

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

HEALTH AND SAFETY HANDBOOK

USEFUL CONTACT TELEPHONE NUMBERS

EMERGENCY ONLY (SECURITY)

From an internal phone	222
From a mobile or external landline phone	0121 359 2922

SECURITY MAIN CONTROL	4803
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HEALTH CENTRE Halcyon Medical	0845 0724632
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UNIVERSITY SAFETY ADVISER	4742
- Sue Braithwaite	

ASSISTANT UNIVERSITY SAFETY ADVISER	4743
- Darnette Cowan	

SITE RADIATION OFFICER - Kevin Hughes	3963
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UNIVERSITY WASTE DISPOSAL OFFICER	3376
- Dave Aveston	

HEAD OF SECURITY – Mark Sutton	4804
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FIRE SAFETY ADVISER – Dave White	4805
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ESTATES HELPLINE	4328
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SCHOOL (EAS) SAFETY ADVISER – Gez Cooney	3406
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CEAC HEALTH AND SAFETY REP	3372
- Professor Sahar Al-Malaika	

CS HEALTH AND SAFETY REP	4868
- Dr Diego Resende Faria	

EAS HEALTH AND SAFETY REP	----
-Vacant	

EE&PE HEALTH AND SAFETY REP	3482
-Andy Abbott	

ESM HEALTH AND SAFETY REP	3576
-Fatemeh Miri	

EBRI HEALTH AND SAFETY REP	3415
-Dr Daniel Nowakowski	

Fire Safety Instructions – Main Building and Wings

<p>1. IF YOU DISCOVER A FIRE</p> <ul style="list-style-type: none"> • Immediately break the glass on the nearest fire alarm call point • From a place of safety contact Security by dialling: <ul style="list-style-type: none"> > 222 from any internal phone > 0121 359 2922 from a mobile or outside line > DO NOT DIAL 999 • Only fight the fire if you have been trained to do so • Evacuate the building immediately using the nearest available fire exit (see evacuation procedure in paragraph 3 below)
<p>2. IF YOU HEAR AN INTERMITTENT SINGLE TONE FIRE ALARM (accompanied by a female voice in most areas)</p> <ul style="list-style-type: none"> • Anticipate a full evacuation by ceasing normal work activities, storing any hazardous materials safely and switching off all power tools. • Do not enter a zone where a continuous two-tone fire alarm is sounding • Do not attempt to use the lifts while an alarm is sounding • If you are in a lift when the alarm sounds, you will be taken to the Ground Floor where the lift will terminate
<p>3. IF YOU HEAR A CONTINUOUS TWO TONE FIRE ALARM (accompanied by a male voice in most areas)</p> <ul style="list-style-type: none"> • If you have a Personal Emergency Evacuation Plan (PEEP), you should follow the instructions in it. Otherwise: • Leave the building using the nearest available fire exit and make your way to Lakeside Parade to await further instructions • If you are on the upper floors, if possible use one of the protected escape routes to exit the Building. The protected escape routes are the stairways at each corner (A, C, E, G corners) of the Main Building and the stairways at either end of the North and South Wings. • Take responsibility for any visitors and take them with you • Be vigilant and consider the needs of anyone you see in difficulties • Do not stop to collect belongings • Do not attempt to use the lifts while an alarm is sounding • If you are in a lift when the alarm sounds, you will be taken to the Ground Floor where the lift will terminate • Do not re-enter the building until authorised to do so
<p>4. IF THE ALARM STOPS</p> <ul style="list-style-type: none"> • If you heard a continuous alarm which was then silenced, continue your evacuation. Leave the building using the nearest available fire exit and make your way to Lakeside Parade to await further instructions. • If you heard an intermittent alarm which was then silenced, you may carry on as normal.
<p>5. IF YOU GET INTO DIFFICULTIES DURING THE EVACUATION</p> <ul style="list-style-type: none"> • Within the protected stairways, there is a red emergency telephone or a flashing green communication box (South Wing only) located on each floor. Red phones automatically dial security when hand set is lifted and the communication boxes dial Security when the green flashing button is pressed. • Contact Security (ext: 222 from an internal phone or 0121 359 2922 from your mobile telephone) and tell them your location. • Security will advise you what to do next. • If you are unable to contact Security directly, ask someone to relay your exact location to a Security Officer once they are outside the building.

Most other campus buildings are fitted with a 'two-tone' electronic alarm. Evacuate these buildings **IMMEDIATELY** the alarms sound continuously (see procedure above) and go to the designated fire/emergency assembly point for that building.

- Main Building & Wings, Vision Sciences, Aston Day Hospital – **Car park 12 –under the sports pitch**
- EBRI, Library, Lakeside Conference Ctr, Students' Union, Woodcock Sports Centre, and all Residences Buildings – **FOUNTAIN AREA IN FRONT OF MAIN BUILDING.**
- Nelson Building (ABS) and Conference Aston -**CAR PARK No 3 (by the Students Union glass bridge)**

OTHER EMERGENCIES WHICH MAY REQUIRE EVACUATION

In the event of other emergencies, for example, a serious chemical spillage, gas leak, or the discovery of a suspicious package, contact Security for further advice on the telephone numbers listed above.



IN THE EVENT OF AN ACCIDENT OR ILLNESS AT WORK

Notify a First Aid Officer and cooperate with that person. If no First Aider is available contact the Security Office should be contacted for assistance and advice using the emergency internal telephone extension 2222.

Give the following information:

- i The location of the ill/injured person
- ii The nature of the illness or injuries
- iii The extension number of the internal telephone

If the First Aider considers that medical help is required the Security Office should be contacted, ext. 4222, for direction to the Accident & Emergency Department of a local hospital or to call the ambulance service.

IMPORTANT NOTES

- The Health Centre does not normally provide medical services for students, staff , conference delegates or visitors who are not registered with the practice.
- Each area has a number of First Aiders, who are in charge of First Aid boxes and whose names are posted in prominent positions. Get to know where your local First Aiders and First Aid boxes are.
- First Aiders have undergone formal training and assessment in dealing with emergency situations.
- All Security Officers are qualified First Aiders.
- All accidents must be recorded on a University Accident Report Form.

ENTER DETAILS OF YOUR LOCAL FIRST AIDER HERE:

First Aider Name

Location

Phone number

SCHOOL PROCEDURES FOR SERIOUS AND IMMINENT DANGER

Regulation 7.1a of the *Management of Health and Safety at Work Regulations 1992* requires the establishment of appropriate procedures to be followed in the event of serious and imminent danger to persons at work.

1. Procedure for equipment which malfunctions and subsequently becomes dangerous

It is a requirement that all equipment currently being operated in the School must have both a Safe Operating Procedure (SOP) and an Emergency Shutdown Procedure (ESP). In these circumstances, **but only if considered safe to do**, the Emergency Shutdown Procedure should be activated immediately. The fact that you are activating an ESP must be conveyed to all personnel in the laboratory/room who should immediately vacate the area if their assistance is not required. On completion of this procedure an assessment of the residual risks remaining should take place to determine that it is safe to re-enter. If deemed unsafe to re-enter the procedure outlined below should be followed.

In situations where it is considered unsafe to activate the ESP or re-enter the area after the ESP, this should be conveyed immediately to a person who has H&S responsibility within this area, ideally the Group Safety Adviser, Group Convenor or Laboratory Supervisor. After consultation and consideration, if it is deemed necessary, the evacuation of an area, floor or building will be in accordance with the Emergency Fire Procedures.

2. Procedure for equipment which poses an unacceptable risk

It is a requirement that all equipment currently being operated in the School must have both a SOP and an Emergency Shutdown Procedure (ESP). In cases where no SOP is available the equipment/process will be deemed to pose an unacceptable risk and therefore should be immediately shutdown. In cases where an existing SOP is not being followed e.g. the removal of guards, and it is deemed that an unacceptable risk has resulted, then the equipment/process should be immediately shutdown. If the operator cannot be persuaded to stop, then this should be conveyed immediately to a person who has H&S responsibility within this area, ideally the Group Safety Adviser, Group Convenor or Laboratory Supervisor.

The Subject Group Safety Adviser must be informed of **all** cases that arise and are covered by the above procedures, and they in turn must notify the School Safety Adviser.

The School Safety Adviser is Gez Cooney who can be contacted on ext. 3406 or by email G.Cooney@aston.ac.uk.

ENTER DETAILS OF YOUR SUBJECT GROUP SAFETY ADVISER HERE:

Name

Location

Phone number

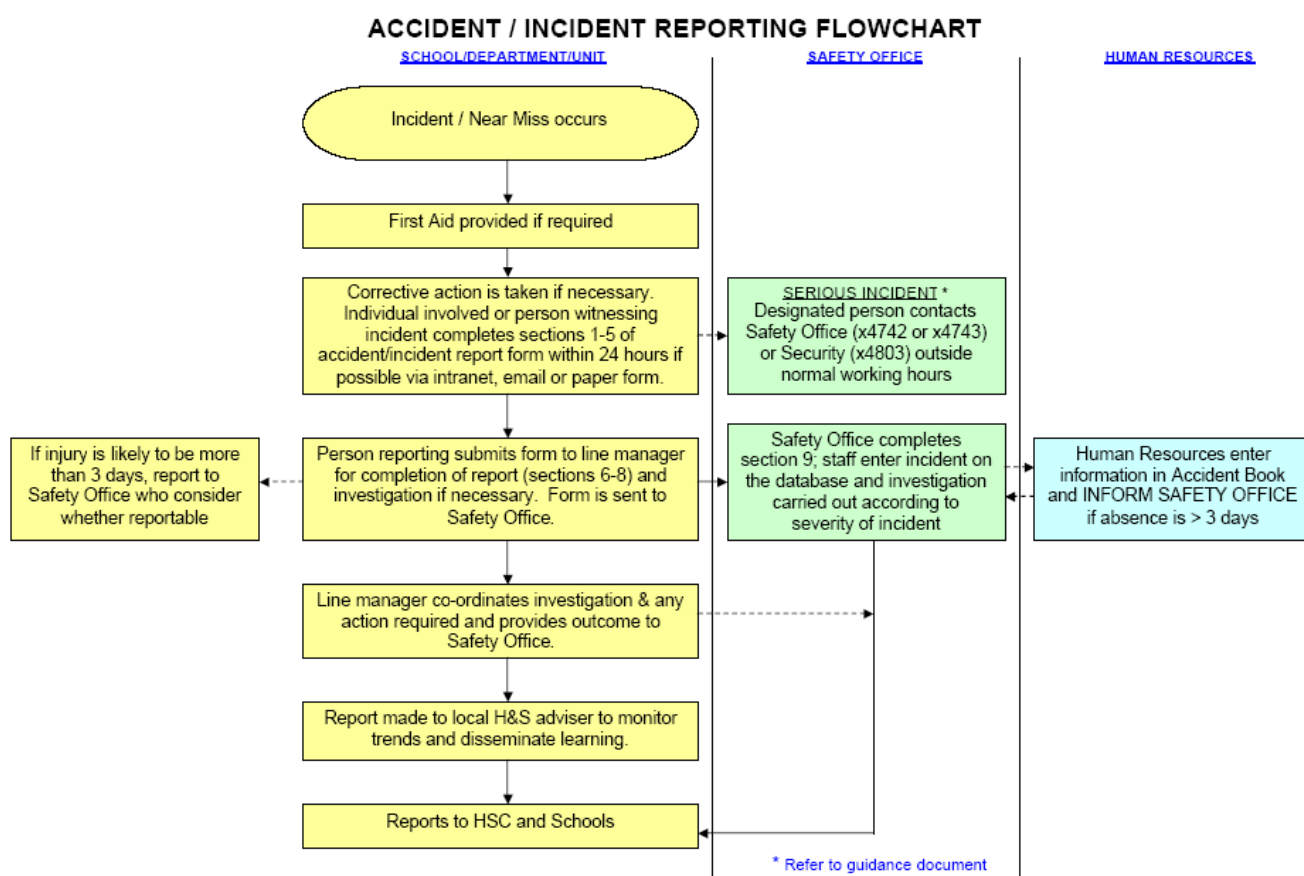
ACCIDENT AND INCIDENT REPORTING PROCEDURE

All accidents and incidents must be reported to Safety office using the new accident form found here - <http://www.aston.ac.uk/staff/hr/safety/emergency-arrangements/accident-incident-reporting/>. A copy of the completed form should also be sent the School's Safety Adviser.

GUIDANCE ON REPORTING PROCEDURES

1. Purpose

The purpose of this guidance is to provide a framework for the incident reporting and recording procedure across the University. This procedural document should be viewed in conjunction with the accident/incident reporting flowchart below



2. Definitions

Accident

An accident is an unplanned event, which has resulted in injury. This includes any physical violence in connection with work.

Near Miss/Unsafe Condition

Where an incident occurs which does not result in an injury, but which had a high potential for injury and/or where there was some damage or disruption.

Hazard

A hazard is something with the potential to cause harm

3. Procedure

3.1 Responsibilities

3.1.1 Deans, Heads of Departments, Managers, School safety advisers and others with health and safety responsibilities are responsible for:

Reviewing the incident in consultation with affected people to determine the appropriate preventative actions

Informing the Safety Office on ext 4742/4743 immediately after a serious incident or near miss/unsafe condition has occurred, or where it is likely that a member of staff will be absent from work for more than 3 days following an accident.

3.1.2 Human Resources should notify the Safety Office of all 7 day work related absences immediately after becoming aware of the incident/absence.

3.1.3 The Safety Office is responsible for notifying the Health and Safety Executive by telephone or in writing of any notifiable incident or dangerous occurrence, and maintaining the Accident Database

3.1.4 Security should notify the Safety Office of all serious incidents that occur after normal office hours or during the weekends by following agreed escalation procedure.

GUIDANCE ON COMPLETING THE ACCIDENT/INCIDENT REPORT FORM

PART A INFORMATION ABOUT THE INCIDENT

SECTION 1: DETAILS OF THE INCIDENT

This section should be completed by an appropriate member of staff involved with the incident: eg.

- person in charge of the activity or the area
- line manager
- first aider or security person
- nominated health and safety co coordinator

Describe how the incident occurred.

Provide a full account of what happened and how. This may include details such as:

- Injury, damage only, near miss/unsafe condition etc.,
- The date and time of the incident
- The exact location of the incident
- What the injured person was doing at the time
- What tools, equipment, material and fixtures were being used or handled
- Who else was involved?
- A description of any personal protective equipment or clothing used at the time

SECTION 2: DETAILS OF INJURED PERSON

Complete the section by providing details of:

- the full name and address of the injured person.
- the status of the injured person
- the injured persons employing department, if it's a contractor the name of the employer.
- the hours worked on day of injury
- the type and position of the injury – specify which part of the body is injured
- the type of injury sustained e.g. Face, leg (L), and arm (R) sprain, bruise, cut, fracture, etc.,

SECTION 3: DETAILS OF WITNESS(ES)

Complete the section by providing a name, address and if possible, a telephone number, where they can be contacted as part of the investigation process.

SECTION 4: DETAILS OF TREATMENT

Please give details of any treatment received, this will include:

- Where the person received first aid treatment, describe the treatment received.
- If the person went to hospital, please state if the person was taken to hospital immediately following the accident
- the mode of transport e.g. taxi, ambulance, by car, did they drive themselves
- If they went to their GP, was it later the same day, evening, next day etc.,
- Select the most appropriate statement of how the injury was managed
- Indicate the likely number of days the person will be absent from work as a result of the injury, this includes the weekends.

The University has a statutory duty to report certain incidents under the requirements of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) to the Health and Safety Executive. These include:

- Major injuries
- Accidents which result in the person being absent from work for more than three days
- Incidents which result in students or members of the public being taken to hospital for treatment; and
- Dangerous occurrences

Serious accidents involving hospital treatment or more than 7 days off work should be referred to the Safety Office as soon as possible on 0121 204 4742/4243

SECTION 5

The person completing Section A should sign and date the form, then submit the incident form to the designated responsible in control of the area where the incident occurred.

PART B INFORMATION ABOUT THE INVESTIGATION

SECTION 6: SUMMARY OF FINDINGS OF INVESTIGATION

Each department must establish procedures to ensure that all accidents and incidents are investigated by an appropriate person(s) within the Department. The investigation must not delay the dispatch of the report form to the Safety Office. Additional information can always be provided later as it becomes known. When the incident has been reported an investigation into the cause of the must take place, the results of the investigation should be documented and preventative measures put in place.

An effective investigation should:

- Seek to establish both the immediate and the underlying causes of the incident, and whether there is a need for any change to be made to prevent similar incidents occurring in the future. Where appropriate specific mention should be made of any defects or inadequacies of the equipment, substances or working conditions, safety procedures, and whether the protective clothing/equipment was being used properly.
- Identify problem areas or particular hazards
- Identify corrective actions

- Provide management, supervisors, School/department health and safety advisers, health and safety committees with data about the health and safety problems
- Identify training needs
- The Safety Office will also investigate particular incidents and assist in the investigation of all serious and dangerous occurrences in consultation with the area managers.

SECTION 7: ACTIONS TAKEN FOLLOWING THE INCIDENT

Give details of what action has been taken or required to prevent reoccurrence of the incident. Any defects to a University building or the grounds must be reported to Estates and Facilities on ext 4000. Specific measures of a long term nature should be documented, and the date when completed.

SECTION 8: PERSON COMPLETING PART B

Deans, Head of departments, are responsible for receiving the incident reports relating to matters under their management and control and signing them to confirm that they are aware of the incident and are reasonably sure that the information is correct, and are committed to the agreed preventative action. On completion, send form to the Safety Office

SECTION 9: TYPE OF INCIDENT

This section is for the Safety Office use only. It allows the Safety Office to monitor and review trends and assists in the production of reports to the Health and Committee, and in the production of annual reports to the University Executive the Universities' Safety and Health Association (USHA).

SECTION 10: FOR USE BY HUMAN RESOURCES

This section is completed by Human Resources, and the form returned to the Safety Office.

INTRODUCTION

This book contains some useful basic information on some of the more important aspects of health and safety, which are particularly relevant to EAS. It briefly describes the School's and University's health and safety arrangements and emergency procedures. Sections concentrating on specific hazards and sources of information follow this. It is intended to serve as a guide and not as a comprehensive manual on health and safety.

Health and safety legislation places the onus to work safely firmly on each and every individual. Every member of EAS has, at all times, a duty to care for the Health and Safety of themselves, and of anyone else who may be affected by their actions. Every member of the School must observe this duty of care.

Responsibility cannot be delegated. As far as is reasonably practicable everyone must observe all safety precautions. The provision or acquisition of information concerning hazards, before they are encountered, and the development of sound practical technique are the main ways in which safety standards can be improved.

SCHOOL HEALTH AND SAFETY POLICY

It is the policy of School to take all reasonably practicable measures to ensure a safe and healthy working environment for staff, students, visitors and contractors, and to comply with current Health and Safety legislation and the Health and Safety policy and Directives of the University.

SCHOOL HEALTH AND SAFETY OBJECTIVES

- The key objective is to protect the Health and Safety of employees, students, the public and any others affected by our work, by providing and maintaining a safe workplace, safe systems and practices.
- To manage Health and Safety within the School with the same degree of determination and competence that other key School issues are managed.
- To manage Health and Safety within the School on the basis of the preparation and review of annual School Health and Safety plans, that seek continual improvement, are founded on Risk Assessments and have their progress monitored and reviewed at senior management level.
- To actively encourage and support consultation on Health and Safety issues.
- To ensure that all its members receive appropriate Health and Safety information, instruction and training, and are aware of any Health and Safety hazards and associated risks in their workplace.
- To endeavour to raise the profile of Health and Safety issues and the importance attached to them, promote the idea of collective responsibility and in general, develop a positive Health and Safety culture with a proactive approach.
- To provide the resources and enabling structure necessary for its groups and members to comply with current safety legislation.
- To define the duties, roles and responsibilities of individual members and School committees in terms of Health and Safety and monitor their performance.

ORGANISATION OF EAS HEALTH AND SAFETY

Individuals with Specific Health and Safety Responsibilities

The Executive Dean, Professor Sarah Hainsworth has overall responsibility for health and safety within the School.

The School Safety Adviser, Gez Cooney assists the Executive Dean on matters relating to health and safety. He is responsible, in conjunction with the chair of the EAS H&S committee for coordinating health and safety activities and actions throughout the School.

Heads of Group are responsible to the Executive Dean for health and safety within their group domain.

Group Health and Safety Coordinators assist their Head of Group on matters relating to health and safety. They are responsible for coordinating health and safety activities and actions within their Subject Group.

The duty of supervising postgraduates is delegated by the Executive Dean to the member of staff directly responsible for the postgraduate.

The School has produced a comprehensive document entitled *EAS Health and Safety, Policy and Objectives, Roles and Responsibilities* (see appendix 1). This document defines the roles and responsibilities of all individuals and committees within the School, and the School's health and safety management structure.

School Health and Safety Committees

The School has adopted a three-tier committee structure in-line with HSE thinking for organising Health and Safety management. The three tiers reflect the roles of Policy Makers, Planners and Implementers.

The School's Management Group represents the *Policy Makers* and is responsible for the management of Health and Safety within the School. Its membership comprises of the Executive Dean (Chairman), Subject Group Heads, Associate Deans and Head of Business, Strategy and Administration.

The School Health and Safety Committee represents the *Planners* and is responsible for producing a planned, systematic and co-ordinated approach to implementing the School's Health and Safety Policy and Objectives. Its membership comprises of the Chair (Dr Trevor Oliver), School Safety Adviser (Gez Cooney - Secretary) and the Group Safety Advisers.

The third tier of the committee structure is designed to implement School Health and Safety Policy at Subject Group level and also inform and consult with members on matters relating to health and safety.

Formal Subject Group health and safety committees exist in CEAC, EE and EMS/MED for this purpose and their meetings are chaired by the Group Safety Adviser with the School Safety Adviser in attendance. These committees are comprised of representatives from all sections of the Subject Group, including students. CS have effectively combined their Health and Safety Committee with their Staff Student Consultative Committee by placing a standing item on the latter's agenda relating to Health and Safety matters and issues. Mathematics have adopted a similar approach, by placing a standing item, relating to Health and Safety matters, on the

agenda of their Programme Committee. These arrangements reflect the general low risk nature of these areas.

These committees all meet at least once a term. The full School health and safety structure is given on the next page.

School Health and Safety Plan

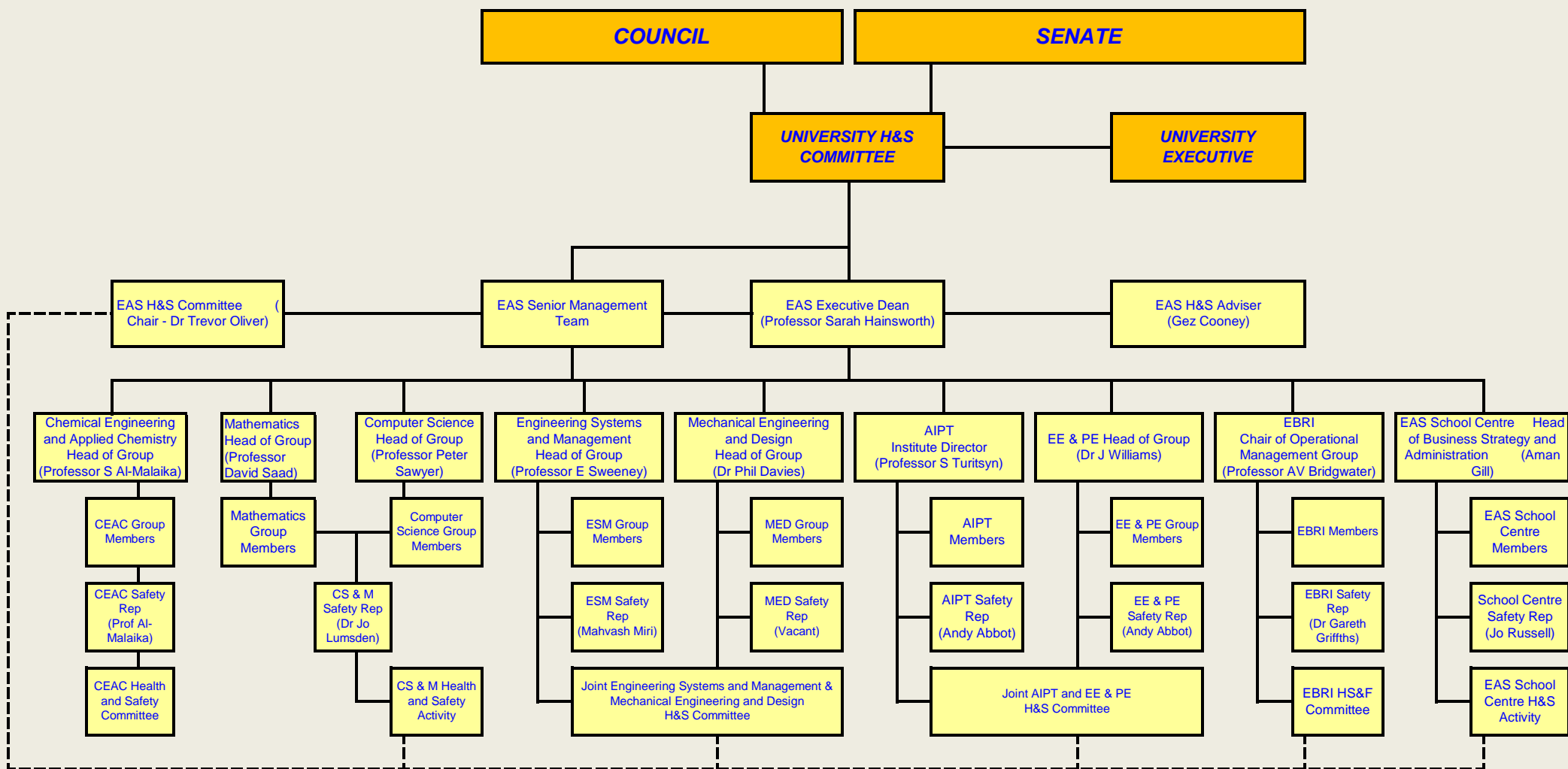
The School's key health and safety objective is *To manage health and safety within the School on the basis of the preparation and review of annual School health and safety plans, that seek continual improvement, are founded on Risk Assessments and have their progress monitored and reviewed at senior management level.* To facilitate this an annual plan is produced at the beginning of each calendar year.

This annual plan reviews progress made against the objectives and targets set out in the previous year's School health and safety plan. The format adopted for this plan is in line with the major headings of the 1997 HSE Audit report for the University and contains sections relating to *Communications, Training and Competence, Co-operation, Planning and Implementation, Monitoring and Reviewing and Auditing Performance.*

Raising Health and Safety Issues

Health and safety concerns of a non-urgent nature should be raised at the Group's Health and Safety Committee or equivalent. This allows for a collective discussion to take place, decisions taken and appropriate records to be made. The Group's Safety Adviser should be consulted directly in other cases or in matters considered to require urgent attention. In their absence these matters can be raised with the Group Convenor, School Safety Adviser or even, in exceptional circumstances, the Head of School.

Additionally, the School actively encourages its members to report all 'hazards spotted and near misses' to the School Safety Adviser (G.Cooney@aston.ac.uk). These are logged and a formal reply will be issued to the individual who has made the initial report.



SEAS Health and Safety Structure

SCHOOL CODES OF PRACTICE AND POLICES

Working in University buildings outside normal working hours

Normal working hours are currently defined as 0800-1800 hrs, Monday to Friday. 'Out of Hours' refers to any time outside these normal working hours.

Legislation does not permit persons to work alone for certain activities, e.g. entering confined spaces, working with unsecured ladders, erecting scaffolding, heavy lifting operations; and there are many other work activities where consideration of potential risks to lone workers is vital, particularly those involving the handling of hazardous chemicals and the use of certain electrically powered tools and equipment.

As a general rule supervisors must ensure that any operation carrying a medium or high risk of injury, is not undertaken by someone who does not have a colleague available to give appropriate assistance.

A risk assessment **must** be carried out before any work is undertaken. The process of risk categorisation into low, medium or high is fundamental to safe working out-of-hours.

Low Risk Work This work may be undertaken by persons authorised to be present under the terms of Local Rules for each Building, e.g. building rules may allow cleaners to be present out of hours. Some buildings will allow members of the public to attend lectures and other functions out of hours.

Medium Risk Work Medium Risk work may only be undertaken if there is at least one other authorised person either in the same room or in an adjoining room within earshot and, preferably, also within sight. (In special circumstances, e.g. certain work by authorised Estates & Buildings personnel, workers may be unaccompanied providing they are in direct radio communication with their base station for the duration of the work.)

Medium Risk work may only be undertaken either - by persons authorised by the Head of School or a Subject Group Convenor for the area concerned.

High Risk Work These operations must never be undertaken outside normal working hours unless:

- A special arrangement has been made to ensure the presence of a first aider available either within the building or on radio call on campus.
- The Head of School or the Subject Group Convenor for the area concerned has approved the work.
- At no time during the work procedures are there less than two persons present together in any high-risk location.

These are extracts from *AstonUniversity - Policy for working in University buildings outside normal working hours*.

Smoking Policy

Under the University's smoking policy, rooms in all University premises except those otherwise indicated in the full 'Policy' are designated as ' **NO SMOKING** ' areas. **All** School rooms are classified as ' **NO SMOKING** ' areas.

SAFE OPERATING PROCEDURES

Equipment in the School can only be operated if it has valid Safe Operating Procedure, which must include an Emergency Shutdown Procedure. The only exceptions will be in cases which are considered trivial or those in which a satisfactory reason for exemption has been proposed and accepted.

RISK ASSESSMENT

The fundamental steps of risk assessment are

1. **Hazard Identification** - Whatever method is used it needs to show that all hazards have been considered. The two most common approaches to this are
 - a. a team of trained risk assessment personnel or
 - b. less competent individuals/teams working with the aid of a very comprehensive hazard checklist to a prescriptive regime.
2. **Who the assessment is for and who may be harmed** - Risk assessments reflect competency, experience and training of individuals and groups and therefore the risk ranking will reflect this. A number of risk assessments may therefore be required reflecting that what may be a relatively high-ranking risk for one individual could be low for another.
3. **Evaluation of the risks** - The *risk related to a particular hazard* is generally defined as a function of the *severity of the possible harm for the particular hazard* and the *probability of occurrence of that harm*. Numerically based systems rank individual hazards in terms of risk and prioritise actions. Alternative systems are simply based on low, medium and high rankings. These systems inevitably have very large steps between rankings and whilst this does not lend itself well to prioritising remedial action, they do have the advantage of being relatively simplistic.
4. **Identify and evaluate risk reduction options for each risk** - All reasonable practical steps must be taken to minimise the level of risk and the risk assessment should show this. The following is a list of control measures in order of effectiveness:- Elimination, Substitution by something less risky, Enclosure – enclose in a way that eliminates or reduces risks, Guarding or segregation of people, Safe systems of work that reduces the risk, Written procedures that are known and understood by those affected, Adequate supervision, Identification of training needs, Information/instruction (signs/handouts) and Personal protective equipment. In many cases a combination of these measures is desirable.
5. **Record findings** - An auditable record of the risk assessment process must be kept. It must show
 - the process by which all significant hazards have been identified
 - the details of all significant hazards have been identified
 - risk evaluations
 - actions taken or proposed to reduce risks including training and Personal Protective Equipment (PPE) requirements
 - timescales for any proposed actions
 - estimates of residual risks
 - any documentation that has been used in making this assessment

The records must show that the risk assessment has been carried out in a competent logical manner and demonstrate suitable and sufficient steps have been taken.

- 6. Set a strategy for reviewing and revising the assessment** - Risk assessment strategies should be revised regularly to ensure control measures are still adequately controlling the risk. When significant changes are detected the risk assessment process is repeated.

School Strategy for Risk Assessment

EAS has now adopted the following three-tier approach to risk assessment, which recognises that the greater the risk the more rigorous the assessment procedure needs to be.

- Level 1** Recognised Low Risk environments are evaluated using a simplistic approach of low, medium and high severity and probability model. Generic assessment of some areas may be possible. Any situations that subsequently are shown not to be low risk are subjected to the next level of assessment.
- Level 2** Risk assessments for non-low risk processes/equipment/areas that cannot be adequately dealt with by the simplistic approach described above, are assessed using a numerically based risk assessment system the School has developed. A comprehensive hazard template has been developed against which risk data for individual hazards is entered and action prioritised. Any processes/equipment/areas/situations in which the risks have been classified as substantial or intolerable by this system will be subjected to the next level of assessment.
- Level 3** Risks, which have been classified as substantial or intolerable will be subjected to a further analysis by a University risk assessment team.

The different forms/workbooks to be used when assessing the risks at each level are available from the School Safety Adviser. The following hazards have their own specific assessment forms:- Chemical and Biological Hazards, Noise, Display Screen Equipment and Manual Handling.

HEALTH AND SAFETY INFORMATION

Each Subject Group has its own health and safety information. EAS has produced a number of booklets relating to specific hazards. A brief synopsis of each follows in this handbook.

SUMMARY OF SAFETY RULES

TREAT SAFETY AS A MATTER OF PARAMOUNT IMPORTANCE.

Other instructions and suggestions are to be found in subsequent sections of this book and specific hazard related School booklets. Everyone must observe the following rules:

- No equipment can be operated unless it has valid Safe Operating Procedure, which must include an Emergency Shutdown Procedure. The only exceptions are in cases which are considered trivial or those in which a satisfactory reason for exemption has been proposed and accepted. Ensure that a risk assessment has been made of the activity.
- Learn the various emergency procedures.
- Know the location of the nearest telephone, fire alarm, fire-fighting equipment, first aid box and eye wash station. Ensure that all these appliances are maintained in a satisfactory state.
- Know the location of main control valves, stopcocks and switches.
- Use all appropriate protective devices. Eye protection must be used in designated laboratory areas at all times. Laboratory coats must also be worn when in laboratories.
- Ensure that adequate information and instruction is available before any process or handling procedure is attempted.
- Ensure that adequate warnings are always displayed, and that warning notices, which no longer apply, are removed.
- Ensure that all equipment intended to run unattended for long periods, e.g. overnight, is safely and securely assembled, and bears a notice showing the contents, condition and emergency shutdown procedure.
- Do not smoke, eat or drink in designated laboratory areas.
- Do not wear laboratory coats in places where people eat or drink.
- Do not leave fire-stop doors open.
- Ensure that all hazardous materials are properly stored, and in the minimum quantities consistent with the work being undertaken.
- Report to the Subject Group Safety Adviser all accidents involving personal injury, and all incidents which might have had serious consequences
- Between certain limits (approx. 4.8% to 13.5% by volume of gas) gas and air form flammable mixtures. If you suspect a gas leak you should extinguish all sources of ignition. Do not switch on, or off, electrical apparatus/appliances. Inform the University Security staff if the situation seems to be an emergency - telephone 222.
- Doorways, gangways, corridors, and emergency exits are unobstructed.
- Working areas are kept clean and uncluttered.
- Waste chemicals are not allowed to accumulate.
- If substances need to be stored in a fridge ensure that it is appropriate. In the case of chemicals it must be sparkproof.

CHEMICAL SAFETY

The hazard from a substance or preparation is defined as its intrinsic ability to do you harm. This could include (and it's not an exhaustive list) its toxicity, temperature, flammability, reactivity, asphyxiant properties, and even its ability to harm the environment.

How much harm it will **actually** do is a complex function of its physical form, the route of entry to the body, the quantity that was involved, its intrinsic properties and the response of the body. Never forget that you are in more danger standing knee deep in a completely non-toxic dust than you are if you have the most toxic substance in the world sealed in a robust container in your pocket. Substances have other properties – they may be very reactive, so may present a considerable hazard in taking part in runaway reactions or even explosions. They may be highly flammable, and pose a threat in the form of fire.

Control of Substances Hazardous to Health (COSHH) Assessment

The COSHH Regulations provide a legal framework to protect people against health risks from hazardous substances used at work.

Complying fully with COSHH involves:

- **assessing the risks** to health arising from work with chemicals. Fundamentally, the risk associated with a particular activity is function of *the potential severity of injury of a hazard* and *the probability of occurrence of that harm*. COSHH risk assessments are exactly the same, although the terminology may vary.
- **deciding** what precautions are needed. No work should be undertaken which could expose employees to hazardous substances, without first considering the risks and the necessary precautions. Unless the risks have been judged correctly, it is unlikely that the right precautions have been decided upon;
- **preventing or controlling exposure**; If it is reasonably practicable, you must prevent exposure by:
 1. changing the process or activity so that the hazardous substance is not required or generated; or
 2. replacing it with a safer alternative, or
 3. using it in a safer form, eg pellets instead of powder.
- **ensuring that control measures are used and maintained** properly, and that any safety procedures which have been laid down are followed;
- **monitoring exposure** of workers to hazardous substances and carrying out appropriate **health surveillance**, where the assessment has shown these are necessary or where COSHH lays down specific requirements;
- **ensuring that employees are properly informed, trained and supervised.**

The first step of the assessment is to determine the hazard category and exposure potential of the substances and products of the process/reaction. The School has developed a COSHH assessment procedure based on the *The Royal Society of Chemistry* model and this must be used for your assessment and to record your findings.

Separate assessments will probably be needed for the different routes of entry into the body – inhalation, skin absorption, ingestion etc. Suppliers of chemicals are legally obliged to provide **Material Safety Data Sheet (MSDS)** to their customers. Most of the safety information you need when completing assessments is there.

Chemical Agents Directive

The Chemical Agents Directive (CAD) requires employers to protect workers from certain health and safety risks arising from chemical agents present in the workplace and from work activities involving chemical agents. The term Chemical Agents is defined very widely and means any natural or artificial substance or mixture of substances whether in solid, liquid or gas form. The Directive is concerned with fire, explosion and health risks from chemical agents and applies to all industrial and commercial sectors.

COSHH deals with the health risks and the recently introduced Dangerous Substance and Explosive Atmosphere Regulations (DSEAR) deals with the safety risks classified under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (S.I. 2002/1689) (CHIP 3) as: **explosive, oxidising, extremely flammable, highly flammable or flammable**. Similar to COSHH a risk assessment of the safety aspects is required.

DSEAR applies to any substance or preparation (mixture of substances) with the potential to create a risk to persons from energetic (energy-releasing) events such as fires, explosions, thermal runaway from exothermic reactions etc. Such substances, which are known in DSEAR as dangerous substances, include: petrol, liquefied petroleum gas (LPG), paints, varnishes and certain types of combustible and explosive dusts produced in, for example, machining and sanding operations.

Reaction Categories

As part of the full risk assessment, consideration must also be given to the level of supervision required when reactions are taking place. This must take account of the experimental procedure(s) being used. An appropriate level of supervision should be assigned according to the following simple scheme:-

- A** This activity **must** be directly supervised
- B** The advice and approval of your supervisor must be sought before the task started
- C** The work involves risks requiring careful attention to the safety related aspects of it. The worker has been trained in the task and has demonstrated competence
- D** Tasks in this category carry no undue risks

Reactions involving substances which are carcinogens, mutagens or teratogens; pose risk of serious eye damage; are pyrophoric, very highly toxic, or pose an explosion risk **are by default placed in category A**.

Eye Protection- It is a legal requirement to wear eye protection in laboratories.

Safety glasses must be worn as an absolute minimum. Normal prescription glasses do not offer protection enough, and protective over-goggles must be worn with them. Spectacles should be worn in preference to contact lenses, which could trap chemicals between the lens and the eye. Soft lens in particular can also absorb solvent vapour.

Lab. Coats

Lab. coats must be worn in laboratories, must be regularly laundered and not worn outside lab. areas.

CRYOGENS

Although this is not an exhaustive list, you should be aware of the following key hazards associated with using liquid nitrogen and liquid helium.

Asphyxiation – due to the displacement of air.

One of the main dangers associated with both liquid helium and liquid nitrogen is the risk of asphyxiation, particularly when used or stored in poorly ventilated areas. This can be rapid, and there are likely to be no obvious warning signs to the victim. There are no physical symptoms of distress, and the function of the brain is seriously impaired in an oxygen deficient atmosphere, without the person's knowledge. It can take as little as two breaths in an oxygen deficient atmosphere to cause unconsciousness, and death will occur within minutes. Below around 10%, death or brain damage may be inevitable, even if the casualty is rescued and resuscitation is attempted. The atmosphere normally contains approximately 21% oxygen by volume. Atmospheres containing less than 18% oxygen are potentially dangerous, and entry into atmospheres containing **less than 20% oxygen is not recommended**. Accident records show that for every person who is overcome and dies in an atmosphere that does not support life, statistically, more than one additional person dies, unsuccessfully attempting a rescue. It is probable that a visible vapour cloud is significantly depleted in oxygen. **Personnel should be instructed never to enter a vapour cloud.**

An assessment of the expected oxygen depletion should be made using the volume of room, liquid nitrogen usage etc. to determine whether this likely to fall below 20%.

Consideration should be given to the installation of oxygen deficiency monitors and alarms in areas where significant amounts of cryogens are being used or stored, particularly when poor ventilation or confined spaces are involved.

Condensation of liquid oxygen

Since oxygen has a higher boiling point than nitrogen, it can condense into liquid nitrogen. Fortunately it is a light blue colour, so if it has condensed in a significant quantity into an open dewar of nitrogen it is obvious. Be aware that liquid oxygen is a serious fire hazard, and pure oxygen can cause organic materials to ignite spontaneously or explode. Also, the liquid that forms and runs off a nitrogen delivery tube from a dewar when you are discharging nitrogen is rich in oxygen. Hence naked flames etc. are prohibited at nitrogen transfer points. Liquid that is allowed to dribble onto clothing can take a very long time to disperse, and the individual is in considerable danger while their clothing is rich in oxygen.

Condensation of water

Most of the time, the air is well laden with water vapour, and in consequence, wherever you are using cryogens, you will have water vapour condensing out and often forming significant ice burdens on pipes, etc. This can give rise to a risk of electrocution from ice forming, water condensing and water dripping onto nearby electrical equipment.

Changes in material properties

We have all seen people smashing rubber hose, etc, when doing demonstrations with liquid nitrogen. In polymers this is primarily due to the fact that cryogenic liquids take the material well below its glass transition temperature, into a regime where it is brittle. It recovers if it is warmed up – but it may break if it is disturbed while cold, or if it contains residual stresses. Flooring may crack and cause a trip hazard. Carpeting appears to be just as vulnerable as lino. Pneumatic tyres on vehicles that are exposed to liquid nitrogen may explode. Carbon steels (i.e. not stainless) are body centred cubic, and also become dramatically more brittle at low

temperatures. **They are not suitable for low temperature service.** The drains cannot cope with liquid nitrogen – the materials can be damaged - expensively. Even if the damage is not immediately apparent, think what might happen when chemicals are disposed of down the drain and where subsequently this leaked material will go. **Damage to the insulation on electric cables** can produce an electrocution hazard.

Exposure to cold gases

Short exposures to cold gas vapour leads to discomfort in breathing whilst prolonged inhalation can produce serious effects on the lungs and can trigger asthmatic attacks in susceptible individuals.

Blockage of outlets from cryogenic containers

Liquid helium can readily cool air below its freezing point, which may lead to blockages in your apparatus. It is possible that an explosion may result, because the helium will evaporate before the blockage clears itself. Blockages can form with nitrogen as well, if ice forms in sufficient quantity. Ice plugs are normally melted using hot air.

Burns

Liquefied gases, particularly when soaked into clothing, can produce burns that are similar to heat burns. Unprotected skin may also stick to un-insulated items and flesh may be torn on removal. More prolonged contact can cause the flesh to freeze. While frozen it will appear yellow and waxy, and will probably not hurt, but when it thaws, it is likely to give rise to intense pain. Such burns require immediate medical attention. Persistent, superficial contact with liquid nitrogen can also give rise to chilblains – itchy, red, irritated patches of skin on the hands.

Reducing the Risks

- Consider removing the problem altogether, which may be achieved by having less cryogen in the space (e.g., not leaving the dewar in the room).
- Ensure that cryogen from your apparatus is vented to a space that is large enough to accept it without threatening the oxygen level.
- Ensure the ventilation level is adequate to disperse the gas (but check on the status of the ventilation system at night or at weekends).
- Reduce the probability of accidental release by ensuring the stability of dewars, maintaining the floor in good condition, ensuring personnel are trained, using labels and diagrams, etc, to remind the forgetful.
- Impose procedural control – such as prohibiting the transport of cryogens in a lift along with personnel, prohibiting the transfer of cryogens at night, unless at least two people are present.
- Suitable gloves should be worn when handling very cold materials. Gloves for usage when handling cryogens should be readily removable and special care should be taken to ensure that the cryogens cannot enter the glove via the cuff area.

DISPLAY SCREEN EQUIPMENT (DSE)

Work involving DSE must comply with the requirements of the Display Screen Equipment Regulations 1992. The University has prepared Guidelines on the Regulations together with three questionnaires relating to DSE use, the first of which is a self-assessment form, which helps determine whether a worker is a 'user' under the Regs. This assessment is based upon a simple calculation involving the type of work and method of working and the number of hours of DSE-related work undertaken per week. If a worker is assessed as a 'user', then his or her workstation and 'user interface' are assessed for compliance with the Regs using further questionnaires.

Under the Regulations 'users' of DSE are entitled to have their eyesight tested and to have their workstations assessed to ensure that these comply with certain minimum standards. Eyesight problems, although important (eye strain and associated headaches can be unpleasant), are not causes for major concern, and radiation hazards (from monitors, etc.) have now been discounted by many authorities as representing a significant risk.

However, it is musculo-skeletal disorders of the back and upper limbs, painful, severely debilitating disorders such as RSI (repetitive strain injury) associated with the hands and wrists which are considered to be very much the major issue. It is therefore important that proper consideration be given to the design of the job, the layout of the workstation and the suitability of the equipment that comprises the workstation and an assessment of these elements is made.

The primary requirements for a satisfactory workstation include the provision of a good quality adjustable chair, a desk with a sufficiently large 'knee-hole' and a good-sized working surface - especially depth, to accommodate a reasonably large-screened adjustable monitor and an ergonomically satisfactory keyboard and mouse. The workstation should be placed so that reflections on the monitor screen can be eliminated or reduced to acceptable levels.

Be aware that portable computers, laptops have comparatively poor ergonomics. The keyboards are often less than full size and not properly angled. The LCD screens are an integral part of the computer and have a more limited angle of view compared to a CRT monitor.

Display Screen Equipment User's General Check List

When using your display for the first time today:

- Raise or lower your seat until your forearms are horizontal. Make sure your wrists are straight when your hands are on the keyboard.
- Sit right back on your chair so that the back rest can support you.
- Form a relaxed curve in your lower back and adjust your backrest to provide support when in this position.
- Use a footrest if your feet do not comfortably touch the floor.
- Remove any obstacle under your desk that prevents you sitting in an upright position.
- Position your copy stand close to your screen, e.g. the same height and viewing distance and next to the display screen.
- Set your display viewing distance to suit screen characters and copystand text size.
- Check that you can reach your copy stand, without leaning forward, if you need to turn pages regularly.
- Adjust your screen and copystand angle to suit your sitting position.
- If you are reading from hardcopy but do not use a copystand, offset your display slightly so that you don't need to lean forward to read from the document.
- Adjust the brightness control to suit the office lighting level.
- Rest your arms and shoulders whenever your work routine allows.

When taking a work break or at the end of the day:

- Exercise your legs and back by stretching and walking.
- Try to avoid excessive wrist and arm activities, such as writing or knitting, during your work break.

- Try to rest your eyes by avoiding strenuous eye activities such as reading small print.
- If you sit during your break adopt informal postures - but remember not to slouch.

When using your display after a 2-3 hour work session:

- Check your workstation has not become disorganised, forcing you to sit in an awkward position.
- Adjust your brightness control if the light levels have altered since you started work.
- Move your screen and document holder back* a little and adjust their angle to suit.
(* i.e. moving them away could help most (potentially long-sighted) users)
- Lower window blinds if sunlight is causing glare.

Display Screen Equipment User's General Check List

Are you sitting comfortably?

- Try not to slouch - keep the curve in your lower back.
- Adjust your backrest - support your lower back.
- Sit right back in your chair - let the back rest support you.
- Remove obstructions - don't let obstructions prevent you from sitting upright at your desk.
- Organise your workstation - place frequently used objects and equipment within easy reach, and limit twisting movements of spine.
- Place documents in holders where possible - don't lean forward to read hardcopy.
- Break up your DSE work - use informal postures when not working.
- Get some exercise - during breaks stretch your legs.

Are your arms and shoulders comfortable?

- Adjust your seat height - make sure your forearms are horizontal.
- Align hands with forearms - try to work with wrists straight.
- Keep your wrist as straight as possible when using the mouse.
- Use a footrest if your seat is too high & your feet don't comfortably reach the floor.
- Adjust your screen angle to suit your sitting height.
- Rest your arms whenever your routine allows.
- Avoid arm and wrist activities, such as writing, during rest breaks

Can you read the screen?

- Place the copystand close to your display
- Adjust the copystand height - this should match display height.
- Adjust your display height to minimise head/neck movement. Screen and angle of viewing may be different for touch/copy typists (who look mainly at their copy) and non-touch (untrained!) typists (who also spend time looking at the keyboard!).
- Vary your viewing distance occasionally - this could be done by moving the display slightly after 2 to 3 hours of continuous working.
- Sit sideways to windows - in particular, avoid windows behind you.
- Use window blinds on sunny days
- Clean your DSE screen regularly using approved cleaners only.
- Adjust the brightness of display when light levels change
- Rest your eyes during work breaks - don't read small print!

For further information see the School's *DSE* booklet. If you require DSE assessment contact your Subject Group Safety Adviser who will arrange this for you.

ELECTRICAL SAFETY

All electrical equipment and wiring must be in accordance with the ELECTRICITY AT WORK REGULATIONS 1989. These are far-reaching and extensive and include many additional items not previously contained in the IEEE regulations. **NO EQUIPMENT SHOULD BE IN USE IF IT DOES NOT MEET THE REGULATIONS.**

All voltages are now included from 400KV to a 6 volt battery; the main criteria is to test whether DANGER EXISTS (the risk of injury). All electrical equipment whenever manufactured, purchased or installed, must conform even if its manufacture or installation pre-dates the regulations.

No students are permitted to undertake any wiring of HV or mains equipment, unless this has been previously authorised by an appropriate Electronics Technician. In these circumstances the technician must check the work afterwards and before connection to any power supply. There are special procedures, which must be followed when on live equipment. **Under no circumstances must students work on live equipment.**

Do not interfere internally with any instruments. Only a competent person with the technical knowledge, experience and necessary skill should undertake or carry out any wiring or repair work. **Remember, if it is not working, contact a person in authority.** Accidents involving electricity are quite often fatal. A high degree of protection is normally afforded by following these established safety techniques:-

- Design and installation by competent personnel
- Earthing of metal work which could become live under fault conditions
- Mechanical protection of conductors / cables
- Fuses or circuit breakers to protect equipment from excess current and to allow safe isolation.
- Residual current circuit breakers
- Safe systems of work, which may include a permit to work system for certain equipment/procedures and electrical lockout.
- Routine maintenance of equipment.
- Safety inspections of equipment, including regular visual inspections supplemented by formal electrical testing at prescribed intervals.
- Using electrical tools, which are appropriately insulated.
- Ensuring flexible cables are firmly clamped at the ends, and damaged or frayed cables are replaced.

Electric Shocks

The following advice is given by the St. John Ambulance,

The first priority with electric shock is to remove the source of current, **DO NOT TOUCH THE CASUALTY UNTIL THE ELECTRICITY SOURCE IS REMOVED.** Switch it off at the supply (meter) if possible, otherwise remove the plug or pull the cable from the casualty. If this is not possible push the casualty's limb away from the source with a wooden pole whilst standing on an insulating material, i.e. phone book. Always ensure your personal safety.

To receive a shock, you require two points of contact with a voltage difference between them, such as *live* to *earth* or *neutral*. A current that flows from hand to hand, across the chest region, presents great danger to heart function, though it is not in fact the worst; left hand to chest or foot is potentially more serious but less likely to occur in a laboratory. As little as 100 mA of current can produce heart fibrillation when the current is applied directly to the heart tissue. Current as low as 50 mA can cause death.

Electrical Testing

The safe use of electricity and electrical equipment is controlled by the Electricity at Work (EAW) Regulations 1989. They require that 'precautions be taken against the risk of death and injury. Under these Regulations, the University (via Estates) is responsible for checking all the electrical services and wiring – from the sub-stations through to the electrical in each room. The School makes arrangements to ensure that its own electrical equipment is both tested and maintained, and that equipment on hire or loan is similarly safe.

The HSE recommend that **user** of any electrical equipment should visually inspect it on each time before use. They should look critically for signs that the equipment is not in sound condition, and particularly for the following:-

- Damage (apart from light scuffing) to the cable sheath – cuts, burns, splitting etc.
- Damage to the plug – cracked case, bent pins etc.
- Inadequate joints, including taped joints in the cable;
- That the outer sheath of the cable is not effectively secured where it enters the plug or the equipment. Obvious evidence of this would be if the coloured insulation of the internal cable cores were showing;
- That the equipment has been subjected to conditions for which it is not suitable, e.g. it is wet or excessively contaminated;
- If there is damage to the external equipment casing or there are some loose parts or screws;

Classification of Equipment

Class I equipment is the most common type; its safety depends on the integrity of its one layer of insulation and the earth bonding of its metalwork.

Class II equipment, often marked with a 'double square', depends on the provision of additional insulation. **Class IIA(All-insulated)** has two layers (or equivalent) of insulation, one of which covers or comprises the outer casing so that metalwork cannot be touched. In **Class IIB (Double-insulated)** the equipment has all exposed metalwork separated from the conductors by two layers of insulation so that the metalwork cannot become live. There is no earth connection and the operator's safety depends on the integrity of the two layers of insulation.

Class III equipment operates on safety extra low voltage (SELV) i.e. at a voltage not exceeding 50V AC between conductors or to earth.

Residual Current Devices (RCD's)

An RCD is a device, which detects faults in an electrical system and quickly switches off the supply. Terms sometimes used to describe RCDs include Residual Current Circuit Breakers (RCCBs) and Earth Leakage Circuit Breakers (ELCBs). RCDs are best used when they are built into the mains switchboard or the socket-outlet, as this guarantees that the power supply cables are continually protected. If this is not possible, a plug incorporating an RCD or a plug-in RCD adaptor can be used.

RCDs have a test button to check that their mechanism is functioning correctly. If an RCD trips, it is a sign that there is a fault and the electrical system should be checked before it is used again

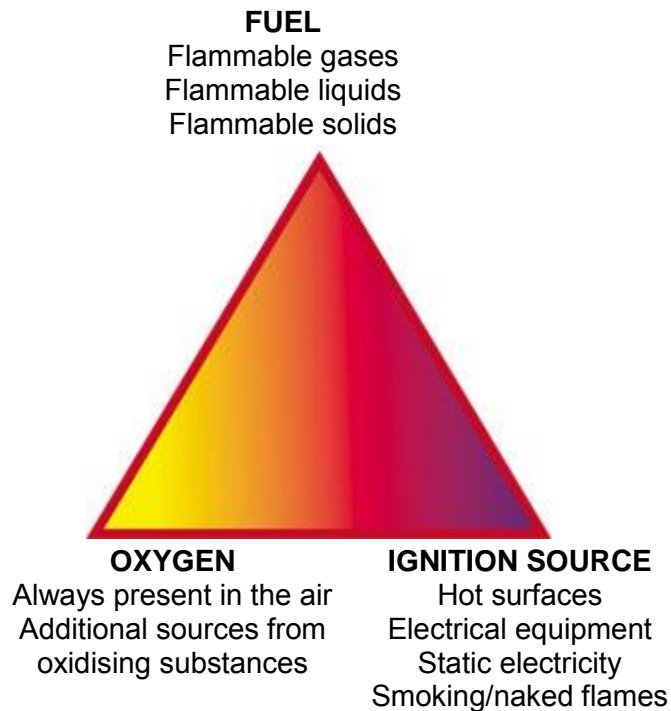
Consult the School's safety booklet *Electrical Safety* for information about electrical safety.

FIRE SAFETY

The Fire Triangle

For a fire to start, three things are needed:- a source of ignition, fuel, and oxygen. If any one of these is missing, a fire cannot start. Taking steps to avoid the three coming together will therefore reduce the chances of a fire occurring.

Once a fire starts it can grow very quickly and spread from one source of fuel to another. As it grows, the amount of heat it gives off will increase and this can cause other fuels to self-ignite. The following paragraphs advise on how to identify potential ignition sources, the materials that might fuel a fire and the oxygen supplies, which will help it to burn.



Identifying ignition sources

- smokers' materials, eg cigarettes & matches.
- naked flames.
- electrical, gas or oil-fired heaters (fixed or portable)
- hot processes eg welding or grinding
- cooking.
- engines or boilers.
- machinery.
- faulty or misused electrical equipment.
- lighting equipment, eg halogen lamps.
- hot surfaces and obstruction of equipment ventilation, e.g. office equipment.
- friction, eg from loose bearings or drive belts.
- static electricity.
- metal impact (such as metal tools striking each other).
- chemical reaction

Identifying sources of fuel

Anything that burns is fuel for a fire. Look for the things that will burn reasonably easily and are in sufficient quantity to provide fuel for a fire or cause it to spread to another fuel source. Some of the most common 'fuels' found in workplaces are:

- flammable liquid based products such as paints, varnish, thinners and adhesives;
- flammable liquids and solvents
- flammable chemicals;
- wood, paper and card;
- plastics, rubber and foam such as polystyrene and polyurethane, eg the foam used in upholstered furniture;
- flammable gases such as liquefied petroleum gas (LPG) and acetylene;

- furniture, including fixtures, fittings and textiles;
- loose packaging material; and
- waste materials, in particular finely divided materials such as wood shavings, offcuts, dust, paper & textiles.
- internal construction materials - areas of hardboard, chipboard, blockboard walls or ceilings, synthetic ceiling or wall coverings, such as polystyrene tiles.

Identifying sources of oxygen

The main source of oxygen for a fire is in the air around us. In an enclosed building this is provided by the ventilation system in use. This generally falls into one of two categories: natural airflow through doors, windows and other openings; or mechanical air conditioning systems and air handling systems. In many buildings there will be a combination of systems, which will be capable of introducing/extracting air to and from the building.

Additional sources of oxygen can sometimes be found in materials used or stored in a workplace such as:-

- some chemicals (oxidising materials), which can provide a fire with additional oxygen and so assist it to burn. The Material Safety Data Sheet (MSDS) will give details of these properties.
- oxygen supplies from cylinder storage and piped systems, e.g. oxygen used in welding processes or laboratories

Fire extinguishers

The type of extinguisher is identified by a colour code as indicated below. Water extinguishers are coloured signal red. Other extinguishers will be predominantly signal red with the manufacturers label, a band or circle covering at least 5% of the surface area of the extinguisher of a second colour to indicate the contents of the extinguisher.

Type of Fire Extinguisher	Colour	Recommended for	DO NOT USE ON
WATER	RED	Wood, paper, textile and solid material fires	Liquid, electrical or metal fires
POWDER	RED with a BLUE BAND	Liquid and electric fires	Metal fires
FOAM	RED with a CREAM BAND	Liquid fires	Electrical and metal fires
CARBON DIOXIDE	RED with a BLACK BAND	Liquid and electric fires	Metal fires

For further information contact the Fire Safety Adviser, Dave White on ext. 4805.

GAS CYLINDERS

Gases are often stored and supplied in high-pressure cylinders. Liquefied or dissolved gases are also supplied in cylinders at lower pressures. Such cylinders are labelled and colour coded for identification.

Guide to the safe use of gas cylinders

- Always transport cylinders using a suitable trolley with the cylinder valve closed.
- Check that the regulator being used is appropriate for the gas being used and cylinder pressure.
- Cylinders in use must be firmly supported in correctly designed racks or clamps, and fixed in place independent of the piping or pressure regulator. Always store cylinders in safe and secure manner. Notice that cylinders containing acetylene must be stored and used in an upright position.
- **Never** use grease or oil on valves, regulators or connections.
- Report any faulty cylinders or regulators to the Subject Group Safety Adviser .
- "Sniffling", i.e. releasing a small amount of gas through the main cylinder valve to flush out the seating, must be done with the cylinder upright and securely supported. It must never be undertaken in a confined room or with toxic, inflammable or liquefied gases.
- If a cylinder key is required it must be readily available, preferably attached to the rig. Pressure regulator keys need not be available.
- If corrosive and/or toxic gases are in use a warning chart should be displayed.
- Copper piping should be used as far as possible for flammable gases but never for acetylene.
- Soft rubber tubing is prohibited for piping gases from cylinders.
- Pipework intended for use with corrosive, toxic or flammable gases should, if possible, be tested with air, nitrogen or carbon dioxide.
- Ventilation should be adequate for normal running and to allow for possible mishaps. Excess gas should not be vented into the room. There is a great danger of explosion with flammables, and even non-toxics such as nitrogen and carbon dioxide may cause drowsiness and possible asphyxiation.
- All cylinders, especially hydrogen cylinders, should be screened from sources of heat (including sunshine).
- Hydrogen cylinder valves should be full-on or full-off, otherwise leakage may occur.
- Special precautions should be taken as appropriate.

For additional information or help contact the University Gas Cylinder technician on Ext. 4772 or consult the School's safety booklet *Use of Gas Cylinders*.

MANUAL HANDLING

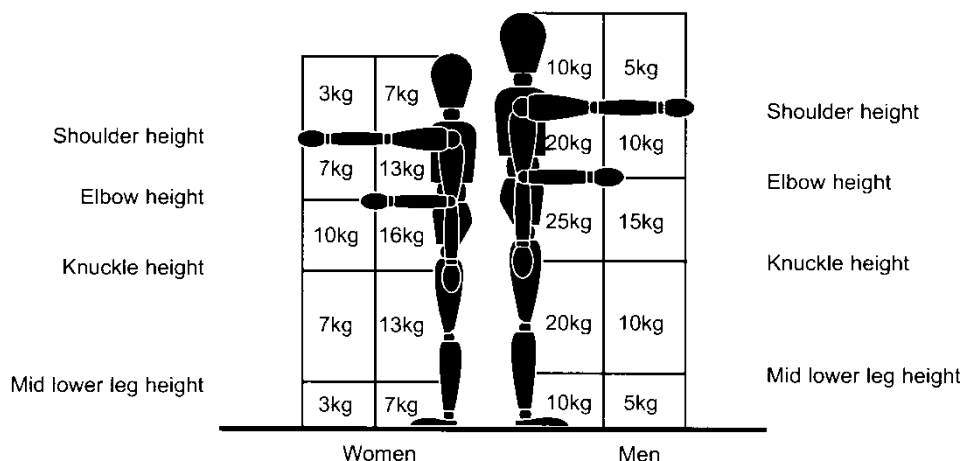
All manual handling work needs to comply with the requirements set out in the Manual Handling Operations Regulations 1992. Manual handling is defined in the Regulations as 'the transporting or supporting of a load (including lifting, putting down, pushing, pulling, carrying or moving thereof) by hand or by bodily force'. Manual handling is a major cause of injury at work. Statistics show that handling currently accounts for over one third of all reported accidents at work. Over **73%** of these handling accidents resulted in **strains and sprains** and almost **50%** of all handling accidents involved **back injury**.

The Approved Code of Practice, which accompanies the Regulations, contains much useful advice on how to undertake an assessment of the risks associated with manual handling. Appendix 1 of the Code of Practice is a detailed assessment guidelines filter. It helps to concentrate the effort of assessment where it is needed by identifying handling operations that warrant detailed examination by eliminating those activities that present only a trivial risk.

One of the best ways to approach an assessment is to consider first the following hierarchy of possible measures:

- Avoid manual handling operations wherever this is reasonably practicable.
- Make an assessment of any hazardous manual handling operations that cannot be avoided.
- Reduce, as far as practicable, the risk of injury from these operations.

The Regulations themselves don't set specific requirements such as weight limits, but they do give some guidance about weights to assist in assessing whether a task needs more attention. These are the guidelines for **lifting** operations:



Note that these guidelines are for the average man and woman, in their prime and in good health. They are based upon work activities involving relatively infrequent operations - say up to 30 operations per hour. The above guidance is also suitable for **carrying** operations where the load is held against the body and carried for no further than 10 m without resting.

The Code of Practice also gives guidance on **pushing** and **pulling** operations. For this and further advice on the assessment procedure, consult the School safety booklet *Manual Handling*.

MECHANICAL SAFETY

Workshops

Mechanical workshops can be very dangerous places especially for the untrained and inexperienced. If you know that you are likely to need to use workshop facilities talk to the workshop technicians **well in advance**. Some machine tools can be operated after only a small amount of training, but others need a lot of training and experience to be operated safely. General guidelines for workshop safety are given below:-

- **Clothing** Wear lab coats/boilers suits in the workshops. They should have close-fitting cuffs, no loose belts, be in good repair, and be worn buttoned or zipped up. Synthetic fibre materials should not be used. Remove ties, scarves, rings, watches, bracelets, necklaces, etc., that are loose and could possibly get caught in machinery. Wear safety shoes or strong leather type shoes in the workshop. Canvas shoes, sandals and other flimsy footwear provide no protection against injury and are not permitted. Wear the special protective clothing, such as aprons, leggings, gloves, goggles, boots, provided in particular areas of the workshops such as Welding and Heat Treatment. Wear eye protection both when operating a machine or process that may produce flying particles, and when passing through an area where such things are happening.
- **Skin Care** Wear disposable gloves and/or barrier cream when handling potentially hazardous or dirty materials. Be sure to wash thoroughly when you have finished. Use the special-purpose hand cleansing creams provided.
- **Guards** It is illegal, as well as dangerous, to operate an inadequately guarded machine. Ensure that all guards, safety switches, etc., are correctly fitted and operational on any machine or piece of equipment, before you operate it. Ask if you are not sure. Report defective or missing guards and do not operate the machine until repairs have been effected.
- **Machine Tools** Before starting, familiarise yourself with the method of quickly stopping the machine that you are controlling. Ask for assistance if you are at all unsure how to control the machine. Always give your full concentration to the job when operating a machine. Stop the machine if you have to pause to talk to someone. Stop the machine if you have to leave it unattended, even if it is only for a few seconds or a few metres distance. Always wear eye protection when operating a machine. Make sure that any machine you operate is in good order, properly adjusted and lubricated. If it appears to you not to be so, report it to your Tutor and do not operate the machine. Stop the machine and isolate it electrically before cleaning it. Remove machinings with a brush, stick or other suitable implement. Never use your bare hands. Do not press buttons, turn handles or move levers on any machine, other than the one you are operating.
- **Bench Work and Hand Tools** Keep the floor area around the bench clear. Always ensure that files have properly fitted handles of correct size. If you do not, the tang may pierce your hand. Do not use tools which appear to be damaged. Use a copper, hide or lead hammer or a soft drift, if you need to strike hard objects or machined surfaces. Hard-faced hammers on hardened surfaces could produce dangerous flying fragments. Use spanners of the correct size when tightening or slackening nuts and bolts. Ill fitting spanners may fly off and injure you, as well as damaging the nut or bolt.
- **General Behaviour** Always behave in a responsible manner. Pranks and horseplay can go wrong and cause injury. Walk! If you run in a workshop you may trip and fall on something, possibly causing injury. Make sure that there is someone else present when working in a workshop. Do not work on your own; there will be no one to help you if you sustain an injury. Remember that you must not operate any machine or piece of power equipment in any section unless the tutor or technician in charge is present or their permission has been obtained and you have received the necessary training to enable you to carry out the work safely.

Work Equipment Regulations

'Work equipment' covers any machinery, appliance, apparatus, tool or installation for use at work and 'Use' relates to any activity associated with the work equipment, e.g. starting, stopping, programming, servicing, cleaning. The Provision and Use of Work Equipment Regulations 1998 requires the following:-

- **Suitability** Work equipment must be suitable for its intended purpose, and for the working conditions in which it will be used.
- **Maintenance** All work equipment must be maintained so that it is safe and does not put people at risk. Maintenance should be performed by competent staff at regular intervals. Where possible, preventative maintenance instructions should be used. These are usually based on the equipment manufacturer's recommendations and if followed will help to reduce the risk of failure whilst the equipment is in use. The PUWER guidance leaflet recommends that maintenance logs be kept.
- **Inspection** In certain circumstances, inspection should be carried out to ensure that work equipment is, and continues to be, safe for use. Any inspection should be performed by competent staff and a record kept.
- **Specific Risks** Equipment, which poses specific health and safety risks, should only be operated by suitably trained employees. As well as this, the maintenance and repair of such equipment should also be restricted to those who are competent and have been specifically designated to perform the work.
- **Information, Instructions and Training** Employers are required to provide adequate health and safety information, instruction, and training for every employee. Written instruction on the use of work equipment and H&S issues should be provided.
- **Dangerous Parts of Machinery** Employers must take measures to restrict access to dangerous parts of machinery. There must be effective measures to prevent access to dangerous parts of machinery or stop their movement before an employee enters the 'danger zone' (defined as any area of risk under health and safety law). The Regulations require a strict hierarchy of measures to be taken, e.g. if the provision of fixed guards does not fully reduce the risks then protection devices should be considered. They advise that any protection devices should be suitable for their purpose and maintained as such, be of good construction, and in good repair. Employees should be appropriately informed, instructed and trained, and if necessary, supervised whilst using dangerous machinery.
- **Protection Against Specified Hazards** This regulation outlines controls for protection against the following hazard areas: Falling or ejected articles or substances, Component rupture or disintegration of work equipment parts, Unintended or premature discharges of gas, dust, or other substances, Over-heating and catching fire, and Unintended explosions. Protective measures should be implemented including measures to minimise hazardous effects and prevent such problems occurring.
- **Controls** Where appropriate, work equipment must be fitted with operating controls (which alter speed and pressure), stop controls and emergency stop controls. All controls must be easily accessible and clearly visible.
- **Stability** Some equipment will need to be stabilised by clamping or otherwise where necessary for purposes of health and safety. Machines which are usually in a fixed position, should be bolted down where possible.

For further information about mechanical, machinery and workshop safety, consult the School's safety booklet *Code of Practice for Mechanical Workshop Safety*.

NOISE

Because the human ear is not equally sensitive to sounds at all frequencies, occupational noise is measured in a way that stimulates the response of a healthy human ear. This is generally referred to as decibels with 'A' weighting, written dB(A). It is not often appreciated that this decibel scale is logarithmic and with every increase of 3 dB(A) the sound pressure is doubled. Thus 85 dB(A) is twice as loud as 82 dB(A) and four times louder than 79 dB(A).

Loud noise can cause :-

- permanent damage to hearing. (noise induced hearing loss is **irreversible**.)
- your hearing to become less sensitive.
- tinnitus (permanent ringing in the ears).
- breakdown of safe and effective communications
- fatigue and tiredness.

Temporary, partial loss of hearing, which may persist for several hours, can be caused by brief exposure to high noise levels. Such exposure if repeated or prolonged may lead to permanent hearing damage. It is one of the most serious and widespread industrial diseases.

The Noise at Work Regulations sets 85 dB(A) as the noise level at which employers are specifically required to act on noise. Noise surveys must be carried out and precautions recommended for those areas where daily average noise exposure exceeds 85 dB(A).

If you are planning, or starting, any new 'noisy' activity contact the School Safety Adviser so that it can be assessed.

"Nuisance" noise which might disturb concentration, e.g. from traffic or a noisy process next door, is not in the range covered by the Regulations. As a rough guide, an assessment of noise exposure is needed wherever people have to shout or have difficulty in being heard clearly by someone about 2 metres away, or if they find it difficult to talk to each other. This 2m distance relates to about 85 dB (A) and a 1m distance relates to about 90 dB(A).

The main provisions of the Regulations are as follows:

- The employer is under a general duty to reduce the risk of occupational hearing damage to the lowest level reasonably practicable.
- Where daily personal noise exposure is likely to be at 85 dB(A) or above, noise level assessments must be made.
- Where employees are exposed to 85 to 90 dB(A) ear protectors must be provided although there is no statutory requirement to wear them.
- Where exposure is above 90 dB(A) the employer is obliged to reduce noise so far as reasonably practicable, by means other than ear defenders.
- So long as exposure is above 90 dB(A) the employer must enforce the use of ear protectors and employees must wear them.
- "Ear protection zones" where exposure is above 90 dB(A) must be clearly marked.
- Information must be provided to workers about risks to their hearing.
- The employer must ensure, in so far as is practicable, that all equipment provided as part of complying with these Regs. is correctly used and maintained.

N.B. When the Physical Agents (Noise) Directive is implemented in early 2006 it will tighten the legal requirements by lowering the exposure action values by 5dB to 80 and 85dB(A). Contact the School Safety Adviser if you think a noise assessment is required.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The main requirement of the PPE at Work Regulations 1992 is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

PPE is defined in the Regulations as 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects them against one or more risks to his health or safety', e.g. safety helmets, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. Waterproof, weatherproof or insulated clothing is subject to the Regulations only if its use is necessary to protect employees against adverse climatic conditions that could otherwise adversely effect their health or safety.

In general, because the effectiveness of PPE can be easily compromised, e.g. by not being worn properly, it should always be considered as the last resort and used only where other precautions cannot adequately reduce the risk of injury. Where PPE is the only effective means of controlling the risks of injury or ill health and then employers must ensure that it is available for use at work - free of charge. Also, in many laboratory and workshop areas minimum PPE levels have been set to reinforce control measures and working practices. In chemical labs. for example there is a minimum requirement to wear both safety spectacles and a lab. coat.

	HAZARDS	CHOICES
EARS	Noise - Assessments are made under the <i>Noise at Work Regulations 1989</i>	Earplugs; Ear defenders.
EYES	Chemical or metal splash; Dust; Projectiles: Gas and Vapours: Radiation	Spectacles: Goggles; Face screens
HEAD AND NECK	Impact from falling or flying objects: Risk of head bumping; Hair entanglement	Helmets; Bump caps; Hats; Caps; Sou'westers and cape hoods; Skull-caps.
BREATHING	Dust; Vapour; Gas; Oxygen deficient atmospheres	Disposable filtering face piece or respirator; Half/full face respirator; Air-fed helmets; Breathing apparatus.
PROTECTING THE BODY	Temperature extremes; Adverse weather; Chemical or metal splash; Spray from pressure leaks or spray guns; Impact or penetration; Contaminated dust; Excessive wear or entanglement of own clothing.	Conventional or disposable overalls; Boiler suits; Donkey jackets; Specialist protective clothing e.g. chain-mail aprons; High visibility clothing
HANDS AND ARMS	Abrasion; Temperature extremes; Cuts and punctures; Impact; Chemicals; Electric shock; Skin infection; Disease or contamination; Vibration.	Gloves; Gauntlets; Mitts; Wristcuffs; Armlets
FEET AND LEGS	Wet; Electrostatic build-up; Slipping; Cuts and punctures; Falling objects; Metal and chemical splash; Abrasion.	Safety boots and shoes with steel toe caps (and steel mid sole); Gaiters; Leggings; Spats.

The above table lists the parts of the body you should consider when making a PPE assessment, the associated hazard categories and the protection choices.

PRESSURE SYSTEMS

Pressure Systems Safety Regulations 2000

In order to accommodate the implementation of the European Pressure Equipment Directive (PED), adopted in May 1997, the Pressure Systems and Transportable Gas Containers Regulations 1989, have been revoked and replaced with new consolidated regulations, the Pressure Systems Safety Regulations 2000.

The aim of PSSR is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system or one of its component parts. The Regulations are concerned with steam at any pressure, gases which exert a pressure in excess of 0.5 bar above atmospheric pressure and fluids which may be mixtures of liquids, gases and vapours where the gas or vapour phase may exert a pressure in excess of 0.5 bar above atmospheric pressure.

PSSR is concerned with the risks created by a release of stored energy through system failure. With the exception of the scalding effects of steam, the Regulations do not consider the hazardous properties of the contents released following system failure. The properties of the stored contents are of concern only to the extent that they may be liable to accelerate wear and cause a more rapid deterioration in the condition of the system, so leading to an increased risk of failure. The risk from steam includes not only any possible deterioration in the condition of the system, which could increase the risk of failure, but also its scalding effect in the event of release. PSSR does not deal with all the hazards arising from the operation of such a system, even though the contents may be highly toxic. These aspects are all subject to separate legislative requirements and will need considering, along with other aspects when deciding on the level of precautions required.

Pressure Equipment Regulations 2002 (PER)

PER contain requirements for the design, manufacture and conformity assessment of certain types of pressure equipment with a pressure greater than 0.5 bar gauge. PER covers the supply and putting into service of equipment that would also form whole or part of a pressure system, that falls within the scope of PSSR.

PER divides pressure equipment into four major categories on the basis of two fundamental hazards:

- The degree of danger from failure of the equipment (expressed by the product of the pressure of the fluid and the volume of the equipment or DN value for piping products).
- The degree of danger from this release of the fluid contained (based on classifications adopted in the directives on dangerous substances).

The regulations define three types of systems:

- (a) a system comprising a pressure vessel, its associated pipe-work and protective devices.
- (b) pipe-work with its protective devices to which a transportable pressure receptacle is, or is intended to be, connected.
- (c) a pipeline with its protective devices.

and these systems in turn are further sub-divided into minor, intermediate or major.

RADIATION

Ionising Radiation

Radiation that produces ionisation in matter e.g. α particles, γ rays, X rays and neutrons. When these radiations pass through the body tissue, they have sufficient energy to damage DNA.

To comply with the necessary registration procedures the Radiological Protection Officer (RPO) MUST be consulted before commencing work involving any of these techniques. The member of staff responsible for experimental work involving these techniques must make the necessary arrangements for undergraduates. A booklet entitled "Recommendations and Notes for the Guidance of Departments Working with Radioactive Substances and Ionising Radiations", is available from the University Safety Adviser (USA).

In the event of an accident involving radioactive contamination or exposure to X-rays or Laser beams, the USA (telephone 4513) or the RPO (4776) must be contacted immediately.

Non-Ionising Radiations

Radiation that does not produce ionisation in matter. Examples are ultraviolet radiation, light, infrared radiation and radiofrequency radiation. When these radiations pass through the tissues of the body they do not have sufficient energy to damage DNA directly. For advice on radiation consult the School's Safety booklet entitled 'Radiation Safety'

Radiation Protection Supervisor (RPS) Any School, or a constituent subject area, which uses ionising radiations must have an RPS, who will be appointed in writing by the University. The RPS supervises work activities in the area(s) specified in the Local Rules, and assists in ensuring compliance with the arrangements made by the University in the Local Rules and other university guidance on radiological safety.

Local Radiation Assistant (LRA) LRA are appointed to provide day-to-day assistance to the RPS. An LRA will be an employee involved in ionising radiation work in a specified work area.

Lasers

Lasers produce electromagnetic radiation at wavelengths extending from 100 nm in the ultra-violet, through the visible (400-700 nm), and the near infrared (700-1400 nm), to the far infrared (1400 nm – 1 mm). Thus, the light emitted can be either visible or invisible. Lasers can be operated in a number of different modes. Some lasers produce a continuous output and are known as continuous wave or CW lasers. The power outputs of CW lasers are usually expressed in terms of watts (W). Others operate in a pulsed mode producing short bursts of radiation. The power of the laser output can vary from less than 1mW to many watts in some CW devices. The energy output of pulsed lasers is generally expressed in joules (J) per pulse.

Because of the wide ranges possible for the wavelength, energy content and pulse characteristics of laser beams, the hazards arising from their use varies widely. It is impossible to regard lasers as a single group to which common safety limits can apply. A system of laser classification is used to indicate the level of laser beam hazard and maximum Accessible Emission Levels (AELs) have been determined for each class of the seven classes (1, 1M, 2, 2M, 3R, 3B & 4).

Class 1 Lasers that are safe under reasonably foreseeable conditions of operation, either because of the inherently low emission of the laser itself, or because of its engineering design such that it is totally enclosed and human access to higher levels is not possible under normal operation.
NB If access panels of a totally enclosed system are removed for servicing etc then the laser product is no longer Class 1 and the precautions applicable to the embedded laser must be applied until the panels are replaced.

- Class 1M** Laser products emitting in the wavelength range 302.5 nm to 4000 nm, whose total output is in excess of that normally permitted for Class 1 laser products but because of their diverging beams or very low power density do not pose a hazard in normal use and comply with the measurement conditions for a Class 1M product. However they may be hazardous to the eyes under certain conditions if gathering optics are used with them, i.e. a) With a diverging beam if optics are placed within 100mm of the source to concentrate/collimate the beam. or b) With a large diameter collimated beam viewed with binoculars or a telescope.
- Class 2:** Lasers that only emit visible radiation in the wavelength range from 400 nm to 700 nm and whose output is less than the appropriate AEL. They are safe for accidental viewing as eye protection is afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation including the use of optical instruments for intrabeam viewing.
- Class 2M:** Laser products that only emit visible radiation in the wavelength range 400 nm to 700 nm, whose total output is in excess of that normally permitted for Class 2 laser products but because of their diverging beams or very low power density are safe for accidental viewing during normal use and comply with the measurement conditions for a Class 2M product. However they may be hazardous to the eyes under certain conditions if gathering optics are used with them, i.e. a) With a diverging beam if optics are placed within 100mm of the source to concentrate/collimate the beam. or b) With a large diameter collimated beam viewed with binoculars or a telescope.
- Class 3R:** Lasers that emit in the wavelength range from 302.5 nm to 1 mm where direct intrabeam viewing is potentially hazardous but the risk is lower than for Class 3B lasers, and fewer manufacturing requirements and control measures for the user apply. The AEL is restricted to no more than five times the AEL of Class 2 for visible wavelengths and no more than five times the AEL of Class 1 for other wavelengths.
- Class 3B:** Lasers that are normally hazardous when direct intrabeam exposure occurs (i.e. within the Nominal Ocular Hazard Distance, which is the distance within which the beam irradiance or radiant exposure will exceed the appropriate MPE). Viewing diffuse reflections is normally safe. Output levels must be less than the appropriate AELs for Class 3B devices.
- Class 4:** High power lasers that exceed the AELs for Class 3B products that are also capable of producing hazardous diffuse reflections. They may cause skin injuries, could also constitute a fire hazard and could cause hazardous fumes to be produced as well as being a hazard to the eyes. **Their use requires extreme caution.**

Laser Protection Supervisor (LPS) Any School, or a constituent subject area, using lasers (Class 3b and above) must have one or more LPS, who will be appointed in writing by the University. The LPS supervises work activities in the area(s) specified in the Local Rules, and assists in ensuring compliance with the arrangements made by the University.

Local Laser Assistant (LLA) LLA provide day-to-day assistance to the LPS. An LLA will be employee involved in non-ionising radiation work in a specified work area.

SLIPS, TRIPS AND FALLS

Over a third of all major injuries reported each year are caused as the result of a slip or trip. Slips are 6 times more frequent than trips. The HSE recommend adopting the following approach.

1. **Look for slip and trip hazards** around the workplace, such as uneven floors, trailing cables, areas that are prone to spillages.
2. **Decide who might be harmed and how.** Who comes into the workplace and are they at risk?
3. **Consider the risks.** Are the precautions already in place sufficient to deal with the risks?
4. **Record the findings.**
5. **Regularly review the findings.**

Good working practice

Ensure that conditions are right from the start. Choose only suitable floor surfaces and ensure that lighting levels are adequate. Cleaning methods and equipment must be suitable for the type of surface being treated.

Carry out all necessary maintenance work, including inspection, testing, adjustment and cleaning at regular intervals, taking care to ensure that additional slip and trip hazards are not created.

Lighting should enable people to see obstructions, potentially slippery areas etc. Floors should be checked for loose finishes, holes and cracks, worn rugs and mats etc. Obstructions and objects left lying around can easily go unnoticed and cause a trip. Try to keep work areas tidy and if obstructions can't be removed, warn people using signs or barriers. Correct footwear can play an important part in preventing slips and trips.

Reducing the risk of slipping and tripping

HAZARD	SUGGESTED ACTION
Spillage of wet or dry substances	Clean spills up immediately. If the liquid is greasy ensure a suitable cleaning agent is used. After cleaning the floor may be wet for some time. Use appropriate signs to tell people the floor is still wet and arrange an alternative bypass route.
Trailing cables	Position cables to avoid cables crossing pedestrian routes. Use cable covers to securely fix to surfaces. Restrict access to prevent contact.
Rubbish e.g. plastic bags	Keep areas clear. Remove rubbish and do not allow it to build up.
Flooring	Ensure that all flooring e.g. carpets, rugs, mats and lino, is securely fixed and does not have curling edges. Replace worn floor covering.
Slippery surfaces	Assess the cause and treat accordingly e.g. treat chemically, devise an appropriate cleaning method.
Change from wet to dry floor surface.	Use suitable footwear. Warn of risks using signs. Locate doormats where changes are likely.
Poor lighting.	Improve lighting levels and placement of light fittings to ensure more even lighting of all floor areas.
Changes of level.	Improve lighting levels. Add apparent tread nosings.
Slopes	Improve visibility. Provide handrails. Use floor markings.
Unsuitable footwear	Ensure that the correct type of footwear is used. Particular attention should be paid to the type of sole.

VACUUM SYSTEMS

Glass systems are particularly vulnerable and should be protected against the risk of implosion should mechanical defects develop while the system is under vacuum. Glassware under vacuum must have a protective cover, e.g. cling-film to prevent flying glass. Thin-walled or non-spherical glass flasks should not be evacuated. Also, all modifications and repairs to glass vacuum systems can only be undertaken by an experienced glassblower.

Gas leaks from the chamber into the lab. may result depending on the gases used, may result in explosion, toxic effects or asphyxiation. Air leaks into the chamber, may produce potentially explosive or toxic mixtures. Ensure systems are leak free before introduction of process gases and ensure that exhaust systems are working effectively and are properly ventilated.

Minimise mechanical shock by turning taps slowly when equalising a large pressure differential, especially if a large bulb volume is involved. Arrangements must be made to ensure that chemical vapours condensed out and their ingress into the pumping system is prevented.

Liquid nitrogen traps on vacuum systems must only be filled after pumping down (to prevent O_2 condensation). Air must not be readmitted until the liquid N_2 reservoir has been removed.

Vacuum Pumps

All oil pumps must be used properly if they are to function efficiently. This efficiency is reduced if the oil becomes thick (due to dissolved chemicals) and the metal surfaces become pitted (due to exposure to corrosive materials). You should be trained in the use of vacuum pumps but it is most important to make certain that the vacuum system in the apparatus is discharged (i.e. the equipment is returned to atmospheric pressure) before the pump is switched off. This prevents suckback of oil from the pump into the system. Diffusion pumps are more complex in operation and an experienced user must be consulted before you attempt any usage.

Consult the School's H&S booklet *Vacuum Systems* for further information.

WORKING AT HEIGHTS

Falls from height are one of the biggest killers of personnel in the workplace. Work at height should ideally be carried from a platform with suitable edge protection. Occasionally this may not be possible and a ladder may have to be used. However, ladders are best used as a means of getting to a workplace and should only be used as a workplace for light work of short duration. It is tempting to use a ladder for all types of work but you should always consider working from a platform first, for example, a properly erected mobile scaffold tower or a mobile elevated working platform.

Stepladders

- Do not use the top platform of the stepladder unless it is designed with special handholds.
- Ensure stepladders are stable and positioned on level ground and used in accordance with the manufacturer's instructions.
- Do not walk down facing the wrong way.
- Do not use stepladders leaning against a wall and do not overreach.
- Be extremely careful if working off the short axis of a stepladder; this is not advised, since stepladders have little stability along this axis - work off the long axis whenever possible.

Ladders

- Ladders should be in good condition and examined regularly for defects.
- They should be securely fixed so they cannot slip, usually by tying them at the top. If this is not practicable then a person must be stationed at the foot of the ladder when in use to prevent it slipping, but this concession can only be applied when the ladder is < 20 feet long.
- The ladder should be angled to minimise the risk of slipping outwards. As a rule of thumb it should be set 'one out for every four up' or 75 degrees.
- Access ladders should extend about 1m above the work platform, to provide a handhold for people getting on and off.
- Do not overreach. If you are working from a ladder, make sure it is long enough and positioned to reach work safely.
- Do not climb or work off a ladder unless you can hold it safely.
- When in use ladders should not obstruct escape routes.

Scaffold Towers

- It is essential that users ensure that scaffold towers are erected, used and dismantled safely. The main cause of accidents involving tower scaffolds are poor erection or misuse.
- A competent person must erect the scaffold in a manner fully compliant with the manufacturer's instructions. Also, any alterations or dismantling must be performed by a competent person.
- When a tower is left incomplete a warning notice 'TOWER INCOMPLETE : DO NOT USE' should be clearly displayed.
- Care should be taken to ensure loads are evenly distributed and do not exceed those set by the manufacturer. Never climb on towers from the outside.
- The tower cannot be used until appropriate working platforms, toe boards, guard rails and stabilisers/outriggers have been fitted. Never use general scaffold boards with a mobile structure. Only use the correct size pre-formed platform supplied by the manufacture.
- Each time before using ensure the tower is vertical and the wheel brakes are on.
- When moving a tower check the following:-
 - a. check that there are no power lines or other overhead obstructions.
 - b. check that the ground is level and firm.
 - c. push or pull on the base – never use powered vehicles.
 - d. never move it while there are people or materials on the upper platforms.
- Traditional scaffold can only be erected by a qualified scaffolding contractor.

Falling objects

Care should be taken to prevent objects falling onto people. This may involve the following:-

- Providing barriers, such as toe boards or mesh guards, to prevent items falling off the edge of a structure.
- Securing objects to the structure.
- Making sure that there are no loose objects and that all tools are secured.
- Creating an exclusion zone beneath areas where work is taking place and where necessary providing personnel with safety helmets.
- Clearly marking areas where work is being undertaken above with safety signs warning workers of the dangers.
- Using safety nets.

WORK ENVIRONMENT

The Workplace (Health, Safety and Welfare) Regulations 1992 require that workplaces meet certain basic standards.

Ventilation

Workplaces need to be adequately ventilated. Fresh, clean air should be drawn from a source outside the workplace, uncontaminated by discharges from flues, chimneys or other process outlets, and be circulated through workrooms.

Ventilation should also remove and dilute warm, humid air and provide air movement, which gives a sense of freshness without causing draught. If the workplace contains process or heating equipment or other sources of dust, fumes or vapours, more fresh air will be needed to provide adequate ventilation.

Windows or other openings may provide sufficient ventilation but, where necessary, mechanical ventilation systems should be provided and regularly maintained.

Temperatures in indoor workplaces

Comfort depends on air temperature, radiant heat, air movement and humidity. Individual personal preference makes it difficult to specify a thermal environment that satisfies everyone. For workplaces where the activity is mainly sedentary, for example offices, the temperature should normally be at least 16 degrees Celsius. If the work involves physical effort it should be at least 13 degrees Celsius (unless other laws require a lower temperature).

Work in hot or cold environments

The risk to the health of workers increases as conditions move further away from those generally accepted as comfortable. Risk of heat stress arises, for example, from working in high air temperatures, exposure to high thermal radiation or high levels of humidity, such as those found in foundries, glass works and laundries. Cold stress may arise, for example, from working in cold stores, food preparation areas and in the open during winter.

Assessments of the risk to worker's health, from working in either a hot or cold environment, needs to consider two sets of factors – personal and environmental. Personal factors include body activity, the amount and type of clothing, and duration of exposure. Environmental factors include ambient temperature, and radiant heat: and if the work is outside, sunlight, wind velocity and the presence of rain or snow.

Lighting

Lighting should be sufficient to enable people to work and move about safely. If necessary, local lighting should be provided at individual workstations, and at places of particular risk. Lighting and light fittings should not create any hazard. Automatic emergency lighting, powered by an independent source, should be provided where sudden loss of light would create risk.