressure of all the solvent being volatilised needs to be calculated also in considering operational limits. Normally a PTFE lined vessel should not be operated above 210 ºC.

17. *Cryogenic Materials*

17.1 Although liquid nitrogen and dry ice have the potential to cause serious burns, the layer of gas normally prevents heat transfer from the skin. To avoid burns, do not wear gloves when handling liquid nitrogen and do not allow it to fall on clothing. In both cases the garment may retain it in contact with the skin. Attempting to pick up dry ice with wet hands or handling dry ice wet with acetone or other liquids can produce severe burns.

17.2 All Dewar flasks used for carrying liquid nitrogen along corridors must be fitted with a carrying handle.

17.3 It is strictly forbidden to travel in any lift together with a large (>5 l) container of liquefied gas. Those responsible for moving such containers between floors must place them in the lift, walk to the destination floor and then summon the lift. If you open the lift and find a large liquid gas container inside, close the door and allow it to continue to its original destination.

17.4 Careful consideration must be given to the siting of large Dewars of liquid nitrogen, particularly those ("pressurised Dewars") which are capable of delivering liquid simply by opening a valve. In general these should be sited in a well ventilated space such as a laboratory with functioning fume cupboards. Under no circumstances are they to be sited in an unprotected fire escape route (such as a main corridor). Those contemplating purchase of a new large Dewar must first consult the School Safety Coordinator to agree upon a suitable location for it.

18. *Biological Hazards*

No work involving biological hazards may be carried out without the permission of Dr T. K Smith, School Biological Hazards Officer. The

guidelines set out in the University Handbooks "Safety in Biological Laboratories" and "Guidance on Chemical and Biological Safety, Part 2 – Biological and Genetic Modification Safety" available from Dr Smith should be followed in all such work.

Any work involving genetic modification or the use of genetically modified organisms must be registered with the University Chemical and Biological Hazards Sub-committee in order to comply with government legislation. The School Biological Hazards Officer must therefore be informed of all such work **before it commences.** An up to date list of all biological agents held within the School is also maintained and so all new biological materials brought into the School (e.g. new strains of bacteria) must be registered with the School Biological Hazards Officer.

19. *Radioactive Materials and Ionising Radiation*

19.1 All work involving radioactive materials or ionising radiation must be carried out in accordance with the rules set out in the School's "Local Rules for working with Ionising Radiations" available from Dr G. Haehner (Room 243, tel: 3889, e-mail gh23).

19.2 Responsibility for this area is shared by Drs C.-J. Dong (e-mail: cd26) and G. Haehner (e-mail: gh23) who represent the School on the University Radiation Hazards Subcommittee. Dr Haehner deals with all matters concerning X-rays, UV and microwave radiation and magnetic fields.

19.3 The SEPA licences for possession, use and disposal of radioactive materials are on a Building rather than School basis. Regardless of which School personnel might belong to, the responsibility for keeping a record of stocks and for disposal in the Purdie Building lies with Dr C.-J. Dong and in the BMS Building with Mr B. L. Precious. The appropriate person must be informed before any radioactive materials are ordered or any new project involving radioactive materials is commenced. When the radioactive materials arrive they must then be properly registered and stored. Workers must adhere strictly to the Local Rules in force for the relevant building and in case of any doubt consult the relevant responsible person.

19.4 Before the initiation of any project involving the use of radioactive materials research workers **must** consult both the School Safety Coordinator and the School Buildings Officer.

19.5 Workers intending to use radiochemicals should take the University Radiation Hazards Course which is run annually. For details see Dr C.-J. Dong.

20. *Manual Handling*

Legislation applies to all operations in the School involving the lifting or moving of heavy objects. The guidelines contained in the appropriate

University Guidance Note, available at http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/Manualhandlingoperations/ should be followed. Anyone who requires to carry out operations which may come under the scope of these Regulations should consult the School Safety Coordinator for advice before proceeding.

All personnel whose work falls within the scope of these regulations must complete the web-based training course and present a completed test certificate to the School Safety Coordinator as soon as possible.

1. Go to the site - http://www.learninglink.ac.uk/moveit/moveit.htm
2. Follow the instructions carefully on the following pages, going through each of the sections in turn.
3. Once you have completed all sections, go on to the "Quiz" and work through it.
4. When you have got a mark of 60% or more print out the certificate and pass it to the School Safety Coordinator.

21. *Display Screen Equipment*

Legislation applies to all workers in the School who, in the course of their normal work are required to use a word processor, computer terminal or other instrument equipped with a VDU for continuous periods of one hour or more on a regular basis. A detailed written risk-assessment should be carried out by each such worker in respect of their own work-stations. See https://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/Displayscreen/Trainingprogram/ .

All personnel whose work falls within the scope of these regulations must complete the web-based training course and present a completed test certificate to the School Safety Coordinator as soon as possible. At the same time they should notify him of any aspects of their "work station" which they feel require remedial action.

1. Go to the site - https://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/Displayscreen/
2. Follow the instructions carefully on the following pages, going through each of the sections in turn.
3. Once you have completed all sections, go on to the "Quiz" and work through it.
4. When you have got a mark of 60% or more print out the certificate and pass it to the School Safety Coordinator.

In case of any problems with this package, contact the School Safety Coordinator or see the helpful manual at:

https://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/Displayscreen/

22. *Safety in Workshops*

Although the hazards present in Workshops are often quite different from those elsewhere in the School they must be taken just as seriously. In particular the work areas must be kept as clean and tidy as possible and waste glass, fragments, metal plastic and wood debris must be regularly swept up and disposed of. Appropriate protective clothing and equipment should be used for all operations which require it and guards and other safety mechanisms on machine tools should never be removed or disabled. The mains electricity supply to all machine tools should be switched off at the end of each working day. Any member of Workshop staff who has any concern about safety should inform the School Safety Coordinator who will obtain the necessary specialised advice.

All personnel taking items to be worked on at the Mechanical, Electronic or Glassblowing workshops must ensure that these are completely clean and safe to work on and not contaminated with any hazardous chemical, biohazard or radioactive material. The Workshop staff are under instructions not to work on any item which they suspect to be contaminated and to report the circumstances to the School Safety Coordinator.

23. *New and Expectant Mothers*

Under current legislation relating to new and expectant mothers, a special assessment has to be carried out in respect of the work activities of any new or expectant mother. Anyone who becomes pregnant or has had a baby in the last 6 months should inform the School Safety Coordinator in confidence as soon as possible so that the required assessment can be carried out. See also:

https://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/Neworexpectantmothers/

24. *Occupational Stress*

Stress in the workplace can have a serious detrimental effect on the health of staff. Work-related stress is defined by the HSE as: 'The adverse reaction people have to excessive pressures or other types of demands placed upon them'. The University has produced a policy on stress entitled: '**Occupational Stress Policy'**

http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Occupationalhealth/

To reduce the risk of workplace stress, managers/supervisors in the School should be aware of six factors, which are often involved in causing stress. Where any of these factors may be the cause of excessive pressure, which may lead to stress, then the manager should undertake an appropriate risk assessment of the work activity. These six factors are:

- **Demands -** Includes issues like workload, work patterns, and the work environment.
- **Control -** How much say the person has in the way they do their work.
- **Lack of Support -** Includes the encouragement, sponsorship and resources provided by the School and colleagues.
- **Poor Relationships -** Includes promoting positive working relationships to avoid unacceptable behaviour.
- **Uncertain Role -** Do people understand their role in the workplace and whether the School ensures that the person does not have conflicting roles.
- **Change -** How change is managed and communicated in the School.

Further guidance on how managers may deal with stress at work can be found in the University publication entitled: '**Manager's Guide to Monitoring Stress**'

http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Occupationalhealth/

If employees believe they are suffering work related stress they should in the first instance raise the matter with their supervisor or, if they get no satisfaction with this, to raise the issue with the Head of School. Staff may also contact Human Resources with regard to stress issues at work.

NOTE: If an employee does not wish to raise the matter through management, they may directly self-refer to the Occupational Health Adviser (Tel: 2752).

Further guidance on stress recognition and reduction can be found in the University document entitled: '**A Guide to Stress Recognition and Reduction'**

http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Occupationalhealth/

Further guidance on stress can be obtained from the Health and Safety Executive at the following website:

http://www.hse.gov.uk/stress/index.htm

Further advice can be obtained from the Environmental Health and Safety Services (tel: 2750) or from the Occupational Health Advisor (tel: 2752) or from Human Resources.

25. *Chemical Weapons*

Under the Chemical Weapons Act (1996) possession or production of certain chemicals is prohibited and possession or production of others must be notified to the relevant regulatory body. The materials involved are mainly sulfur and nitrogen mustards and organophosphorus nerve agents and their direct precursors, but many other categories of material are also included. Any supervisor planning new work in these areas of chemistry should check with the School Safety Coordinator to ensure that it is permitted.

26. *Information on Safety*

All persons should make full use of the following sources of safety information:

University Web Site

http://www.st-andrews.ac.uk/safety/

This site, maintained by the University Safety Office has a great deal of valuable information including copies of all documents concerning safety within the University.

School Library (These books may not be removed from the library at any time).

Dangerous Properties of Industrial Materials. N. I. Sax, 5th edn., 1979.

Hazards in the Chemical Laboratory. G. D. Muir, ed., Royal Institute of Chemistry, 1971.

Handbook of Reactive Chemical Hazards. L. Bretherick, 1975.

Effects of Exposure to Toxic Gases - First Aid and Medical Treatment, W. Braker and A. L. Mossman, Matheson Gas Products, 1970.

First Aid Manual for Chemical Accidents, M. J. Lefevre, 1980.

CRC Handbook of Laboratory Safety, 2nd Edn., 1985.

Solvents: A Guide to Safe Handling, Solvents Industry Association, 1988.

From the University Chemicals Hazards Adviser, Dr R. A. Aitken (available for consultation at any time).

Health and Safety in the Chemical Laboratory. RSC Special Publication No 51, 1984.

Poisons and Toxic Substances Act, Guide and Lists of Restricted Poisons, 1968 and 1974.

Lists of Carcinogens and OEL values adopted for toxic chemicals (Guidance Note EH/40)

Control of Substances Hazardous to Health Regulations 1994 and 1999 and Schedules

Chemicals (Hazard Information and Packaging for Supply) Amendment Regulations, 1996 – Approved List

Chemical Weapons Act 1996, Act and Lists of Scheduled chemicals.

Destruction of Hazardous Chemicals in the Laboratory. G. Lunn and E. B. Sansone, Wiley, 1990.

Chemical Carcinogens. M. Castegnaro and E. B. Sansone, Springer Verlag, 1986.

Rhône-Poulenc, BDH (and various other) Material Safety Data Sheets.

27. *University Bomb Threat Procedures*

POSSIBLE POSTAL BOMBS AND OTHER SUSPECT DEVICES

Postal bombs take many forms. They may come in any shape or size: parcels, envelopes or padded 'jiffy bags'. They may explode or ignite when opened and sometimes before they are opened. They are usually designed to kill or maim the person who is opening them. Instead of being posted, such devices may be delivered by hand or arrive by courier.

All staff who might be required to open mail in the course of their work should know the tell-tale signs which are as follows:

- grease marks on the envelope or wrapping;
- an unusual odour such as marzipan or machine oil;
- visible wiring or tinfoil especially if the envelope or package is damaged;
- the envelope or package may feel very heavy for its size;
- the weight distribution may be uneven: the contents may be rigid in a flexible envelope;
- the item may have been delivered by hand from an unknown source or posted from an unusual place;
- if a package, it may have excessive wrapping;
- there may be poor handwriting, spelling or typing;
- the item may be wrongly addressed or come from an unexpected source;
- there may be too many stamps for the weight of the package.

If a member of staff has any suspicion that a package which (s)he sees is suspect, (s)he should

- if handling it, put it down gently;
- walk away from it;
- on no account let anyone move it, touch it, place it in anything (including water) or place anything on top of it;
- on no account let anyone close doors giving access to the suspect item, switch off lights or transmit on a personal radio or mobile phone within 20 metres of the suspect device;
- telephone 9–999 and inform the police immediately;
- evacuate the immediate area by sounding the fire alarm (unless the police immediately advise otherwise) so that occupants of the building gather at the normal fire assembly point(s) of the building;
- take no further action until the police arrive other than doing all that can reasonably be done to ensure that no-one re-enters the building or gets too close to it;
- ensure that Dr J. S. G. Smith (Tel: 3696; Mobile: 07515 190958) or Prof R E Morris (Tel: 3818) and the University Security Manager (Mobile: 07990 784356) and the Deputy Principal (Tel: 2548 or 07900 607690) are informed of the incident;
- ensure that a full report reaches the Deputy Principal within twelve hours of the incident.

TELEPHONE WARNINGS

Bombers frequently (but not always) give telephone warnings of explosions. So, unfortunately, do hoaxers whose threats are empty.

Any member of the University may, therefore, receive a warning that premises and colleagues are at risk. In **all** cases, whether or not the threat is credible, the receiver of a call should

- dial 9–999 and inform the police immediately **and**

if it is the receiver of the call's own building which is threatened

- sound the building fire alarm to evacuate the premises unless the police immediately advise otherwise
- make sure that the colleagues named below are informed of the situation immediately
- wait at the fire assembly point for the police to arrive before any further action is taken other than doing all that can reasonably be done to ensure that no-one re-enters the building or gets too close to it.

If it is another University building which is threatened

- telephone that building.

In all cases

- telephone the University Security Manager (Tel: 07990 784356) and the Deputy Principal (Tel: 2548 or 07900 607690)

In addition to taking the above steps after the caller has rung off, it is important for the receiver of a call to stay calm enough during the call to

- try to fill in the form on the back of this notice
- if possible, signal to a colleague to contact the police on another line so that an attempt may be made to trace the origin of the call
- keep the caller talking for as long as possible
- keep the line open even when the caller has rung off.

If a building is evacuated in consequence of a telephone warning and a search for a device is advised by the police, it is important to realise that the police themselves are unlikely to know the layout of the premises or to be aware of what is or is not out of place. It is vital, therefore, that the police are advised by Dr J. S. G. Smith (Tel: 3696; Mobile: 07515 190958) or Prof R E Morris (Tel: 3818). These colleagues should be contacted, in the event of an emergency, at the following fire assembly point to which they will go when the fire alarm has been sounded. They are also responsible for ensuring that a full report of the incident reaches the Deputy Principal within twelve hours of the incident.

Fire Assembly Point: *Purdie Building, Level 2 Entrance*

BOMB THREAT CHECKLIST

INSTRUCTIONS: LISTEN, DO NOT INTERRUPT THE CALLER!

Caller's Identity

Male _____ Female _____ Approximate Age _____

VOICE CHARACTERISTICS	SPEECH	LANGUAGE	ACCENT	MANNER	BACKGROUND NOISES
____ Loud	____ Fast	____ Excellent	____ Local	____ Calm	____ Office Mach
____ High Pitch	____ Distinct	____ Fair	____ Foreign	____ Rational	____ Factory Mach
____ Raspy	____ Stutter	____ Foul	____ Race	____ Coherent	____ Bedlam
____ Intoxicated	____ Slurred	____ Good	____ Not Local	____ Deliberate	____ Animals
____ Soft	____ slow	____ Poor	____ Region	____ Righteous	____ Quiet
____ Deep	____ Distorted	____ Other	____ Other	____ Angry	____ Mixed
____ Pleasant	____ Nasal	_____	_____	____ Irrational	____ Street Traffic
_____	_____	_____	_____	____ Incoherent	____ Aircraft
_____	_____	_____	_____	____ Emotional	____ Party Atmos
_____	_____	_____	_____	____ Laughing	____ Trains
_____	_____	_____	_____	____ Other	____ Music
_____	_____	_____	_____	_____	____ Voices

BOMB FACTS

Try to keep caller talking

Essential Questions:

WHEN WILL BOMB GO OFF?
WHERE IS BOMB PLANTED?
WHAT DOES IT LOOK LIKE?
WHAT TYPE OF BOMB IS IT?

ACTION TO TAKE IMMEDIATELY AFTER CALL

Notify following persons in order given:

Name:	**POLICE**	Phone No:	**9–999**
Name:	**Dr J S G Smith**	Phone No:	**3696 / 07515 190958**
Name:	**Any other University Building threatened**	Phone No:	
Name:	**University Security Manager**	Phone No:	**07990 784356**
Name:	**DEPUTY PRINCIPAL**	Phone No:	**2548**
Name:	**Prof R E Morris**	Phone No:	**3818 / 07751 579252**