CS CoP002 - Good Laboratory Practice

Good laboratory practice means safe laboratory practice and should come as second nature to the professional laboratory worker. It should not be something that is seen as an extra to normal procedures, an additional and arduous planning task that requires special thought, or indeed merely a paper exercise that delays work, or research projects. This University is a world renowned teaching organisation and as such good and safe laboratory practices should be the norm in order to set good example to our students, be they undergraduate or post graduate, and to instil a safety culture into their work ethos. Prospective employers of our graduates should be not only confident that in employing a graduate from this University that they are gaining an employee whose academic knowledge is sound, but also one who is able to work safely using best practice methods without the need for further training in this fundamental. It also follows that if good practice and a safety culture are the norm that the health and safety of staff and students will not be compromised, or the integrity of the University infrastructure threatened by unsafe acts.

The object of this Code of Practice is to provide a standard for good laboratory practice when working with chemicals rather than attempt to be specific regarding either substances or procedures. There are of course many thousands of chemicals that may be encountered by laboratory workers, some are purchased proprietary chemicals with known and well documented health hazards, others will be known and result as a by product of work, and sometimes new substances will be generated the health hazards of which are unknown. It is therefore of paramount importance that laboratory workers undertake their work and conduct themselves in a manner that ensures that exposure to chemicals that are hazardous to human health, or physical safety, is minimised and that where this does occur both exposure, by all available routes, and physical hazard, is adequately controlled so as to prevent risk to health or safety.

002.1 Principles of good practice

Four basic principles are the corner stones of good practice in all laboratory work:

002.1.1 Forward planning

The potential hazards associated with laboratory based work projects, including, crucially, the hazards posed by any chemicals being used, or produced, should be determined well before the commencement of the project. To do this you will have to consult literature, this could be: chemical manufacturers Safety Data Sheets (SDS) which are required, by law, to be supplied by the manufacturer, data bases of generic SDSs, text books, toxicity reviews, etc. If it is possible to carry out a particular work project without recourse to the use of hazardous chemicals then this must be the approach adopted. If it is not possible to avoid the use of hazardous chemicals, but it is

possible to substitute a hazardous chemical that is contemplated for use with one that presents less hazardous properties then, again, this must be the approach adopted.

002.1.2 Risk assess, minimise risk and control exposure to chemicals

You must undertake risk assessment of the entire laboratory work project(s) including; equipment that you intend to use and any chemicals that you will use, or produce, during the work. The aim of the risk assessment process is to minimise the risk to persons health or safety from physical hazards e.g. glass, fire, explosion, etc., and from health hazards e.g. chemical vapours, fume, dusts, toxic powders, corrosives, etc. by implementing risk control measures e.g. intrinsically safe equipment, use of fume cupboards, use of suitable protective clothing and equipment, etc. Importantly the risk assessment process must result in the development of a Safe System of Work (SSW), sometimes known as Safe Operating Procedures (SOP), this is essentially a set of rules, that is conveyed to the persons involved in the work project(s), that they must follow in order to ensure, so far as is reasonably practicable, the health and safety of not only themselves but that of others who may be affected by what they do.

Of course if you follow good laboratory practice you will need to do little else to satisfy the requirements of health and safety law, indeed the Control of Substances Hazardous to Health Regulations (COSHH) requires the following of good practice by the introduction of eight principles of good practice that apply regardless of whether a substance has been assigned a Workplace Exposure Limit (WEL). According to the Health and Safety Executive (HSE), employers who do not follow these eight principles will, by implication, not be properly protecting their employees.

The principles are:

- Design and operate processes and activities to minimise emission, release and spread of substances hazardous to health.
- Take into account all relevant routes of exposure - inhalation, skin absorption and ingestion - when developing control measures.
- Control exposure by measures that are proportionate to the health risk.
- Choose the most effective and reliable control options, which minimise the escape and spread of substances hazardous to health.
- Where adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures, suitable personal protective equipment.

- Check and review regularly all elements of control measures for their continuing effectiveness.

- Inform and train all employees on the hazards and risks from the substances with which they work and the use of control measures developed to minimise the risks.

- Ensure that the introduction of control measures does not increase the overall risk to health and safety

Detailed information and guidance on the Control of Substances Hazardous to Health Regulations, including risk assessment forms for complicated/high hazard procedures (HS1) and those involving only proprietary purchased materials (e.g. cleaners, paints, glues) (HS2), can be accessed at: http://www.ed.ac.uk/schools-departments/health-safety/risk-assessments-checklists/risk-assessments

002.1.3 Do not underestimate the risk

It is sensible to assume that where more than one chemical is used in an activity that the resultant mixture will be more toxic than its most toxic component. Do not assume that a fume cupboard will prevent the build up of explosive atmospheres, especially when working with very volatile chemicals that have a low flashpoint e.g. ethers. If a substance or preparation is classified as explosive, oxidising, extremely flammable, highly flammable or flammable then it is a dangerous substance and you are required by law to undertake a risk assessment in compliance with the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), as well as the risk assessment you undertake to satisfy the requirements of COSHH. See guidance on DSEAR and risk assessment form at: http://www.ed.ac.uk/schools-departments/health-safety/risk-assessments-checklists/risk-assessments

002.1.4 Be prepared for emergency situations

Everyone who works in a laboratory must know the action to take should something untoward occur, such as a chemical spill, or unintentional release of gas or vapour. There may be specific action that requires to be taken in the case of certain chemicals e.g. hydrofluoric acid, therefore you must ensure that your laboratory colleagues are informed of your activities in order that they can respond appropriately. All laboratory workers must be familiar with the local emergency procedures; they should know the location of: the nearest fire alarm point, fire extinguishers, chemical spill kits, the nearest telephone and the emergency telephone numbers that are to be used. They should know how to call out area spill response teams, if such a system is in place, and how to summon local first aiders. They should know the health effects of the chemicals being used in order that basic first aid can be administered and the MSDS should be readily available, so that a copy can be sent to the hospital with the casualty.

002.2 Behaviour in the laboratory

The highest standards of professional personal behaviour are expected in the laboratory:

- Always wear laboratory coats of a type commensurate with the hazard (long sleeved coat, high necked Howie type coat, coverall, etc.) and always wear them properly fastened. The wearing of normal everyday clothing alone can never be justified in a laboratory and is indicative of sloppy practice and poor risk assessment.

- Laboratory coats, or coveralls, must not be worn outwith laboratories e.g. common rooms, dining rooms, libraries, computer labs, etc

- In order to prevent cross contamination chemical resistant gloves must not be worn outwith the laboratory, or in designated write up areas, where telephones, door handles, pens, etc. may subsequently be touched by persons not wearing protective gloves.

- Long hair must be secured behind the head when working in a laboratory to reduce the risk of it dipping in chemicals or catching fire.

- Open-toed shoes or sandals should never be worn in a laboratory where chemicals are used and trousers are to be preferred to shorts or skirts.

- Do not indulge in horseplay or practical jokes in the laboratory.

- Never run in a laboratory, or hurry through doorways.

- Do not allow visitors into laboratories where hazardous substances are in use, or stored, unless accompanied and provided with suitable personal protective equipment. This is particularly important in the case of young persons on school educational visits, etc.

- All work in laboratories by contractors/University maintenance personnel is subject to a Permit to Work Scheme; which must be adhered to.

- Make sure equipment is used only for its designated purpose.

- Never alter the design, or construction, of any purchased equipment.

- Make sure all equipment is serviceable and suitable for the intended use.

- If photography, or video filming, is to be undertaken for publicity or teaching purposes make sure that all of those shown are wearing appropriate personal protective equipment e.g. laboratory coats, chemical safety spectacles, chemical resistant gloves, etc.

002.3 Safe Systems of Work

A safe system of work, or safe operating procedure, will generally arise naturally out of the COSHH risk assessment. However, it should be noted that all chemical substances are hazardous in some way or another and thus must be regarded as potentially dangerous materials. When planning new research work, all possible sources of danger must be considered and specialist advice must be sought before commencing experimental work with unknown risks. Literature on reactive chemical hazards should be searched before designing experiments.

"First time experiments" involving novel combinations of chemical reagents should always be carried out on a small scale; an experienced chemist should be consulted prior to scaling-up the size of any preparative reactions. In general, the danger periods of a chemical reaction are during the initial heating, when the reflux or reaction temperature is reached, and when further reactants or catalysts are added. Provision should always be made for the rapid removal of any heating source.

Never attempt to carry out experimental work with hazardous materials when alone, or when tired or unwell.

Safe Systems of Work that have developed from the risk assessment process must be conveyed in writing to the operative(s) and a signature obtained to conform that they have both read and understood the SSW. The University's model template risk assessment forms have a portion appended for recording the SSW and obtaining the signatures of operatives.

002.4 Exposure routes and minimising risk

Ingestion

- Eating, drinking, chewing gum, applying cosmetics is strictly prohibited.
- Smoking is prohibited in all University buildings.
- Food, and drinking or eating utensils must not be stored within laboratories.
- Laboratory refrigerators, freezers, ovens, etc. must never be used for food storage or preparation.
- Water supply points within a laboratory should never be used for drinking purposes, with the exception of dedicated drinking fountains.
- Laboratory glassware must never be used for food purposes.
- Mouth pipetting is prohibited in this University. Electric pipettes, bulbs, or aspirators should be used to pipette chemicals or start a siphon.

- Gloves should be washed before being removed and hands washed following work with any laboratory chemicals.

Inhalation

- Chemicals, or chemical by-products, that are very toxic, or toxic by inhalation, must be worked with only in a glove box, or fume cupboard, the appropriate mechanical control having been chosen as a result of thorough and documented risk assessment.

- Chemicals that are classed as harmful, or irritant, by inhalation should be used whenever possible within a fume cupboard. They should only be worked with on the bench top when risk assessment concludes that it is safe to do so and with any required combination of risk control measure (e.g. Local Exhaust Ventilation (LEV), Personal Protective Equipment (PPE)) in place and operating.

- Use only fume cupboards that have been tested for adequate face velocity and containment within the last 14 months and have visible evidence of such testing posted on the sash screen.

- You should keep hazardous chemicals and any reactions at least 15cm behind the plane of the sash.

- You should never insert your head inside an operating fume cupboard to check a procedure, remember the barrier between clean and contaminated air is the plane of the sash.

- Always work with the sash in the lowest practicable position and always close the sash when leaving the fume cupboard unattended.

- If Hydrofluoric Acid (HF) is being used as part of a process within a fume cupboard and the process is to be left unattended, always close the sash window and ensure that a notice informing that HF is being used is attached to the sash window.

- Do not clutter fume cupboards with unnecessary equipment, or store bottles of chemicals within them as this may restrict the airflow and affect containment. Where possible raise equipment that is to remain in the fume cupboard on racks, etc, so that air can flow freely underneath it.

- Always ensure that the space below the fume cupboard sill is kept clear of obstruction so as to ensure optimum airflow and thus containment.

- Never use a fume cupboard that is suspected to be malfunctioning, or override a warning indicator and always report any malfunction immediately to Works Division.

- Maintenance of recirculating fume cupboards is not the responsibility of Works Division, but that of the purchasing School. Ensure that a maintenance agreement with a competent engineering company is in place, that includes 14 monthly inspection and test, and that this test includes a filter integrity test.

- If PPE in the form of Respiratory Protective Equipment (RPE), commonly referred to as masks, is to be worn as a control measure then care must be taken that the correct respirator and appropriate filters is chosen. Importantly: in compliance with the COSHH Regulations wearers of respirators that rely on a tight fit to the face to protect the worker are required to be individually face-fit tested to a particular make and size of respirator and a certificate of successful fit-test obtained, see: http://www.ed.ac.uk/schools-departments/health-safety/guidance/ppe/rpe and http://www.ed.ac.uk/schools-departments/health-safety/guidance/ppe/facefit

Dermal contact

Dermal hazards are varied in their presentation; excesses of heat or cold, corrosives, toxic chemicals that can be absorbed through the skin, skin irritants, etc. and the exposure route is not confined to the hands, but may also include the forearms, face, and any other area of uncovered skin. Gloves of a type suitable to protect against a particular hazard should be worn; the following is general good practice that applies to the selection and use of gloves.

- Only wear gloves that you know to be resistant to permeation by the chemical in use and for the type and duration of use e.g. splash contact or immersion contact. Do not assume that, say a general nitrile disposable laboratory glove, will protect against the particular chemicals in use, it may not, different chemicals permeate through differing glove materials at different rates. Wearing gloves of the wrong material can be more hazardous than not wearing gloves at all, as if a chemical permeates through the glove material it can be trapped in contact with the skin for a prolonged period.

- You should always inspect gloves as you don them for small holes or tears.

- Reusable gloves should be washed as appropriate before removal to prevent prolonged chemical residue contact and premature degradation. Disposable gloves should be rinsed before removal as this helps to prevent contamination transfer to the hands on removal. However, bear in mind that some glove material is water permeable e.g. polyvinyl alcohol (PVA), leather, etc.

- Reusable gloves should be subject to regular inspection and replaced periodically dependent on their permeation and degradation features in respect of the chemical in use.

- In order to prevent the unintentional contamination of surfaces that may subsequently be touched by other persons not wearing gloves, gloves must be removed before leaving the laboratory, touching door handles, telephones, pens, books, computer keyboards, etc.

- Always wear your laboratory coat sleeves rolled down in case of accidental splashing and always wear close fitting chemical resistant safety spectacles. In the case of work with corrosive liquids a chemical resistant face shield should be worn.

- When transferring cryogenic materials always wear proper cryogenic temperature resistant gloves and a full face shield.

More specific and detailed guidance can be found at:

Personal Protective Equipment - http://www.ed.ac.uk/schools-departments/health-safety/guidance/ppe

Specware Online Chemical Hand protection - http://www.ansellpro.com/specware/index.asp

Ethidium Bromide Hand Protection - http://www.ed.ac.uk/schools-departments/health-safety/guidance/hazardous-substances/ethidium-bromide

Eye protection

- Close fitting chemical resistant safety spectacles, or goggles, should always be worn when working with chemicals out-with fume cupboards, or glove boxes. When working with corrosive chemicals, or chemicals which toxicity can be absorbed through skin, a chemical resistant full face shield should be worn. Guidance on prescription safety spectacles is available at http://www.ed.ac.uk/schools-departments/health-safety/guidance/ppe/prescription-spectacles

Minimizing injection hazards

There may be instances where solutions of chemicals are transferred in syringes and in some cases these may be fitted with hypodermic needles. In such instances extreme care is required as the risk of inadvertent injection is significant.

- Never walk about with an unsheathed hypodermic syringe in your hand, always secure in a secondary containment for transfer.

- Never re-sheath a hypodermic needle.

- Dispose of needles only in properly designed and designated sharps boxes.

More detailed information and guidance relating to work with glass and sharps, including needlestick injuries can be accessed at: http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/blm/prevent_injuries_sharps.pdf

002.5 General housekeeping

There is an accepted correlation between order and safety; in the main an untidy and disorderly laboratory is one where safety is given low priority and sloppy work practice prevails. The following general points must be adhered to in all laboratories:

- The laboratory floor and in particular traffic areas should be kept free of obstructions, items such as chemical containers, boxes, apparatus, etc, should not be stored on the floor.

- Access to emergency exits, emergency showering facilities, or emergency equipment such as fire extinguishers and first aid boxes must never be obstructed.

- Benches should be clean and tidy and free from clutter by chemicals or apparatus that is not in use.

- Floors should be cleaned regularly and spills dealt with immediately, in the appropriate manner, by persons who are able to take due account of the nature of the materials spilled. In certain Schools there may be a dedicated ‘Spill Team’ or Trained ‘Breathing Apparatus Team’ available to deal with toxic or highly volatile materials.

- All compressed gas cylinders must be securely fastened in an upright position to proper cylinder cradle which are in turn secured to benches or walls.

- Do not write, hang, or secure, non-hazard warning notices to fume cupboard sash panes as this can restrict proper view of apparatus and experiments and result in accident.

- Correctly label all containers containing chemicals with detail of the content; this is particularly important in the case of materials that have been decanted from a larger container, or where solutions have been made from two or more substances. In the case where the master container displays orange hazard warning symbols in compliance with the Chemicals (Hazard Information and packaging for Supply) Regulations (CHIP) identical labels should be affixed to the new container. (These labels are readily available, in differing sizes to suit container size, from your laboratory consumables supplier.) In addition when a chemical is transferred from the container in which it was supplied to another container, as much as possible of the information

given on the label of the original container should appear on the label of the repackaged material.

A laboratory self-inspection checklist is available at: http://www.ed.ac.uk/schools-departments/health-safety/risk-assessments-checklists/checklists

002.6 General Laboratory Services

Laboratory workers should familiarise themselves with the positions of the main laboratory controls for electricity, gas and water, and should ensure that these do not become obstructed by equipment.

Water leads to condensers should be inspected regularly, kept in good condition and should be secured so as to prevent accidental detachment which can lead to flooding or to the escape of toxic or flammable vapours.

Serious floods have resulted from failure to realise that the pressure of mains water can be higher at night compared to during the day. For this reason, all tubing connected to water sources must be securely wired or clipped. Waste water tubing leading to the sink or fume cupboard drain, should be securely wired to a weight or extension metal tube to prevent flooding. For long term and overnight reflux, a waterless condenser may be used where appropriate.

Rubber tubing used to connect Bunsen burners to the gas supply should also be inspected regularly for perished sections that may leak and replaced. Rubber tubing used to convey gas should be replaced at regular intervals not exceeding two years.

Gas heated apparatus should never be placed directly on to wooden benches without a sheet of non-asbestos insulating board under the apparatus. Gas supplies to oxygen/air torches must be fitted with approved non-return valves.