



SCHOOL OF CHEMICAL AND PHYSICAL SCIENCES

LENNARD JONES BUILDING SAFETY HANDBOOK

(Revised September 2018)

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Introduction

This handbook is a guide to the safety policy and procedures that operate within the Lennard Jones Building; the rules and regulations described herein apply to all users of the building. University Safety Policy is further dealt with by the University's Department of Occupational Health and Safety. Further information can be supplied by the Workplace Safety Advisor or alternatively found at the following address: <http://www.keele.ac.uk/dohs/>

All users of the Lennard Jones building are required to sign a declaration stating that they have received, read and understood this document and attended a building safety induction before they start any work within the building. It is your duty to be familiar with the contents of this handbook and with University Safety Policy.

Health surveillance is provided by the Department of Occupational Health and Safety for all members of the University. Further details can be provided from them.

There are two parts to this handbook, "General Safety" and "Laboratory and Chemical Safety". If you are intending to work in the laboratories it is essential that you are familiar with both parts.

Building Safety

General Safety Policy

It is the policy of the School of Chemical and Physical Sciences to fully implement University Safety Policy in all aspects that are applicable to the School.

In particular the School is responsible for:

- Ensuring (so far as is reasonably practical) that the design, construction, operation and maintenance of experimental equipment is safe and without risk to health.
- Ensuring (so far as is reasonably practical) the health and safety of all members of the School and all other persons who may be affected, by providing suitable information and instruction regarding the safe handling, storage and disposal of toxic substances and safe operation of equipment.
- Establishing appropriate emergency procedures within the School.
- Establishing a mechanism for consultation with all members of the School in respect of matters of health and safety.

Legal Aspects of Safety

You are reminded that under the Health and Safety at Work Act 1974, it is your responsibility while working in the Lennard Jones building to:

- Take reasonable care for the health and safety of yourself and other persons who may be affected by your acts and omissions
- Co-operate as necessary to enable any duty or requirement imposed on the School by or under any relevant statutory provisions to be performed or complied with.
- Not interfere or misuse anything provided by the School or University in the interests of health, safety or welfare.

Failure to observe any of the points above will be regarded as a serious disciplinary matter and may result in legal action being taken against you by Health and Safety Executive Inspectors.

Emergency Procedures - Fire

Make sure that you are familiar with the University's "Fire Action" and with the more detailed procedures contained in the Fire Drill. Practice fire drills are held twice a year and at least once every semester. You need to ensure that you are familiar with the fire drill procedure.

- If you discover a fire raise the alarm immediately by operating the nearest fire alarm call point
- Call the fire service by dialling 999 (9-999 from an internal phone)
- Inform security on 888
- Only use the fire extinguishers provided if you consider it safe to do so and you have been trained – do not put yourself at risk!

The fire alarm is a continuously sounding siren.

The entire building MUST be evacuated if this alarm sounds.

- Only use a fire extinguisher when appropriate. Most of the fire extinguishers within the Lennard Jones Building contain carbon dioxide. If using one of these, DO NOT hold the nozzle when the extinguisher is being discharged.
- There are a number of experiments which take place where carbon dioxide extinguishers are not suitable. (The MSDS should tell you which ones). There are powder fire extinguishers available. If you are conducting such experiments, it is essential that you inform either a fire steward or an appropriate technician who will provide you with one before the experiment takes place.
- All safety equipment provided within the building is checked regularly and records are kept in the Fire Safety Logbook. YOU MUST inform the Work Place Safety Advisor if you use a fire extinguisher so that a replacement can be provided.

Emergency Procedures - First Aid

- If you receive any injuries, swallow any material which is at all toxic, spill any toxic or corrosive material on yourself, have an allergic reaction to any material or feel unwell in any way during normal working hours, YOU MUST seek first aid immediately.
- Call a First Aider immediately if any substance enters your eye.
- First aid is available at all times. During normal working hours a first aider is likely to be found in the building. If there isn't one available there will always be a member of security who is first aid trained who can be contacted on 888 from an internal phone.
- All First Aiders have a mobile first aid kit and can be called to any location.
- A current list of first aiders can be found in all laboratories and in all entrances.
- Please notify a First Aider of any illness or disability that may affect your work. Such information will be treated in the strictest of confidence
- A statutory first aid kit is located in the foyer. This must only be used if a First Aider cannot be found. YOU MUST notify a First Aider as soon as possible after this kit has been used.
- Some laboratories are provided with safety showers for use in an emergency only. YOU MUST NOT use the showers to treat spillages.
- If you have an allergic action to any material or feel unwell in any way after you have left the building, go to the Accident and Emergency Department at your local hospital. Tell them where you were working, what chemicals you were using and who was in charge.
- If you suspect that you or someone else may have been poisoned as a result of using a particular substance, you can obtain further advice from the National Poison Information Service (telephone 0844 892111).

Reporting Incidents

Accidents

Whenever an accident occurs within the Lennard Jones building which involves injury to you or to others, the Accident or Dangerous Occurrence Book MUST be filled in, this book is kept in the Safety Resource Room off the main foyer. The First Aider who has dealt with the accident is responsible for ensuring that this is done but anyone can do this. The filled in form from the book must then be handed to the Workplace Safety Advisor, who will then send a copy onto the Occupational Health and Safety Department. The Occupational Health and Safety Department will then decide if the Health and Safety Executive needs to be notified.

Dangerous Occurrences and Near Misses

Whenever an accident occurs within the Lennard Jones which does not involve injury to a person but which may have resulted in an injury being sustained, an entry must be made in the Accident or Dangerous Occurrence Book, this book is kept in the Safety Resource Room off the main foyer. Anyone can enter the details of a dangerous occurrence or near miss in the book. The filled in form from the book must then be handed to the Workplace Safety Advisor, who will then send a copy onto the Occupational Health and Safety Department. The Occupational Health and Safety Department will then decide if the Health and Safety Executive needs to be notified.

Noxious Odours

If you suspect a noxious odour within the Lennard Jones building, inform the Workplace Safety Advisor or other appropriate member of staff (eg technical or academic) immediately. If you are working out of hours and an appropriate member of staff cannot be found, contact security on 888 from an internal phone.

Flooding

If there is a flood anywhere in the building, contact the Workplace Safety Advisor. If safe to do so, attempt to turn off the water supply that is causing the flood. YOU MUST NOT attempt to deal with a flood if you suspect there to be live electrical equipment in the water.

Radioactive Accidents

- The Radiation Protection Supervisor must be informed immediately of any accident which involves radioactive materials or ionising radiation.
- If you sustain any personal injury, however minor (even a small cut or skin abrasion) as a consequence of an accident in which there is likely to be radioactive contamination, YOU MUST inform the Radiation Protection Supervisor and a First Aider.
- Major injuries take precedence over the decontamination of the laboratory.
- If possible, two people should carry out the decontamination, one of whom remains “clean” and monitors the success of the decontamination by a suitable hand held monitor.

Working Hours and Building Access

Normal Working Hours

The normal working hours which the Lennard Jones building is open are:-

Monday to Friday 8:30am-6:00pm

With the exception of Open Days, Offer Holder Days and other special events, the building is closed on Saturdays, Sundays and Bank Holidays.

The doors to the Lennard Jones building will be locked at 6:00pm and access is restricted to users who have the appropriate key fob or access via their Keele Card.

Working Outside Normal Hours

Users are not permitted access to the building out of hours unless they have received a building induction conducted by the Workplace Safety Advisor, or if they are constantly supervised by a member of academic or support staff who has received an induction.

An entry must be made in the Out of Hours Book; the book is located in the Safety Resource Room off the main foyer. Security will check this book to check on the safety of users.

If you are issued with a key to access the building out of hours, it must not be loaned to any other person and should be returned to the Workplace Safety Advisor if it is no longer required.

Any lost keys must be reported to the Workplace Safety Advisor as soon as possible.

Out of Hours Practical Working

If you are a postgraduate student or visitor and have received a building induction you are permitted to work out of hours. However, your supervisor must be made aware of exactly what work you wish to carry out during this time and give their permission for you to do so.

Two COSHH forms must be filled in. One is to be placed next to the experiment and one is to be given to the supervisor.

Supervision

On completion of a Building Induction, staff (academic and support) are free to work in the building without supervision. There are however certain areas which are subject to additional local rules which may require special training and supervision.

Supervision – Visitors and Casual Workers

If a visitor or casual worker is going to be working in the building unsupervised, they must attend a building induction conducted by the Workplace Safety Advisor.

Visitors or casual workers who wish to also work in the laboratories unsupervised must complete a Research Competency Form which will determine how much supervision is required.

Visitors or casual workers who have not received a building induction **MUST** be accompanied at all times by either a member of academic or support staff, who is entirely responsible for their safety and behaviour.

All work carried out by a visitor or casual worker must be approved by their supervisor.

Children are permitted in the building but they must be under the direct supervision of a member of academic or support staff at all times.

Supervision - MSc Students and Postgraduates

MSc Students and Postgraduates may work in laboratories under different levels of supervision determined by their level stated on their Research Competency Form.

Work Permits

Before any inspection, maintenance or other work which may alter the fabric of the Lennard Jones building can take place, the Workplace Safety Advisor MUST be informed. Permission will probably be required from the Estates and Development Department due to potential asbestos and other hazards risks.

Details of any special rules and regulations for maintenance staff, cleaners and other ancillary staff who work within the building are available from the Workplace Safety Advisor.

Roof Permits

Access to the roof of the Lennard Jones Building is strictly forbidden without the completion of a Roof Permit Form. These are provided by the Workplace Safety Advisor.

Risk Assessments

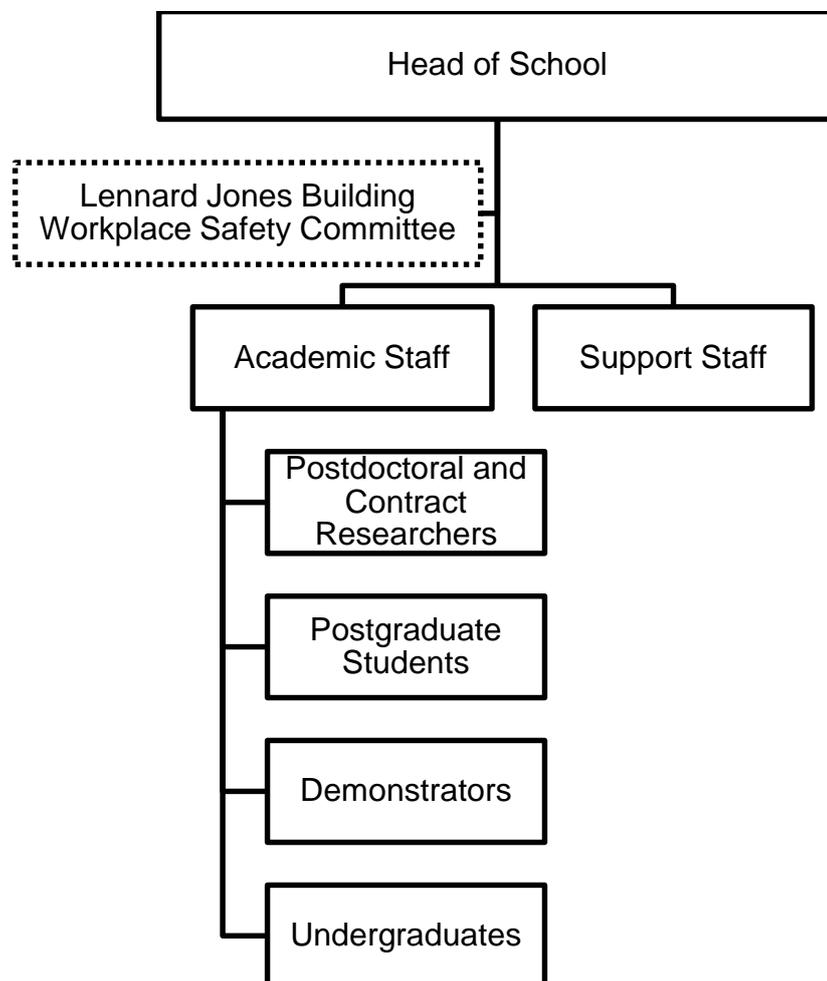
A risk assessment is required for any procedure that may present a serious or permanent hazard. A risk assessment completed for a permanent hazard must be reviewed at least once a year.

COSHH Forms

All experiments and processes which involve the use of chemicals must be accompanied by a completed Control of Substances Hazardous to Health (COSHH) risk assessment. COSHH regulations and risk assessment is covered in detail in the Chemical Safety section of this handbook.

Responsibility for Safety within the Lennard Jones Building

The chain of responsibility for safety in the Lennard Jones Building is as follows:



Lennard Jones Workplace Safety Committee

The composition of the committee is as follows:

Head of School	Office Manager
Workplace Safety Advisor	Laser Protection Advisor
Chemistry Safety Advisor	Radiation Protection Supervisor
Technical Manager	Postgraduate Representative
School Manager	Postdoctoral Representative

The committee meets at least twice a year to discuss any safety matters brought before it and to advise the Head of School on matters to be taken.

Medical Details

You must declare any medical conditions which may affect your ability to work (specifically in laboratories) to your line manager. If there are any changes to your medical details (for example becoming pregnant) your line manager must be informed.

Smoking Policy

Smoking is not permitted in any area of the Lennard Jones Building. It is also not permitted directly outside any exits. There is a smoking shelter located at the corner of the building.

Eating and Drinking Policy

Eating and drinking is not permitted in any of the laboratories within the Lennard Jones Building.

Electrical Safety

The University Occupational Health and Safety Committee has drawn up rules to ensure that the use, repair, modification and testing of all fixed electrical installations and electrical equipment (whether permanently wired in or portable) in the University is in accordance with the Electricity at Work Regulations 1989 and later amendments.

In particular, the rules are designed to ensure:

- that all persons carrying out electrical installation work, repairs, modifications and testing have been adequately trained,
- that all electrical systems and equipment are tested at appropriate intervals and maintained in a safe condition, and
- that work on live electrical systems is only carried out when absolutely necessary and then only in suitable locations and with suitable safeguards.

The Head of School is responsible for ensuring that arrangements are made so that all repairs and modifications of portable electrical equipment are carried out in a safe manner and that an annual electrical test of all portable equipment is carried out.

To enable the Head of School to discharge these responsibilities a Departmental Electrical Safety Advisor has been appointed. The role of the Departmental Electrical Safety Advisor is advisory and is similar to that of the Departmental Safety Advisor.

ONLY THE DEPARTMENTAL ELECTRICAL SAFETY ADVISOR MAY CARRY OUT REPAIR AND MANUFACTURE OF ELECTRICAL EQUIPMENT WITHIN THE DEPARTMENT. Approved persons may only carry out types of work for which specific permission has been granted.

NO PRIVATELY OWNED ELECTRICAL EQUIPMENT CAN BE USED IN THE DEPARTMENT WITHOUT PRIOR APPROVAL OF THE DEPARTMENTAL ELECTRICAL SAFETY ADVISOR.

- When equipment is being used out of doors it must be fitted with a residual current device (RCD) and prior approval must be obtained from the Departmental Electrical Safety Advisor.
- It is the responsibility of all students and staff to report any electrical faults that they observe to the Departmental Electrical Safety Advisor. Visitors are also requested to report such faults.
- If a fuse should fail on a piece of equipment, the power should be switched off and the equipment disconnected. The fuse **MUST NOT** be replaced until the fault has been ascertained and corrected by an approved person.

The following safety precautions must be observed:

- **YOU MUST NOT** touch electrical equipment or apparatus with wet or damp hands nor when standing on a wet surface.
- Before use, the wiring to communal equipment, *e.g.* stirrers, hotplates, heating mantles *etc.*, should be examined and, if not in a safe condition, the equipment should be returned to the Departmental Electrical Safety Advisor for repair. Each item of equipment should have a date of testing displayed (usually on the plug). Before using equipment inspect the test date; if the safety test date has expired **YOU MUST NOT USE** the equipment. Notify the Departmental Electrical Safety Advisor of any equipment that requires safety testing.
- If possible, keep all wiring off the bench tops. This is particularly important where equipment is being used in a fume cupboard and is more likely to be exposed to water and corrosive chemicals. The electrical controls (simmerstats, speed regulators *etc.*) should also be raised clear of the bench top and located out of the way of possible spillage.
- Where electricity is being used to supply equipment located close to metal frames, *e.g.* supports for vacuum systems, the frames must be earthed. Always consult the Departmental Electrical Safety Advisor for advice on this matter.
- Electric ovens, drying cabinets, fume cupboards and extractors **MUST NOT** be left on overnight unless absolutely necessary. If such equipment is left on, the user should attach a signed and dated notice otherwise it is liable to be switched off.

Fire Drill

Familiarise yourself with the location of:

- the nearest fire exit route from your normal working area
- fire alarm points
- telephones (both internal and external lines)
- the First Aiders and the emergency first aid box
- fire extinguishers and fire blankets
- emergency showers

Fire Fighting Procedure

In the event of fire

- **DO NOT TAKE ANY PERSONAL RISKS.** Only if the fire is small, tackle with an extinguisher and warn neighbouring workers.
- If it seems that the fire might get out of control, sound the fire alarm (alarm points are located on all main corridors and escape routes) and evacuate the building.
- Call for the fire brigade (dial 9-999 from an internal PAX telephone, 999 from an external telephone), stating clearly that the fire is in the Lennard-Jones Laboratories at Keele University.
- Call 24 hour security in the Darwin Building (33004) and state clearly where the fire is. Security personnel will guide the Fire Brigade to the building.

Evacuation Procedure

- The fire doors on all main corridors are normally held open by magnetic catches connected to the Fire Alarm system. When the alarm is activated these doors are automatically released from the catches and will close slowly. The doors can still be opened manually to enable safe and rapid evacuation from the building.
- **DO NOT USE THE SERVICE LIFT IF THE FIRE ALARM SOUNDS.**
- If time permits, turn off all equipment and services and close all windows and doors behind you as you leave the building.
- Assembly point
- Assemble on the grassed area outside the front entrance of the Lennard-Jones building. This area will be the control point during the evacuation of the Lennard-Jones building.
- Report any missing persons known to have been in the Lennard-Jones building to a Fire Marshall at the control point; all Fire Marshalls will be wearing reflective tabards and some will be stationed around the Lennard-Jones building.
- The person responsible for raising the alarm must report to a Fire Marshall at the control point.
- Keep the access road opposite the main entrance doors clear at all times so that Fire Brigade appliances may approach the building without obstruction.
- Fire Marshalls and School staff will control all entrances to the building during the emergency. Re-entry to the building will not be allowed until the Senior Fire Brigade Officer gives permission to do so.

Protocol for Radioactive Sources in the event of a fire

The following procedure is recommended for any lab containing a sealed source, which, at the moment, only applies to the Physics Lab:

- The most important priority is to evacuate the Lab.
- The doors to the Lab should be locked (anyone inside the Lab will be able to let themselves out from the inside).
- The Fire Marshall should be informed by the member of staff in charge of the Lab that sealed sources are in there.
- The Fire Marshall should then pass this information on to the Fire Brigade upon their arrival.

Laboratory and Chemical Safety

Laboratory Safety

- The continuous practice of good housekeeping is essential for the prevention of accidents, fires and personal injury. All users of the building are expected to keep their laboratory benches, reagent shelves and fume cupboards clean and tidy and free of all materials, apparatus and equipment which is not in use.
- Benches and fume cupboards **MUST** be cleared on request to allow access for essential maintenance. As much prior notice as possible will be given.
- Local rules may apply for the particular laboratory that you intend to work in. **YOU MUST** ensure that you are aware of any such local rules before beginning work. Contact the Departmental Safety Advisor for more details.

General Aspects of Laboratory Safety

- **LEAVE ALL BAGS, COATS, etc., OUTSIDE THE LABORATORY.**
- **MAKE SURE THAT THE FLOOR BETWEEN THE BENCHES IS CLEAR, THAT LOCKER DOORS ARE KEPT SHUT AND THAT ALL EXITS FROM THE LABORATORY ARE UNOBSTRUCTED AT ALL TIMES.**
- **YOU MUST NOT EAT, DRINK OR SMOKE IN ANY LABORATORY.** Always wash your hands before leaving the laboratory and certainly before eating, drinking or using the toilet.
- **ALWAYS WORK TIDILY.** An untidy bench is not only a safety hazard but it may also prevent you from obtaining results of suitable accuracy. Always remove equipment after use and return any unneeded chemicals and equipment to the Stores immediately after use.
- **BE ALERT TO YOUR SURROUNDINGS.** In the interests of safety, as well as for academic reasons, you should always take an interest in the experiments going on around you.
- **MAKE SURE THAT YOUR EXPERIMENT DOES NOT CONSTITUTE A RISK TO OTHER WORKERS.** If you are working with a dangerous material (normally in a fume cupboard) let other workers nearby know about this.
- **CONSULT YOUR SUPERVISOR OR THE CHEMISTRY SAFETY ADVISOR BEFORE WORKING WITH ANY HIGHLY TOXIC OR HAZARDOUS SUBSTANCE.** If you need to work with such substances your supervisor **MUST** be consulted beforehand to ensure that adequate precautions are taken.
- **ALWAYS** consider all of the safety aspects of any experiments or processes that you will be concerned with: can a less hazardous chemical be used or can the scale of the experiment or process be reduced?
- **ALWAYS READ THE INSTRUCTIONS PROVIDED.** Many items of equipment are provided with detailed instructions as to their correct use. **YOU MUST NOT** use such equipment without having read and understood the instructions.
- **IF THERE ARE NO INSTRUCTIONS AVAILABLE, DISCUSS THE OPERATING PROCEDURE WITH YOUR SUPERVISOR OR AN APPROPRIATE PERSON BEFORE COMMENCING ANY WORK.**
- **ALWAYS** report any safety problem that you observe to the Departmental Safety Advisor or to an appropriate person.
- **NEVER TASTE ANY CHEMICAL SAMPLE.**

- **DO NOT DELIBERATELY INHALE ANY CHEMICAL VAPOUR.** Many organic and some inorganic vapours (e.g. mercury) are highly toxic and should never be inhaled.
- **NEVER PIPETTE BY MOUTH.** Pipette fillers are provided.
- **DO NOT RETURN UNUSED MATERIAL TO THE STOCK BOTTLE FROM WHERE IT WAS ORIGINALLY OBTAINED.** Treat such unused material as waste.
- **NEVER USE A NAKED FLAME TO HEAT FLAMMABLE SOLVENTS.** Many organic solvents are volatile and highly flammable; obviously, such solvents must never be heated in open vessels over a naked flame. Appropriate precautions should be taken, such as heating the solvents in a water bath or by using a heating mantle.
- **DO NOT APPLY EXCESSIVE FORCE TO DISASSEMBLE GLASS JOINTS.** If you have to apply any force to glassware, wrap a piece of towelling around your hand. Cuts resulting from shattering glass are the most common type of accident in any Chemistry department.

Protective Clothing and Equipment

- **YOU MUST NOT WEAR OPEN-TOED SHOES, SANDLES OR SHORTS WHEN IN THE LABORATORY.** You will be refused entry to a laboratory if your clothing does not offer suitable protection.
- **YOU MUST ALWAYS WEAR A LAB COAT** (cotton or cotton/polyester but not nylon). This will not only protect your clothing but is also easily removed if you get burning solvent or some other dangerous material on it.
- **YOU MUST ALWAYS WEAR SUITABLE EYE PROTECTION.** The safety spectacles issued to you should provide suitable protection. However, if you are working with corrosive or dangerous materials or lasers, suitable goggles or a face shield may be appropriate.
- **IF NECESSARY, WEAR GLOVES.** Skin contact with most reagents should be avoided as some can cause allergic contact eczema. Researchers must wear suitable protective gloves when handling material that is corrosive or dangerous by skin adsorption or capable of causing allergic reaction. Gloves must also be worn when washing apparatus used with such material. If you believe that you are particularly prone to allergic reactions you must wear gloves at all times.

Some gloves may be permeable to common solvents and other reagents. You should seek advice concerning the most suitable type of glove to use whenever you are to handle dangerous material.

Added protection may be obtained by wearing disposable gloves inside non-disposable gloves. This will help to prevent the problems associated with inadequate decontamination.

Gloves must be carefully washed with soap and water immediately after any contamination and always after use. They must not be worn if they show signs of deterioration or contamination.

- **KEEP YOUR HAIR UNDER CONTROL AND OUT OF THE WAY.** Long hair is not only a fire hazard but it may also catch in equipment. Even relatively short hair can be caught in stirrer motors.

Laboratory Safety Prescription Glasses for Staff and Postgraduate Research Students

Where members of staff normally wear prescription spectacles and their work requires them to spend significant time in the laboratory, the School/University will meet the cost of an eyesight test and suitable safety prescription glasses. The University already has an arrangement with Vision Express for the provision of eyesight tests.

All staff working in the laboratory who normally wear prescription glasses **MUST** either cover them with “wrap around” safety glasses or wear proper prescription safety glasses.

Procedure

- The member of staff/PGR student should e-mail Bernadette Scanlon (Occupational Health) to obtain a Vision Express voucher for an eye test which also provides a discount for appropriate glasses. The School Manager should also be copied into the e-mail for budgeting purposes. The normal interval between eye tests is 2 years.
- For staff, the School will meet the full, reasonable cost of the prescription safety glasses. For PGR students, the current costs that can be refunded are:
 - Up to £55 (single vision glasses)
 - Up to £80 (Bifocal or standard varifocal)
- The staff member should complete an expenses claim and provide original receipts in order to claim costs back for prescription safety glasses through the usual expenses claim procedure and pass this to the School Manager. The expense claim form can be found at:
<http://www.keele.ac.uk/media/keeleuniversity/fait/finance/accountspayable/STAFFEXPONLINECOMP%20TRAV%20C1.pdf>

Please note:

- The PGR student is responsible for meeting any costs incurred over the amounts listed above
- All claims must be supported by receipts

Electrical Safety in the Laboratory

- **YOU MUST NOT CARRY OUT ANY REPAIRS OR ALTERATIONS TO ELECTRICAL EQUIPMENT.** Defective equipment should be returned immediately to the Departmental Electrical Safety Advisor.
- **ELECTRICAL EQUIPMENT SHOULD NEVER BE TOUCHED WITH WET OR DAMP HANDS, NOR WHEN EITHER IT OR YOU ARE STANDING ON A DAMP SURFACE.**
- **BEFORE USE**, all wiring to communal equipment, e.g. stirrers, hotplates, heating mantles *etc.*, should be examined. If it is not in a safe condition, the equipment should be returned immediately to the Departmental Electrical Safety Advisor for repair. Each piece of electrical equipment should also display a safety test date, usually on the plug. Any item for which the test date has expired must be returned to the Departmental Electrical Safety Advisor for testing.
- **WHEREVER POSSIBLE, KEEP ALL WIRING OFF THE BENCH TOP.** This is particularly important where the equipment is being used in a fume cupboard and is more likely to be exposed to water and corrosive chemicals. Electrical controls (rheostats, speed regulators, *etc.*) should also be raised clear of the bench top and located out of the way of a possible spillage. Wiring must not be allowed to become entangled with rubber tubing carrying water or to trail through drainage troughs.

Water Safety in the Laboratory

- Care must be taken to ensure that all water taps are turned off when not in use, particularly overnight. Strict observation of this requirement is necessary to prevent flooding and also to reduce water consumption. It is essential that pressurised water pumps be used for the minimum time necessary.
- Where apparatus is connected to a water supply for long periods, the connections should be secured with hose clips or wire and the tubing regularly examined to ensure that it is in good condition. In the case of condensers, the lowest flow rate consistent with efficient cooling should be chosen.
- **DO NOT DRINK THE WATER IN THE LABORATORIES OR USE IT FOR WASHING OPEN WOUNDS.** The laboratory water supply is obtained from storage tanks and not directly from the mains. Drinking water is obtainable from labelled taps throughout the Department.
- In the event of any fault in the water supply, including dripping taps, notify the Work Place Safety Advisor immediately.

Natural Gas Safety in the Laboratory

- The flame obtained from the natural gas supply is extinguished easily by even a slight draught. It is, therefore, essential to set up experiments using open flame heating in a draught-free location or to fit a draught shield to the burner.
- Before using gas in conjunction with oxygen or compressed air, both of which are supplied at higher pressures than the natural gas, a non-return valve **MUST** be fitted in the natural gas supply line to prevent oxygen or air from entering the gas main.
- Gas burners **MUST NOT** be left on unnecessarily and must be turned off at the bench stopcock when not required and certainly at the end of the day. Wherever possible, the natural gas supply to the laboratory should be isolated at the end of the day and whenever the laboratory is not going to be used for long periods of time.

Flammable Solvents

- All bottles of over 500 cm³ capacity which contain flammable solvent must be carried in a suitable carrier and must be returned to a flame-proof cabinet immediately after use.
- When transferring flammable solvents from 2.5 litre bottles, you should transfer only the amount that you require and no more.

Fume Cupboards

- The purpose of a fume cupboard is the secondary containment of fumes and other material. Primary containment must be part of the experimental design, which should allow for the trapping of any expected release of fumes. All experiments involving toxic vapours **MUST** be carried out in a fume cupboard. It is important to note that noxious fumes and odours **MUST** be trapped and destroyed in an appropriate manner, rather than vented to contaminate the atmosphere.

DO NOT put your head inside the fume cupboard unnecessarily when making adjustments to equipment.

- Modern fume cupboards have a balanced flow of air and are fitted with alarms that activate if there is a drop in air flow or if the fume cupboard sash is too high. Some fume cupboards are labelled with face velocities for various openings; for all work within any fume cupboard a face velocity of 0.5m/s is recommended. **YOU MUST** work with the sash as low as practicable at all times. Turn off fume cupboards when not in use.
- An annual engineering and electrical inspection of the fume cupboards is carried out by the Estates and Buildings Department. The support staff carry out other checks, again on an annual basis. The date of these checks is displayed on the fume cupboards; if the date is not displayed you should inform the Work Place Safety Advisor immediately.
- Keep the amounts of apparatus and chemicals in fume cupboards to a minimum. Fume cupboards **MUST NOT** be used as storage areas. Any faults involving the proper operation of the fume cupboards **MUST** be reported to the Work Place Safety Advisor immediately.

Distillations and Work with Reduced Pressures

- When glass apparatus is used under reduced pressure conditions an implosion hazard exists and suitable precautions should be taken. All distillations under reduced pressure **MUST** be carried out in a fume cupboard and shielded appropriately: seek advice on the correct method of shielding. All glassware, especially rotary evaporator flasks, to be used in reduced pressure distillations **MUST** be checked for cracks before use. **YOU MUST NOT** use chipped, heavily scratched or cracked glassware. **YOU MUST NOT** use flat bottomed or conical flasks unless they are specially designed for vacuum work. When carrying out any distillation or reflux operation always make sure that the condenser system is operating correctly before commencing heating.
- Vacuum manifolds **MUST NOT** be left open to the atmosphere when liquid nitrogen cooling traps are still in position around the condensing apparatus.
- Vacuum dessicators and bulbs **MUST** be covered by wire cages, strong canvas bags or wrapped in thick cloth and sited in a safe location. They **MUST NOT** be carried whilst under vacuum.
- Dewar flasks should be sheathed in protective cases and any exposed glass should be taped.
- Allow distillation residues to cool before letting air into the system, otherwise a vigorous or explosive oxidation may occur. Before disconnecting the apparatus ensure that the vacuum has been released from all parts of the system.
- When a water pump is used, a suitable trap or non-return valve should be installed between pump and apparatus to protect the apparatus and its contents from the consequences of a drop in the water pressure.
- Mechanical vacuum pumps should be protected from condensable volatile and corrosive vapours by the use of cold traps. These cold traps **MUST NOT** be used as receivers. The traps **MUST** be cleaned after use; volatile materials left in the traps contaminate the pump oil when the coolant evaporates. If liquid nitrogen is to be used appropriate precautions should be taken.

High pressure work

- The Departmental Safety Advisor must be consulted before any work is carried out at pressures above atmospheric, e.g. reactions in sealed tubes.

Compressed Gas Cylinders and Piped Gas Installations

- Cylinders **MUST** only be transported by trolley. Cylinders **MUST** be kept in a trolley or be securely chained or strapped to a bench or wall. Cylinders **MUST NOT** be left freestanding. Cylinders **MUST NOT** be sited in any place that would cause an obstruction.
- The following points should be observed when using cylinders of compressed gas or piped gas installations:
 - (i) Never apply oil or grease to threads and connections on gas cylinders, supply pipes or gauges as a violent explosion may occur.
 - (ii) Ensure that the correct type of regulator is fitted to the cylinder or gas supply. For fine control a needle valve must also be fitted.
 - (iii) A pressure relief valve **MUST** always be used between the cylinder or piped gas supply and the apparatus to prevent a build-up of pressure should a blockage develop in the system.
 - (iv) A suitable trap **MUST** always be fitted between the cylinder or piped gas supply and any apparatus to prevent the reaction mixture entering the gas supply piping.
 - (v) Cylinders containing poisonous or corrosive gases **MUST** always be returned to the Chemistry Stores when not in use.
 - (vi) Cylinders which have stiff or locked valves **MUST NOT** be used but should be returned to the Stores with a note attached describing the fault.
 - (vii) After use, the cylinder or gas supply valve **MUST** be closed immediately and the gas supply disconnected from the apparatus. If possible, pressure on the regulator diaphragm valve should be released.
 - (viii) You **MUST NOT**, under any circumstances, accompany cylinders that are being transported in the service lift.
 - (ix) Cylinder regulators should only be changed by people who have been trained accordingly and are competent.
 - (x) Anti-spark tools should be used when used cylinders containing explosive gases.

Explosion Hazards - Explosive Materials

- When working with potentially explosive materials the following principles should be observed:
 - (i) Use only small quantities under carefully controlled conditions, particularly when working with a substance for the first time.
 - (ii) An electric water bath should be used for heating the material, not a naked flame.
 - (iii) The work should be carried out in a fume cupboard.
 - (iv) Special attention must be paid to the use of suitable eye protection and protective screens.
 - (v) Remove any other materials from the vicinity, *e.g.* flammable solvents, mineral acids *etc.*, which in the event of an explosion could worsen the situation.
 - (vi) Display warning notices.
 - (vii) Destroy all dangerous residues.

- Liquid nitrogen **MUST NOT** be used to cool systems that are open to the air because oxygen from the air will condense in the system. Liquid oxygen may cause explosions, either through evaporation and build-up of pressure in the system is subsequently closed or by reaction with substances that are readily oxidised.

- Glass ampoules must be cooled slowly before opening or resealing, first in ice (provided that the contents do not react with water) followed, if necessary, by an ice-salt mixture and a carbon dioxide powder bath. Ampoules containing water-reactive materials can be cooled safely using a carbon dioxide powder bath. Carius tubes and NMR tubes that are to be flame sealed should be cooled with solid carbon dioxide or a mixture of liquid nitrogen with a non-flammable solvent. Always use protective screens and wear gloves when opening Carius tubes or glass ampoules.

Radioactive Materials, X-ray Equipment and Lasers

- **YOU MUST** obtain permission to carry out any work with sources of ionising radiation and X-rays from the Departmental Radiation Protection Advisor. Radiation workers **MUST** familiarise themselves with the local regulations governing the use of radioactive materials.
- **YOU MUST** obtain permission to carry out work using lasers from the Departmental Laser Safety Advisor.

Unattended Experiments

- Any experiment or process which needs to be left unattended for a period of time, e.g. overnight, **MUST** be accompanied by a completed COSHH risk assessment and an Unattended Experiment form; the Unattended Experiment form constitutes the lower portion of the COSHH form. **YOU MUST** display the forms in a prominent position. Additional forms may be affixed if the same experiment or process is to continue for a longer period or is to be repeated. Like the COSHH risk assessment form, two copies of the unattended experiment form are required: one copy to accompany the apparatus, and a copy must be retained by your supervisor for future reference.

Labelling of Chemicals and Research Samples

- All chemical samples, large or small, **MUST** be labelled properly. As a result of new legislation it is extremely expensive to dispose of unidentified chemical waste. In view of this, research workers are expected to carry out the following procedure for all chemicals and materials that they intend to store:
 - (i) attach a label to the bottle stating your name, an identification code which cross-references to your laboratory notebook, the chemical structure, formulation or nature of the contents and the date of storage,
 - (ii) write the identification code directly on the bottle,
 - (iii) complete a thorough COSHH risk assessment and either label the sample with the code generated from the COSHH assessment (see below) or keep a copy of the COSHH assessment with the sample.
 - (iv) ensure that a note has been made in your laboratory notebook of the identification code and any additional information written on the label and bottle,

All chemicals and research samples must be labelled correctly and have a current COSHH risk assessment if they are to be stored for any length of time.

- When you finish your studies or term of employment **YOU MUST** make sure that all information concerning the stored samples is handed to your supervisor.
- Whenever possible, research workers should render safe and dispose of any material for which no further use can be found.

Refrigerators

- Only materials which are unstable at room temperature, reaction mixtures, crystallising solutions and NMR solvents may be stored in the refrigerators.
- All containers must be fitted with airtight covers and must be clearly labelled with the description of the contents, the name of the owner and the date. Ideally, a completed COSHH risk assessment should accompany the container. A catalogue must be maintained of all chemicals that are stored in each individual refrigerator. Unlabelled material is liable to be removed and destroyed.
- **FOODSTUFFS MUST NOT BE STORED IN THE REFRIGERATORS. NO MATERIAL MAY BE STORED IN THE ICE-MAKING MACHINE.**

Drying Cabinets, Ovens and Furnaces

- Chemicals must not be placed in a drying cabinet without the approval of a member of the academic staff and must **ALWAYS** be accompanied by a COSHH risk assessment.
- The drying ovens must only be used for evaporating water. No sealed vessel may be placed in such ovens. If you wish to alter the temperature of an oven **YOU MUST** consult all other users first. All vessels that contain chemicals and are placed in an oven must be labelled in the usual way and must be accompanied by a COSHH risk assessment. **YOU MUST** consult a member of the academic staff before using any furnace.

Centrifuges

- When using a centrifuge make sure that:
 - (i) the correct tubes are used,
 - (ii) the tubes are properly balanced,
 - (iii) cushioning pads are in place, and
 - (iv) suitable guards are in place.
- Many centrifuges within the Lennard-Jones building have specific instructions for their use. If in doubt, always consult your supervisor or an appropriate person about the correct use of the centrifuges.

Sharps

- Waste sharps (syringes and needles) must be disposed of safely by placing them in the designated "sharps" boxes located in the laboratories. When the sharps boxes are full, contact the Work Place Safety Advisor to arrange for their disposal and the supply of new boxes. Sharps (needles or syringes) **MUST NOT** be left lying around the laboratory as someone may be injured.
- Glass sharps **MUST** be cleaned if possible and disposed of in a glass waste bin.

Spillage Containment

- Spillages of chemicals or water on the bench or floor **MUST** be dealt with immediately. The first priority is containment to prevent any liquid flowing into inaccessible areas. Acid and alkali solutions should be neutralised before cleaning up. Equipment, materials and protective clothing for dealing with spillages of corrosive or noxious chemicals are provided in each laboratory.

Chemical Safety

HAZARD AND RISK ASSESSMENT - Monitoring of Hazardous Substances

The COSHH regulations require that the employer shall ensure that the exposure of employees to substances hazardous to health is monitored in accordance with a suitable procedure in any case in which

- (i) it is requisite for ensuring the maintenance of adequate control of the exposure of employees to substances hazardous to health, or
- (ii) it is otherwise requisite for protecting the health of employees.

The Approved Code of Practice suggests that monitoring is required in all circumstances unless it is immediately obvious that adequate control is in place. Any indication that control might be less than that planned would lead to an increased requirement for monitoring.

It is the University's policy that processes involving hazardous substances will be carried out so that, in all normal circumstances, exposure to a particular substance is as far as is reasonably possible below the Maximum Exposure Limit (MEL) or Occupational Exposure Standard (OES) for that substance, as appropriate. Anyone wishing to work with a substance listed in Schedule 4 to the COSHH regulations, *i.e.* substances which must be continuously monitored, must seek written permission to do so from the Chemistry Safety Advisor and the Head of School. A written monitoring scheme that meets the requirements of Schedule 4 must be submitted.

One aim of control should be to reduce all concentrations of toxic substances to the point at which even the most sensitive persons cannot detect them. Odours should always be investigated unless they can be attributed positively to non-toxic material. Some substances have noxious odours at concentrations much less than the MEL or OES; such substances constitute a nuisance and should also be controlled. Toxic substances with no odour might, in the event of equipment failure, result in an excessive concentration in the laboratory atmosphere and must be provided with a specific permanent monitoring system that will trigger an alarm if the concentration rises above a safe level. An example of this would be the use of carbon monoxide.

The Chemistry Safety Advisor is responsible for advising the Head of School on appropriate monitoring schemes for all processes carried out in the Lennard-Jones building. Advice on devising a suitable monitoring scheme may also be obtained from the University Safety Advisor.

HAZARD AND RISK ASSESSMENT - COSHH Risk Assessment

The identification of hazards and the assessment of risks associated with an experiment is not intended to produce a fear of experimental work; rather, it will enable you to carry out experiments in a safe manner and handle hazardous materials with confidence. It is the responsibility of the School to provide suitable safety advice at all times. However, it is important that you must assess the dangers presented by an experiment or process and what steps are necessary to make any equipment safe.

You **MUST** complete a COSHH risk assessment before beginning a particular experiment or process. **BOTH THE WORKER AND THEIR SUPERVISOR MUST SIGN THE FORM.**

A COSHH risk assessment should include explicit details concerning the following:

- safe handling procedures,
- the safe exposure limits of substances to be used and whether these are likely to be exceeded in the normal operation of the experiment,
- safe disposal procedures, and
- what to do if there is some mishap in the experiment, *i.e.* planning an emergency response.

TWO copies of a COSHH risk assessment form must be completed. One copy must be located near to the experiment in a secure position, and a second copy must be handed to your supervisor.

A primary source of information concerning the risks and hazards associated with a particular chemical substance is the Material Safety Data Sheet (MSDS) which is supplied with the chemical by the manufacturer or supplier. MSDS information can also be obtained from a variety of other sources, *e.g.* commercial software such as ChemOffice/ChemACD and the Aldrich database. However, the most useful sources of MSDS data may be found on the Internet. The following addresses may be useful:

<http://www.sigma-aldrich.com>

The Sigma-Aldrich home page now allows access to their extensive range of MSDS.

<http://www.ilpi.com/msds/index.shtml>

<http://www.hazard.com/msds/index.html>

<http://www.pdc.cornell.edu/ISSEARCH/MSDSsrch.htm>

EC legislation had led to the introduction of standard Risk (R) and Safety (S) Phrases to describe concisely the properties of hazardous materials. All hazardous products were marked with R and S numbers corresponding to one or more of the assigned Risk and Safety Phrases. This information could be found on the product labelling and was repeated in the product description as listed in any catalogue. They may be listed as individual numbers or, more often, as combinations of several R and S Phrases which describe succinctly any potential risks and the safety measures which must be taken when handling the substance. Risk and Safety Phrases can be an invaluable aid when completing COSHH risk assessments.

H and P Statements

In 2015, the risk and safety statements were replaced by hazard statements and precautionary statements in the course of harmonizing classification, labelling and packaging of chemicals by introduction of the UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

All chemicals and research samples must be labelled correctly and have a current COSHH risk assessment if they are to be stored for any length of time. The Chemistry COSHH risk assessment procedure has been adapted so that all the information required by the COSHH regulations is contained in a short code generated for each individual sample.

Examples of Dangerous Materials

- **Hydrogen Fluoride**

Hydrogen fluoride burns are extremely serious and may require surgery. Hydrogen fluoride is only issued with the approval of the Departmental Safety Advisor. **YOU MUST** wear gloves, goggles and work in a fume cupboard whenever you use hydrogen fluoride. **YOU MUST** notify a First Aider whenever you are using hydrogen fluoride and must have an emergency treatment (issued from the Stores) at hand.

Details of safe working procedures and first aid treatment for hydrofluoric acid injuries will be provided by the Stores personnel when hydrofluoric acid is drawn from the Stores for use. Further details are available from the Departmental Safety Advisor.

- **Carcinogens**

Before using materials that are known or suspect carcinogens you **MUST** consult your supervisor or the Departmental Safety Advisor. Many prohibited or controlled carcinogens will not be issued from Stores without the prior written approval of the Departmental Safety Advisor. All users of carcinogens must contact the Occupational Health Nurse for health surveillance.

- **Chromic Acid**

Chromic acid is a suspected carcinogen, the preparation of the compound is potentially hazardous (exothermic reaction) and there are associated storage and disposal problems. You must obtain permission to prepare and use chromic acid from Departmental Safety Advisor.

- **Cyanides**

Such compounds will only be issued from the Stores on the instruction of the Departmental Safety Advisor and only after you have been issued with the relevant safety information. Undergraduates should not normally use cyanides in their work. **YOU MUST** work in a fume cupboard and notify people working close to you that you are working with cyanides; these people must also be aware of the procedures to be followed in the event of cyanide poisoning. A First Aider must be present at all times and have an Oxygen Respiratory Kit. **CYANIDES MUST NOT BE ALLOWED TO COME IN CONTACT WITH ACID.** Dispose of all cyanide waste residues to a labelled cyanide residue bottle. **YOU MUST** wash your hands and decontaminate any personal protective equipment thoroughly after using cyanides.

- **Sodium**

YOU MUST be instructed in the safe use of sodium before using it for the first time. **SODIUM MUST NOT COME INTO CONTACT WITH YOUR HANDS AND MUST ON NO ACCOUNT BE ALLOWED TO COME INTO CONTACT WITH WATER.**

- **Mercury**

Mercury vapour is extremely toxic and the metal **MUST NEVER** be heated in an open vessel. Spilled mercury should be collected immediately, by means of some suitable apparatus. Any remaining droplets should be treated with a thin paste composed of equal parts of calcium hydroxide and sulfur mixed with sufficient water. After 24 hours the paste should be removed with clean water.

A mercury spillage 'clean-up' kit is located in the Spillage Materials Cupboard.

Toxic, Corrosive And Reactive Chemicals

- Large quantities of such substances **MUST NOT** be allowed to accumulate in laboratories. **YOU MUST NOT** store unstable materials for prolonged periods without first consulting your supervisor or the Departmental Safety Advisor. Regular checks should be made to ensure that any chemicals being stored by individuals are in a safe condition. Workers should familiarise themselves with the toxic properties of and antidotes for the compounds that they are working with and **MUST** complete a thorough COSHH risk assessment before their use. They should also ensure that suitable protective clothing is worn and that all correct safety measures are observed.
- All work involving toxic, corrosive and reactive materials **MUST** be carried out in a fume cupboard and every effort should be made to prevent the escape of gases or vapours from the experiment by using suitable chemical traps. Many common solvents have highly toxic vapours.
- Benzene should only be used in exceptional cases where no alternative solvent can be used. Research students **MUST NOT** use benzene without first obtaining permission to do so from their supervisor. If benzene must be used, even in relatively small quantities, the work **MUST** be carried out in a fume cupboard.

Disposal of Waste

- The Deposit of Poisonous Waste Act forbids the disposal of solvents and chemicals in any other way than in an approved manner. Any person or institution may face a heavy fine if they are found to be committing an offence under this act. Solvents of any description other than water **MUST NOT** be disposed of in the laboratory sinks but should be collected in the appropriate residue bottles for disposal. **DO NOT MIX HALOGENATED AND NON-HALOGENATED SOLVENTS.** Residues containing materials in solution that may form toxic, corrosive or otherwise dangerous substances should be rendered harmless before being transferred to a solvent residues bottle.
- Do not order large quantities of chemicals since disposal of any excess is expensive.

- **Water soluble chemicals**

Relatively non-toxic dilute aqueous solutions and suspensions of solids that do not hydrolyse to form volatile, toxic or noxious materials may be disposed of down the sink, accompanied by copious amounts of water.

Small quantities of corrosive chemicals, e.g. acids and bases, should be diluted with copious amounts of water before being disposed of down the sink. Large quantities of acids and bases and chemicals which hydrolyse to form corrosive and hazardous products should be neutralised before flushing down the drain with copious amounts of water.

- **Water insoluble chemicals**

Harmless solid materials should be put separately into plastic bags, the necks of which should then be tightly secured, and deposited in the red waste bags provided.

- Harmful solid materials which can be stored safely without deterioration and for which there is a use should be kept in their original containers and returned to the Stores.

- **Toxic and other dangerous materials**

Appreciable quantities of toxic or dangerous waste **MUST NOT** be allowed to accumulate in the laboratories. Advice should be sought from the Departmental Safety Advisor before making any attempt at disposal of toxic or dangerous materials.

- **Radioactive materials**

YOU MUST inform the Departmental Radiation Protection Advisor before attempting to dispose of any radioactive materials. You will be advised of an appropriate disposal method.

- When you need to dispose of material not covered by the above categories **YOU MUST** seek advice from the Departmental Safety Advisor as such material may require special containment procedures. After you have decontaminated all apparatus that has contained particularly toxic material, leave all residues and washings in a fume cupboard with a label which states your name, the date and the nature of the toxic material.

- **CARE SHOULD BE TAKEN NOT TO MIX ANY CHEMICALS FOR DISPOSAL.**