# 14. SPECIAL SAFETY PRECAUTIONS

### 14.1.1 Contents:

**14.2.1 Aim:** To describe special precautions and practical arrangements related to University buildings on the Edinburgh bioQuarter campus.

**14.3.1 Introduction:** General safety precautions and general laboratory safety precautions for University buildings on the Edinburgh bioQuarter campus are described in Sections 12 and 13 of this Manual.

**14.4.1 Policy:** The following paragraphs span a range of potential threats to health and safety, and describe means to minimise the likelihood of dangerous occurrences and undesired consequences.

14.4.2 Full compliance is expected from all staff and students with regard to the policies, procedures and arrangements set out in this and all other Sections of the Safety Manual.

## GENERAL SAFETY MATTERS

**14.5.1 Fire in the Building:** Fire Stewards and Deputies have been appointed for all University buildings on the Edinburgh bioQuarter site. These individuals are responsible for surveying their areas on a regular basis to ensure that fire safety matters are in order and, insofar as it proves safe for them to do so, ensuring that their respective areas are cleared should a fire alarm sound within them.

14.5.2 The University is also required by law to familiarize everyone employed within these buildings with the procedures that have been put in place to evacuate the building in the event of a fire emergency; to that end, a weekly fire alarm test and

annual fire drills are held for each building. Prior notice of a full-scale evacuation rehearsal *may* be given; but, equally, it may be a "no-notice" exercise. In either event, you *must* conform to the procedures set out in Sections 5 and 6 of this Manual (dealing with Fire Safety, and Mobility, Sensory and Cognitive Impairments and Buildings Emergencies respectively), and be prepared to evacuate immediately upon hearing a continuously sounding alarm tone (🔊:  ) or a voice message broadcast over tannoys.

**14.6.1 General Fire Precautions:** The following are general measures intended to limit the potential for a fire-related emergency to arise within University buildings on the Edinburgh bioQuarter site:

- Practical work which may entail a fire risk should never be attempted outwith *hours of normal building occupancy* (see definition at Paragraph 9.4.1), and a list of high-risk activities that are vetoed outwith *hours of normal building occupancy* is contained at Paragraph 9.7.1;
- As a matter of priority, *before* commencing work, you should familiarise yourself with the escape routes and exits from all parts of the building within which you are working;
- You should familiarise yourself with the position and correct operation of fire alarm call points in or near any laboratory, write-up area, office or other location within which you are working; and
- No goods or materials should be left or stored in any place which could obstruct an escape route or exit, and combustible waste should not be allowed to accumulate unreasonably in any area within buildings at any time.

14.6.2 Further information on aspects of fire safety is contained in Sections 5 (Fire Safety) and 6 (Mobility, Sensory and Cognitive Impairments and Buildings Emergencies) of this Manual.

**14.7.1 First Aid**: Guidance on general emergency procedures, including those to be adopted in the event of a first aid emergency, are contained in the Key Emergency Actions section to be found towards the front of this Manual, and further information is contained also in Section 11 (First Aid, Accidents and Near-Miss Reporting).

14.7.2 In the event that first aid is required for any reason, send for the nearest available *qualified* First Aider or Emergency First Aider. A list of those who are currently qualified is included at Appendix 6 to this Manual. Notices are posted throughout the buildings, and you should familiarize yourself with the names and usual locations of individuals serving the areas where you work. Make sure that you also know the location and contents of the first-aid box closest to your normal place of work; this too is specified in safety notices displayed throughout each building.

14.7.3 Items taken from first aid boxes *must* be promptly replaced, so *always* ensure that the relevant First Aider is informed when the first aid box has been used. First Aiders should, in any event, regularly and routinely inspect first aid boxes in their areas to confirm the immediate availability of these and that they contain all necessary materials.

14.7.4 *Always* complete an injury report when an accident at work has resulted in actual injury requiring use of a first aid box. On-line reporting to the University's Health & Safety Department can be achieved using:

https://www.ed.ac.uk/health-safety/accident-reporting

Further information on accident and "near-miss" reporting is contained in Section 11 (First Aid, Accidents and Near-Miss Reporting) of this Manual.

14.7.5 If the situation is clearly more than trivial, **send for an ambulance by dialing (9)999** from any extension at a safe location, and report the precise location and nature of the emergency. The fact that all University buildings on the Edinburgh bioQuarter are located on the same campus as the Infirmary does not affect this; **an ambulance *will* respond to a 999 call from any of the University buildings**. Do *not* call 2222 or phone the Infirmary's Emergency Department directly; their "crash teams" will *not* attend medical emergencies arising within a University building. Always, though, send someone to Reception to meet attending Paramedics, and lead them to the casualty.

14.7.6 People injured by exposure to chemical substances should be taken immediately to the Infirmary's Emergency Department. A report of the circumstances and properties of substances involved should be made to medical staff within the Infirmary, and a copy of all relevant material safety data sheets and COSHH risk assessments should, whenever possible, be sent together with the casualty.

14.7.7 Special arrangements for injuries involving medical or laboratory sharps are set out in in Section 11 (First Aid, Accidents and Near-Miss Reporting) of this Manual.

**14.8.1 Personal Protective Equipment**: Requirements for personal protective equipment should generally have been identified beforehand, arising from a formal risk assessment linked to work that is to be done.

14.8.2 *Laboratory Coats*: These are an **essential** item of personal protective equipment for **all** laboratory work done in *Containment Laboratories* (most laboratories within University buildings on the Edinburgh bioQuarter campus are designated at Containment Level 2; see also Paragraph 14.31.1 *et seq*), and *all* people working in Containment Laboratories **must** wear an appropriately designed laboratory coat, **properly fastened up**. The requirement for laboratory coats to be worn within containment laboratories is in no way relaxed outside hours of expected buildings occupancy (see Section 9 of this Manual).4

14.8.3 Exposed skin is at greater risk from contamination; open-toed footwear and clothing that exposes midriffs and legs should, therefore, be avoided. Clothing that becomes contaminated is likely to result in harmful chemicals or biological material remaining in contact with the worker's skin until the contaminated clothing is removed and changed (see also Paragraph 14.9.1). Care should be taken with the handling and subsequent management of contaminated clothing; advice should be sought from your laboratory's Health & Safety Adviser.

14.8.4 Laboratory coats, theatre scrubs *etc* **must not** be worn outside the laboratory area (*e.g.* into common rooms and rest rooms, anywhere food is being prepared or consumed, offices, lecture theatres and auditoria, Reception areas, Stores, the Medical Library *etc*). This policy is an important aspect of infection control within University buildings on the Edinburgh bioQuarter site. Neither, of course, should these items of laboratory clothing be worn outside the buildings.

14.8.5 *Gloves*: An increasing number of people are allergic to latex; this problem may be exacerbated by the powder that is present in some gloves. Use of *powdered* latex gloves, in particular, is **strictly prohibited** within the University. The Health & Safety Executive has recommended that latex use be discontinued, so latex gloves have been outlawed on the Edinburgh bioQuarter site unless a very specific case has been made by an individual worker, and use has been explicitly approved in that case; but this should be on an exceptional basis only, with great care being taken to ensure that other workers do not come into accidental contact with the latex gloves or the packaging within which they have been supplied and contained.

14.8.6 Workers should be aware of the concept of *breakthrough times*, which are quantitative indices of the resistance of glove material to specific chemicals being handled by workers; this factor should be considered during preparation of risk assessments (see Section 8 of this Manual). Breakthrough times for various glove products are available from manufacturers and suppliers.

14.8.7 Laboratory gloves **must not** be worn outside the laboratory area (*e.g.* anywhere food is being prepared or consumed, into common rooms and rest rooms, lecture theatres and auditoria, offices, Reception areas, Stores, the Medical Library *etc*, nor when transporting materials between laboratories, when the material should first have been properly contained for transport, including areas where contact could be made between a gloved hand and door handles, banisters, lift call buttons, *etc*). This policy is an important aspect of infection control within University buildings on the Edinburgh bioQuarter site. Neither, of course, should these items of laboratory clothing be worn outside the buildings.

14.8.8 *Eye Protection*: A formal risk assessment related to work that is to be undertaken should identify if eye protection is necessary. It will also identify the level of eye protection required (*e.g.* whether glasses, goggles or a full-face visor are required). Eye protection is a very important consideration in respect of work within liquid nitrogen plant rooms where splashes of cryogenic material onto eye tissue may result in permanently blinding injuries.

14.8.9 *Respiratory Protection*: Respiratory protective equipment (RPE) should only be necessary where significant hazards remain after adequate alternative precautions have been applied (*e.g.* use of a fume hood, biological safety cabinet *etc*). Respiratory protective equipment should be close-fitting and provide maximum protection. Few respiratory protection systems are suitable for protection against biological hazards, though they may have at least partial place in the armoury of protection necessary for a worker.

14.8.10 Disposable masks must be identified with a CE mark and be suited to the purpose.

14.8.11 Animal work, in particular, may dictate use of respiratory protective equipment, and every person expected to work within a Bioresearch & Veterinary Services (B&VS) facility must have been assessed by the University's Occupational Health Unit prior to starting work (to establish a baseline of their lung function status) and be subject to regular checks thereafter. In such circumstances, a comprehensive risk assessment relating to the work must also be a feature of prior preparations. Further information is set out in Paragraph 4.54.1 *et seq* of this Section.

14.8.12 Where chemicals such as formaldehyde are vaporised to decontaminate safety cabinets, full face masks may be required (fitted with an appropriate filter) for those engaged in such work

14.8.13 Face-fit testing will be arranged as required to meet demand so that users are properly fitted for respiratory protection equipment. Advice is available from the University's Occupational Health Unit.

14.8.14 Lung function testing for those for whom testing and retesting has been specified in relevant risk assessments will also be provided by the Occupational Health Unit.

14.8.15 Further information relating to respiratory protection equipment face-fit testing is available at:

https://www.ed.ac.uk/health-safety/guidance/ppe/facefit

14.8.16 *Hearing Protection*: This may be necessary where equipment such as sonicators are being used, and if workers must remain within MRI scanner rooms when the scanner is operating. Hearing protectors suited to the activity must be worn, and the need for warning signs should be considered.

14.8.17 *Training* R*elated to Personal Protective Equipment*: A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.9.1 Emergency Showers:** Laboratory workers should familiarise themselves with the location of emergency showers where these may be provided within their building:

- Chancellor's Building Ground Floor: GU415 and GU515;
- Chancellor's Building First Floor: FU512;
- QMRI Level 0: West end of west block (within EIF-QMRI PET Radiochemistry area, as signposted at the location);
- QMRI Level 1: East end of centre block, as signposted at the location;
- QMRI Level 2: East end of centre block, as signposted at the location;
- QMRI Level3: East end of centre block, as signposted at the location;

14.9.2 Building users are responsible for conducting regular checks to ensure that emergency showers will work as and when required, and also that shower heads are regularly flushed (weekly checks are recommended) to minimise the risk of contamination by *Legionella* and other potentially harmful bacteria.

14.9.3 Where, as is the case for some emergency showers, there is no floor drain beneath the shower outlet, those testing the showers must take steps to contain the discharge and prevent the floor becoming slippery; this may be done by bagging the discharge while the shower head is tested and flushed and/or by placing a bucket beneath the shower. Where showers have been used in response to a contamination incident, urgent steps should be taken to make the area safe from chemical residues, slip hazards, *etc*.

**14.10.1 Overnight Experiments:** If you intend leaving any equipment running overnight, you *must* previously obtain prior permission from the relevant Laboratory Manager.

14.10.2 Any equipment which is found to be working outwith *hours of expected building occupancy* (see definition at 9.4.1) may be switched off by Security staff *etc* unless it has the appropriate notice attached. A notice must be affixed to the laboratory door and/or at the electrical supply indicating precisely *what* equipment is required to run overnight, indicating the dates from which the work is to commence and later discontinue, and the name of the responsible person/person in charge of the laboratory, together with his or her home telephone number(s). If preferred, the Security section's telephone number can be left as a means of contact, providing that staff there can, in turn, then contact the individual concerned.

14.10.3 Most modern computer equipment and peripherals have a facility to go into standby mode, and the prevailing school of thought suggests that these can be safely left in that state; although it remains sensible to switch off all equipment (including computing equipment) that is not going to be used for prolonged periods of time, such as would be the case during University holidays, *etc*.

**14.11.1 Fume Hoods (Fume Cupboards)**: In laboratories where these have been provided, management of potentially respirable chemical substances that may be hazardous to health is generally achieved by placing the work inside a fume hood (also sometimes known as a fume cupboard) that effectively reduces exposure levels to the operator and others sharing the same general working environment.

14.11.2 There are several factors that affect the capability of a fume hood to provide safe containment for the hazardous chemicals; amongst these are:

- the volatility, flash-point and other relevant physical and chemical properties of the substance(s) used;
- the rate of release of a hazardous substance within the fume hood;
- the amount of heat generated within the fume hood;
- air draughts within the laboratory;
- the presence of bulky apparatus within the fume hood, which may distort air flow within the hood and compromise its function;
- the linear face velocity of the airflow across the front opening of the hood; and

- the toxicity *etc* of the substance(s) used.

14.11.3 *General Rules for the Safe and Appropriate Use of Fume Hoods*:

- Select appropriate control measure(s), and commence work only after completing a suitable and sufficient risk assessment (remembering that where a less hazardous substance can be used to achieve the desired effect, generally speaking the less hazardous substance *must* be used as a safer option);
- Use fume hoods for handling substances that generate dust, particulates, gas, vapours, fumes and aerosols that have a real potential to be harmful;
- Understand the limitations of protection afforded by the equipment;
- Understand the correct use of the equipment, including recognition and understanding of fault indicators;
- Check that the fume hood is in a good state of repair and operating within normal parameters before commencing work.
- **Do not use the fume hood if you have any doubts about its performance**;
- Plan the work beforehand, and do not place paperwork *etc inside* the fume hood to be read while doing the work (And, by the same token, do not paste it onto the sash in such a way that this might obscure work being done within the hood);
- Wear a lab coat, properly fastened up, and gloves if required (see Paragraph 14.8.1 *et seq*);
- Sit comfortably in front of the fume hood;
- Use good laboratory technique (*i.e.* **Do not rely on the fume hood to compensate for poor technique**);
- Fume hoods should be located within laboratories so that airflow and users are not disturbed by the movement of colleagues past their workplace (a minimum distance of one metre behind the operator is recommended);
- The rate of release of toxic or flammable vapours should be minimised by good experimental design;
- The fume hood's extract fan must be switched on when the equipment is being used, and at all times when it contains volatile compounds;
- Check airflow and fault indicators regularly to ensure that the fume hood is operating within specified limits.
- **Faults should be reported immediately**. Work should not be commenced, or should be suspended immediately, if the hood displays a fault condition;
- During use, the sash opening should be set at the minimum depth that is practicable for the job being done, and never set above that at which the face velocity has been measured and found to be acceptably safe;
- It must be possible to close the sash quickly in the event of spillages *etc* without any risk of disturbing chemicals or apparatus within the fume hood;
- Appropriate hazard warnings must be displayed during each procedure, and removed after completion of hazardous work, removal of the hazardous substances, and clean-up of the fume hood (*e.g.* presence of liquid nitrogen);
- Do not use the fume hood merely to routinely store materials, and keep the work area as clear as possible of all unnecessary equipment;
- For each use, the fume hood must be allocated to the control of one operator only;

- The fan should be left switched on for a period of time after completion of the work to ensure that fumes *etc* are completely purged from the hood, though the good must kept switched on at all times when it contains volatile compounds;
- Correspondingly, once fumes *have* been purged from the fume hood, the fan speed should be reduced to help minimise energy costs;
- Keeping sashes lowered when work is *not* being done helps reduce energy costs;
- Fume hoods *must not* be used as a substitute for a microbiological safety cabinet when handling biological materials; and
- Fume hoods must be efficiency and safety tested at least once per year, and test records kept for at least five years.

14.11.4 *Purpose and Limitations of Fume Hoods*:

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| **Description:** | An open-fronted cabinet with inward airflow leading away from the worker, designed to exhaust fumes from the laboratory environment to atmosphere (with or without filtration), depending on design. Unlike microbiological safety cabinets, fume hoods do not generally exhaust their air through HEPA (high efficiency particulate air) filtration. |
| **Protects:** | Provides partial containment, thus protecting both users and co-workers from the potentially harmful effects of gases, vapours, aerosols and particulates. |
| **Does *not* protect:** | Material being worked on, which may become contaminated *via* the inflowing air stream. |
| **Uses:** | Low to moderate risk work. |
| ***Not* to be used for:** | Human tissue and other biological materials. Apart from the incompleteness of protection afforded, these may contaminate exhaust ducts, which are far less easily decontaminated in fume hoods than is the case for purpose-designed biological safety cabinets. |
| **Notes:** | A fume hood is most emphatically *not* a substitute for a biological safety cabinet (see Paragraph 14.12.1 *et seq*); these have quite different purposes, and the most appropriate medium of protection should be based on a formal risk assessment. Select the correct fume hood design carefully. There are two designs of fume hood:<br>• Ducted fume hoods (which work by drawing laboratory air into the fume hood, thus containing and diluting chemicals in use, before discharging them to the environment, often without filtration); and<br>• Recirculatory filtration fume hoods (which work by drawing air into the fume hood and exhausting it through a set of filters (usually some type of activated charcoal) back into the laboratory. Recirculating fume hoods *must not* be used in the same way as ducted fume hoods. They are tailored by the cabinet design and type of filtration fitted for the procedures that they will be used to support. The user must carefully consider the substances that will be exposed in the hood, the size of hood required for these procedures, the period between scheduled filter changes, and what method it is intended should be used to use to ensure that filter efficiency is maintained. A risk assessment is required before a recirculatory fume hood may be used (as, of course, it should be also for a ducted fume hood). |

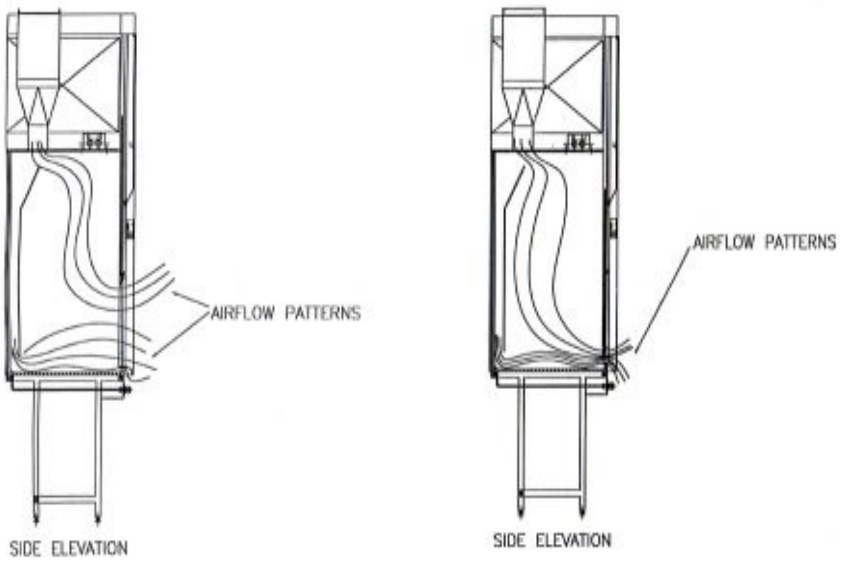


*Figure 2: Schematic diagram of a Fume Hood (a. Sash open; b. Sash closed)*

**The purpose and function of fume hoods and microbiological safety cabinets are different, and users must be *completely* clear about which represents the appropriate level of protection for and from their work.**

14.11.5 *Environmental Considerations*: It is a legal requirement under relevant environmental protection legislation for workers to use the *best practicable means* to prevent emission into the atmosphere of noxious or offensive substances, and to render harmless and inoffensive such substances as may be so emitted. In this connection, it must be stated that, where at all practicable, a fume hood should *not* be used as primary containment for a recognised environmental hazard. It should instead be regarded at best as a second (or even third) line of defence, capable of dealing with an unexpected breach of the primary/secondary containment built into the user's experimental protocol, to prevent the escape of noxious or offensive fumes, vapours, *etc*.

14.11.6 A general purpose laboratory fume hood should *never* be used simply to remove a very toxic substance from the proximity of the user and, in effect, to eject such material into the atmosphere at the other end of the fume hood duct. In such circumstances, the use of more appropriate containment apparatus, such as a fully enclosed glove box, must be considered. Likewise, any intention to manage very corrosive vapours or gases *etc* by use of a general purpose laboratory fume hood must be carefully considered, and only the correct design of fume hood chosen for the job (*e.g.* a fume hood with a water wash-down or scrubbing facility).

14.11.7 Users of recirculatory filtration fume hoods, in particular, should take steps to ensure that the standard of supervision, training, system of work and record keeping are always such that there is no risk at any time of the fume hood being used for work involving chemicals for which the fitted filters are unsuitable, or when a filter is saturated, or for work with different chemicals at different times which might produce within the filter a combination that constitutes a hazard.

14.11.8 Homogenisers and other items of equipment present within a fume hood are a particular concern with regard to airflow within a safety cabinet; further guidance regarding this matter is contained at Paragraph 14.13.1

14.11.9 Fume hoods must be efficiency and safety tested in accordance with manufacturers guidance. Test records should be retained for possible future reference.

14.11.10 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.12.1 Microbiological Safety Cabinets:** Microbiological safety cabinets constitute local exhaust ventilation (LEV) systems in that they offer protection to the user from airborne hazards. General guidance and prescribed rules for safe and appropriate use of microbiological safety cabinets are set out in the following paragraphs.

14.12.2 Particular care should be taken to ensure that airflow within a microbiological safety cabinet is not compromised by equipment inside the cabinet, and also with regard to the health and safety implications of ultra-violet lights which are commonly installed as part of the cabinet systems (*i.e.* safety cabinets should not be used while the ultra-violet light remains on, although many safety cabinets fitted with ultra-violet light have a safety cut-out which switches the ultra-violet light off when the operator switches on the fans).

14.12.3 First time users must attend face-to-face training or complete an on-line version of the training course "Introduction to Biological Safety", a component of which includes consideration of control measures. Requests for face-to-face training may be made to the Safety Manager for University buildings on the Edinburgh bioQuarter campus. Further information regarding the on-line course is available at:

https://www.ed.ac.uk/health-safety/biosafety/training/intro

14.12.4 Detailed guidance on microbiological safety cabinets, including aspects of siting within laboratories, testing and fumigation, is provided on the University's Health and Safety Department web site. Workers in the University must, at the earliest opportunity, read and follow the guidance at:

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/containment_controls/safety_cabs.pdf

**The precise purpose and function of fume hoods and microbiological safety cabinets are different, and users must be *completely* clear about which represents the appropriate level of protection for and from their work.**

14.12.5 A risk assessment should *always* be undertaken prior to commencement of work entailing use of pathogens *etc*, not least in order that the most appropriate class of microbiological safety cabinet be selected for a particular work activity. The forms provided by the University (and which can be accessed at https://www.ed.ac.uk/health-safety/online-resources/risk-assessments). *NB:* The class of microbiological safety cabinet to be used (Class I, II or III) is not necessarily directly related to the biological containment level of the laboratory (Containment Level 1, 2 3 or 4) within which the work is being conducted, the hazard group of the microbiological agent being studied, nor (for example) the class of work entailing contained use of genetically modified microorganisms (Class 1, 2, 3 or 4) *i.e.* the work may, for example, dictate use of a Class II MSC within a CL3 laboratory). The risk assessment should take into account the nature of the potential hazards in terms not only of the micro-organisms involved and their known route of infection, but also the techniques to be carried out and whether protection of the work is needed in addition to protection of the operator.

14.12.6 *General Rules for the Safe and Appropriate Use of Microbiological Safety Cabinets*:

- Select appropriate control measure(s), specifying the class of microbiological safety cabinet most appropriate to the work proposed, and commence work *only* after completing a formal risk assessment;
- Understand the limitations of protection afforded by the equipment;
- If there is a chemical hazard too that has the potential to compromise high efficiency particulate air (HEPA) filters, this must usually be done in a ducted Class I microbiological safety cabinet (see 14.12.10);
- If homogenising human tissue, always use a Class I microbiological safety cabinet;
- Understand the correct use of the equipment, including recognition and correct interpretation of fault indicators;
- Check that the microbiological safety cabinet is in a good state of repair and operating within normal parameters before commencing work (**Do not use the microbiological safety cabinet if you have any doubts about its performance**) ;
- Do not use while the microbiological safety cabinet's ultra violet light is switched on;
- Plan the work beforehand (and do not place paperwork *etc* inside the microbiological safety cabinet to be read while doing the work);
- Wear a lab coat, properly fastened up, and gloves if required (see Paragraph 14.8.1 *et seq*);
- Sit comfortably in front of the centre of the microbiological safety cabinet;
- Use good aeseptic technique (*i.e.* **Do not rely on the microbiological safety cabinet to compensate for poor technique**);
- Microbiological safety cabinets should be located within laboratories so that movement of people through the area does not disturb airflow within the microbiological safety cabinets and so that users are not disturbed by the movement of colleagues past their workplace (a minimum one metre of clearance behind the operator is recommended);
- All air ducts and grilles that are a feature of the microbiological safety cabinet must be kept free from obstructions;

- Equipment within the microbiological safety cabinets must be kept to an absolute minimum necessary to support the work, and located so as to minimise disruption to the airflow;
- Fans that are a feature of the microbiological safety cabinet should be allowed to run before use to establish a satisfactory airflow, and continue for a period of time after completion of the work to purge the equipment;
- For each use, the microbiological safety cabinet must be allocated to the control of one operator only;
- Check airflow and fault indicators regularly to ensure that the microbiological safety cabinet is operating correctly. Faults should be reported immediately. Work should not be commenced, or should be suspended immediately, if the microbiological safety cabinet displays a fault condition;
- Bunsen burners disrupt airflow and may also damage microbiological safety cabinet filters. Use these only if necessary, and then use low-profile types with the flame turned down as far as possible and located in the centre of the microbiological safety cabinet;
- Appropriate hazard warnings (*e.g.* radiation signage where isotopes are being used) must be displayed (and removed after completion of hazardous work and removal of the hazardous materials);
- Microbiological safety cabinets should most emphatically *not* normally be used for managing purely chemical hazards, as the HEPA filters may be damaged by fumes and, in some cases, may be recirculated back into the laboratory. Special consideration should be made when the material to be handled has combined biological *and* chemical hazards, in which case a ducted Class I microbiological safety cabinet *might* be considered the most suitable medium of protection for the user; and
- Microbiological safety cabinets must be efficiency and safety tested at least once per year (at least once every six months for MSCs being used within a Containment Level 3 laboratory), and test records kept for at least five years.

14.12.7 *Purpose and Limitations of Class I Microbiological Safety Cabinets*:

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| **Description:** | Safety cabinet with a front aperture through which the operator can carry out manipulations inside the cabinet, which is constructed so that the worker is protected, and the escape of airborne particulate contamination generated within the cabinet is controlled, by means of an inward airflow through the working front aperture, and exhaust air is filtered through a high efficiency particulate air (HEPA) filter. |
| **Protects:** | User, by virtue of inward airflow limiting potential for material to be blown back over user, and environment by virtue of HEPA-filtered exhaust air. |
| **Does *not* protect:** | Material being worked on, which may become contaminated *via* inflowing air stream. |
| **Uses:** | Risk assessment-based, taking into account the route and likelihood of infection and techniques being used (*e.g.* risk of aerosol generation). |
| ***Not* to be used for:** | High risk work, and where materials are known to damage HEPA filters. |
| **Notes:** | A Class I microbiological safety cabinet is most emphatically *not* an automatic substitute for a fume hood; these have quite different purposes, and the most appropriate medium of protection should be based on a formal hazard analysis and risk assessment. |

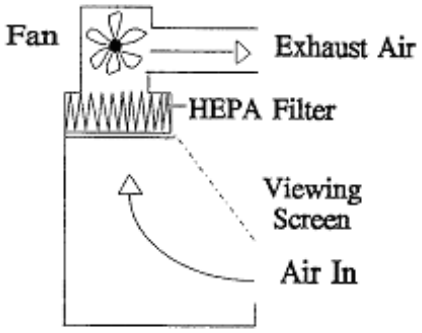


*Figure 1: Schematic diagram of a Class I Microbiological Safety Cabinet*

14.12.8 *Purpose and Limitations of Class II Microbiological Safety Cabinets*:

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| **Description:** | Safety cabinet with a front aperture through which the operator can carry out manipulations inside the cabinet, which is constructed so that the worker is protected, the risk of product and cross contamination is low, and the escape of airborne particulate contamination generated within the cabinet is controlled by means of an appropriately filtered internal airflow and filtration of the exhaust air. Note: A typical way of achieving this is by means of a uni-directional downward (laminar) airflow inside the cabinet and an air-curtain at the front aperture. |
| **Protects:** | User by virtue of inward airflow, material being worked on by virtue of HEPA-filtered down-flow of air, and environment by virtue of HEPA-filtered exhaust air. |
| **Does *not* protect:** | May not protect user to the same degree as a Class I or Class III cabinet, since airflow is being forced down over the work to keep it clean, and some proportion of the air down-flow may eddy out from the front of the cabinet where the flow is disturbed by the user's hands and arms. Class I cabinets should therefore be used if procedures within the cabinet are likely to generate a significant aerosol and/or disrupt the air flow pattern within a Class II cabinet and so compromise user protection. |
| **Uses:** | Risk assessment-based, taking into account the route and likelihood of infection and techniques being used (*e.g.* risk of aerosol generation). |
| ***Not* to be used for:** | Work with the potential to damage the HEPA filter. |
| **Notes:** | 1. There are two types of Class II microbiological safety cabinets being used in Edinburgh bioQuarter:<br>• One which recirculates most of the air; and<br>• One which exhausts most of the air through a duct and filters to the atmosphere.<br>• Select the correct Class II cabinet design carefully.<br>2. As the performance is dependant on a continuing closed loop-cycle of inflow and |

| | |
|---|---|
| | down-flow air being maintained, it is very important that the cabinet is located in a suitably surveyed location within the laboratory and that, wherever possible the cabinet, is left uncluttered with items that disrupt the down-flow air patterns (though provisions can sometimes be made when large items have to remain in the cabinet or when, say, a microscope is to be used). Homogenisers and other items of equipment present within a biological safety cabinet are a particular concern with regard to airflow within a microbiological safety cabinet; further guidance regarding this matter is contained at Paragraph 14.13.1. |

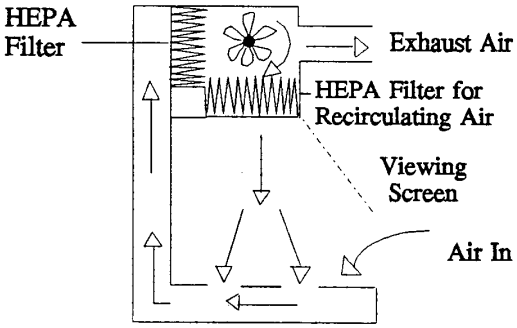



*Figure 2 - Schematic diagrams of a Class II Microbiological Safety Cabinet*

14.12.9 *Purpose and Limitations of Class III Microbiological Safety Cabinets*:

| | |
|---|---|
| **Description:** | Safety cabinet in which the working area is totally enclosed and the operator is separated from the work by a physical barrier (*i.e.* gloves mechanically attached to the cabinet). Filtered air is continuously supplied to the cabinet, and the exhaust air is treated to prevent release of micro-organisms. |
| **Protects:** | User by virtue of inward airflow, material being worked on by virtue of HEPA-filtered down-flow of air, and environment by virtue of HEPA-filtered exhaust air. |
| **Does *not* protect:** | |
| **Uses:** | Risk assessment-based, taking into account the route and likelihood of infection and techniques being used (*e.g.* risk of aerosol generation), but likely to be a requirement for work involving particularly "high risk" biological agents. |
| ***Not* to be used for:** | Work with any materials that have a potential to damage the HEPA filter and compromise containment efficiency. |
| **Notes:** | The Class III microbiological safety cabinet is a highly specialized product designed for the most hazardous work; which is, in any event, typically carried out in a Biological Containment Level 3 or 4 laboratory. |

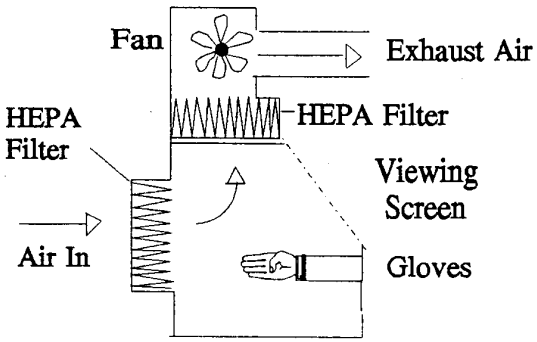


*Figure 3 - Schematic diagram of a Class III Microbiological Safety Cabinet*

Some hybrid Class I/III cabinets exist, whereby a removable port may be attached to the front aperture of the cabinet. However, the construction and testing of these cabinets is such that when used in Class III mode it is *not* equivalent to the specification of a standard Class III cabinet.

14.12.10 *Combined Biological and Chemical Hazard*: Mixed hazard operations should be evaluated (and risk assessed) on a case-by-case basis. Where there is a combined biological and chemical hazard (*e.g.* a phenolic chemical has been added to a microbial suspension), a ducted Class I microbiological safety cabinet may be the most appropriate selection, **subject to a suitable and sufficient Risk Assessment having been done** that confirms the suitability of the cabinet for such use. Engineers should be asked to examine filters in cabinets that have been used for combined biological and chemical hazards at the end of each service interval (*i.e.* not less than annually) to ensure that work being done in these has not damaged the HEPA filters, and users should examine the cabinets regularly for evidence of rust/staining *etc* in the interim. In all such circumstances, clearly worded and patently visible labels should be attached to filter access ports so that engineers are immediately aware of the potential for filters to have been damaged by chemical agents and employ appropriate techniques to dispose of filters.

**The purpose and function of fume cupboards and microbiological safety cabinets are different, and users must be clear on which represents the appropriate level of protection for and from their work.**

14.12.11 *Ultraviolet Lights*: Microbiological safety cabinets are often equipped with a source of ultraviolet (UV) irradiation that is intended to help manage contamination within the cabinet, usually in the form of a UV-generating strip-light which, when switched on, illuminates the working space of the cabinet from inside. The UV source is usually shielded so that operators cannot easily look directly at the source, and interlocks usually work to prevent UV illumination when the cabinet is being used, but the cabinet should *never* be used while the UV light is working.

14.12.12 Where UV light has been provided, great care should be taken by users to avoid looking directly at the light source or exposing skin to UV radiation; this is important to avoid the possibility of eye and/or skin damage from UV light.

14.12.13 Confidence in the efficacy of UV irradiation at an adjunct to safety cabinet disinfection/sterilisation should, however, be tempered by the knowledge that the quality of UV source emissions from these devices degrades markedly with time, and the bulb (though giving every impression to a casual observer that it is still irradiating in the UV spectrum) may well not be irradiating to the extent that it is contributing anything of significance towards disinfection/sterilisation. Bulbs must be changed in accordance with manufacturer's recommendations no later than at appropriate service intervals. Even when effective UV radiation actually is being generated from bulbs,

disinfection/sterilisation is only effective in "line of sight" from the source, and the treatment is totally ineffective behind shadows created by the presence of apparatus *etc* within the cabinet. UV light should not, therefore, be considered anything more than an additional source of treatment, and certainly **not** as the primary means of disinfecting/sterilising a microbiological safety cabinet.

14.12.14 *Fumigation*: Prior to routine servicing or commencement of repairs at any other time, engineers will require assurances that the microbiological safety cabinet, including all constituent HEPA filters, are biologically safe. To that end, users will undertake fumigation of safety cabinets scheduled for inspection, in accordance with manufacturer's instructions, using agents such as:

- formaldehyde; or
- hydrogen peroxide.

14.12.15 Fumigation using these substances is potentially hazardous, and must never be undertaken unless by specially trained and specifically authorised members of staff or contractors.

14.12.16 Fumigation of containment laboratories is an even more specialised task, and requires considerable pre-planning and monitoring.

14.12.17 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.13.1 Equipment within Fume Hoods and Safety Cabinets:** Homogenisers and other items of equipment that are sometimes operated inside fume hoods or microbiological safety cabinets have some potential to disrupt airflow. As stated in the preceding paragraphs, care should be taken to minimise the amount of equipment present within microbiological safety cabinets, and also laboratory consumables, *etc*. However, where use of equipment is genuinely unavoidable (*e.g.* a homogeniser), and where workers are likely to use a procedure repeatedly, then an air flow test should first be requested as part of the risk assessment associated with the procedure; this must be undertaken by a properly qualified person. Proper prior assessment should be geared towards an overall reduction of the risk (*e.g.* specifying use of a sealed homogeniser that can be operated outside a fume hood or microbiological safety cabinet).

**14.14.1 Pipetting:** In some laboratories, workers may spend several hours per day using single and multi-channel pipette devices. Repeated depression of pipette plungers and tip ejection buttons, and resting an elbow on hard benches for long periods of time, may result in debilitating conditions such as carpal or cubital tunnel syndrome, lateral epicondylitis (tennis elbow) or thumb tenosynovitis.

14.14.2 Good pipetting practice includes attention to posture at the bench (whether seated or standing), wrist posture, and correct setting-up of the instruments. If, for example, the tip rack is placed too far away, the operator will have to fully extend his

or her elbow, and often wrist too, each time a tip is to be picked up. Poorly fitted pipette tips that require repeated pounding, or rocking the pipette shaft into the tip, can compound the problem.

14.14.3 If a thumb-operated pipette is used, choose one with low tip ejection and plunger forces and minimal plunger stroke lengths.

14.14.4 The following important points should be observed when pipetting:

- Do not overstretch to reach your work;
- Work at a height that is comfortable for you;
- Avoid twisting motions;
- If possible, try to vary pipetting activities;
- If possible, try to alternate pipetting with other tasks, in order to help relax muscles *etc*;
- Try using your other hand occasionally for pipetting;
- Stretch your arms and rotate your wrists frequently;
- Grip the pipette lightly; and
- Take regular short breaks.

14.14.5 On-line safety training relating to laboratory ergonomics is available at:

https://www.ed.ac.uk/health-safety/training/e-learning/cardinus

14.14.6 A further raining package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.15.1 Transport**: Certain materials, including biological samples and cultures, fall within the description of dangerous goods for carriage, and both national and international legislation demand that stringent requirements must be met if the goods are transported by any means. All workers in the University must ensure regulations applicable to the transport of potentially hazardous materials are complied with for each particular consignment, and not carry, consign, package or play any other role in the transport chain if they have not been formally assessed as competent to do so.

14.15.2 Further information on the transport of biological materials may be obtained from members of staff (including the H&S Manager for the EbQ campus) who have attended special training in related matters, and/or from the University's health and safety website at:

https://www.ed.ac.uk/health-safety/biosafety/policy/guidance/transport

**14.16.1 Manual Handling Operations**: Routine manual handling operations, such as moving equipment or boxes containing laboratory consumables, should be assessed at least informally to identify and quantify any potential risk. Where the risk is assessed as being more than trivial, the risk assessment process must be escalated to a more formal footing in order to identify the best way to approach the task and minimise the

potential for injuries to be caused. All staff undertaking manual handling operations should be aware of the guidance contained in the University's health & safety web site:

https://www.ed.ac.uk/health-safety/guidance/workplaces-general/manual-handling

14.16.2 For heavier or more awkward items, and for regular manual handling tasks, a formal risk assessment is required, taking into consideration: physical aspects of the load; the capacities of the individual(s) who will be involved in the task; the nature of the task itself; and the environment within which the manual handling operation is to be undertaken.

14.16.3 It may be possible to dismantle items or disaggregate loads to make moving and handling easier (*e.g.* emptying filing cabinets before moving). It may be necessary for professional movers to be contracted to undertake some tasks. No member of staff should be expected or asked to tackle a manual handling task if they feel they would be putting their health at risk.

14.16.4 Manual handling operations risk assessments should be carried out using the relevant form at:

https://www.ed.ac.uk/health-safety/online-resources/risk-assessments

14.16.5 Members of staff who may be required to carry out more frequent or heavy handling tasks should attend the University's manual handling operations training course, further details of which will be made available at:

https://www.ed.ac.uk/health-safety/training/general/manual-handling

14.16.6 Further information may be obtained at Section 16 of this Manual, and an on-line training course is available at:

https://www.ed.ac.uk/health-safety/training/e-learning/cardinus

**14.17.1 Display Screen Equipment**: Staff and students who use display screen equipment, such as word processors and computers, should undertake training dealing with the correct layout and adjustment of their workstations and means to limit the potential for discomfort and injury. Display screen equipment operators should also carry out a safety risk assessment relating to display screen equipment safety in a form that is available for staff and student at:

https://www.ed.ac.uk/health-safety/training/e-learning/cardinus

14.17.2 Remedial actions indicated by the risk assessment should be taken as soon as possible.

14.17.3 Further information on display screen equipment safety generally may be obtained at Section 17 of this Manual.

14.17.4 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.18.1 Autoclaves and Pressure Cookers**: Hazards include those associated with creation of high temperature steam inside pressure vessels, loading and unloading operations, and failure to properly sterilise contaminated waste, *etc*.

14.18.2 Autoclaves should be operated only by persons who have been properly trained to use them safely and correctly. Protective clothing should be available in the loading/unloading area, including an impervious apron, heat-resistant gauntlet-type gloves, suitable heavy-duty footwear or overshoes, and a full-face visor.

14.18.3 Before each use, a visual inspection should be made of seals, valves, metal surfaces designed to come into contact with operators during operation, dials, gauges and other instruments, to check that these are undamaged and fit and safe for use. All faults and defects must be reported to the relevant senior laboratory manager and steps taken to ensure that the equipment is not used again before inspection by a competent person, and that such repairs as may be necessary have been completed and the equipment recertified as safe for use before recommencement of operations.

14.18.4 All autoclaves and other pressure vessels (including pressure cookers and other gas pressure vessels such as gas cylinders) must be notified to a designated engineering insurance surveyor, and inspected at the statutorily required interval. Notification of newly acquired equipment within Edinburgh bioQuarter, and arrangement of inspections and repairs, should be made through the relevant Building Manager, to ensure compliance with the relevant safety regulations.

14.18.5 Where an autoclave is used to decontaminate or make-safe waste, the process must be validated at least annually and at any other times when the previous test may no longer be valid (such as part of re-commissioning after maintenance work). Records of validation must be kept for at least five years.

14.18.6 Detailed guidance on autoclaves is provided on the University's Health and Safety Department website. Workers in the University must refer to and follow the guidance at:

https://www.ed.ac.uk/health-safety/guidance/laboratories-workshops/pressure-vessels

and

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/bio_agents/ba_risk_assessment.pdf
(see Paragraph 9.8.2)

14.18.7 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.19.1 Maintenance of Equipment**: Certain types of laboratory equipment must, by law, be committed for routine inspection by competent persons. These are:

- all types of centrifuge;
- pressure vessels, including autoclaves and liquefied gas containers; and
- microbiological safety cabinets and fume hoods (see paragraphs 14.11.1 *et seq* and 14.12.1 *et seq*).

14.19.2 Records of maintenance contracts and service visits must be kept on file by the relevant Building/Centre/Laboratory Manager.

14.19.3 *Pressure Vessels*: The University's centrally-based Insurance Department must be made aware of all pressure vessels, including autoclaves. Such equipment must be serviced at regular intervals and inspected also by the University appointed assessors, which will issue appropriate certification for each autoclave that has successfully passed inspection.

14.19.4 *Microbiological Safety Cabinets*: These must be serviced at least once every fourteen months (and at least once every six months for microbiological safety cabinets being used within Containment Level 3 laboratories), although maintenance contracts often ensure that service visits take place more frequently. Risk assessments should identify the need for and describe the means to achieve decontamination prior to service visits.

14.19.5 Great care is needed when using formaldehyde for fumigation. There is an increasing move away from decontamination with formaldehyde to alternatives such as the use of hydrogen peroxide vapour. Manufacturers' guidance must be closely followed when using such equipment; further information is contained at Paragraph 14.12.14 *et seq*.

14.19.6 *Gas Regulators*: Regulators should have a replacement date stamped on them, which is generally five years after the date of manufacture, and they must not be used after that date. **If no expiry date is indicated on the regulator, it should not be used.** In some cases, competent contractors may be engaged to carry out interim safety inspections, and attention should be paid to authoritative-looking tags affixed to regulators that may indicate that the item should not be used beyond the next agreed inspection date.

14.19.7 It is strongly recommended that a database be created within each laboratory area listing all regulators that are in use and when these are scheduled for replacement.

14.9.8 **Regulators should be regularly inspected, and discarded if there is any suspicion that they are unfit for purpose.** Regulators should also be inspected on each and every occasion that they are fitted to a cylinder and when being removed.

14.19.9 **Under no circumstances should oil, grease or PTFE tape be used on any fitting associated with any compressed gas system.**

14.19.10 It is policy for UofE buildings on the Edinburgh bioQuarter campus that all workers involved in moving or handling compressed gas cylinders or involved with fitting regulators *etc* or who will be working with laboratory gases must attend gas safety training, which is organised and provided on the campus by the Health & Safety Manager.

14.19.11 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

14.19.12 It is an essential part of gas safety competence training that practical considerations (such as connection of regulators to supplies, and moving and handling cylinders) are underpinned by practical training within the area where such work is to be done, led by laboratory managers and suitably experienced technicians.

## ELECTRICAL SAFETY MATTERS

**14.20.1 Electrical Equipment:** Any electrical equipment, including personal items, that is brought into the buildings, *must* be portable appliance tested (PAT) before connecting into the electrical supply for the first time and thereafter at such frequency as is dictated by relevant regulations and University policy. PAT testing is undertaken by specially trained and qualified technical staff, and equipment *must* carry an up-to-date test label before it can be plugged into the electrical supply. If this is not done, the equipment may be rendered safe by the plug being removed by buildings management.

14.20.2 Regardless of the last mandatory inspection date, users should, on a regular basis, visually check leads, plugs and connectors on all equipment that they routinely use, and also check the integrity of supply sockets *etc*, **before** connecting equipment to electrical supplies and powering it up. All faults must be immediately reported to the relevant laboratory manager and the equipment withdrawn from use until it has been repaired and recertified *by a competent person*.

14.20.3 Care should be taken to avoid collocating electrical equipment with water supplies, *etc* and to ensure that ventilation slots on the equipment are not obstructed.

**14.21.1 Electric Heating Mantles, Water Baths and Thermometers:** Only those electrical heating mantles that feature solid-state controllers may be used, and an earth leakage detector/controller should be fitted. The mantle size must be correct for the size of flask in use, and the experiment performed using all appropriate safety procedures.

14.21.2 Equipment such as heating mantles and water baths consume a substantial amount of electricity, and these should therefore be disconnected when not in use. If

the reheat time proves to be inconvenient, consideration should be given to use of timer plugs to ensure the readiness of these items of equipment when they are actually likely to be needed.

14.21.3 Mercury thermometers (formerly commonly associated with use of water baths) should not be used anywhere within laboratories on the Edinburgh bioQuarter campus.

**14.22.1 Ovens:** Unventilated ovens must not be used for heating or evaporating organic solvents, or to dry molecular sieves that have been used to absorb organic solvents. In general, any experiment involving the removal of organic solvents *must* be carried out in a fume cupboard. Only ovens which have been previously approved for overnight use may be so used; attention is drawn to the provisions set out in Sections 12 and 13 of this Safety Manual regarding safety arrangements for equipment that may be left working overnight. Paper and plastic should not be put in, or placed on top of, an electric oven.

**14.23.1 Cold Rooms**: Whilst the atmosphere in a cold room is often very dry, workers should be aware that condensation can occur on equipment when it is removed from the room. If the cold room is to be used as a laboratory, a risk assessment must first be undertaken, and appropriate personal protective equipment issued to workers. Great care needs to be taken to ensure that electrical equipment removed from the cold room is not used in normal temperature environments until it has had time to warm up and dry out, which can take several hours. Where possible, equipment intended for use within cold rooms should be of a low voltage type. Correspondingly, however, chiller units occasionally overflow condensate onto floor surfaces, and care should be taken to look out for, and promptly mop-up, puddles of condensate before they become slip hazards.

14.23.2 Care should be taken also, when working in cold rooms, to ensure that fire alarms can be clearly heard by occupants. Where this could be a problem, workers should ensure that one or more of their colleagues (who will be working in an area where there are no problems with alarm audibility) are aware that they will be working in an area where there is potentially problematic alarm audibility, and arrange for those colleague(s) to alert them to any building emergency by checking the cold room as they commence evacuation.

14.23.3 The general cleanliness of cold rooms *etc*, which are often communal resources shared by numbers of different groups, is occasionally less than it ought to be. Each user should take steps to properly and promptly manage spills and to ensure that waste generated by them is promptly and properly gathered together and committed to the correct disposal route, and steps should be taken not to accumulate cardboard boxes which can quickly become moisture traps, supporting the growth of moulds, *etc*.

**14.24.1 Further Information**: Further information on electrical safety, pertaining specifically to laboratory equipment, is contained on the University's Health & Safety web site at:

http://www.docs.csg.ed.ac.uk/Safety/general/Electrical_equipment_labs.pdf

## MECHANICAL SAFETY MATTERS

**14.25.1 Mechanical Equipment:** Laboratory and service managers must take appropriate measures to ensure that mechanical equipment used within their areas is safe and suitable for the purpose intended. All relevant persons should be made aware of the associated hazards, and of the requirements to adopt working procedures designed to keep the risks to their health, and to the health of other persons, as low as is reasonably practicable. Local rules must be formulated for safe workshop practice, so that there is an effective means of securing the safe use of mechanical equipment.

14.25.2 Certain types of laboratory equipment are required by law to undergo regular inspection by suitably competent persons; these include all types of centrifuge.

14.25.3 *Centrifuges*: Care must always be taken to ensure that centrifuge tubes are not cracked or flawed, and that all heads, trunnion-rings and buckets, as well as other working parts, are regularly inspected for defects by a competent person. Centrifuge tubes should not be filled more than three-quarters full, especially if an angled head is used, and loads must be correctly balanced.

14.25.4 The lid of a centrifuge must not be opened whilst the rotor is still in motion, and flammable liquids should never be centrifuged unless it is known that the centrifuge motor and control gear are spark-proof. Contingency plans should always be made to deal with tube breakages and mechanical failures before either event occurs so that the response if measured and correct.

14.25.5 Ultracentrifuges should only be used by suitably trained staff. Very great care should be taken to set up the equipment correctly, with regard to balance *etc*, whether or not the device is equipped with automated imbalance detection systems. Ultracentrifuges, which may be required to run for considerable periods of time, should be closely monitored as they ramp-up to the intended operating speed. Once again, contingency plans should be made beforehand to deal with tube breakages and mechanical failures associated with an ultracentrifuge before either event occurs.

14.25.6 Attention is drawn to any local rules that may exist for a laboratory, which may impose further restrictions on the use of ultracentrifuges outside hours of expected buildings occupancy (see Section 9 of this Safety Manual).

**14.26.1 Further Information:** Further information on mechanical safety, including that pertaining to centrifuges, air compressors and manual handling equipment, is contained on the University's Health & Safety web site at:

http://www.docs.csg.ed.ac.uk/Safety/general/Workshop_guidance.pdf

14.26.2 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

## BUILDING SERVICES MATTERS

**14.27.1 Water:** Connections to water supplies and hoses supplying water to equipment should be examined regularly. A plastic tie device for safe and tight-fitting of water hoses to couplings is available from Stores**.**

14.27.2 Unless absolutely necessary, taps/water pumps should not be left running overnight; however, if they genuinely, unavoidably *must* be left running, a note should be attached to the tap; otherwise taps may be turned off by cleaners, security staff, *etc*. The note should indicate the date and the name of the person responsible for the work, together with his or her home telephone number. If preferred, a building security number can be left as a means of contact, providing that staff there, in turn, can then contact the individual concerned.

**14.28.1 Communal-Use Cold Rooms:** Any material which you wish to use or store in one of the communal cold rooms, must be labelled with your name, the contents of packages and the date. Any material which is not so-labelled, may be thrown out. Any potentially hazardous biological, chemical or radioactive material must be properly packaged and labelled before it is committed to storage in a communal cold room. See also Paragraph 14.23.1 regarding electrical safety and cold rooms, and special arrangements for problematic fire alarm audibility.

14.28.2 In order that the general cleanliness of cold rooms *etc*, which are often communal resources shared by numbers of different groups, is not compromised, each user should take steps to ensure that spills are promptly and correctly managed, and all waste generated by them is promptly and correctly gathered together and committed to the correct disposal route, and steps should be taken not to accumulate cardboard boxes which can quickly become moisture traps, supporting the growth of moulds, *etc*.

**14.29.1 Rooms Supplied with $CO_2$**: Building ventilation systems may be shut-off for periods of time, either for maintenance or to conserve power outwith *hours of expected building occupancy* (see Section 9 of this Manual for definition). In laboratories with piped supplies of $CO_2$ (most often to supply $CO_2$ incubators), staff should be aware of, and locally-generated risk assessments for work outwith hours of expected building occupancy should take into account, the potential for a room to be partially flooded with $CO_2$. Staff should know where ventilation shutdown override switches are located and how to use these to ensure adequate air changes before commencing work outwith hours of expected building occupancy. In some cases, provision of CO2 monitoring may be considered appropriate.

**14.30.1 Further Information**: Further information on building systems, including vacuum systems, $CO_2$ manifolds, liquid nitrogen plant rooms and autoclaves is contained in Section 24 of this Manual.

## BIOLOGICAL SAFETY MATTERS

**14.31.1 Introduction**: It is illegal (the COSHH Regulations refer) to carry out a work activity involving bio-hazardous materials without first preparing a suitable and sufficient risk assessment. The University's Health and Safety Policy regarding safety relating to biological laboratories may be supplemented by local rules.

14.31.2 Those intending to work for the first time with pathogenic micro-organisms or genetically modified micro-organisms must attend the biological safety training courses organised by the University's Health & Safety Department before commencing such work. The course, delivered over several modules, covers: an introduction to biosafety; safety requirements for genetic modification work; disposal of biological waste; correct use of microbiological safety cabinets (see Paragraph 14.12.1 *et seq*); and transport of biological materials. Further information is available at:

https://www.ed.ac.uk/health-safety/biosafety/training

14.31.3 There are three different levels of biological containment laboratories within University buildings on the Edinburgh bioQuarter campus, depending on the type of materials present:

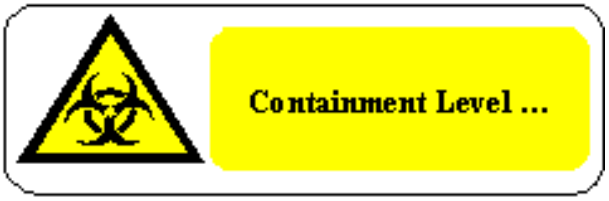
**Containment Level 1** – Microbiological agents that are unlikely to cause any harm;

**Containment Level 2** – Risk is intermediate between levels one and three; or

**Containment Level 3** - Microbiological agents that may cause serious illness.

No laboratories on the Edinburgh bioQuarter campus operate at a level greater than that which requires CL3 precautions.

14.31.4 The Containment Level of each laboratory must be indicated by safety signage displayed at the door:




14.31.5 Detailed guidance on a range of biological safety topics (including containment laboratories, microbiological safety cabinets, biological waste disposal, transport of biological materials, work with genetically modified organisms and *good microbiological practice*) is provided in the Resources and *Safenet* sections of the University's Health & Safety Department website (https://www.ed.ac.uk/health-safety). This includes guidance on risk assessment and the control measures required

in order to work safely when carrying out various different types of biological work. Specific references to policy for biological safety matters are provided at:

https://www.ed.ac.uk/health-safety/biosafety/policy

14.31.6 Special aspects pertaining to work with genetically modified organisms is dealt with at:

https://www.ed.ac.uk/health-safety/biosafety/policy/guidance/gm-organisms

14.31.7 Whilst working in containment laboratories it is also necessary at all times to employ *Good Microbiological Practice*. Further guidance on related aspects is contained at:

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/bio_agents/ba_risk_assessment.pdf

14.31.8 *Fumigation*: Fumigation of containment laboratories is a highly specialised task, and requires considerable pre-planning and monitoring. Agents that may be used include:

- formaldehyde; and
- hydrogen peroxide.

14.31.9 Fumigation using these substances is potentially hazardous, and must never be undertaken unless by specially trained and equipped contractors, and with the prior knowledge of buildings managers, who may be required to isolate air movement plant and fire detection systems while the procedure is underway.

14.31.10 *Immunisation and Compromised Immunity*: The University is required by law to offer immunisations to individuals who may be exposed to pathogens at work (where an effective vaccine is available); for example, those who in the course of their employment are expected to handle uncharacterised human blood, tissues or body fluids may be advised to obtain an assessment of their current immune status in respect of Hepatitis B virus and, if is considered appropriate, seek immunisation against that virus.

14.31.11 The University's Occupational Health Unit will provide any immunisations that have been identified as required for a particular work activity; these will be free of charge to the individual, the cost of vaccine being borne by the relevant School/Department. The Occupational Health Unit can also be contacted for further advice regarding immunisations.

14.31.12 Principal Investigators should consider and determine the need for immunisation as part of general and specific risk assessments linked to work being done under their direction.

14.31.13 Principal Investigators must also consider whether work that they are undertaking and/or directing may have an increased or special potential to cause harm to people who have compromised immune systems, even when such harm would be unlikely to be caused or manifest in people with an uncompromised immune systems.

In such circumstances, consideration must be given, and suitable arrangements put in place, to inform people likely to be in the area where such work is being done, including any special measures that might be necessary for their health and safety.

**14.32.1 Work Entailing Use of Medical and Laboratory Sharps:** A proportion of all injuries experienced within the Edinburgh bioQuarter campus is related to handling of sharp objects such as hypodermic needles, scalpels and microtome blades. It has been estimated that annually one out of every seven healthcare and medical research workers is accidentally stuck by a contaminated sharp. However, studies suggest that only one out of three needle-stick injuries is reported.

14.32.2 Most needle-stick injuries are not too serious, but some may dictate treatment in Hospital. In some cases, by virtue of the work that is done within our buildings, there may be a risk of infection.

14.32.3 Safe systems of work should be designed so that:

- Use of sharps and glass items should be avoided where ever possible;
- Alternatives to glassware (*e.g.* laboratory plastic-ware) should be considered;
- Know before starting work with sharps precisely what action to take in the event of injury, particularly where there may be a risk of infection;
- Be diligent in the prompt reporting of *all* sharps-related injuries;
- Avoid unnecessary force in the use of syringes, *etc*;
- Do not dispose of sharps and broken glass together with other laboratory waste. A special disposal policy exists for these, which is set out in Section 18 (Waste Management) of this Safety Manual;
- Minimise handling, and potential for injury, by discarding sharps and broken glass promptly and properly using the special disposal containers that must be made available in all laboratories where sharps and glass are being used;
- Sharps disposal containers must be puncture and leak-resistant and properly labelled;
- Use proprietary containers, and not something that has been cobbled together for the sake of expediency;
- Never dispose of sharps into plastic bags (even when you intend to transfer these later into a sharps container);
- Do not allow sharps containers to overfill (*i.e.* do not fill to more than two thirds of the nominal capacity of the container or above the indicated line if one is present);
- Transport sharps and glassware waste with care;
- Do not allow yourself to be rushed when carrying out work involving sharps, and always allocate sufficient time to complete the work safely;
- Clear sufficient space around yourself to allow unrestricted movement and easy access to sharps disposal in order to minimise double-handling, and ensure that you are not standing or sat in a place where you might be jostled by others in the area;
- Work strictly within the scheme described in a *Safe System of Work* linked to a formal *Risk Assessment* (see Section 8 of this Safety Manual), and do not improvise;
- Use sharps only for the purpose intended;
- Do not reuse hypodermic needles, *etc*;

- Before commencing work, place sharps in a tray so that they are clearly visible and unable to roll off or be easily knocked off the bench;
- Do not leave sharps lying around where they might be forgotten and later come into contact with another person (*e.g.* cleaners);
- Comply with all relevant Risk Assessments, local rules, *etc*;
- Do not re-sheath needles, and absolutely *never* bend needles to make them fit more tightly back into the sheath;
- Dispose of needles and other sharps directly into a sharps disposal container (*without* disconnecting needles from syringes);
- Do not place sharps (including scissors, scalpels, *etc*) in lab coat pockets (whether the sharps are contaminated or not) as injuries are occasionally sustained by workers thrusting their hands into pockets and encountering sharp objects;
- Take extra care when handling substances that are known or suspected to be of higher risk, including radioisotopes, cytotoxic chemicals, pathogens, GMMOs, human blood and tissues (although the Risk Assessment that should have been done beforehand will ideally have ruled-out use of sharps in association with hazardous agents);
- Take special care when using unguarded blades (extra special care is required when handling and working with microtome and cryostat blades);
- Use the correct instrument for the job to be done, and do not improvise with something that may be more readily available;
- Wherever possible, choose single-use scalpels over those which require blades to be replaced;
- Wherever possible, make use of safety guards, blade removers, *etc*; and
- Consider using cut-resistant gloves in addition to all other items of personal protective equipment that are required (*e.g.* lab coat, and perhaps also goggles or a face shield when dispensing hazardous substances through hypodermic needles).

14.32.4 When inoculating animals, take steps to immobilise or restrain the animal (using only approved techniques) to minimise any unexpected movement. Ensure that you will not be disturbed during the procedure. Position your hands (and those of any helper) so that the needle is not pointed at either person. Wear eye protection and other PPE as required, particularly when dispensing hazardous substances through hypodermic needles

14.32.5 Regrettably it may be safest to assume that waste bags *might* just contain something sharp (even though we all should know *never* to commit sharps to plastic waste bags). So, handle these with care, as though there is the potential for something sharp to protrude through the bag and stick into you. And *never* fill bags more than two-thirds full. As you withdraw bags from bins, attach the plastic bag seal so that you have a ‘safe' part of the bag to handle as you then transport the bag to the waste store; use the same ‘safe’ part of the bag to handle it at any other time too. Handling bags in that way should avoid any need for your hands to come into contact with the filled part of the bag. Do not allow waste bags to bang against your leg or body as you walk with it to the waste store, but it is probably always better to use a trolley to convey even a single bag to the waste store.

14.32.6 Never allow sharps bins to be filled to more than about two thirds of their nominal capacity; doing so very greatly increases the risk of them over-spilling or of users thrusting their hands into boxes full of sharps to squeeze in one or two more needles. And use only approved containers. Transport sharps bins only in a way that avoids the risk of their contents being spilled (perhaps by sealing the box and/or transporting them on a trolley).

14.32.7 Microtome and cryostat blades cause a significant proportion of biological laboratory-based sharps injuries. Always use these according to manufacturers' instructions, and with safety guards in place. Signage should always be displayed indicating whether – or not – a microtome/cryostat blade is fitted.

14.32.8 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

14.32.9 Guidance on steps to be taken in the event of an injury or near-miss involving medical or laboratory sharps is contained within Section 11 (First Aid, Accidents and Near-Miss Reporting) of this Manual.

**14.33.1 Schedule 5 Materials:** Certain pathogens and toxins are controlled under the Anti-Terrorism, Crime and Security Act 2001; these are listed in Schedule 5 of the Act (list reproduced at Appendix 4 of this Manual, though care should be taken to ensure that you are working to the most current version).

14.33.2 The holding, in storage or in use, of any micro-organism listed in Schedule 5 of the Act, or genetic material from a listed micro-organism or toxin, is subject to notification to the Home Office (the notification should be made to the Home Office by the University's centrally-based Health & Safety Department). Further information on the anti-terrorism controls on pathogens and toxins is available on the Health and Safety Department website at:

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/bio_security/bio_security_path_toxins.pdf

14.33.3 It is the responsibility of the individual user to determine whether or not any material they propose to use is controlled under this legislation, and to inform the University Biological Safety Adviser and this site's Health & Safety Manager that they either have, or intend to acquire, such materials.

14.33.4 Further information regarding the reporting mechanism alluded to in the previous paragraph (which within The University of Edinburgh is known as **RETAIN**) is contained at:

https://www.ed.ac.uk/health-safety/biosafety/policy/guidance/retain

14.33.5 In all cases, corporate guidance on biological security on the BSU website should be read and must be followed:

https://www.ed.ac.uk/health-safety/biosafety/policy/guidance/biological-security

14.33.6 A list contained within this guidance specifies all the designated pathogens and toxins controlled under terrorism laws. These pathogens and toxins are Schedule 5 agents, so there must be a Security Plan and security controls must be put in place in addition to the safety controls, but Schedule 5 agents are also High Consequence Dangerous Goods (HCDG), so they must also have a Transport Security Plan and related transport security controls. The plans can be separately or combined in one single security plan.

14.33.7 There are regulatory exclusion limits for some (though not all) of the designated toxins covered under anti-terrorism legislation. There is a regulatory control limit for Tetrodotoxin and Conotoxin of 5mg. This means that if users have 5mg or within a single detached building, then it is subject to the full controls under the terrorism laws. If there is less than 5mg on a site, then its excluded. But, whatever quantity of any designated toxin, it must be registered in **RETAIN**, and local security arrangements must still be put in place as below:

14.33.8 The PI should do BA/GM risk assessment(s) that must go to the GMBSC for review and advice. (This will give us a lot of the background information that will be needed in order to provide specific advice).

14.33.9 The UBSA and Campus H&S manager should visit the PI and their laboratories *etc* where the work is proposed to be carried out (eg handling, storage, waste areas etc). If the work is to proceed, then the CTSA should be informed by email (except where excepted, toxins held lower than 5mg).

14.33.10 If the work is to proceed, then the Home Office/NaCTSO should be informed using the relevant email address pathogensandtoxins@homeoffice.gov.uk (unless where excepted, toxins held lower than 5mg).

14.33.11 A local Security Plan will need to be prepared and put in place, drawing upon advice from UofE Security/

14.33.12 A local Transport Security Plan will to be need prepared and put in place.

14.33.13 A copy of each Security plan(s) must be emailed to the UBSA for their records.

14.33.14 The PI should develop SOPs for the work and keep Security Plans *etc* updated, monitored and tested.

14.33.15 Police CTSAs will usually visit to check the premises and give advice on security arrangements. The UBSA as well as UofE Security must always be informed about CTSA inspections or visits.

14.33.16 No Schedule 5 pathogens or toxins can be brought into the University until all the related safety and security arrangements are in place and the relevant permissions given by management and GMBSC, GMBSO, *etc*.

14.33.17 NaCTSO/Police Scotland have a security guidance document that details the security controls that we must have in place (NACTSO Security of pathogens and toxins 2010). This is a Restricted Document, which can only be given them to Safety Advisers who need them, and they must not be circulated. They need to be kept securely locked when not in use, *etc*.

14.33.18 The security controls will include safe storage of stocks and working materials, safe handling, waste disposal, records, *etc*.

**14.34.1 Genetically Modified Micro-Organisms**: There is an explicit requirement in the GM (Contained Use) Regulations to *immediately* report to the Health & Safety Executive any accident or incident involving Class 2 or Class 3 GMMOs. Researchers are not expected to, indeed they *should not*, contact HSE themselves, as any notifications that are required to be made the Health and Safety Executive must *always* to be done by the University's Health and Safety Department; clearly this requires that the University's Health and Safety Department *must* be informed as quickly as possible (though UofE Security if necessary).

14.34.2 An accident is defined as any incident involving a significant or unintended release (outside of primary containment) of a GMMO which presents a hazard, immediate or delayed, direct or indirect, to either human health and safety, or the environment. This therefore includes any occasion when a person is exposed, or potentially exposed, to a Class 2 or 3 GMMO, or a significant spillage within the lab.

14.34.3 The immediate priority following any accident or incident is appropriate first aid treatment and, where necessary, additional medical treatment; see Section 11 (First Aid, Accidents and Near-Miss Reporting) of this Manual. The area should also be made safe and decontaminated as necessary to prevent any further exposures. Following these actions, the University's Health & Safety Department should be contacted by telephone as soon as possible. To do so, phone the Biological Safety Adviser on 0131 651 4245; or, alternatively, phone the Director on 0131 651 4257 or the Deputy Director on 0131 657 4258, informing the Health & Safety Department of the incident, in order that an immediate notification can be phoned through to the HSE should this be required. Contact with UofE advisers may be made through UofE Security if necessary. Completion of an electronic University accident report should not be regarded as an alternative to phoning, as the reporting system is not monitored at all times, although an electronic report should also be prepared and sent as soon as possible after the occurrence.

14.34.4 In all cases where an individual may have been accidentally exposed to a Class 2 or 3 GMMO, irrespective of the availability of immediate prophylactic treatment or likelihood of infection, the person must make contact with the Royal Infirmary's Accident & Emergency Department and obtain advice on immediate action to be taken and for any follow-up. Whilst researchers may instinctively seek advice from colleagues with specialist expertise in the particular organism involved, this should not be regarded as an alternative to contacting the NHS. Copies of the relevant risk assessment should be provided to attending medical practitioners/occupational health advisers.

14.34.5 Details of the accident notification requirements outlined above are described in guidance at:

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/gm_organisms/gm_risk_assessment.pdf (see Paragraph 11.4)

14.34.6 Guidance on steps to be taken in the event of an injury or near-miss involving medical or laboratory sharps is contained within Section 11 (First Aid, Accidents and Near-Miss Reporting) of this Manual.

14.34.7 Those intending to work for the first time with genetically modified micro-organisms must attend the biological safety training courses organised by the University's Health & Safety Department before commencing such work. The course covers safety requirements for genetic modification work, disposal of biological waste *etc*. Further information is available at:

https://www.ed.ac.uk/health-safety/biosafety/training

14.34.8 The safety implications of working with genetically modified animals and/or plants should be discussed with the University's Biological Safety Adviser before commencing such work.

14.34.9 The role of Genetic Modification and Biological Safety Committees et is set out in Section 7 of this Manual.

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**14.35.1 Further Information:** Detailed policy on a range of biological safety topics, including guidance on risk assessment and the control measures required in order to work safely when carrying out various different types of biological work, is provided on the University's Health and Safety Department website at:

https://www.ed.ac.uk/health-safety/biosafety

## CHEMICAL SAFETY MATTERS

**14.36.1 Hazardous Chemicals:** Investigators must ensure that all those working under their direction, or who might otherwise be affected by that work, are aware of any hazards associated with chemical substances that they may come into contact with as a result of that work (and associated use of hazardous chemical substances), and that steps are taken to ensure that risk to the health of workers and any other person is kept as low as reasonably practicable.

14.36.2 Decisions on how best to work safely with hazardous chemical substances stem from formal risk assessments (see Section 8 of this Manual). **It is Illegal** to carry out a work activity involving substances with the potential to be hazardous to health (ones that are toxic, highly toxic, irritant, corrosive and/or harmful in some other way) without first making such an assessment.

**14.37.1 Highly Reactive Chemicals and Explosive Reactions:** Certain highly reactive chemicals, such as acetylides, azides, diazoalkanes, nitrogen halides, perchlorates, peroxides and poly-nitro compounds, may behave unpredictably and can

decompose explosively. Reactions involving these, and similarly reactive materials, must therefore only be undertaken by, or under the close supervision of, suitably experienced and properly cautious investigators who are fully conversant with the relevant regulations and safety data relating to the substances. A careful appraisal must first always be made of the proposed operating conditions and techniques, and the batch size must be strictly limited to no more than that which is strictly necessary.

14.37.2 Further information on the safe storage of hazardous substances is contained within the University's Health & Safety web site at:

https://www.ed.ac.uk/health-safety/guidance/hazardous-substances/storage-of-hazardous-substances

14.37.3 Further information on the safety implications of using reactive chemicals is contained in Appendix 5 to this Manual and, regarding licencing and storing explosives and desensitised explosives, within the University's Health & Safety web site at:

https://www.ed.ac.uk/health-safety/guidance/hazardous-substances/explosives-and-desensitised-explosives

**14.38.1 The Drugs Act 2005 and Misuse of Drugs Act 1971 (as amended) and Precursor Chemicals**: The Home Office requires organisations holding substances that fall within the scope of the Misuse of Drugs Act to make an Annual Compliance Statement. The three classes of reportable drugs are:

| | |
|---|---|
| **Class A** | Ecstasy, LSD, heroin, cocaine, crack, magic mushrooms and amphetamines (if prepared for injection). |
| **Class B** | Amphetamines, methylphenidate (*Ritalin*) and pholcodine. |
| **Class C** | Cannabis, tranquilisers, some painkillers, gamma hydroxybutyrate (GHB) and ketamine. |

14.38.2 Further information on drugs, including licensing and compliance, can be found at:

http://www.homeoffice.gov.uk/drugs/

14.38.3 A copy of the compliance statement can be downloaded from:

https://www.gov.uk/guidance/precursor-chemical-licensing#precursor-chemicals-annual-returns

14.38.4 When completed, copies of the compliance statement should be sent also to the University's Director of Health & Safety, copied to the Health & Safety Manager for University buildings on the Edinburgh bioQuarter campus.

14.38.5 Regulation of Drug Precursors legislation impinges on Universities that wish to purchase specific scheduled materials. Since 18th August 2005, Universities have been required to obtain a Home Office licence if they intend to purchase Category 1 precursor chemicals (listed at Appendix 10 to this Manual). Schools within this

University that intend to purchase Category 1 *or* Category 2 precursor chemicals are required to complete a Declaration of Specific Use before a supplier can provide the substances.

14.38.6 Schools must appoint a responsible officer for "trade" in Category 1 and 2 substances to ensure that the "trade" takes place in compliance with the Regulations. Schools will also be required to report annually on their use of Category 1 and Category 2 substances.

**14.39.1 Chemical Weapons Convention**: The University is required to annually submit our holdings and usage of certain chemicals classified under the Chemical Weapons Convention to the Department for Business, Energy and Industrial Strategy. The administration of this is undertaken by the Health and Safety Department, although all Schools and Departments are responsible for ensuring they hold up to date records of these chemicals and reply to the annual request for any holdings in the timeframe given. Each year, identified individuals within Schools/Departments will be contacted directly for their areas return (including nil returns).

14.39.2 Further information is available at:

https://www.ed.ac.uk/health-safety/guidance/hazardous-substances

**14.40.1 Flammable Reagents and Organic Solvents:** Before using any organic solvent, it is *imperative* that you are familiar with the properties and potential hazards of the material; refer to the appropriate material safety data sheet and risk assessment that **Must** exist for the chemical concerned (see Section 8 of this Manual). Many organic solvents are flammable, and some can form explosive mixtures with air. Organic peroxides, for example, can violently and spontaneously decompose and may be formed from ethers on storage (see Appendix 5 to this Manual).

14.40.2 Flammable solvents *must not* be put into any refrigerator which has not been certified and clearly labelled as being spark-proof. If there is no label, and the specifications of the fridge are not known, assume that the refrigerator is *not* spark-proof and do not use it for storage of flammable materials.

14.40.3 No more than 500*ml* of any organic solvent should be kept in a laboratory unless the work justifies it, safe storage is available, and a risk assessment has been carried out and documented (see Section 8 of this Manual). Any excess quantity should be returned to Stores for commital to a dedicated solvent storage facility.

14.40.4 Organic solvents should be stored in specific, purpose-dedicated solvent storage cabinets. Special care should be taken in storing only compatible chemicals in any one cabinet. Solvents and corrosives should be stored separately. in suitably labelled cabinets (see Appendix 5 to this Manual).

14.40.5 It is a requirement of fire safety regulations that containers of flammable solvent *must not* be stored routinely in the working area of fume cupboards. These must be stored on a more regular basis in the ventilated storage spaces below the fume cupboard, and returned there immediately after use.

14.40.6 Where it is safe and acceptable to do so, empty containers should be decontaminated before disposal, after first defacing labels on the container.

14.40.7 If there is no acceptable alternative to the use of metallic sodium to dry off an organic solvent (though this only ever be done after a formal risk assessment has been completed and signed off - see Section 8 of this Manual), this should be carried out in a suitable glass container. After use, the solvent should be decanted, the vessel cooled in ice, and the sodium neutralised with cold alcohol.

14.40.8 A formal risk assessment (see Section 8 – Risk Assessment - of this Manual), and relevant COSHH (Control of Substances Hazardous to Health Regulations) and (if relevant) DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) forms, *must* be completed before commencing work describing *which* flammable substances will be used and *how* they will be used, and a corresponding safe system of work prepared and distributed. Consistent with the hierarchy of controls, consideration should be given first to possible alternative means to achieve the desired experimental objective, but then also to the location of the work within each laboratory where they are to be used (particularly in the context of room ventilation) and any possible requirement for of specific chemical detection and/or monitoring.

14.40.9 Guidance on the correct management of solvent waste is set out in Section 18 (Waste Management) of this Safety Manual.

14.40.10 Further information on flammable reagents and solvents is contained on the University's Health & Safety web site at:

https://www.ed.ac.uk/health-safety/guidance/hazardous-substances/solvents

In addition, a partial list of incompatible chemicals, along with a list of chemicals liable to produce peroxide on storage, can be found in Appendix 5 to this Manual.

**14.41.1 Toxic or Dangerous Substances:** Substances of high consequence and of particular concern should not be purchased or obtained without first discussing their use and ultimate disposal with your Health & Safety Adviser; and, if approved, all other workers in the laboratory should be notified of the potential hazard.

14.41.2 Work involving toxic reagents, products and by-products that are are gaseous or volatile should be carried out in a fume hood (see Paragraph 14.11.1 *et seq*), so as not to endanger other workers sharing the same laboratory environment. If a fume hood is not available, the work should *not* be carried out.

14.41.3 *Schedule 1 Poisons*: The purchase, issue and use of Schedule 1 poisons must be logged. The receipt from the supplier will be logged by the Stores Manager, who will require a signature for issue to the end-user. These, and all highly toxic chemicals (*i.e.* those which carry the warning, "Highly Toxic", "Extremely Toxic", "Very Toxic", or "Poison" including display of the relevant hazard pictogram), *must* be kept in a locked cupboard when not is active use. Dilutions of these should be similarly labelled (proper chemical name and relevant hazard pictogram) to provide a clear indication of the identification of the substance and nature of the hazard. Workers

should keep a record of usage of all such material. A list of Schedule 1 poisons, taken from The Poisons Rules 1982, can be found in Appendix 4 to this Manual.

14.41.4 *Schedule 5 Materials*: Certain toxins are controlled under the Anti-Terrorism, Crime and Security Act 2001. The controlled agents are listed in Schedule 5 of this Act (reproduced at Appendix 4 of this Manual). It is the responsibility of the individual user to determine whether or not any material they wish to use is regulated under this legislation, and to inform the University Biological Safety Adviser and the Health & Safety Manager for University buildings on the Edinburgh bioQuarter campus that they either have, or intend to acquire, such materials (using the RETAIN system described within https://www.ed.ac.uk/health-safety/biosafety/policy/guidance/retain). The holding, in storage or in use, of any toxin on Schedule 5 is subject to notification to the Home Office (the notification will be made to the Home Office by the Health and Safety Department). Further information on the anti-terrorism controls on pathogens and toxins is available at Paragraph 14.33.1 *et seq* of this Safety Manual and also on the Health and Safety Department website at:

http://www.docs.csg.ed.ac.uk/Safety/bio/guidance/bio_security/bio_security_path_toxins.pdf

Any queries regarding Schedule 5 materials should be referred to the University's Biological Safety Adviser (Tel: 514245 or email: biosafety@ed.ac.uk).

14.41.5 Chemicals that are carcinogenic, mutagenic or teratogenic must be stored in a locked cupboard. A partial list of incompatible chemicals, along with a list of chemical liable to produce peroxides on storage, can be found in Appendix 5 to this Manual. Working dilutions of these should be similarly labelled (proper chenical name and relevant hazard pictogram) to provide a clear indication of the identification of the substance and nature of the hazard.

14.41.6 See Paragraphs 14.39.1 *et seq* regarding substances that fall within the scope of the Misuse of Drugs Act 1971 (as amended), including certain drug precursors.

14.41.7 Further information on substances of high consequence and of particular concern is contained on the University's Health & Safety web site at:

http://www.docs.csg.ed.ac.uk/Safety/Policy/Chem/CS_CoP009Subs_particular_concern.pdf

**14.42.1 Compressed Gases:** If you are inexperienced in the use of compressed gases, you *must* first seek advice from the member of academic staff in charge of your laboratory. Training is available, through the Health & Safety Manager for University Buildings on the Edinburgh bioQuarter campus, related to:

- general laboratory gases safety awareness;
- selecting, inspecting and connecting gas cylinder regulators; and
- moving and handling gas cylinders.

Special guidance related to handling cryogenic and liquefied gases is contained at Paragraph 14.43.1 *et seq* of this Manual.

14.42.2 Following satisfactory completion of relevant safety training, and locally-delivered training specific to working with laboratory and compressed gases, a formal assessment of competence should be made by each worker's supervisor, and the appropriate entry made in the worker's personal training record, before that person may be authorized to work unsupervised with compressed gases.

14.42.3 Only the minimum number of cylinders of compressed gases that are actually required for use should be kept within each laboratory, and all cylinders *must* be kept upright and firmly secured by restraining chains, bench clamps or similar devices (both at the laboratory bench and during transport). Cylinder stores are maintained by the Stores personnel in each building.

14.42.4 Pending deployment within buildings, compressed gas cylinders should be kept in a properly constructed, well-ventilated store, where full and empty cylinders should be separated, and where smoking and the use of naked flames is prohibited. Cylinders of oxidising gases must be kept separate from cylinders of flammable gases, and toxic and/or corrosive gases should always be stored separately. General guidelines for gas cylinder storage are published by the British Compressed Gases Association; further information is available at:

http://www.bcga.co.uk/

14.42.5 Cylinders should be moved only by personnel who have received training in safe manual handling techniques relating specifically to compressed gas cylinders and who are wearing appropriate personal protective equipment. It should be noted that injuries are occasionally caused while transferring cylinders in and out of cylinder transport trolleys, usually by handlers neglecting safe manual handling techniques. Consult Section 16 of this Manual for guidance regarding safe manual handling operations.

14.42.6 Gas cylinders should be transported using a gas cylinder trolley of an approved design, and should *never* be dragged, rolled or slid across the floor, especially when using the head end of the cylinder as a steering aid. Unless being moved over only *very* short distances within a laboratory, regulators should be removed before moving the cylinder and replaced only after the cylinder has been properly secured in place at a new location.

14.42.7 Gas cylinders should not be transported in passenger lifts. Freight elevators are closely collocated with gas storage areas for each building.

14.42.8 Cylinders must be located at a safe distance from any source of heat or flame, and *never* immediately alongside the exit door or close to an escape route from the laboratory. The preferred location for compressed gas cylinders within a laboratory is furthest from entrance/exit doors.

14.42.9 *Only the correct regulator and/or valve should be used, and these must always be fitted by a competent person*. The regulator should be suitable for the gas being used, and be compatible both with the upstream supply pressure from the source and the downstream pressure requirements of the work to be done. The inlet and

outlet connections must be free of oil, grease, dirt, and fragments of plastic from the "full cylinder" seal; neither should PTFE tape be used to augment the seal around connections. Oil and grease may auto-ignite in the presence of pure oxygen; and, if the latter is under pressure, an explosion may occur. The valve, the regulator and any other connections at high pressure, should always be checked for leaks *using approved leak detection fluid* (a "pressure drop test" may also be done). Use of soapy water to detect the presence of leaks is generally unsafe, since some detergents contain organic chemicals that may increase the likelihood of fire.

14.42.10 Regulators must be checked regularly, and serviced and/or replaced as appropriate in accordance with the manufacturer's instructions. Regulators intended for gases that are flammable, reactive or corrosive *etc* should have a replacement date stamped on them, which is generally five years after the date of manufacture (*i.e.* not merely five years after first being obtained from Stores, which might in turn have been a year or two *after* the date of manufacture), and they must not be used after that date. There is no corresponding requirement to cease using regulators for inert gases after five years, but it would be sensible to include these too in a rolling strategy for replacement of regulators within laboratories. Do not use a regulator beyond the indicated "use before" date. By the same token, do not use a regulator where there is no clear indication of an end of safe life date (since there is no way of being certain just how old that regulator might be) or beyond an interim date indicated by an authoritative inspection tab attached by a competent person. In any event, regulators should be regularly inspected, and immediately discarded if there is any suspicion that they are unfit for purpose. Regulators that are discarded on that basis should be disposed of promptly to avoid them later being selected for use by another worker.

14.42.11 Before contemplating connecting a regulator to a compressed gas cylinder, the worker should be wholly and justifiably confident that they are competent to do so safely. Competence will be better assured after completion of suitable training, and by working for a period of time under the direct supervision of a person more experienced in such work.

14.42.12 Before connecting a regulator, the worker *must* check that the cylinder contains the correct gas, and that they know also the pressure of gas contained inside the cylinder; that information will be shown on the cylinder label (If it is not, then the work must not proceed).

14.42.13 The worker must also be aware of the maximum pressure that will be safely tolerated by apparatus to be connected downstream of the regulator, and the degree of control over which they will be able to effectively and safely regulate the upstream supply. Ideally, the selected regulator will simply be incapable of delivering more than the maximum input pressure that the apparatus will safely tolerate.

14.42.14 **A PRE-USE VISUAL CHECK** *must* be made of the regulator **ON EACH AND EVERY OCCASION** that it is to be connected anew to a cylinder (the following may be used as a check/tick list, and these checks should be done **BEFORE** attempting to connected the regulator to a gas supply):

- Confirm that the regulator is in good condition and intended for use for the gas contained in the cylinder (*e.g.* a nitrogen regulator should only ever be

connected to a cylinder containing nitrogen gas, and no regulator used that is intended for any other gas).

- Check that all pressure relief components of the regulator are intact, in place, and unimpaired.

- Check that the gauges are in good condition, the scales are readable, the needles are resting on the pins (and are not trapped behind them), the needles read zero when the regulator is unconnected to a supply, the covers are intact, and the pop-out backs are in place and unimpaired.

- Confirm that the regulator is within the indicated "replace by" date. If no such date is indicated, or the indicated date has passed, the regulator *must not* be used. If the indicated date precedes the date by which the work is intended to be completed, it might be preferable to select a newer regulator rather than have to replace it before completion of the work.

- Look also for tags or labels indicating when the regulator was last inspected or is next to be inspected, and reject any that have not been inspected in accordance with standing arrangements.

- Look for the maximum inlet pressure of the regulator, and confirm that it is capable of being safely connected to the upstream supply (*e.g.* to a compressed gas cylinder).

- Check that the maximum outlet pressure is compatible with the capacity of the downstream apparatus to sustain the pressures being delivered, and also that there is adequate "controllability" of downstream pressure delivery using the regulator adjustment screw.

- Check that the pressure adjusting screw stops turning when it reaches the point at which there is no downstream pressure delivery, and does not detach from the regulator body. Reject any regulator where there is any doubt at all about its controllability.

- Examine the regulator "bullnose" (the component of the regulator assembly that inserts into the cylinder outlet), and reject the regulator if there is any evidence of damage to the bullnose or to its screw threads.

- Examine the outlet connector, and reject the regulator if there is any damage to that or to its screw threads.

- Confirm that there is no trace of oil, grease or PTFE tape on any of the threads.

- Other aspects to be examined and checked include that the regulator has been purchased from a reputable supplier, and that there is no evidence of inappropriate repairs or modifications.

14.42.15 A pre-use visual check must be applied while setting-up work (the following may be used as a check/tick list):

- Don appropriate personal protective equipment (which, depending on the task and associated risk assessment, will usually include attention to eye protection and often also to foot protection and glove material requirements).

- Confirm that the gas cylinder is completely shut off before proceeding to make any connections to it.

- Confirm that the gas that has been selected is correct for the purposes intended, that all relevant properties of the gas are sufficiently well understood by the person about to make the connection and that it has been factored into a suitable and sufficient risk assessment and corresponding safe system of work (see Section 8 of this Safety Manual), and will be delivered to the regulator at an upstream pressure that is compatible with the regulator that is to be used (see above). The primary means of identifying a gas contained in a cylinder (and the pressure of gas contained in the cylinder) is obtained from the cylinder label, with some secondary confirmation being obtained from reading the cylinder's collar colour(s), which speak to something of the properties of the gas. Where there seems to be an inconsistency between information set out on the label and the collar colour of the Cylinder, or if in doubt in any other way regarding the identity of the gas, **IT MUST NOT BE USED**.

- The cylinder must be transported *using safe manual handling techniques* using a purpose-built cylinder trolley that is appropriate to the size of the cylinder and into which it should be properly secured (using belts or chains, *etc*).

- The cylinder must be positioned upright; and, before connecting the regulator.it should be properly secured in a safe, well-ventilated position using purpose-built wall/bench clamps featuring suitable belts or chains.

- Carry out a regulator pre-use check (see above) and be wholly and justifiably confident that the chosen regulator is suitable and fit for the task intended.

- Reject unfit regulators in favour of those that can be shown beyond doubt to be suitable and fit for purpose.

- If one is fitted, remove the dome cap from the cylinder and also any disposable seal/plug from the cylinder valve outlet.

- Check for the presence of oil or grease on threads within with cylinder outlet. If these are present, *do not* proceed to use that cylinder (though these, and dust and dirt, may be cleaned out using clean, dry, lint-free cloth). **DO NOT** open the valve briefly to blast away any debris that might be present.

- Ensure that the correct tools are available to remove any valve outlet plugs, and to open the cylinder valve outlet and to make downstream connections.

- Ensure that the regulator's pressure adjusting screw is fully wound out so that no gas would be released from the supply side after the cylinder valve is first opened.

- Attach the regulator firstly to a finger-tight connection, ensuring that the final position of the gauges will enable these to be easily read and so that the regulator outlet valve will be easily operated, and *then* make a final connection using the correct tool (ideally *not* an adjustable spanner, which might cause damage to the connecting nut if incorrectly set).

- Check that downstream apparatus (including hoses) are clean, free from oil and grease, are within any specified use-before dates, are suitable for the gas and downstream pressures to be delivered, are unimpaired, that there is no evidence of inappropriate repairs or modification, and that only correct connectors are being used (*i.e.* NOT jubilee clips).

- Connect hoses and downstream apparatus using the correct tools and consistent with manufacturer's recommendations, *etc*.

- After confirming that the regulator's pressure adjusting screw is fully wound out so that no gas would be released from the supply side, SLOWLY open the cylinder valve. DO NOT stand directly in front of the regulator, nor allow anyone else to do so, so that no-one will be injured by an incorrectly attached regulator flying off the cylinder.

- If the needle of the upstream pressure gauge has risen in an uneven or jerky way, or bounces around erratically, turn off the supply, depressurise the regulator (see below), re-inspect everything (including the supply) and carefully refit it.

- When at all in doubt, perform a leak test using an approved leak test solution (NOT soapy water), testing the cylinder valve stem and all components of the regulator (pressure relief device, gauges, upstream and downstream connectors, *etc*) and its connection into the cylinder. If bubbles appear through the leak detection fluid, there would seem to be a leak at that location, and checks should be made.

- Perform also a "pressure drop test" by turning off the supply and observing the upstream gauge needle. If it remains steady, the operator can have some coincidence in the patency of the connection. If it begins to fall, while the downstream supply valve remains shut off, there would seem to be a leak, and checks should be made.

- Where a leak is detected or suspected, the cylinder supply valve and the regulator's downstream supply valve should be shut off, then pressure in the regulator should be released by opening up the regular's downstream valve (exhausting the gas in a safe and controlled way), before disconnecting the regulator from the cylinder and repeating the visual checks indicated above. If, after doing that, and reconnecting the regulator, there continues to be doubts, the regulator should be rejected and another one chosen and tested.

- After completion of leak testing, opening the upstream supply valve fully, then turn it back half a turn, and leave the spindle key in the cylinder valve (where that is a feature of the set-up) so that the cylinder can be quickly and easily shut-down in an emergency.

- At the conclusion of the work, the system should be depressurised using the same technique set out above.

14.42.16 Where any gas is to be passed through a reaction vessel, a pressure release device and a trap to prevent suck-back should be used. An appropriate arrangement is generally:

i. cylinder;
ii. regulator;
iii. (valve);
iv. suck-back trap pressure relief device; then
v. reaction vessel.

14.42.17 There may be merit in drawing out the arrangement on paper and then consulting experienced people regarding the proposed set-up before actually deploying resources and making connections. In that way, some problems may be spotted, and solutions put in place, before reaching the stage at which serious problems might manifest.

14.42.18 The main valve of the gas cylinder should always be turned off after use and any excess pressure in the regulator released with caution before attempting to remove it.

14.42.19 Certain cylinders and their contents require special precautions, and the manufacturer's or supplier's instructions must *always* be followed (further guidance will be set out in Material Safety Data Sheets for each gas). For example, acetylene cylinders must *always* be kept vertical and the regulator *must* be fitted with an approved design of flash-back arrestor. Copper or copper alloy piping and/or equipment must *never* be used in association with acetylene, and supply pressures in excess of 9 psi (0.6 bar) must not be exceeded.

14.42.20 If an acetylene, hydrogen (including any gas mixture containing more than 5% $H_2$), methane or CO cylinder may be required, you *must* first consult your laboratory's Health & Safety Adviser; special risk assessments and safe systems of work may be required, and it may be necessary to share certain information with other laboratory users (*e.g.* the need for them too to control sources of ignition around sources of flammable gas, and to be aware of the correct response in the event of gas alarms beginning to sound).

14.42.21 A formal risk assessment (see Section 8 – Risk Assessment - of this Manual), and relevant COSHH (Control of Substances Hazardous to Health Regulations) and (if relevant) DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) forms, *must* be completed before commencing work describing *which* gases will be used and *how* they will be used, and a corresponding

safe system of work prepared and distributed. Consistent with the hierarchy of controls, consideration should be given first to possible alternative means to supplying gas to equipment (*e.g.* gas generators), but then also to the location of cylinders within each laboratory where they are to be used (particularly in the context of room ventilation) and any possible requirement for of specific gas leak detectors and/or oxygen depletion meters.

14.42.22 Appropriate safety signage must be displayed on doorways leading into rooms where compressed gases are being stored or used.

14.42.23 The University's COSHH (Control of Substances Hazardous to Health Regulations) and DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) risk assessment forms may be accessed at:

https://www.ed.ac.uk/health-safety/online-resources/risk-assessments

14.42.24 It is policy for UofE buildings on the Edinburgh bioQuarter campus that all workers involved in moving or handling compressed gas cylinders or involved with fitting regulators *etc* or who will be working with laboratory gases *must* attend gas safety training which is organised and provided on the campus by the Health & Safety Manager (see Section 32 – Health and Safety Training - of this Safety Manual).

14.42.25 Further information on pressurized gas cylinders is contained on the University's Health & Safety web site at:

http://www.docs.csg.ed.ac.uk/Safety/Policy/Chem/CS_CoP005Pressurised_gas.pdf

14.42.26 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.43.1 Cryogenic Materials, Liquefied Gases and Solid Carbon Dioxide:** If you are inexperienced in the use of cryogenic materials and liquefied gases, you *must* first attend training, which is available through the Health & Safety Manager for University buildings on the Edinburgh bioQuarter campus, related to:

- properties of and hazards associated with cryogenic materials;
- the relevance and importance of risk assessment related specifically to cryogenic materials;
- safe handling and use of cryogenic materials;
- the importance and correct use of personal protective equipment and oxygen depletion monitoring related to cryogenic materials;
- safe dispensing and handling operations related to cryogenic materials; and
- management of first aid emergencies related to cryogenic materials.

Guidance related to handling compressed gases is contained at Paragraph 14.42.1 *et seq* of this Manual. Guidance related to work within one of the site's liquid nitrogen plant rooms is contained at Paragraph 14.44.1 *et seq*.

14.43.2 Following induction safety training, and locally delivered training specific to handling cryogenic materials and liquefied gases, a formal assessment of competence should be made by each worker's supervisor, and the appropriate entry made in the worker's personal training record, before that person may be authorized to work unsupervised with cryogenic materials and liquefied gases.

14.43.3 Be aware of the danger of oxygen depletion when working with cryogenic materials and liquefied gases. Liquid nitrogen and solid carbon dioxide must only be stored in rooms which are actively and adequately ventilated, and in containers specifically designed for storage of cryogenic materials. Be aware, at all times, that as liquid nitrogen and dry ice convert to gas, they displace several hundred times their original volume (as a solid), and will create substantial pressures inside sealed vessels; for that reason containers must be capable of releasing pressure, and there must be good ventilation around the vessel at all times.

14.43.4 It is strictly forbidden to travel in a lift together with cryogenic materials and liquefied gases, and only freight elevators should be used for that purpose. If lifts must be used to transport such materials between floors in substantial quantities, arrangements should be made to ensure that passengers do not enter lifts between the floor where the materials are loaded and the floor where they are to be unloaded. Consult Section 16 of this Manual for guidance regarding safe manual handling operations.

14.43.5 Work with these materials must be done in well-ventilated rooms; *do not* work with them in confined spaces. *Do not* dispose of solid $CO_2$ in a sink; please take any surplus to Stores for safe disposal or re-use. Neither is it sufficient to store excess dry ice in a refrigerator, since the substance sublimates at −78.5 °C, well below the operating temperature of a refrigerator. Appropriate personal protective equipment is available and *must* be used when handling cryogenic materials (cryogenic handling gauntlets, appropriate eye/face protection and, where necessary, a robust apron; open-toed footwear and shorts *etc* are unsuitable). Rings, watches, bracelets *etc* should be removed before commencing work with cryogenic materials.

14.43.6 Work with cryogenic materials, liquefied gases and solid carbon dioxide is ***very strictly prohibited on a lone-working basis*** (see Section 10 of this Manual). There are no reasons why it would ever be acceptable to be inside a plant room unsupported by another person (by which it meant that the other person be physically present and able to see his or her colleague inside the room; it is most certainly *not* sufficient merely to tell someone that you intend going to the room, and ask them to raise the alarm if you do not return by a certain time).

14.43.7 Further information regarding first aid treatment and contingency planning in respect of cryogenic gases *etc* may be obtained from the following paragraphs, which are specifically related to liquid nitrogen and liquid nitrogen plant rooms, but which may be generally applicable to other situations in which cryogenic materials may be used.

**14.44.1 Liquid Nitrogen and Liquid Nitrogen Plant Rooms**: The following guidance ***must*** be complied with … ***at all times***:

- Workers must not handle liquid nitrogen until they have first undergone training and have read these paragraphs of the Safety Manual (14.44.1 – 14.44.47), a copy of which should be displayed outside each of the University's liquid nitrogen plant rooms on the Edinburgh bioQuarter campus);
- Only workers who have completed *all* elements of prior training, and who have been specifically authorised to work in liquid nitrogen plant rooms, will be permitted to access one of the campus's liquid nitrogen plant rooms;
- A "buddy system" *must* be employed ***on each and every occasion*** that the plant rooms are to be accessed (so that workers are always *directly supported* by another person when entering one of the plant rooms);
- The "buddy system" ***always*** applies, whatever reason workers may have for entering a liquid nitrogen plant room (*e.g.* to install, service or retrieve compressed gas cylinders from the Chancellor's Building $LN_2$ plant room);
- **There are no reasons why is will ever be considered acceptable for a worker to enter a plant room unsupported by another person directly present;**
- The lead worker (or leader of a team) intending to work within the plant room *must* be carrying a portable $O_2$ depletion monitoring alarm before entering the room;
- Where there is no reason for the plant room "buddy" to actually have to enter the room together with the lead worker, the "buddy" should remain at the door, but remain fully alert to all that is happening inside the room;
- Ideally, where there is a need for two or more people to be inside the plant room, another person should remain outside the room to act as "buddy" to the whole group (though, if that is not practicable, a "buddy" inside the room should never be in a position to be anything less than wholly aware of all that is happening within the plant room so that they can properly alert the lead worker(s) who may be more focused on a task in hand);
- In the event of an emergency, the "buddy" should not attempt to personally effect a rescue, but to go immediately to a telephone and summon the assistance of the emergency services (by making a 9-999 call from any extension at a safe location, and then meet attending emergency personnel at the main entrance into the building);
- **The main function of the "buddy" is to raise help if help is required;**
- $O_2$ depletion monitors are available, together with plant room keys, from Reception at both QMRI and the Chancellor's Building - further information at Paragraph 14.44.11;
- Arrangements differ slightly for the CRM building, where access is controlled by a swipe card and PIN system, and the $O_2$ depletion monitors are located at the side of the room monitoring panel opposite the entrance to the plant room;
- For the QMRI and Chancellor's Building, an entry must be made in the log kept at Reception within each building, on each and every occasion that the plant room keys are signed out, recording *who* has uplifted keys, at what date and time the keys were uplifted, *who* is acting as the "buddy", the volume of any liquid nitrogen that was drawn off (if any), and that the keys and oxygen depletion monitor were returned at the conclusion of the task;

- A list is maintained by managers within each building of all those who have been authorised to work within the building's liquid nitrogen plant room. Keys will not be issued (or swipe card access granted) to anyone not listed as an authorised person;
- Harassment of Receptionists in an effort to obtain access beyond the authorised user lists will not be tolerated (queries related to access entitlement should be directed to building managers);
- Personal $O_2$ depletion monitors should be switched on, calibrated (allowed to run through the full internal self-test and calibration cycle), and then finally tested by gently exhaling onto the sensor to confirm that it will alarm at levels below ~18% $O_2$, *before* accessing the plant room. Any failure in operation of the monitor should be reported, and a replacement obtained from Stores before proceeding into the plant room;
- After confirming, by observation of the plant room's external $O_2$ monitoring indicators (the locations and interpretation of these will be explained during training) that the room may be presumed safe to enter, the first person to enter the plant room should be the person carrying the personal $O_2$ depletion monitor, in order to obtain additional reassurance that the room is indeed safe to enter and work within;
- In the event that the plant room's external $O_2$ monitoring indicators that the room may *not* be safe to enter, or if alarms begin to sound at any time (including a personal $O_2$ depletion monitor), or there is any other doubt at any stage of the work regarding any aspect of safety, all workers should evacuate the room ***as quickly as possible***;
- If the alarms (including fire alarms) begin to sound, leave the area ***immediately*** in accordance with normal procedures (see Sections 5 and 6 of this Manual regarding fire safety arrangements);
- When working within a liquid nitrogen plant room, *all* entrance/exit doors should be unlocked and left ajar (the Chancellor's Building plant room has two doors, *both* of which should be unlocked and left ajar when the room is occupied and in use);
- Although the access door leading into the CRM plant room cannot be left propped open without triggering door alarms, there is a fire exit at the far end of the room, which should be used to escape the room if workers are closer to that than the main entrance when alarms begin to sound;
- A clear and unobstructed route to exit must be maintained at all times when working within a plant room (*i.e.* materials should not be placed on the floor between where the worker is standing and his/her exit from the room, where these might become an obstruction to rapid egress, particularly if the plant room floor was partly flooded with liquid converting to opaque clouds of nitrogen gas);
- The plant room door(s) should be relocked/resecured after use, and the keys and personal $O_2$ depletion monitor returned to where they were taken from;
- If the nature of the work to be done allows for workers to leave the room for a period of time between tasks, the doors should be relocked/resecured as workers vacate the room, but thought must be given to how others will be able to gain access to keys *etc* if these are not (even temporarily) returned to Reception;

- Use all appropriate personal protective equipment, which is provided in each plant room (and do not remove gauntlets *etc* from the plant rooms, or at least return them to there as quickly as possible after use outside of the plant room);
- Where there may be concerns regarding the hygiene implications of sharing gauntlets and face shields with others, nitrile gloves may be worn inside the gauntlets, and face shields can be cleaned between uses by spraying these with ethanol and allowing the alcohol to vent off before putting one on. Hand should always be washed promptly after completion of work inside a plant room;
- If the necessary PPE is found to be missing or damaged, do not persist with the task, but obtain replacements from Stores;
- Liquid nitrogen must only be transported through the buildings or handled in laboratories *outside hours of expected building occupancy* (see Section 9 of this Manual for definition) on *an exceptional basis*, with the explicit prior approval of the relevant Principal Investigator, and certainly *never* on a lone working basis (see Section 10 of this Manual); and
- In any event, if liquid nitrogen is to be handled in a laboratory, then a local risk assessment must first be completed and properly endorsed (further information on this aspect is available at Section 8 - Risk Assessment and Supervision - of this Manual).

14.44.2 An in-date and properly endorsed COSHH (Control of Substances Hazardous to Health Regulations) risk assessment and linked Safe Systems of Work *must* exist for all work involving use of liquid nitrogen, and all relevant staff should be appropriately trained and familiar with local variations pertaining to each plant room within that they propose to work. Further information is available at Section 8 (Risk Assessment and Supervision) of this Manual.

14.44.3 *Hazards Associated with Liquid Nitrogen*: Liquid nitrogen is *extremely* cold (-196$^{o}$C) and may cause *severe* skin burns. Vessels containing liquid nitrogen will become correspondingly cold, and direct contact with the metal components of liquid nitrogen plant (including pipework supplying liquid nitrogen from bulk tanks to individual cryovaults) may also result in skin burns. Burns which may seem to be quite superficial should nevertheless *always* be referred to a competent physician, as tissue damage may be more deeply penetrating that can be easily assessed by a first aider.

14.44.4 Nitrogen is not toxic, but is an asphyxiant in its gaseous state. In large volumes, a relatively small spillage of liquid may translate into a serious hazard as the liquid converts to gas, and the expanding gas volume (an approximately seven hundred-fold increase in volume) effectively displaces oxygen from a confined space. When the oxygen concentration in air is sufficiently low, a worker may become unconscious, often without first sensing any warning symptoms such as dizziness. Detrimental health effects are first likely to become evident when the oxygen concentration falls below 19.5% (compared with the normal concentration of approximately 21%). But it is important to realise that not all people will react the same to diminishing oxygen concentrations, and those with impaired lung function (smokers, for example) may experience adverse effects rather earlier than others in a group of people present within a plant room; for that reason, it is important that workers remain alert to the health status of others working alongside them.

14.44.5 Symptoms of asphyxia due to oxygen depletion may have a rapid onset, often with no prior warning to the victim.

| **% $O_2$** | **Effects and Symptoms** |
|---|---|
| ~ 21 | Normal. |
| 18-21 | Health effects begin to become apparent, though generally minor, *and usually without the exposed person being aware.* |
| 15 -18 | Impaired physical and mental performance, *still usually without the exposed person being aware.* |
| 10 -15 | Respiration becomes deeper, pulse rate increases, impaired co-ordination, perception and judgement, giddiness and possible fainting. |
| 8 – 12 | Mental failure, nausea, vomiting and fainting. |
| 6 – 8 | Fatal within a few minutes. Resuscitation may be possible if carried out immediately. |
| 0 – 6 | Fainting occurs almost immediately. *Death rapidly ensues.* |

It is more likely, however, because of the design of our plant rooms and safety features of the plant itself, that depletion of oxygen levels within the plant room would progress relatively slowly, and the progression of symptoms would be correspondingly more gradual.

14.44.6 When used as a cryogen, liquid nitrogen boils off rapidly, converting into gaseous nitrogen with a volume equivalent to approximately seven hundred times the original liquid volume*. Rapid venting can cause near-total displacement of breathable air, leading to a local concentration of something approaching 100% nitrogen.

* The volume expansion rate of liquid nitrogen is 696 (*i.e.* 1 $m^3$ of liquid nitrogen will expand to 696 $m^3$ of gaseous $N_2$ at 21°C and standard atmospheric pressure).

14.44.7 Liquid nitrogen may spatter while being decanted, and there is a risk that it may splash into a worker's eyes. Disfiguring facial burns are also a possibility. Minimum ***essential*** safety precautions should, therefore, include wearing a full-face shield whenever pouring liquid nitrogen, and use of cryogenic gauntlets and/or tongs to handle any object present within a liquid nitrogen storage vessels, and while transporting Dewars containing liquid nitrogen.

14.44.8 *Personal Protective Equipment*: Hand and lower arm protection (cryogen gauntlets) and a suitable full-face shield *must* be worn when dispensing and handling liquid nitrogen. When handling large quantities, a full-length apron will minimize the chance of spillage into the worker's footwear. Open-toed shoes and sandals, and shorts *etc*, are unsuitable for work in the liquid nitrogen plant rooms, and items such as rings, watches and bracelets *etc* should be taken off before commencing work. Where there may be concerns regarding the hygiene implications of sharing gauntlets and face shields with others, nitrile gloves may be worn inside the gauntlets, and face shields can be cleaned between uses by spraying these with ethanol and allowing the alcohol to vent off before putting one on. Hand should always be washed promptly after completion of work inside a plant room.

14.44.9 *Other Safety Precautions*: Only trained workers, formally accredited by their laboratory manager as competent to undertake work with liquid nitrogen and cryogenic storage facilities, will be permitted to handle liquid nitrogen and retrieve material from or commit material to a cryostore.

14.44.10 Entry to liquid nitrogen plant rooms is strictly restricted to those who have a specific need to be there, and who have completed all mandatory training requirements and received the explicit prior permission of their Principal Investigator or senior laboratory manager to enter those rooms. Lists of authorised workers who are permitted to collect plant room keys *etc* are maintained by management within each building.

14.44.11 Members of Reception staff in the QMRI and Chancellor's Building, and colleagues in Security, have been instructed **not** to issue keys to anyone whose name does not appear on the list for the building concerned. Special arrangements apply to the CRM building, where access to the plant room is managed by use of swipe cards and PIN. Harassment of Reception or Security personnel will not be tolerated *under any circumstances*. Those to whom access may have been denied, for any reason, should argue their case with their Principal Investigator or Laboratory Manager; anyone found to be in breach of this arrangement, and abusing Reception or Security personnel, may be denied future access to the plant room.

14.44.12 Anyone found to be in neglect of safety arrangements pertaining to liquid nitrogen plant rooms on this campus, including working without support off a "buddy" will be removed from the authorised user list and denied further access, at least until the circumstances have been investigated by management.

**14.44.13 Access to liquid nitrogen plant rooms is strictly prohibited on a lone-working basis** (see Section 10 of this Safety Manual).

14.44.14 Keys for the liquid nitrogen plant rooms in the QMRI and Chancellor's Building must be signed out from Reception within the relevant building, and returned there immediately after use, the workers having securely locked the room after completion of the procedure (*i.e. both* doors in the Chancellor's Building plant room). An entry must be made in a log kept at Reception within each building, on each and every occasion that the plant room keys are signed out, recording who has uplifted keys, who is acting as "buddy", at what date and time the keys were uplifted, the volume of any liquid nitrogen that was drawn off (if any), and that the keys and oxygen depletion monitor were returned at the conclusion of the task.

14.44.15 A personal oxygen depletion monitor and alarm is kept together with plant room keys in the Reception area of the QMRI and Chancellor's Building, and should be uplifted and worn by one the first worker to enter the plant room and then by someone who will remain present throughout the procedure. The monitor must be returned to Reception, together with the keys, after completion of the procedure.

14.44.16 Workers should not enter either plant room unless the personal oxygen depletion monitor has been uplifted and tested. Users should make a final test of the sensitivity of the device by exhaling slowly onto the sensor until the alarm sounds. If

the monitor does not seem to be operating correctly, workers should not proceed to enter the room since the monitors are an essential component of safety arrangements for the plant rooms. Spare monitors are available from Stores.

14.44.17 In the event that a second team enters the plant room and intends to continue working after the first team has completed work, a clear understanding should be reached about who is responsible for securing the room and returning keys, monitors *etc*, so that they room is not inadvertently left unsecured because of a misunderstanding.

14.44.18 Arrangements differ slightly for the CRM building, where access (restricted to specifically authorised workers) is controlled by a swipe card and PIN system, and the $O_2$ depletion monitors are located alongside the monitoring panel opposite the entrance to the plant room, but the monitor should still be tested (as above) before commencing work. A PIN will be issued only upon completion of all mandatory training requirements and authorisation from the relevant Principal Investigator or Laboratory Manager.

14.44.19 If the nature of the work to be done allows for workers to leave the room for a period of time between tasks (including replenishment of cryostores from the main feeder tank), the doors should be relocked/resecured as workers vacate the room, but thought must be given to how others will be able to gain access to keys *etc* if these are not returned (even temporarily) to Reception. Once again, different arrangement apply to the SCRM building where access is controlled by swipe card and PIN.

14.44.20 External “traffic light” indicators are provided immediately outside liquid nitrogen plant rooms serving the QMRI and Chancellor’s Building (at each entrance doorway) providing an indication of oxygen concentrations within each room. Workers should enter one of these liquid nitrogen plant rooms only if the green light is illuminated. A red or amber light (only the Chancellor’s Building plant room has an amber light in addition to the green and red lights), with or without an audible alarm, or when no light at all is illuminated, indicates a potentially unsafe state within the room, and no-one other than a properly equipped and trained plant engineer or a senior manager, having taken appropriate precautions, should enter the room under these circumstances. Faults with the alarm system *etc* must be reported urgently to building managers. A digital display of oxygen levels measured at each fixed sensor is mounted high on the wall to the left of the rear door leading into the Chancellor’s Building plant room and to the left of the door leading into the QMRI’s plant room.

14.44.21 The external alarm indicator provided for the CRM building’s liquid nitrogen plant room (located directly opposite the entrance door) is a blue beacon together with an audible alarm, and there are digital indicators of oxygen concentrations within the room. Workers should enter the SCRM liquid nitrogen plant room only if the blue light is not illuminated. A blue light, with or without an audible alarm, indicates a potentially unsafe state within the room, and no-one other than a properly equipped and trained plant engineer or a senior manager, having taken appropriate precautions, should enter the room under these circumstances. Faults with the alarm system *etc* must be reported urgently to building managers.

14.44.22 Where work has been proposed *outside of hours of normal building occupancy* (see Paragraph 9.4.1 for definition), or a member of staff has been called into work to replenish depleted reservoir tanks *etc*, a "buddy system" is required. It should be noted that members of the Security team are unable to offer to act as a "buddy" for the purposes of safety within liquid nitrogen plant rooms, since Security Officers may be redeployed to other tasks at very short notice.

14.44.23 In principle, though, workers should plan to undertake tasks involving liquid nitrogen *within* normal working hours when others are more likely to be available to help if there is a problem, and late working should be done only on *an exceptional basis*.

14.44.24 Nevertheless, **all standing rules governing working within a liquid nitrogen plant room remain fully in force *outside of hours of normal building occupancy* (see Paragraph 9.4.1 for definition), including mandatory "buddy" system, use of PPE and personal $O_2$ depletion monitors, *etc*.**

14.44.25 No person should enter a liquid nitrogen plant room without a "buddy" being immediately available. Unless required for some good reason to be present for periods of time within the plant room, the "buddy" should remain at the door of the room while their colleague enters and confirms, by use of the portable $O_2$ monitor, that the atmosphere is safe. Only a person who has completed training in liquid nitrogen plant room safety, and has been formally accredited by their senior laboratory manager as competent to undertake work with liquid nitrogen and cryogenic storage facilities, will be permitted to act as a "buddy". The "buddy system" applies whatever reason workers may have for entering a liquid nitrogen plant room (*e.g.* to retrieve or return $CO_2$ cylinders from the Chancellor's Building $LN_2$ plant room). In the event of the room alarm or personal oxygen depletion monitor beginning to alarm audibly, all persons present within the room should evacuate immediately.

14.44.26 Ideally, where there is a need for two or more people to be inside the plant room, another person should remain outside the room to act as "buddy" to the whole group. If that is not practicable, a "buddy" inside the room should never be in a position to be anything less than wholly aware of all that is happening within the plant room so that they can properly alert the lead worker(s) who may be more focused on a task in hand.

14.44.27 In the event that a worker present within the room seems to have become compromised by falling oxygen levels, the "buddy" should obtain help by dialling '9' from any extension at a safe location to obtain an outside line and then '999' to summon the Fire & Rescue Service; fire-fighters have access to self-contained breathing apparatus and protective clothing that will enable them to safely enter an area which may be flooded with asphyxiant gas. Under these circumstances, the "buddy" *must not* attempt to personally effect a rescue, as he/she may then also be rapidly overcome by asphyxiant gas. Alternatively use may be made of a cellular telephone to call the Fire & Rescue Service directly. Do not call '2222' as this would entail longer delays before the Fire & Rescue Service is contacted (though that number remains the correct one to call to provide update information to the Fire &

Rescue Service in the event of a fire emergency). Someone must be deployed to the main entrance to the building to lead attending firefighters to the plant room.

14.44.28 If a worker collapses, but alarms have not sounded, and the "traffic light" remains green, the collapsed person can be safely extricated from the room. ***First aid should not be administered in the plant room***.

14.44.29 A worker and "buddy" should also notify colleagues beforehand that they are going to be in the plant room for a specified period of time. Their colleagues should investigate if the worker and "buddy" do not return from the plant room at the time that they said they would.

14.44.30 Remove metal jewellery and wrist watches before commencing work with liquid nitrogen, as these may trap and hold liquid nitrogen against the wearer's skin.

14.44.31 Ensure that all necessary personal protective equipment (PPE) is available before commencing work, and inspect items for damage before donning them. Do not commence work where there is inadequate PPE. Replacements can be obtained from Stores.

14.44.32 Do not transport liquid nitrogen in an elevator likely to be occupied also by people; only freight elevators should be used for that purposes. Do not personally accompany substantial quantities of cryogen being transported in a lift, and take steps to ensure that people do not attempt to enter a lift at another floor while substantial quantities of cryogen are being transported in a lift.

14.44.33 Use only vessels that have been specifically designed for extremely cold temperatures. Note that not all Dewars are rated for liquid nitrogen. Always follow manufacturer's guidelines for use of cryogen vessels of any size.

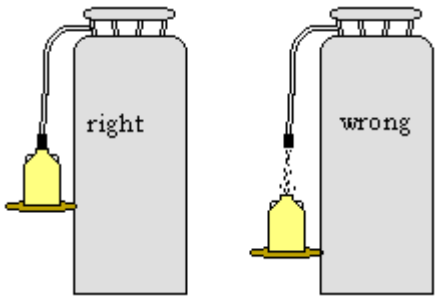
14.44.34 Tubes *etc* containing samples stored in liquid nitrogen may explode without warning when these are retrieved from storage in a cryovault. This may be caused by liquid nitrogen having entered the tube through minute cracks and then expanding rapidly as the tube thaws in the warmer temperatures of the plant room. Use of gauntlets and a full-face shield while handling liquid nitrogen and material in cryogenic storage will safeguard also against the risk of shards of tube material flying towards a worker's hands and face. Only tubes which are specifically designed for cryogen work should, therefore, be used.

14.44.35 Note that *outside of hours of expected building occupancy* (see Section 9 for definition) workers should be entering the liquid nitrogen room only *in exceptional circumstances*, and with the prior knowledge and specific approval of their Principal Investigator, and certainly *never alone*. Failure of a container or a large spillage when the building is largely unoccupied could result in creation of a potentially lethal asphyxiating environment at a time when you are unlikely to be found or be able to call upon assistance.

14.44.36 Only qualified personnel (competent plant engineers) should service or attempt to correct problems associated with liquid nitrogen plant. Faults must be reported as a matter of urgency so that engineers can be summoned to the site.

14.44.37 *Dispensing Liquid Nitrogen*: The following guidance should always be complied with:

- *Never* refill Dewars or transfer liquid nitrogen on a lone-working basis;
- Do so on a late-working basis only *in exceptional circumstances* and with the prior knowledge and explicit approval of you Principal Investigator;
- Make full and proper use of personal protective equipment to avoid liquid nitrogen coming into contact with any part of your body or becoming trapped in clothing or jewellery next to your skin, and take care to avoid any risk of cryogenic liquids pooling inside your footwear;
- Wear *all* required items of Personal Protective Equipment as appropriate to the work that you are intending to do:
    - Cryogenic protection gauntlets (not merely gloves),
    - Lab coat,
    - Appropriate footwear, and
    - Full-face shield;
- Remove rings, watches bracelets *etc* before donning personal protective equipment and commencing work;
- Where there may be concerns regarding the hygiene implications of sharing gauntlets and face shields with others, nitrile gloves may be worn inside the gauntlets, and face shields can be cleaned between uses by spraying these with ethanol and allowing the alcohol to vent off before putting one on. Hand should always be washed promptly after completion of work inside a plant room;
- Workers filling vessels must be in constant attendance throughout the whole filling operation;
- Do not hold the dispensing pipe or vessel being filled with unprotected hands while filling;
- Do not use a funnel;
- Dewars with capacity greater than twenty litres must be lifted and poured by two people (see Section 16 of this Manual for guidance on aspects of safe manual handling), while having regard to the continued need for adequate "buddy cover" during the task;
- Do not allow the liquid nitrogen to fall through a distance to reach the receiving vessel - Raise the vessel safely up to the delivery tube, but do not hold it there by hand, even if wearing cryogen handling gauntels:




- Do not bend the dispensing pipe unnecessarily - Doing so may cause damage that will eventually cause the pipe to break;

- Persons filling Dewars should wear full-length, non-cuffed trousers (covering the tops of their shoes, and not tucked inside boots, *etc*) or a full-length apron, and shoes which will not admit spilled cryogen and which are easy to remove quickly - Also, wear cryogen-handling gauntlets and a full-face shield throughout the whole procedure;
- Do not touch any item that has been immersed in or splashed with liquid nitrogen until the handle-able surfaces of the item have returned to room temperature;
- Do not store liquid nitrogen in any container with a tight-fitting lid - A tightly sealed container will build up pressure as the liquid boils-off to gas, and the container will explode after a short time;
- Never dip a hollow tube into liquid nitrogen, as liquid nitrogen will begin to spurt out of the tube as it expands;
- Boiling and splashing always occurs when filling a warm container with cryogenic liquid or when inserting objects into these liquids;
- Always fill warm Dewars slowly to reduce temperature shock effects within the container and to minimize splashing;
- Do not fill cylinders and Dewars to more than 80% of capacity, since expansion of gases during warming may cause excessive pressure build-up;
- Perform tasks slowly to minimize boiling and splashing; and
- Never dispose of liquid nitrogen by pouring it onto the floor or into a drain (Relatively small quantities can be allowed to boil-off within a fume hood, but boiling-off next to an oxygen depletion sensor within a plant room may well result in the room alarms being activated – If using a fume hood to vent-off unwanted $LN_2$, always display suitable warning signage).

14.44.38 *Transporting Liquid Nitrogen through a building or between buildings*: The following guidance should always be complied with:

- Apply guidance for safe manual handling operations (see Section 16 of this Manual);
- Do not accompany substantial loads on lifts, and ensure that no-one else uses the lift while cryogen is being transported between floors (this may dictate posting colleagues at doors on each level);
- Probably the best means of transporting cryogenic materials within buildings is by use of a Dewar supported on a trolley, or on its own wheels, and where the Dewar has a pressure relief valve or a pressure venting lid;
- For short distance movements, it is generally acceptable to hand-carry a pint (~ 500ml) sized Dewar of nitrogen, if:
    - The Dewar is your only load (*i.e.* you are not also carrying other items),
    - The vessel has a venting lid (a loose-fitting stopper is fine),
    - You are carefully watching for people who might bump into you, and
    - The vessel is carried/supported using both hands and held as far away from your face as is comfortably possible;
- Dewars with pressure relief valves must be serviced according to manufacturer's instructions;
- Transport between buildings is potentially very much more complicated, and should not be undertaken without a great deal of prior planning; and

- Where a container spills, no effort should be made to arrest the fall (in order to avoid the risk of liquid nitrogen flowing inside a gauntlet), but workers should clear all people away from the area until the nitrogen has dispersed before clearing up materials that will by then have warmed to room temperature.

14.44.39 *Contingency Planning*: A comprehensive risk assessment (see Section 8 of this Manual) *must* be undertaken *before* commencing work with cryogenic material, and a Safe System of Work should include a plan of what must be done if:

- A liquid nitrogen containment vessel spontaneously vents to atmosphere;
- Liquid nitrogen spills out from a container; and
- Liquid nitrogen splashes onto exposed skin and/or into eyes.

14.44.40 *First Aid Measures for Asphyxia*: The following symptoms may indicate onset of asphyxia:

- Unusual behaviour, consistent with confusion and disorientation;
- Rapid and gasping breath;
- Sudden fatigue;
- Nausea;
- Vomiting; and/or
- Collapse.

14.44.41 In these circumstances, if you can do so without placing yourself in danger, immediately move the affected person to an area away from the plant room (but ***do not enter a plant room to attempt recovery of a person exhibiting signs of asphyxia***, as you too may end up as a casualty. Where you can do so safely, keep the casualty warm and rested. Call for an ambulance, but also send someone to Reception to meet responding paramedics and lead them to the casualty. Apply resuscitation techniques if necessary.

14.44.42 If you cannot rescue a casualty without placing yourself in danger, obtain help by dialling '9' from any extension for an outside line and then '999' to summon the Fire & Rescue Service, inform them of the circumstances and precise location of the incident (including the postcode of the building), and send someone to the main entrance to the building to lead attending firefighters to the plant room. Fire-fighters have access to self-contained breathing apparatus and protective clothing that will enable them to safely enter an area which may be flooded with asphyxiant gas. Under these circumstances, the "buddy" should *not* attempt to enter the room, as he/she may then also be rapidly overcome by asphyxiant gas.

14.44.43 *First Aid Measures for Skin/Eye Contact*: Immediately and thoroughly flush with tepid water (~20ºC) for fifteen minutes. In case of frostbite, spray the affected area with tepid water for at least fifteen minutes. In both cases, apply a sterile dressing to the affected area and *always* obtain urgent medical assistance.

14.44.44 *Business Continuity*: The value of much of the material in our various cryostores is incalculable, and continued maintenance of these depends on regular resupply of liquid nitrogen. We are vulnerable to interruptions to the supply chain due

to severe weather impact on roads networks *etc*, and must be prepared to lock-down plant rooms to preserve whatever volumes of liquid nitrogen remain available to us when there may be no guarantee of timely resupply. Workers should be prepared also to consider a phased sacrifice of cryostores in order to preserve the most mission-critical materials at the expense of those that would cause less problems if they were to be lost.

14.44.45 *Further Information*: 14.44.46 A copy of this guidance should be available at the entrance to each liquid nitrogen plant room, together with standard operating procedures, and both documents should be regularly reviewed by workers since changes may, from time to time, be introduced (although buildings-wide emails will also be used to intimate significant changes).

14.44.46 A training package related to certain specific aspects of this general subject matter is contained within:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

14.44.47 It is an essential part of liquid nitrogen safety training that practical considerations (such as accessing cryovaults) are underpinned by practical training within the premises where such work is to be done, led by laboratory managers and suitably experienced technicians.

**14.45.1 Chemical Disposal:** The disposal of chemical substances, whether contaminated or excess stocks or experimental residues, is governed by a number of statutory regulations. It falls to individual users to ensure that their chemicals are disposed of in accordance with a duty of care outlined in environmental protection legislation. Policy and procedures for waste disposal is contained in Section 18 (Waste Management) of this Manual. Further advice is available from your local Health & Safety Adviser and/or Waste Adviser regarding appropriate waste disposal procedures.

14.45.3 The Campus's Health & Safety Manager will offer practical help in connection with the safe disposal of waste chemicals, in both solid and liquid form, including solvents. Inventories should be prepared and maintained by laboratory managers as items of chemical waste are identified, ensuring that all data points in the relevant pro forma are provided, otherwise there may be delays in arranging an uplift and some items may be rejected by the contractor.

14.45.4 The University's Waste & Environment Manager too can offer practical help in connection with the safe disposal of waste chemicals.

14.45.5 Items committed for disposal may be held in a central location approved for that purpose, but an obligation remains to manage that waste diligently pending final uplift, and attention needs to be paid to area security, segregation into chemical types with regard to incompatibilities *etc*, and we remain responsible for highlighting any concerns about the quality of containment of items. Special requirements exist with respect to disposal of "unknown" substances; further information is available from the Campus's Health & Safety Manager.

14.45.5 Individual cost centres will be charged *pro rata* for the chemicals that they dispose of by this route. Further details of this system are available from the University's Waste & Environment Manager.

**14.46.1 Spill Management**: It is essential that laboratory workers are aware of how to safely and properly manage at least the immediate response to spillages of solids or liquids, even if the consequences are limited to creation of a slip hazard only. Some substances used within the campus, however, have the potential to cause considerably more of a hazard, potentially to the extent of requiring evacuation of laboratories as a precautionary measure. Spill kits are available in most laboratories, or are otherwise readily accessible, but these should only be deployed by workers who are confident and properly competent to do so. Training is available from the site's Health & Safety Manager and should be attended by anyone designated to form part of a spill management team. A brief on-line training course is also available at:

https://www.ed.ac.uk/medicine-vet-medicine/staff-and-current-students/cmvm-health-and-safety/edinburgh-bioquarter/training-presentations

**14.46.2** A model for a spill management plan to be adopted within laboratory areas is attached to this Section at Annex A.

**14.47.1 Further Information**: Further information on chemical safety generally is contained on the University's Health & Safety web site at:

http://www.docs.csg.ed.ac.uk/Safety/Policy/Chem/CS_CoP002GLP.pdf

## RADIATION SAFETY MATTERS

**14.48.1 Ionising Radiation:** It is the duty of all employees and students to comply with those parts of the University Health and Safety Policy that are relevant to their own work, as well as observing any additional local rules and regulations on health and safety published at Edinburgh bioQuarter Buildings, School/Deanery, Centre or individual laboratory-levels.

14.48.2 Storage and disposal of radio-isotopes are governed by the Radiation Substances Act (1993) (as amended) and "policed" in Scotland by the Scottish Environment Protection Agency (SEPA).

14.48.3 All work with ionising radiations must comply with the Ionising Radiations Regulations 2018 (as amended), which are published and monitored by the Health & Safety Executive (HSE). The Regulations set the standard for radiation protection in every place of work, including research and teaching. The primary concern of the Regulations is the safety of everyone involved in work, and they place duties on both employers and workers to establish good working practices.

**14.49.1 Designated Areas**: Relevant regulations specify two categories of area for radiation work; these are determined by the likely radiation dose of those working in the areas:

- *Controlled Area*: An area within which it is necessary to follow special procedures to restrict exposure; and
- *Supervised Area*: An area within which working conditions need to be kept under review to ensure that designation as a Controlled Area is not required. Most radiation areas within the University buildings in Edinburgh bioQuarter are normally designated as Supervised Areas, and these tend to be parts of laboratories used also for other purposes.

14.49.2 A third classification (non-designated area) may be used where the risk from radiation is very small.

Non-designated - Risk from radiation is very small;

Supervised Area – Risk is intermediate between non-designated and "Controlled"; and

Controlled Area - Risk from Radiation is high.

14.49.3 Signage for Supervised and Controlled Areas look like this:


14.49.4 A programme of regular monitoring (on a minimum frequency of once per month per groups using any controlled or supervised area), including swab testing where relevant, must be carried out and records kept.

14.49.5 Local rules govern access to and use of facilities within the Chancellor's Building and CRM irradiator facilities, and a list is maintained of those who have undertaken appropriate training and who have been specifically authorised to enter and work within those facilities.

14.49.6 Local rules also govern access to and use of facilities within the Edinburgh Imaging Facility (QMRI), and which includes PET/CT and PET/MRI scanning facilities and a cyclotron and associated radiochemistry facilities. A list is maintained of those who have undertaken appropriate training and who have been specifically authorised to enter and work within these facilities. Local rules exist also in respect of pre-clinical micro-CT and microPET-CT scanners located within the Chancellor's Building

14.49.7 Further information on aspects of ionising radiation safety, including minimum necessary monitoring arrangements and standards, is provided on the University's Health and Safety Department website at:

https://www.ed.ac.uk/health-safety/radiation-protection

**14.50.1 Non-Ionizing Radiation:** Exposure to infrared (IR) or ultraviolet (UV) radiation is potentially harmful, and precautions are necessary to avoid harmful effects, either by engineering controls or by appropriate personal protective equipment.

14.50.2 Use of UV transilluminators must be supported by preparation, in advance of use, by risk assessments and safe systems of work. The location of these in a laboratory *must* be highlighted by displaying warning signs directing the need for workers and visitor to those areas to use personal protective equipment. When new UV transilluminators are brought into the building, the local Health & Safety Adviser

*must* be notified, as he or she must inform the University's Health & Safety Department to organize an inspection of the equipment, certify its safe use, and issue or approve the requisite door notice.

14.50.3 Further information is provided on the University's Health and Safety Department website at:

https://www.ed.ac.uk/health-safety/radiation-protection

**14.51.1 Lasers:** Use of laser equipment within University buildings is regulated according to the CVCP Guidelines on Safety, Part 2:1 Lasers and University of Edinburgh Health and Safety Policy, and Part 7:3 Radiation Protection Laser Equipment. Copies are available from the Laser Safety Officer (LSO), or Section Laser Supervisor (SLS), or to download from:

https://www.ed.ac.uk/health-safety/radiation-protection

14.51.2 Lasers are classified according to possible hazards they present. Class I lasers are considered safe either because of very low output power or because they are totally enclosed. Low-power Class I lasers, and lasers in printers, CD drives and similar devices, do not require special control measures and need not be registered. It is the responsibility of Laser Supervisors to ensure that all other lasers in their respective areas are registered with the Laser Safety Officer.

14.51.3 All personnel intending to work with lasers of Class 3A and above must first:

- receive appropriate training;
- undergo eye examination;
- be registered with the relevant Laser Supervisor and Laser Safety Officer; and
- receive copies of local rules and schemes of work.

14.51.4 Class 3B** and Class 4 lasers are extremely hazardous and must only be used:

- in Designated Laser Areas, to which only authorized personnel are admitted; and
- after precautions required have been carefully considered by the Laser Supervisor and Laser Safety Officer, and a scheme of work registered with the Laser Supervisor and Laser Safety Officer.

**14.52.1 Magnetic Resonance Imaging (MRI):** A high magnetic field strength (~9T) magnetic resonance imaging (MRI) scanner is located in the Chancellor's Building, and a lower field strength (3T) diagnostic medical imaging scanners are located in the Edinburgh Imaging Facility (QMRI); these represents a potential health and safety hazard in three distinctly different respects:

- Incompatibility of magnetic resonance imaging equipment for people with cardiac pacemakers, intra-aural implants, programmable shunts and other implants and devices that may be adversely affected by a high magnetic field;

- Incompatibility of magnetic resonance imaging equipment with items containing ferro-magnetic components and/or which are sensitive to magnetism (information technology, digital photography, credit cards, *etc*) resulting in damage being caused to such items; and
- Incompatibility of magnetic resonance imaging equipment with items containing ferro-magnetic components which may be drawn uncontrollably into the magnet and become attached, possibly trapping or injuring people who are in the path of such items.

14.52.2 The health and safety implications for people working within these facilities are managed through the strict application of local rules which describe access controls. A "Restricted Area" and "Controlled Area" are delineated. It is the responsibility of staff serving that facility to ensure that people with contraindications to exposure to high magnetic fields are not permitted to enter the Controlled Area by ensuring that:

- Appropriate warning signs are displayed;
- Staff are trained, alert and regularly updated regarding contra-indications to magnetic resonance imaging;
- A screening system is operated to confirm that people entering the facility definitely do not have contraindications to magnetic resonance imaging;
- A screening system is operated also to ensure that prohibited items (containing ferro-magnetic components or which might be sensitive to magnetism) are not taken into the Controlled Area; and
- Local rules for health and safety and maintained and regularly updated.

14.52.3 Prevention of ferro-magnetic objects being introduced within the Controlled Area is achieved by similar means to those for safeguarding people (*i.e.* by conscientious and effective screening of people intending to work within the Controlled Area).

14.52.4 Magnetic resonance imaging entails the use of radio-frequencies (RF). The equipment in use within the Chancellor's Building and QMRI is shielded against interference and leakage. Any possible health and safety implications of exposure to the non-ionising radio-frequencies involved will be covered by steps that are taken to reduce exposure to magnetism (*i.e.* by observing the restrictions imposed by local rules and the delineation of Restricted and Controlled Areas).

14.52.4 The primary magnet of magnetic resonance imaging equipment is super-cooled using helium which, in the event of a "quench" (planned or spontaneous), may partly vent into the magnet room, creating a possible asphyxiation hazard. There are engineered systems designed to extract helium and vent it to outside the building, and magnet room doors open outward in order that an overpressure will not prevent the door being opened. Oxygen monitor/alarm systems are provided in both MRI scanner rooms.

14.52.4 Local rules will also include:

- Lists of appropriately qualified people permitted to operate the equipment and be present inside the Restricted and Controlled Areas;

- Special arrangements for fire-fighters (including access outside normal working hours);
- Any special arrangements that might be necessary before lone working in the magnetic resonance imaging facility will be authorised (in addition to general lone-working arrangements described in Section 10 of this Manual); and
- Steps to be taken in the event of a person becoming trapped inside the magnet room by a ferro-magnetic object drawn inside the room (and criteria for initiating a magnet quench).

14.52.5 In any event, staff within the Chancellor's Building's pre-clinical imaging facility will comply also with local rules for the adjacent Bioresearch & Veterinary Services facility where these may apply to work being done within the magnetic resonance and microPET-CT and MRI facilities.

**14.53.1 Further Information:** Section 19 of this Manual describes arrangements for disposal of radioactive waste. Part 7 (Sections 1 to 3), of the University's Health and Safety policy describe arrangements for radiation protection in respect of ionizing radiations, non-ionising radiations, and laser equipment respectively. These may be accessed at:

https://www.ed.ac.uk/health-safety/radiation-protection

## COSHH HEALTH PASSPORT SYSTEM

**14.54.1 General Information**: Members of staff are required to have a health record if there is a possibility that they may be exposed to a sensitising agent, including laboratory animal allergens.

For more information on sensitising agents, see:

http://www.ed.ac.uk/health-safety/guidance/hazardous-substances/sensitisers

14.54.2 To access the University's COSHH passport system, users must be able to verify the following information:

- if health surveillance is required;
- if face-fit testing is required for respiratory protective equipment; and
- if all mandatory training has been undertaken.

Information and guidance on the above can be found at:

https://www.edweb.ed.ac.uk/health-safety/online-resources/coshh-health-passport-system-chps

which also contains user guides and the answers frequently asked questions.

## CONTAINMENT LABORATORIES

**14.55.1 Biohazards**. Work involving the use of biological materials is subject to standards that aim to eliminate the hazards, or ensure adequate control of the resultant risks, thus preventing or minimising the risks to human health and to the environment.

14.55.2 This policy applies to all work involving biological agents, pathogens, genetically modified organisms (GMOs) and other biological materials (*e.g.* microorganisms, cell cultures, parasites, human or animal tissue, including blood and other bodily fluids, or plant material), which have the potential to give rise to a risk of infection, allergy or toxicity or other harm to people or damage to the environment.

**14.56.1 Legislation**. Enacted under the Health and Safety at Work *etc*. Act, the Control of Substances Hazardous to Health Regulations (COSHH) are designed to protect people against risks to their health arising from exposure to hazardous substances (including biological agents) associated with their work.

14.56.2 An Approved Code of Practice (Appendix 2) supporting the COSHH Regulations details the additional provisions relating to work with biological agents. A brief summary of the requirements under the COSHH Regulations for work with biological agents is provided on the University's Biosafety website at:
http://www.ed.ac.uk/schools-departments/health-safety/biosafety

14.56.3 The COSHH Regulations cover work involving biological hazards, but particular work activities may fall within the scope of more specific Regulations, such as genetic modification (GM) work, which is subject to the control of the Genetically Modified Organisms (Contained Use) Regulations.

14.56.4 Some aspects of GM work are also controlled under environmental protection legislation; and if work involves activities outside containment, then the requirements of Genetically Modified Organisms (Deliberate Release) Regulations may apply.

14.56.5 The provisions of a Specified Animal Pathogens (Scotland) Order (SAPO) and/or the Anti-Terrorism Crime and Security Act may also apply in some circumstances.

14.56.6 A brief summary of the requirements of various GM Regulations for genetic modification work under containment is provided on the Biosafety website at:

http://www.ed.ac.uk/schools-departments/health-safety/biosafety

**14.57.1 Risk Assessments**: The COSHH and the GM (Contained Use) Regulations impose duties on the University to protect its staff and any other persons, whether at work or not, who may be affected by the University's work involving biological agents or other materials which are potentially hazardous to health.

14.57.2 In order to ensure compliance with the Regulations, Deans within the School of Medicine must ensure that work is not undertaken that is liable to expose any employees, or others, to any substance hazardous to health or that the exposure is kept to a minimum after a suitable and sufficient risk assessment is undertaken by a competent person.

14.57.3 Additional duties are set out in various Acts and Regulations to carry out risk assessments and protect the environment from damage that may be caused by work activities involving biological agents or other materials which are potentially hazardous to health.

14.57.4 Risk assessments, and arrangements set out in the form of standard operating procedures (SoPs) or safe systems of work (SSWs), must be communicated to all relevant staff and students prior to work being commenced.

14.57.5 It is the responsibility of the person in charge of the area or procedure to ensure that risk assessments are undertaken; this will usually be the relevant Principal Investigator.

14.57.6 COSHH risk assessment forms and guidance, with a specific template BA1 for use with biological substances, are available at

http://www.ed.ac.uk/schools-departments/health-safety/biosafety/forms

14.57.7 Work with biological agents or other materials which are potentially hazardous to health must not commence without a suitable and sufficient risk assessment being formulated and recorded, and suitable control measures put in place.
14.57.8 All such work must be conducted according to accepted safe systems of work, in appropriate facilities, and by suitably trained and experienced personnel. In addition, work with certain pathogens or GMOs must not commence until the appropriate statutory notifications have been completed and, where appropriate, permissions have been granted (*e.g.* by a GM and Biological Safety Committee).

**14.58.1 Security and Transport Security Plans**: Security Plans are required for work involving designated pathogens, toxins or other relevant materials controlled under laws relating to terrorism and serious crime. Biosecurity Plans should include site, building, laboratory, personnel, data, handling, storage, waste, transport and emergencies.

14.58.2 Transport Security Plans are required for work involving transport of high consequence dangerous goods (HCDG). The Security Plan and Transport Security Plan may be separate or integrated into a single document. For the EbQ Campus, these are prepared by the Campus H&S Manager.

**14.59.1 Safety Folder**: CL3 Lab Managers should maintain a Safety Folder with the CoP and full set of SOP, management arrangements for the CL3 laboratory and work activities as well as important records. Key information from the safety folder should be available within the CL3 laboratory so that workers have immediate access to the written management arrangements and procedures where needed.

14.59.2 The Safety Folder should include the following documents, although other documents may be required:

- Code of Practice (CoP)
- All relevant general, COSHH, BA and GM risk assessments
- All relevant Material/Product Safety Data Sheets

- Standard Operating Procedures (SOP) for all routine, non-routine and emergency procedures
- Plans and operating instructions for the laboratory, equipment, plant, and controls
- Suppliers and manufacturer's instructions
- Maintenance and service records
- Validation and test reports and certificates
- Auditing and inspection reports
- Self-inspection checklists
- Inventories
- Training and assessment of competence records
- Lists of authorised persons
- Individual exposure records
- Security and Transport Security Plans
- Emergency contact information

**14.60.1 Role and Responsibilities of Principal Investigators**: Line managers and Principal Investigators (PIs) have overall accountability and responsibility for the management of their CL3 laboratories and facilities.

14.60.2 PIs and their own line managers must ensure that the management, operation and maintenance of their CL3 laboratories meets the required standards for health and safety and environmental protection.

14.60.3 PIs may designate a CL3 Laboratory Manager to assist them in the management of their CL laboratories. This does not change the overall management responsibility of the PI. If the PI does not appoint a CL3 Laboratory Manager to assist them in the operational duties, then the PI is the CL3 lab manager with direct responsibility for the day to day management, operation and supervision of their labs and staff, students and visitors.

14.60.4 Managers and PIs must to support and cooperate with the CL3 Lab Manager to ensure the safe and effective management and operation of the CL3 laboratories.

**14.61.1 Role and Responsibilities of CL3 Laboratory Managers**: Every CL3 laboratory must have a designated CL3 Lab Manager, and preferably also a Deputy. The CL3 Lab Manager will be the PI(s), or else a person appointed to take on the day-to-day responsibilities of the laboratory management and operational control.

14.61.2 The CoP for the CL3 lab should specify the general responsibilities of the CL3 Lab Manager (and Deputy, where one is appointed); and briefly, they will include overseeing the safety systems and arrangements for the management, operation and maintenance of the laboratory and related activities and dealing with contractors.

14.61.3 The CL3 Lab Manager should monitor and review the effectiveness of the safety arrangements and ensure that there is adequate supervision of staff, students and visitors to their laboratory. They should ensure that there are systems in place for training and assessment of competence of workers. The CL 3 lab manager assists management in planning, implementing, monitoring and reviewing the risk controls.

14.61.4 The appointment of a CL3 Lab Manager does not replace the responsibility and accountability of line management and Principal Investigator(s).

**14.62.1 Role and Responsibilities of Research Staff and Students**: The CoP should specify the general responsibilities of research staff and students and this would include cooperation with the relevant PI(s) and CL3 Lab Manager and compliance with the safety systems and arrangements for the management and operation of the CL3 laboratory and project specific activities.

14.62.2 Staff and students must comply with the CoP, SOPs and emergency procedures, and report any issues or incidents to the CL3 Lab Manager as soon as practicable.

**14.63.1 Role and Responsibilities of Visitors and Contractors**: The CoP should specify the general responsibilities of visitors, and this will include cooperation with the relevant PI(s) and CL 3 lab manager and compliance with the safety systems and arrangements for the management and operation of the CL3 laboratory.

14.63.2 Visitors should comply with the CoP, SOPs and emergency procedures and report any issues or incidents to the CL 3 lab manager as soon as practicable.

14.63.3 Contractors must communicate and cooperate with the CL3 Lab Manager in relation to maintenance, servicing and others activities relating to the CL3 lab.

**14.64.1 Instruction, Information and Training (1)**: The University's Biosafety Unit offers training courses to provide the necessary basic knowledge in biosafety, genetic modification work and the transport of biological materials. Further guidance on this training can be found at:

http://www.ed.ac.uk/schools-departments/health-safety/biosafety/training

14.64.2 The Health and Safety Department's Biosafety Training Institute (BTI) also provides professional training to the Biosafety Practitioner level 1, a SCQF level 11 course accredited by the University of Edinburgh and the Institute for Safety in Technology and Research (ISTR). Further guidance on this training can be found at:

http://www.bti.ed.ac.uk/

**14.65.1 Supervision**: Suitable and sufficient day-to-day supervision of work with biological agents must be arranged by each research group's line managers; GMBSOs/BSAs do not provide supervision of biological workers.

14.65.2 It is for the line manager (this will usually be the relevant Principal Investigator) to determine what is an appropriate degree of supervision, although direct supervision is always required for undergraduates and other inexperienced individuals working with potentially biohazardous materials.

**14.66.1 Control Measures (1)**: Appropriate control measures to protect people and the environment must be identified during the risk assessment process.

It is the responsibility of the Campus and relevant Deanery within the School of Medicine to ensure that these control measures are fit for purpose, are being correctly used, and equipment is being properly maintained (*i.e.* to the required standard and at the correct frequency).

14.66.2 Some equipment may be maintained by the University's Estates Department (*e.g.* air handling plant); however, Deaneries must ensure that this equipment is available for testing, and that any defects are reported as soon as possible (and that the equipment is deactivated/removed from use until defects are remedied).

14.66.3 Further guidance on equipment such as microbiological safety cabinets and autoclaves can be found within:

http://www.ed.ac.uk/schools-departments/health-safety/biosafety

**14.67.1 Personal Protective Equipment (PPE) (1)**: Personal Protective Equipment, including Respiratory Protective Equipment (RPE), must be worn at all times by workers where stipulated by the relevant risk assessment.

13.67.2 It is the responsibility of the PI/supervisor/manager in these circumstances to ensure that the Personal Protective Equipment is obtained, deployed, worn and used properly by all staff, students and visitors.

**14.68.1 New Facilities and Equipment**: Health and safety must always be given prominent consideration when planning a new facility or upgrading, refurbishing or reequipping an existing one. Equipment should be chosen after careful consideration of all requirements, including level of control or containment needed, as well as space, utilities and cost considerations.

14.68.2 It is essential that the planners/designers/architects consult at an early stage with the end-users as to specific requirements, and the Campus H&S manager and/or a member of the University's corporate Health and Safety Department will usually be invited to attend early project and design meetings along with users representatives in order to ensure that health and safety matters are raised or considered, and that appropriate expertise is available.

14.68.3 Further guidance is available online at:

http://www.ed.ac.uk/schools-departments/health-safety/biosafety

**14.69.1 Basic Requirements for Work with Biological Agents**: Some requirements for work with biological agents (BA) are determined by the specific group of the biological agents involved in the work.

*Group 1 BAs*: The possession or use of Group 1 Biological Agents is subject to the following requirements:

1. BA Risk Assessment: A BA risk assessment (completed and endorsed) is required for work involving the use of or exposure to Group 1 Biological Agents.

2. Monitoring: PIs must monitor the work to ensure that the controls are used and effective.
3. Review: BA risk assessments must be reviewed and amended immediately where there are any changes to the activity or the risks.
4. Records: Campus-based GM & Biological Safety Officers (GMBSOs) must maintain records of BA risk assessments, including all revised versions, and all other relevant records.

*Group 2 BAs*: The possession or use of Group 2 Biological Agents is subject to the following requirements:

1. BA Risk Assessment: A BA risk assessment (completed and endorsed) is required for work involving the use of or exposure to Group 2 Biological Agents.
2. Pathogen and Toxin Registration: Group 2 Biological Agents must be notified to the Campus and relevant Deanery, and registered with the University using the pathogen and toxin registration form on the RETAIN system. The registration of pathogens and toxins must be done before any biological agents are brought onto the EbQ campus.
3. Monitoring: PIs must monitor the work to ensure that the controls are used and effective.
4. Review: BA risk assessments must be reviewed and amended immediately where there are any changes to the activity or the risks.
5. Records: Campus-based GM & Biological Safety Officers (GMBSOs) must maintain records of BA risk assessments, including all revised versions, and all other relevant records.

*Group 3 BAs*: The possession or use of Group 3 Biological Agents, also including the Group 2 Agents *Bordetella pertussis*, *Corynebacterium diphtheriae* and *Neisseria meningitidis*, is subject to the following requirements:

1. BA Risk Assessment: A BA risk assessment (completed and endorsed) is required for work involving the use of or exposure to Group 3 Biological Agents, also including the Group 2 Biological Agents *Bordetella pertussis*, *Corynebacterium diphtheriae* and *Neisseria meningitidis*.
2. GM & Biological Safety Committee Advice and Permission: Group 3 Biological Agents and the Group 2 agents *Bordetella pertussis*, *Corynebacterium diphtheriae* and *Neisseria meningitidis* require BA risk require assessments and permission from a GM and Biological Safety Committee (GMBSC) and the Health and Safety Executive (HSE) before bringing any biological agents into the University or starting work. The Principal Investigator (PI) must complete and email the BA risk assessment form to the relevant GM Biological Safety Officer (GMBSO) for submission to the relevant GMBSC. The GMBSO must contact the University's Biological Safety Adviser (UBSA) for advice on all notifiable BA risk assessments. The GMBSC will review and advise on the BA risk assessment and may request amendments.
The GMBSC will provisionally approve satisfactory BA risk assessments. Final approval by the GMBSC will only be issued once HSE consent has been obtained.

3. HSE Notification and Consent: For Group 3 Biological Agents, including the Group 2 agents *Bordetella pertussis*, *Corynebacterium diphtheriae* and *Neisseria meningitidis* a BA risk assessments must be notified to the HSE using an HSE CBA1 notification form. There is no HSE fee required for this type of notification. The UBSA will advise the relevant GMBSO and PI on completion of the CBA1 form and notify the HSE by sending the completed CBA1 form and BA risk assessments to them. The HSE may request further information about the work, or request changes to the risk assessment or controls. The UBSA will inform the GMBSO and PI of all HSE requests and advice and issue the HSE consent once received. The PI may commence the work only once all controls are in place.
4. Pathogen and Toxin Registration: Group 3 Biological Agents must be notified to the Campus H&S Manager and GMBSOs, and registered with the University using the pathogen and toxin registration form on the RETAIN system. The registration of pathogens and toxins must be done before any biological agents are brought onto the EbQ campus, and they must not be acquired until the relevant PI has obtained HSE permission and the relevant campus-based managers have been informed.
5. Monitoring: PIs must monitor the work to ensure that the controls are used and effective.
6. Review: BA risk assessments must be reviewed and revised where there are any changes to the activity or the risks of the work. The University BSA should be contacted by campus-based GMBSOs for advice on revision of all notifiable BA risk assessments. The relevant GMBSC must approve revised BA risk assessments. The GMBSC will notify any significant changes to the project or risks to the UBSA for notification to the HSE. There is no HSE fee required for this type of notification. The UBSA will inform the relevant GMBSC and PI of all HSE requests and advice, and issue the HSE consent once received. The PI may only commence the work once all controls are in place.
7. Records: Campus-based GM & Biological Safety Officers (GMBSOs) must maintain records of BA risk assessments, including all revised versions, and all other relevant records.

14.69.2 The School of Medicine on the Edinburgh bioQuarter campus does not store or work with Group 4 BAs.

**14.70.1 Controlling Risks of Work with Biological Agents**: Control measures intended to protect people, animals, plants and other aspects of the environment from exposure to biological agents must be well-described. The COSHH Regulations require that the risks of exposure to biological agents is prevented; or, where that is not reasonably practicable, then adequately controlled to reduce the risk of exposure to an acceptable level. SAPO, PHO and other environmental laws and regulations require similar specific control measures for animal pathogens or plant pathogens and pests.

14.70.2 The purpose of the BA risk assessment process is to enable workers to select the most suitable controls or combination of controls that are proportionate to the risks. Control measures are systems and actions used to reduce the risks of exposure to biological agents. These include engineering controls such as Containment

Laboratories and Microbiological Safety Cabinets, management controls such as safe operating procedures, training, supervision, and personal protective equipment including laboratory coats, gloves and eye/face protecttion.

**14.71.1 Containment Levels**: Specific control measures and Containment Levels are required for activities with biological agents under COSHH, SAPO, PHO and other relevant laws and regulations, and these are described in HSE guidance *etc* and all relevant licences.

14.71.2 Workers must select the appropriate Containment Level for their work, which is derived from the group classification of the biological agent or what is suspected about the possible presence of a hazardous biological agent.

14.71.3 COSHH specifies minimum containment levels required for the following types of work:

- Containment Level 1 (CL1) for activities which involve work with Hazard Group 1 Biological Agents.
- Containment Level 2 (CL2) for activities which involve work with hazard Group 2 Biological Agents.
- Containment Level 2 (CL2) for laboratories which do not intentionally propagate, concentrate or otherwise increase the risk of exposure to a biological agent, but which work with materials in respect of which it is unlikely that a Hazard Group 3 or Hazard Group 4 Biological Agent is present.
- Containment Level 3 (CL3) for activities which involve work with Hazard Group 3 Biological Agents.
- Containment Level 4 (CL4) for activities which involve work with Hazard Group 4 Biological Agents.
- Containment Level 3 (CL3) or Containment Level 4 (CL4), where appropriate, for laboratories which do not intentionally propagate, concentrate or otherwise increase the risk of exposure to a Hazard Group 3 or Hazard Group 4 Biological Agent but where the employer knows, or it is has grounds to suspect, that such a Containment Level is necessary.
- Containment Level 3 (CL3) for activities where it has not been possible to carry out a conclusive assessment. but where there is concern that the activity might involve a serious health risk for employees.

14.71.4 The School of Medicine on the Edinburgh bioQuarter campus does not store or work with Group 4 BAs.

14.71.5 Essentially, Containment Level 1 is for “no to low-risk work”, Containment Level 2 is for “low to medium risk work”, and Containment Level 3 is for “medium to high risk work”.

14.71.6 There are minimum and recommended control measures that are required for work at each containment level, and these are specified in the relevant HSE guidance as well as SAPO and PHO licences. Containment laboratories, animal facilities and

plant facilities must therefore be classified into one of the three containment levels (CL1-3).

14.71.7 The containment level and all the necessary controls required for the activity must be specified in detail in the BA risk assessment and implemented. In some cases, depending on the nature of the biological agents, or the activity, it may be necessary to use additional control measures.

**14.72.1 Derogations**: In some other cases, there are provisions on the basis of the risk assessment or by obtaining permission for derogation from HSE to apply less than the minimum containment and control measures normally required for that containment level.

14.72.2 Requests for derogations must be made to the HSE, and must be fully justified on the basis of risk assessment and may only be applied on receipt of written agreement from the HSE.

**14.73.1 Control Measures (2)**: The range of control measures that will be necessary should reflect the risks, activity and potential routes of exposure of people, animals or release to the environment. Control measures must be selected also on the basis of the specific requirements of the legislation, which are detailed in relevant HSE guidance.

14.73.2 Any associated SAPO or PHO licences will require additional controls.

14.73.3 The control of risks entails a systematic approach, which requires the application of the most effective control measures that are reasonably practicable, and the selection of risks control measures should be done using a hierarchical approach.

14.73.4 The most effective control measures must be used in preference to the least effective ones, starting with:

- Elimination, followed by;
- Substitution;
- Engineering Controls;
- Administrative Controls; and lastly
- Personal Protective Equipment, Policies and Procedures, and Good Laboratory/Microbiological Practice (Discipline).

14.73.5 If hazardous activities cannot be eliminated, substitute less hazardous activities substituted, control measures should be implemented that prevent or minimise exposure to risk. Control measures must be selected in order of priority set out above according to the level of risk identified in the BA risk assessment to ensure that they are effective.

14.73.6 When deciding on the sort of control measures that it is intend should be used, the most important requirement is that control of exposure should be achieved by the most effective means, and this must not be only by the use of Personal Protective Equipment where more effective measures can be used.

14.73.7 In practice, a combination of control measures are generally used to reduce the risks of exposure to the biological agents. In some cases, depending on the activity, additional control measures may also be necessary; or, in other cases, less stringent control measures may be applied.

14.73.8 Once a decision has been taken regarding the appropriate controls, they must be implemented and used. The controls must be used to reduce the level of exposure to the level that is *As Low as Reasonably Practicable*, and at least to a level which is adequate to protect human health, animals and the environment.

14.73.9 Details of where the work is to be done (*e.g.* in a containment laboratory or animal facility), and how the biological agents will be properly contained, should be clearly set out in the risk assessment.
General control measures should include:

- Systems and procedures for safe use, handling, storage and transport of biological agents;
- Sharps controls;
- Maintenance of equipment;
- Reducing numbers of exposed persons, duration of exposure and quantities to the minimum;
- Controlling the working environment;
- Appropriate disinfection and decontamination;
- Safe collection, storage and disposal of contaminated waste;
- Displaying hazard warning signs; and
- Providing and applying appropriate hygiene measures.

14.73.10 Consider if the work will require partial enclosure (e.g. Class I or Class II microbiological safety cabinets or cage cleaning cabinets, *etc*), total enclosure (*e.g.* Class III microbiological safety cabinets, isolators, anaerobic cabinets, *etc*), other local exhaust ventilation systems (*e.g.* exhaust ducting for laboratory equipment) or general ventilation (e.g. containment laboratories or animal facilities).

14.73.11 Consideration should be given also as to whether there will be a need to control access to the area where the work will be done, by limiting it to authorised persons only.

14.73.12 Where an effective vaccine is available consideration should be given to the possible need for that to be offered to individuals who may be exposed to biological agents at work.

14.73.13 Control measures which are used to prevent or control exposure to biological agents must be properly maintained, examined and tested to ensure that they are working efficiently. The control measures subject to detailed examination and testing include engineering controls, local exhaust ventilation (LEV), which includes microbiological safety cabinets and extract ventilation for equipment, and respiratory protective equipment (RPE).

14.73.14 The precise nature of the maintenance, examination and test and degree of competence of the tester will vary depending on the nature of the equipment. Controls must be visually inspected periodically and maintained according to the manufacturer's instructions.

14.73.15 Local Exhaust Ventilation (LEV) must be regularly maintained and thoroughly examined and tested at least once annually. Respiratory protective equipment must be thoroughly examined and tested at suitable intervals. People and contractors carrying out examinations and tests must be competent.

14.73.16 Where equipment is uncomplicated, and its operation easily checked, a local examination will normally be sufficient. However, where more complex systems are in use an examination by a specialist contractor is likely to be required. This is generally undertaken by the institution where such systems form an integral part of a buildings fabric, such as the air handling systems in containment laboratories and microbiological safety cabinets which are externally ducted to the roof of a building.

14.73.17 Personal protective equipment (PPE) used to protect workers should be stored, checked and cleaned in such ways as to prevent the equipment being a contaminated by biological agents.

14.73.18 An effective fault reporting system must be established. The requirement to inspect and test extends to administrative controls where it may be work practices that ensure adequate control and in these circumstances such systems should be subject to regular monitoring and inspection.

14.73.19 Suitable records of any testing and examination of controls must be kept.

**14.74.1 Local Exhaust Ventilation (LEV) and Microbiological Safety Cabinets (MSCs)**: Local exhaust ventilation is equipment used to control airborne contaminants by containing and capturing hazardous solids, liquids or gases. There are many types of LEV such as fume cupboards and Microbiological Safety Cabinets (MSCs).

14.74.2 Details should the LEV that will be required to control aerosols of biological agents should be set out in the relevant risk assessment.

14.74.3 There are three basic types of MSC .which offer different types of protection to the operator, work and environment:

- Class I (Operator and environment protection).
- Class II (Operator, material and environmental protection).
- Class III (Operator, material and environmental protection).
- Class I/III hybrid (Operator and environmental protection only, or operator, material *and* environmental protection).

14.74.4 Microbiological safety cabinets function by using airflows to capture hazardous aerosols generated by work, transferring microorganisms away from the operator before trapping them in a high efficiency particulate air (HEPA) filter.

14.74.5 Selection requires an assessment of the work and operator protection requirements, but also the proposed location as draughts or physical obstacles may compromise cabinet performance. MSCs must be tested after installation to ensure they provide operator and environment protection.

14.74.6 Commissioning tests need to be repeated whenever an MSC is moved or there is a major change to the local environment. LEV and MSC must be selected, installed and maintained according to the relevant British Standards. Note that fume cupboards and clean cabinets have different functions from MSC and must not be used instead of MSC for work with biological hazards. Clean cabinets are not LEV or safety cabinets. but are designed solely to provide a clean working area, so they do not protect people or the environment and must not be used for work with biological hazards.

**14.75.1 Special Controls**: Details must be provided of any special control measures that workers intend to use. For example, work with toxic or carcinogenic hazards requires a high level of control.

14.75.2 When selecting the appropriate measures for controlling the risks of carcinogens or toxins, the potential for long term and possibly fatal effects must be taken into account. Priority should be given to the Elimination or Substitution of carcinogenic biological agents with a non-carcinogen.

14.75.3 If alternatives are not reasonably practicable then this must be stated with explicit reasons in the risk assessment. If no suitable alternative to the carcinogen is available, exposure to the carcinogenic biological agents must be prevented by the best practicable means and following the hierarchy of control measures. Because of the nature of the risks posed by carcinogens, it is particularly important to select the most effective measures possible.

14.75.4 Strict control measures should be adopted including for example, totally enclosed process and handling, extensive cleaning and disinfection procedures, safe storage and disposal, and prohibition of eating and drinking. The storage, use and disposal of carcinogenic substances require careful control. Carcinogenic substances used in the workplace should be kept to the minimum needed for the process.

14.75.5 Workers must clearly identify the areas in which exposure to carcinogens may occur and take measures to prevent the spread of contamination within and beyond these areas. The number of people likely to be exposed to carcinogenic agents and the duration of their exposure must be kept to the minimum necessary for the work. Non-essential personnel must be excluded.

14.75.6 Where appropriate, store and transport them on-site in closed containers, clearly labelled and with clearly visible warning and hazard signs. Clearly label and securely store carcinogenic waste products until they are removed according to the proper procedures for removal of hazardous waste.

**14.76.1 Personal Protective Equipment (2)**: Details must be provided regarding the personal protective equipment (PPE) that will be required to protect the body, hands, eyes, face *etc*, such as laboratory coats, gowns, gloves or spectacles, goggles or full face shields.

14.76.2 The risk assessment may specify that PPE is required to control exposure to a biological agent or hazard when it is not possible to achieve adequate control over-exposure by any other means and then it should be used only in addition to other appropriate controls. The PPE must be suitable to adequately protect against specific biological agents.

14.76.3 Workers should consider the potential routes of exposure to the biological agents when deciding on appropriate PPE. All PPE must be carefully selected and properly maintained, serviced and cleaned. Workers should be fully trained in the correct use and limitations of each item of PPE.

**14.77.1 Respiratory Protective Equipment**: Details of respiratory protective equipment (RPE), such as respirators, should be set out in the relevant risk assessment, but should only be used where other more effective control measures cannot be used and generally only as an only additional control. RPE may be useful for work with animals.

14.77.2 The type of RPE used must be suitable to adequately protect against the specific biological agents. Simple disposable dust masks do not provide protection against biological agents and should not be used. All RPE must be carefully selected to be appropriate, properly maintained and cleaned. Workers must be fully trained in the correct use of RPE and the limitations of the equipment.

14.77.3 RPE which relies on a tight-fit to the face for protection, such as disposable filtering masks, reusable half-face and full-face masks, and breathing apparatus must be face-fit tested for each individual wearer. Testing must be carried out by trained competent persons.

14.77.4 Once face fit tested to a specific type of RPE then a certificate of test must be obtained and recorded. Workers must only wear the type of RPE on which they were tested, and they may need to be retested periodically.

14.77.5 Face fitting RPE does not work equally well for all individuals or situations, and an alternative option is a powered respirator hood, which supplies filtered air at positive pressure to the breathing zone of the wearer by a soft or hard top hood that encompasses the head.

**14:78.1 Storage and Transport of Biological Agents**: Consideration must be given to the quantity of agents needed and the facilities required to safely store them. Special conditions may also be required, such as ventilation and security. Details of how biological agents will be transported should be set out in the relevant risk assessment (For example, what special packaging and multiple containment will be required for internal and external transport of the biological agents). Special controls may also be required such as, hazard signage, carrying spillage kits and PPE.

**14.79.1 Inactivation of Biological Agents**: Details must be set out in the relevant risk assessment regarding how biological agents used in the work will ultimately be destroyed, since effective inactivation and disposal of waste is an important part of the work.

14.79.2 Biological agents must be inactivated by validated methods. There are chemical and physical methods of inactivating biological agents and validation of effectiveness is required to prove that the inactivation method works.

14.79.3 Biological agents and contaminated waste must be inactivated by either autoclaving or disinfection or both unless other methods are specified in the BA risk assessment and approved by the relevant Biological Safety Committee.

14.79.4 There are situations where autoclaving is not possible (such as where there are biological agents labelled with radioactive isotopes).

14.79.5 Records must be kept.

**14.80.1 Disinfection**: Disinfectants must be appropriate for the relevant biological agents, animals or plants used in the work. The effectiveness of many disinfectants can vary considerable depending on the biological agent, concentration, exposure time, pH and presence of organic matter, liquids or solids.

14.80.2 Disinfectants may be used for inactivating biological agents in solid and liquid materials, and also on contaminated surfaces and equipment. The effectiveness of some disinfectants rapidly diminishes after dilution to working concentrations.

14.80.3 Validation procedures are generally more difficult to achieve for disinfectants than for autoclaving. information on the efficacy of a disinfectant can be obtained from the manufacturer's instructions, published data or in-house testing. In many cases disinfectants are used just as an additional control measure rather than the sole means of inactivating biological agents such as where disinfectants are used prior to autoclaving.

14.80.4 Inactivation is defined as achieving a sufficient % kill commensurate with the risks although 100% kill is normally required. The % kill to be achieved must be defined and appropriate methods of validation and monitoring that demonstrate this is achieved need to be specified and employed.

**14.81.1 Autoclaving**: Autoclaving is the most effective inactivation method and by far the easiest and least time consuming to both validate and monitor. For these reasons it is strongly recommended that all biological agent contaminated waste including all liquid waste and waste destined for incineration be autoclaved unless there is a very good reason to use another method.

14.81.2 Biological agents can be inactivated by autoclaving, typically at 121ºC or 134ºC. Inactivation is defined as achieving a sufficient % kill commensurate with the risks although 100% kill is normally required. The % kill to be achieved must be defined and appropriate methods of validation and monitoring that demonstrate this is achieved need to be specified and employed.

14.81.3 Validation of autoclaving should be carried out using thermocouple mapping. This involves placing multiple independent thermocouples at various sites, including the most inaccessible, within a typical load and recording output during a standard run

to determine if all sites maintain the required temperature for the required time. This is usually done by a maintenance engineer as part of the annual maintenance contract and the printout recording the output from each thermocouple will be provided and should be kept as a record. Because steam penetration varies it is important that validation be conducted using a load that represents the most difficult encountered in normal use.

14.81.4 Monitoring of autoclaving should be carried out on each run to confirm that both the correct temperature and time has been employed. This is very easy if the autoclave includes a built-in thermocouple linked to a chart or digital recorder that monitors each run and provides a printout or that can download the information electronically, and which can be kept as a record.

14.81.5 Most commercially available indicators, including standard autoclave tapes, are not adequate for monitoring inactivation of waste, because they change colour either at temperatures considerably lower than 121ºC, or within minutes of reaching 121ºC, or in the absence of steam penetration, and therefore do not confirm that the appropriate conditions have been maintained for a sufficient time.

14.81.6 A suitable indicator is Browne TST (Time, Steam, and Temperature) test strips. Note that there are several versions of these and it will be necessary to ensure that the appropriate strips for the temperature and time (*e.g.* 121ºC for 20 min or 134ºC for 5 min) are being used. These indicators can be obtained from commercial laboratory suppliers.

14.81.7 A brief statement about the disinfection or autoclaving methods, including and validation and monitoring must be included in the relevant risk assessmentand associated safe system of work. For autoclaving, one or both of the following standard statements should be used:

- All contaminated materials, including waste destined for incineration will be inactivated by autoclaving (100% kill) prior to disposal of waste or cleaning and recycling of reusable laboratory equipment. Autoclaves will be validated by annual thermocouple mapping and each run will be monitored by continuous chart or digital recording of the temperature/time profile;

  Or

- All contaminated materials including waste destined for incineration will be inactivated by autoclaving (100% kill) prior to disposal of waste or cleaning and recycling of reusable laboratory equipment. Autoclaves will be validated by annual thermocouple mapping and each run will be monitored using Browne TST (Time, Steam, and Temperature) test strips (TST indicator 121ºC for 20 min or 134ºC for 5 min).

14.81.8 Records must be kept.

**14.82.1 Waste Management and Disposal**: All aspects of safe waste management must be properly addressed, including labelling, safe handling, storage, transport and

disposal. Waste containing biological agents must be properly inactivated using a validated means before disposal. Workers must describe what waste containers will be used, such as waste bags, bins or sharps bins, and must also describe how waste will be managed and disposed of, such as whether it will be classified as hazardous or non-hazardous waste, biological, chemical and/or radioactive waste.

**14.83.1 Health Surveillance and Immunisation**: Health surveillance is not usually required for most work with biological agents but may be required for certain occupational diseases or adverse health effects to check that people exposed to biological agents are not harmed during their work. It may be useful where there is an identifiable disease or adverse health condition related to work, valid techniques are available for detecting indications of the disease or condition, there is a reasonable likelihood that the disease or condition will occur under the particular work, and where surveillance is likely to further the protection of health of workers. Health surveillance may involve preliminary and ongoing surveillance, questionnaires, interviews, examination, tests, monitoring and referrals. Health surveillance may be required for workers exposed to hazardous biological agents or certain animals and animal allergens.

14.83.2 Monitoring exposure may also be required for certain activities such as work involving laboratory animal allergens (LAA).

14.83.3 Immunisation may be useful as a control measure to protect people against infection by certain biological agents. Vaccines must not be considered as a primary defence against infection, but only as an additional control measure. Refer to guidance published by the University's Occupational Health Unit the website of which contains contacts for information and advice on health surveillance and immunisation.

**14.84.1 Emergency Procedures**: Workers must describe control measures and emergency intended to protect people and the environment from accidental exposure to biological agents. The relevant Principal Investigator and workers together are responsible for ensuring that incidents and emergencies are properly dealt with.

14.84.2 An assessment must be made of the potential for accidental exposure, setting out how to implement emergency procedures. Emergency Plans and procedures must be prepared in advance where needed.

14.84.3 The primary objective of the emergency procedures is the containment of the biological agents and the minimisation of risks to people and the environment.

14.93.4 Consideration must be given to all of the relevant factors, which may include assessing situations, instructions, informing others of accidents, isolation of area, evacuation, seeking assistance, PPE (including RPE), preventing spread of contamination or spills, decontamination of work area or laboratory, safe waste disposal, first aid treatment and medical treatment if required.

14.84.5 Anyone not required to support the emergency action should be excluded from the area. Only people essential for dealing with the emergency of carrying out repairs and other essential work may be permitted in the affected area. They must be

provided with appropriate personal protective equipment and any other necessary equipment.

14.84.6 Emergency and spillage procedures should be specified in relevant standard operating procedures, and spillage kits are likely to be required, and should therefore be provided suitably replete with materials likely to be required.

14.84.7 It is necessary to provide, and prominently display, important emergency procedures within the containment laboratory in the form of clear written instructions. For example, a spillage procedure can be provided on a laminated instruction sheet which can be placed where the hazardous work is done on the wall above a bench or on a piece of equipment.

14.84.8 Appropriate training must be provided in all accident and emergency procedures.

14.84.9 All workers must understand and be able to implement the emergency procedures.

14.84.10 If an emergency occurs, procedures must be put into effect as soon as possible to minimise harm and restore the situation to normality as quickly as possible.

14.84.11 Incidents and emergencies must be reported immediately or as soon as practicable to supervisors, safety advisers, and managers, including use of the accident and incident reporting form that is available to complete on the Health and Safety Department website.

14.84.12 Details should be provided of first aid procedures that may be needed to deal with the specific biological agents or associated with procedures involved in this work in case of an accident or emergency.

14.84.13 Training must be provided in all the relevant emergency first aid procedures. Consider all relevant factors, which may include removing contaminated clothing as quickly as possible, removing contamination from skin, eyes and mouth by thorough washing with water, dealing with minor cuts and small puncture wounds, washing wounds with soap and water and dressing wounds. Use PPE if required when helping injured persons.

14.84.14 Seek help promptly where required from first aiders, paramedics or hospital staff.
Injured persons should be referred to hospital. Call for an ambulance if necessary. Explain the incident and biological agents involved to attending first aiders, paramedics and medical staff.

14.84.15 Occupational Health support in the events of injuries such as needle-stick should be sought from the Infirmary, and not deferred until the next opening hours of the University's own Occupational Health Unit or the casualty's general medical practitioner.

**14.85.1 Emergency Contacts**: Workers must have immediate access to the names and contact details of people to contact in case of an accident or emergency. These must include the name of the Principal Investigator is in charge of the work, together with details of other relevant persons including the workers doing the work and other colleagues involved in the work.

14.85.2 Emergency contacts should not normally include the names of Safety Advisers or Safety Managers, since they are not responsible for the work or for implementing emergency procedures, and are unlikely to know about the specific work or biological agents involved. The information and contact details of managers, safety advisers and coordinators, security, and emergency services should be provided separately (for example in emergency arrangements posters and websites).

**14.86.1 Information, Instruction, Training and Supervision (2)**: Principal Investigators must provide details in the relevant risk assessment of the information, instruction, training, and supervision required for the work. All workers and visitors must be provided with adequate information, instructions, training and supervision to enable them to carry out their work safely. This should include local rules, safe working practices and standard operating procedures on the hazards, risks and effective application of control measures and emergency procedures.

14.86.2 Standard operating procedures are required for every aspect of the work relating to high containment laboratories. It is important that information, instructions and training is appropriate to the level of risk and in a form that will be understood by those involved in the work. Information should be kept up to date taking into account any significant changes in the work. The control measures will not be effective if those involved in the work do not know their purpose, how to use them properly, or the importance of reporting faults. Records of information, instruction and training should be kept.

14.86.3 All workers and visitors must be adequately supervised. The Principal Investigator must decide on the level of supervision required to do the work, and that should be proportionate to the risks of the work, the containment level and competence of workers. Some work may not be carried out without direct personal supervision, or not be started without the advice and approval of supervisor, while other work can be carried out without direct supervision. Some work may require more than one person to carry it out safely; this has implications also for late and lone working policies and arrangements (See Sections 9 and 10 of this Safety Manual).

**14.87.1 Approval of BA Risk Assessments**: The (risk) assessor and Principal Investigator or manager must sign and date the form to state that they have assessed the risks and reviewed and approved the risk assessment. The Principal Investigator may delegate the work of preparing a risk assessment to a competent member of the team, but the Principal Investigator retains the responsibility for approval and ensuring that the assessment is adequate for the work.

14.87.2 The assessment must be carried out correctly and to a suitable and sufficient standard identifying the hazards, risks, who or what might be at risk and the selection of appropriate controls for the work. You should consult with other people who might be adversely affected by the work where it is necessary including other groups and

workers. Note that all notifiable BA risk assessments require advice and approval from the relevant (GM)BSO and (GM)BSC.

**14.88.1 Notification and Licensing of Work with Biological Agents**: COSHH requires HSE to be notified of premises and certain higher risk activities in advance of commencement of the work. The University of Edinburgh is notified to HSE as a single premises (207) for the purposes of work with biological agents.

14.88.2 Group 3 and 4 biological agents and the Group 2 agents and hazards *Bordetella pertussis*, *Corynebacterium diphtheriae* and *Neisseria meningitidis* activities have to be notified in advance to the HSE on an individual basis and specific consent obtained to carry out the work.

14.88.3 HSE produces a CBA1 notification form to provide the information and request consent for the activity. A copy of the BA risk assessment for the work has to be provided as part of the notification. HSE will send acknowledgement of the notification and there are then various notification periods before work can start depending on the particular activity and whether that group of work has been done at the premises previously. HSE examines notifications and may request additional information, impose conditions and time limits to consents and revoke or vary them. HSE does not charge any fees for processing COSHH notifications. Work may not start until HSE has given written consent.

14.88.4 HSE must be notified of any subsequent significant changes to the scope or risks of the work covered by a BA risk assessment that has been notified under COSHH which may have a bearing on the risk assessment or controls. HSE must be informed of any changes to processes, procedures or agents that are of importance to health and safety and which render the original notification invalid. Workers must review and revise the risks of the project and make the appropriate changes to the BA risk assessment. If the changes are within the scope of the original notified project, and there is no significant increase in the risks of the work, then they only need to make the changes to the risk assessment and obtain the relevant BSC approval and no further action is required.

14.88.5 If the changes are within the scope of the original notified project, but will significantly increase the risks of the work, then workers must not carry out the work until consent for these changes has been obtained from the relevant (GM)BSC and HSE. This will require making changes to the BA risk assessment and sending the modified risk assessment and an updated CBA1 notification to the HSE.

14.88.6 Note that workers cannot change the scope of the original notified project. If the changes are outside the scope of the original notified project, whether or not it changes the risks, then they must not carry out the work until consent has been obtained from the BSC and HSE. This will require a separate new BA risk assessment, (GM)BSC approval and CBA1 notification to HSE.

14.88.7 HSE must be notified when any notified project has ceased and all of the biological agents have been destroyed. Information submitted to HSE as part of a notification is placed on the public register on the HSE website. However, in certain circumstances, it is possible to claim confidentiality and exemption from public

disclosure for some information but any claim has to be fully justified against stringent criteria and is subject to agreement by HSE.

14.88.8 COSHH notifications do not have to be made if the activity has already been notified under the Genetically Modified Organisms (Contained Use) Regulations.
Serious animal pathogens and pests are covered by specific animal health and environmental laws and may require licences from HSE on behalf of animal agencies for possession, use, consignment, importation and exportation.

14.88.9 The COSHH and SAPO or environmental classifications are not complementary, and the requirements are very different for the containment and control of human and animal pathogens and pests. Compliance with one does not absolve managers, principal investigators and their workers from responsibilities under the other, and in all cases where there is any discrepancy between COSHH, SAPO or other relevant requirements then workers must comply with all of the requirements for containment and control although the higher control requirements must be the minimum standard, which must then be followed.

14.88.10 Principal Investigators must keep a list of workers exposed to Group 3 or 4 agents, including details of the type of work involved, the agents to which they have been exposed, and records of exposures, accidents or incidents. There is an exemption to this requirement if the risk assessment indicates the activity does not involve a deliberate intention to work with or use the agent or that there is no significant health risk to exposed workers. The list must be kept for at least 40 years from the last known exposure or work.

14.88.11 HSE must be notified of any accident involving a significant and unintended release of biological agents that present an immediate or delayed hazard to either human health and safety or the environment. This requirement is in addition to any notification requirements under Reporting of Injuries, Diseases and Dangerous

14.89.12 Occurrences Regulations (RIDDOR). The HSE notification must provide information on the circumstances of the incident, identity and quantity of biological agents concerned, any information necessary to assess the risks and the actions taken to deal with the accident. Note that all incident reports should be made to the Health and Safety Department and Biosafety Unit, which makes RIDDOR and other reports to HSE.

**14.89.1 Registration of Pathogens and Toxins**: Workers must register any Group 2, 3 or 4 biological agents and any animal pathogens or pests, and also any pathogen or toxin on Schedule 5 list of the Anti-Terrorism, Crime and Security Act. Workers must also register any species, strains or isolates not appearing in any of one above lists when there are reasonable grounds for suspecting it might be a previously unrecognised human, animal pathogen or plant pathogen or pest. The Principal Investigator must register their materials using the pathogen and toxins registration form using the RETAIN system.

14.89.2 Principal Investigators must keep details of strains, origin, or other identification of the biological agents and of all individuals who have access to the

materials. These records must be kept readily available for inspection and use in an emergency.

**14.90.1 Monitoring of Work with Biological Agents**: The Principal Investigator must carefully monitor the work. If the relevant BA risk assessment is suitable and sufficient for the work, then each identified control measure is necessary to prevent or control exposure to risk of people, animals and other aspects of the environment. Active monitoring is necessary to ensure that the control measures identified in the BA risk assessment are appropriate, effective and properly implemented. The review process will provide a point of reference to decide if the risk assessment remains valid but regular monitoring can identify problems at any stage.

14.90.2 Regular checks must be made of what workers are doing to ensure that the work is being done safely. The type of monitoring needed is proportional to the risks with higher risk work requiring a higher level of monitoring than lower risk work.

14.90.3 Where problems are identified, such as with the BA risk assessment, controls or the need for additional training or supervision, then action must be taken and the necessary changes or improvements must be to the risk assessment, controls, instructions, training and supervision.

**14.91.1 Records and Review of BA Risk Assessments and Controls**: BA risk assessments and controls must be reviewed regularly and immediately if they are no longer valid such as if there has been a significant change to the scope or risks of the work. When reviewing the risk assessment the effectiveness of the preventative or control measures should be carefully re-examined. BA risk assessments should in any case be periodically reviewed at least annually. If review of the risk assessment concludes that changes are required then those changes must be made while following the correct process.

14.91.2 When work relating to a notified BA risk assessment has been completed, the project can be closed. A notified BA risk assessment project can legally only be closed if all biological agents are destroyed or transferred to another appropriate notified and approved BA risk assessment. Notified BA risk assessment projects can only be closed by notifying the BSC and HSE.

14.91.3 The Principal Investigator must keep the BA risk assessments, training records, maintenance and testing records and any other relevant records. The BA risk assessment should be prepared and maintained electronically so that these may be accessed, reviewed and communicated easily. The records must be available for examination at any reasonable time by the managers, safety advisers, safety representatives and HSE inspectors.

**14.92.1 CL3 Lab Audits**: At least two audits/safety inspections of each CL3 laboratory must be carried out each year, one of which should involve the University's Biological safety Unit.

**14.93.1 HSE ACDP Guidance on the Management and Operation of Microbiological Containment Laboratories**: This is the main HSE guidance on the

management of CL3 laboratories which we need to use (including safety advisers, CL3 lab managers, PIs, *etc*). The document is available to review at:

https://www.hse.gov.uk/biosafety/management-containment-labs.pdf

**14.94.1 UofE Biological Safety Unit Guidance on Management of CL3 Laboratories**: There is a considerable amount of guidance and training on the University's H&S Department website in relation to management of CL3 labs. Links to key HSE, SAPO, GMO(CU), COSHH *etc* guidance and websites is available within on the BSU website and in BSU guidance docs. Relevant BS/EN standards are available online through the University Library.

**14.95.1 CL3 Roles and Responsibilities, Competence and Training**: Every CL3 lab must have a Code of Practice that includes details of the roles and responsibilities, training and competence of PIs, CL3 lab manager, research staff and students and visitors, *etc*. An assessment of competence for each role and individual worker is required. SOP and training records/competence checklist(s) should be used to demonstrate the assessment of competence (CL3 lab managers, staff/students, visitors, *etc*).

14.95.2: Schools and Principal Investigators have overall responsibility and accountability for the management of their CL3 labs. Schools/PIs may choose to appoint one or more CL3 lab managers to assist them in carrying out their duties. If no separate CL3 Lab Manager is appointed then it is the PI who will be designated as the CL3 Lab Manager.

14.95.3 Training and competence of CL3 lab managers requires careful selection of competent and suitable persons to fulfil the role (preferably workers with previous relevant experience). Principal Investigator(s) and their team(s) must provide local induction and training for their CL3 Lab Managers, which may include: School/Campus-based training; University H&S Department and Biological Safety Unit training; BTI BSP Level 1 training; and possibly external training courses. Training and competence must be assessed for all CL3 workers, including CL3 Lab Manager(s) in formal local processes.

14.95.4 New and inexperienced CL3 Lab Mangers should be supported by experienced CL3 Lab Managers in other University areas operating CL3 laboratories. Useful general training can be delivered by experienced CL3 lab managers.

14.95.5 CL3 Lab Managers can undertake more advanced formal training in CL3 laboratory (e.g. HSE's Buxton Training CL3 course or UKHSA Porton Down Training's CL3 course). This is training that any CL3 Lab Manager may find useful, but it is particularly valuable and applicable to CL3 Lab Managers who manage 'Full CL3 laboratories' as opposed to 'Derogated CL3 laboratories'.

14.95.6 The University strongly recommends that CL3 lab managers who manage a 'Full' CL3 lab do one of the formal CL3 training courses (*e.g.* HSE or UKHSA).
HSE Training at Buxton, Derbyshire. Course title (in-person training): Biosafety - Working Practices and Managing Safety at Containment Level 3

(https://www.hsl.gov.uk/health-and-safety-training-courses/biosafety---working-practices-and-managing-safety-at-containment-level-3).

Or

UKHSA Biosafety and Applied Microbiology Training at Porton Down, Wiltshire. Course title (in person): An Introduction to the Principles and Practices of Working Safely at ACDP Containment Level 3 (https://www.ukhsa-protectionservices.org.uk/nadp/).

**14.96.1 Maintenance and Validation**: The following is an overview and notes of some points to assist in relation to key maintenance and validation reports for CL3 labs. The list below does not include all the checks and checklists needed for systems and equipment operation and lab activities *etc*, but is mainly about some key maintenance and proving reports required. (Note this list is not exhaustive and other things may be required depending on equipment and CL3 lab types, *etc*).

14.97.2 For CL3 laboratories the following key reports for the safety critical systems and equipment include: LEV room ventilation and control systems; sealability of labs; fumigation of labs and MSC; MSCs; and autoclaves (including for autoclaves used for CL3 even if outside CL3 laboratory or suite):

*Microbiological Safety Cabinets (MSC)*

- Report for '6 monthly' COSHH Thorough examination and test and including KI test (BS EN 12469 2000 Microbiological safety cabinets.
- Performance criteria: Fumigation before thorough examination and test (Preferably Hydrogen peroxide, unless formaldehyde is absolutely required for a hazard control reason).
- Regular local checks on MSC airflows using a calibrated vane anemometer (See the MSC manufacturer's instructions and BS EN 12469 2000 Microbiological safety cabinets - Performance criteria).
- CL3 laboratories should obtain or have use of a vane anemometer (maintained and calibrated in accordance with manufacturer's instructions etc). Checklists kept with readings for each MSC.

*Autoclaves*

- Report for 'Annual' Thorough examination and test based on the requirements in the PSSR Written Scheme of Examination (WSE).
- Report for '6 monthly' validation tests for waste inactivation runs.

*LEV Room Ventilation Systems*

- Report for Thorough examination and test of room LEV systems.

*Room Sealability of Full CL3 labs*

- Report for annual validation of room sealability (*e.g.* combination of visual inspection, smoke pencil, room 'smoke' and leak detection tests, and pressure test at commissioning or first use and periodically which could be annual if desired but at least every five years, and when required).

*Room fumigation of Full CL3 labs*

- Report for validation of fumigation for routine fumigation (This need not be done every year, but is typically developed at the commissioning or first use stage then redone where needed – failures, changes of fabric or systems, changes of fumigation system or equipment, or relevant lab equipment or controls, *etc*).
  Report for validation of fumigation for emergency fumigation (As above for routine fumigation).

*Other safety critical systems or equipment*

- As required

14.97.3 Timescales above may change if there are failure events, retests needed, *etc*.

## EXPORT CONTROLS

**14.98.1 General Information**: People intending to share information (including samples of certain specified substances, microbiological agents, equipment, *etc*) with others in overseas institutions *etc*, must first determine the legality of doing so, taking into account restrictions and embargoes that might exist between this country and the place where they may wish to send materials or from which a request has been received, and sanctions that in existence.

14.98.2 Advice and guidance should always be sought from the University's Research Support Office and Legal Services.

## FURTHER INFORMATION

**14.99.1 Further Information:** General safety precautions are described also on the University's Health and Safety web site:

https://www.ed.ac.uk/health-safety

14.99.2 General safety regulations and general laboratory safety precautions for University laboratories on the Edinburgh bioQuarter site are described in Sections 12 and 13 of this Manual.

14.99.3 The College's Health and Safety Manager for the Edinburgh bioQuarter campus (Tel: 26390 or email: lgm@staffmail.ed.ac.uk) or the University's centrally-based Health and Safety Department may be contacted for further advice (Tel: 514255 or email: Health.Safety@ed.ac.uk). If the query relates specifically to biological safety matters, then contact the University's Biological Safety Adviser (Tel: 514245 or email: Biosafety@ed.ac.uk) or, for radiation matters, the University's Radiation Protection Adviser (Tel: 502818 or email: Radiation@ed.ac.uk).

**ANNEX A**

# Model for a Spill Management Plan

# Laboratory Spills


## Scope

This document provides guidance on how to deal with biological and chemical spills in the containment level 2 (CL-2) laboratory. The need for spill planning is a part of the Control of Substances Hazardous to Health (COSHH) legislation and a risk assessment for working with a hazardous substance, both chemical and biological hazards, must include information how to deal with a spill to supplement a generic spill action plan. This guide does not cover spills in higher containment laboratories (CL3), or spills involving radioactive substances as spill response in the CL3 and radiation controlled areas are covered in the CL3 Code of Practice and Radiation Local Rules respectively. A general spill guide cannot provide prescriptive guidance for every spill situation as a spill response is dependent on the,

- the hazard (infectious, corrosive, toxic, flammable),
- the quantity spilled (large or small),
- the location (contained inside a fume Cupboard, microbiological safety cabinet, centrifuge or on the floor or benchtop).
- the presence of noxious, toxic or harmful vapours

The document contains information on biological and chemical spill actions and generic spill guidance and systematic actions, there is one for simple spills and one for complex spills. Dealing with casualties and first aid emergencies takes priority over cleaning up a spill and first aid guidance on chemical burns and dealing with contamination are given.

The use of spill kits and personal protective equipment (PPE) and how to deploy these when dealing with a spill is covered. The guide discusses specific spill scenarios, including a biological spill inside a safety cabinet or a centrifuge, as well as the most common chemical spills in the laboratory. Spill prevention and mitigation measures are also touched on.

## Biological Spills

A biological risk assessment for the work with the biological material/agent (and any chemicals used in the procedure) should identify the appropriate action in the event of

a spill. This includes the disinfection method and waste streams to use. The user of the biological material should be aware of the method of decontamination before any work begins and, as the person handling the biological material, they will be responsible for cleaning up the spill using the correct procedure.

As necessary, inform lab users in the immediate area of the spill. Remove contaminated clothing and personal protective equipment and wash contaminated skin with soap and warm water. In the event of contact with the eyes, rinse the affected eye using an emergency eye shower for the minimum of 10 minutes.

Prevent the spill spreading using a suitable absorbent, or the contents of a spill kit, by creating a barrier around the spill. Placing the absorbent around the perimeter of the spill to prevent further spread.

The absorbent material should be soaked in a solution of the appropriate disinfectant for the established contact time. Once the disinfection is complete, place the waste absorbent into a biological waste bag or container. Heat treatment, *via* autoclave, may also be required to ensure decontamination and disposal.

## Biological Spills in a Microbiological Safety Cabinet (MSC)

Keep the MSC operational and do not switch off. Stop the spill spreading using a suitable absorbent, and treat with the appropriate solid or liquid disinfectant and established contact time. If the spill involves glass, or other sharps, exercise caution when placing and handling absorbent material.

If the spill has entered the underside of the MSC grill, disinfect and clean the upper area, then remove the grill to disinfect and clean the underside of the cabinet. Ensure that both sides of the grill, and the bottom of the cabinet, are disinfected and cleaned. Splashes onto the sides of the cabinet and/or glass are similarly disinfected and cleaned. Remove residual disinfectant by washing the apparatus/area at least once with clean water and blue roll after disinfection.

## Biological Spills in a Centrifuge

The significant hazard of a biological spill in a centrifuge is the release of aerosols containing biological hazards and specifically infectious agents that transmit by the respiratory route. If a centrifuge malfunctions and a spill containing respiratory pathogens is likely, then respiratory protection is required prior to opening the centrifuge. In the situation where a biological spill has occurred in a centrifuge unbeknown to the user, close the lid again immediately.

When safe to do so turn off the power and isolate centrifuge from the mains, do not open the lid until at least 30 minutes after the run has stopped to minimise the risk posed by aerosol release. Place a warning sign on the centrifuge, to inform users of the incident, whilst waiting for aerosols to dissipate.

Before opening the lid of the centrifuge to begin decontamination, wear safety glasses to protect against splashes to the face and eyes. Spills involving biological agents whose transmission is via the respiratory system require the use of Respiratory

Protective Equipment (RPE), until disinfection is completed and the centrifuge rotor(s) are inside a MSC cabinet.

Blue roll, paper towels or another form of absorbent material may to absorb the spill. The design of some centrifuges will make this problematic but it is important to absorb as much as possible in both the buckets and the base of the centrifuge chamber before the next step.

Broken glass may be present inside the centrifuge if the vessel has ruptured and spilled its contents.

Remove the centrifuge buckets/rotors and place them in a Microbiological safety cabinet for disinfection and cleaning. This will allow all sides of the buckets and rotors to be decontaminated. Consult the manufactures instructions on decontaminating centrifuge rotors and buckets. The lid, walls and base of the centrifuge should be disinfected as small particle spray may have spread anywhere in the chamber. Remove residual disinfectant by washing the apparatus/area at least once with clean water and blue roll.

## Simple Chemical Spills

These are spills where only a very small of amount of liquid or powder has spilled, or the spilled material is a low hazard substance or the spilled substance is contained inside a fume hood or safety cabinet. A spill that is contained within a fume cupboard or safety cabinet and does not pose an immediate risk to laboratory users.

Small spills that do not pose an undue risk to the person cleaning up the spill can be cleaned-up immediately. In this situation, the person cleaning up the spill will understand the risk posed by the chemical hazard and the control measures needed.

For a small volume of liquid, a readily available absorbent such as blue roll or tissue might be suitable. For solids, a dampened absorbent, or careful collection using a brush and scoop, might be appropriate.

## Complex Chemical Spills

Where a large volume of liquid, more than few hundred ml, has spilled, or the spill involves a large amount of powder or the material is very hazardous and is not contained within a fume hood or other LEV and there is a risk to laboratory users from inhalation of vapour or particulates.

A priority is to clear the area and warn other laboratory users. This is particularly important if there is a risk of inhalation of harmful vapours, dust or mists e.g. vapours from volatile solvent or a concentrated acid or particulates or dust from a toxic substance.

Support will be required to deal with a complex spill and the additional actions for safely dealing with a complex spill require a systematic approach to assess and plan the clean-up. Although the action may be as simple as waiting for expert help to

arrive, or it could involve containing the spill and waiting for the vapours to evaporate away followed by any clean up.

A generic spill action plan is outlined on the next page.

# Spill Action Plan:

1. Quickly assess the situation and avoid unnecessarily delaying the spill response.

2. Do NOT attempt to clean up a spill if you are unsure, secure the area and seek advice.

    i. Do not conceal the fact that a spill has occurred.

    ii. Raise awareness and seek assistance.

3. Do NOT put yourself at risk of exposure to hazardous chemicals or infectious agents.

        i. Avoid inhaling vapours where practicable.

4. If flammable liquids are involved, extinguish all sources of ignition

5. Prioritise dealing with contamination on a person first before attempting to clean up spills on surfaces.

    i. Move any casualties to a safe area if possible for treatment.

    ii. As a priority, decontaminate skin and items of clothing including shoes if personal contamination has occurred.

    iii. Provide First Aid and seek medical help as necessary.

6. If the spill has occurred inside the fume hood or safety cabinet close the sash, post a warning sign.

    i. For some chemicals it might be possible to allow it to evaporate away safely inside the fume hood.

7. Spills onto the laboratory floor require immediate action to avoid slips, post a warning in the immediate vicinity to warn users of a spill, or clean up immediately.

    I. Evacuate and isolate the area and inform other lab users immediately, move everyone to a safe distance from the spill.

    II. Isolate the work space to prevent inadvertent entry: Lock access doors and place signs on doors warning of a chemical spill *e.g.* “DO NOT ENTER - SPILL”

    III. If chemical vapours from the spill prevent clean up leave the spill, switch on any LEV in the room, close the laboratory door, post a warning notice and leave dealing with the spill until ventilation of the area has removed any vapour.

8. To deal with the spill, first identify the chemicals spilled, their hazardous properties and assess the risk of exposure.

9. Use the COSHH Risk Assessment detailing the hazard to evaluate the risk, and plan a spill response using appropriate personal protective equipment.

10. Once a risk assessment of the spill is complete, and the correct PPE available, clean up can start. Staff fitted for a suitable respirator with the correct chemical filters may be required

## Personal Protective Equipment (PPE)

Having the correct PPE is essential when dealing with spills. For a simple spill involving a small quantity of material, PPE may be limited to a laboratory coat, chemically resistant gloves and eye protection.



Thin disposable nitrile gloves provide protection against contact with infectious agents but provide limited protection against corrosive or toxic chemicals, and are not suitable where direct contact with hazardous chemical is necessary for example; mopping up a spill by hand using an absorbent pad.

Thicker nitrile, neoprene/nitrile or butyl gloves will be required to prevent skin contact if corrosive or harmful liquids are involved. For spills of large quantities of hazardous chemicals, a chemical suit and breathing apparatus may be required along with expert help.

## Respiratory Protective Equipment (RPE)

If noxious or harmful vapours are present, do not commence spill management until the vapours have dispersed, or there are trained staff wearing appropriate RPE available to assist.

Staff using tight fitting RPE must be face fitted and masks equipped with the correct filter for the hazard present; particulates, organic & inorganic vapour, acid or ammonia.

Positive pressure respirators with a filtered airflow (powered hoods) do not require face fitting, but staff need training to use these correctly as well as having knowledge about the correct filters to the use to protect against the hazard with a powered hood.




## Cleaning-Up Spills

1. If safe to do so and wearing, laboratory coat, eye protection and chemically resistant gloves plan how to clean up the spill safely using a suitable absorbent.

2. Do not use your hands to pick up glass.

3. Pick up broken glass using a scoop or forceps and place in a rigid container for transport and disposal. If the glass is contaminated, place the container with the broken glass inside a fume hood.

4. A damp tissue may be suitable for wiping up low hazard solid chemicals, whilst a dry tissue or other suitable absorbent from a spill kit might be useful for absorbing a liquid spill.

5. Chemical waste and contaminated absorbent collected during clean up should remain in the fume hood, or placed inside the fume hood immediately to contain the hazard.

6. Transfer the contaminated absorbent and waste chemical to a suitable sealable container inside the fume hood. Note: choose an appropriate container as some materials may degrade on contact with an incompatible chemical.

7. Leave the container in the fume hood. Place a warning notice on the fume hood to alert other users to the hazard. Do <u>not</u> remove the container from the fume hood until it is safe to do so.

8. After the bulk of the spill is collected, use a suitable size spill pad or tissue/blue roll and carefully wipe the area down several times. Place the absorbent with the other waste in the container in the fume hood.

9. Decontaminated all items used (plastic scoop, tongs, *etc*.) inside a fume hood if necessary. Remove gross contamination with a dampened paper towel and dispose of the contaminated paper towels to the waste container inside the fume hood. Finally rinse the tools off with copious amounts of water inside the fume hood.

## Cleaning-Up Solids

1. For non-hazardous solids a brush and dust pan or scoop can be used to collect up a solid.

2. Carefully collect the solid and avoid creating an airborne particulate or dust hazard a dampened absorbent could be used.

3. For harmful solids, RPE will be required to prevent inhalation of particulates during the clean-up.

4. Place the solid into a suitable container *e.g.* plastic container or heavy gauge plastic bag.

5. Dampen a spill pad or blue roll to wipe the area down.

6. Use wet-wiping only if the material does not react with water.

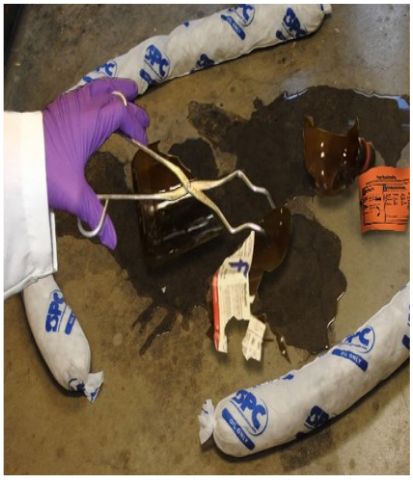
7. Place the contaminated wipes in the plastic bag or container.

## Cleaning-Up Liquids

1. Wearing suitable PPE clean up the spill carefully. Laboratory coat eye protection and chemically resistant gloved to prevent chemical contact with skin as a minimum.
2. Take suitable precautions against inhaling vapours *e.g.* ventilate area and disperse the fumes or wear a respirator with the correct chemical filter.
3. Using a suitable absorbent for example absorbent pads or pillows, absorbent rolls, vermiculite or other granules soak up the liquid and prevent the liquid spreading as follows.
   i. **Carefully place absorbent around the perimeter of the spill and form a bund or dyke to prevent the spill spreading.**
   ii. **Once the spill is contained at the edge, place more absorbent pads, sheets, or granules in the centre of the spill to soak up the liquid. Allow time for the absorbents to collect the liquid.**
   iii. **Pick up broken glass using a scoop or forceps and place it in a rigid container. Do not use your hands to pick up glass.**

**i**

**ii**



**iii**

4. Carefully collect up the contaminated absorbent and place it in a thick polythene bag or other waste container. Alternatively, transfer the saturated absorbents to a tray inside a fume cupboard where vapours can evaporate safely.
5. After removal of the contaminated absorbent use a suitable size spill pad or tissue/blue roll and carefully wipe the area down several times. Place the wipes with any other hazardous waste in the waste container or polythene bag.

6. Any tools used should be decontaminated (*e.g.* plastic scoop, tongs, *etc*.). Remove gross contamination with a dampened paper towel and rinsing the tools off with copious amounts of water inside a FC where necessary.
7. Add any contaminated items to the waste container/bag. Place polythene bags containing the waste inside a strong cardboard box or plastic container.
8. Label the outer container with the contents and arrange for disposal as hazardous chemical waste.

## Balance Spill

It is important to clean up solids spilled onto a balance immediately. The person responsible for the spill may be aware that the chemical is non-hazardous but no one else does.

1. Turn off the balance.
2. Wear protective gloves
3. Remove the material by gentling brushing the solid away using a soft brush.
4. If possible, lift off the top pan and brush the material into a suitable container.
5. To remove liquids, take the pan off and clean it with a soft tissue.

## Mercury Spill

Mercury vapours are toxic, immediately clean-up the spill using: a mercury sponge, suction or dusting with spill kit powder. Mercury spill kits to deal with mercury spills are commercially available. These contain powder, sponges and metal wool.

1. To deal with a small Mercury Spill (*e.g.* a broken Mercury thermometer) dust the area of the spill with the mercury absorbing powder. The powder forms a solid mercury-metal amalgam that is safer and easier to handle than elemental mercury. Collect up the powder using the brush and scoop and place in a suitable container.
2. If a thermometer, breaks above the bulb recover the intact bulb using forceps to carefully lift and place the bulb into a rigid plastic container.
3. Smaller beads of mercury can be carefully ‘herded’ together to form a large bead using a rubber squeegee or piece of card. Using a disposable pipette and bulb a large bead can safely sucked up and transferred to a waste container.
4. Pinhead size beads of mercury can be collected using sticky tape. The sticky side is placed downwards onto the beads of mercury, which will stick to the tape. This technique is useful for collecting mercury beads on carpet or soft furnishing.

Ensure that the area has been thoroughly decontaminated and place the waste mercury and other waste from the clean up into a rigid container with a lid and label as hazardous waste for disposal.

## Spills Involving Very Hazardous Chemicals

Some spills may be so complicated, or involve very hazardous chemicals, that expert assistance is required. For example;

**Flammable & Volatile Liquids:**

The risks from a spill of highly flammable solvents are fire and inhalation of vapours. Volatile liquids spilled within a small space are a risk for inhalation of vapours.

For a large spill of flammable liquid use the complex spill plan, as fire is a significant risk extinguished any ignition sources immediately. For a small spill of a flammable liquid, the liquid can absorbed and the sorbent placed inside a fume cupboard to and the vapour allow to evaporate safely.

Alternatively, place the contaminated sorbent in a suitable container with a sealable lid and relocated to the container to a ventilated location. Contaminated absorbents in the sealed container are disposed of *via* the authorised disposal routes.

**Corrosive Liquids:**

A small spill of corrosive liquid *e.g.* hydrochloric acid or sodium hydroxide can be dealt with quickly and safely by immediately absorbing the liquid onto an absorbent. Standard laboratory PPE; a laboratory coat, eye protection and thick nitrile or other chemically resistant gloves are sufficient. Place contaminated absorbent in a container with a lid, and transfer this to a fume cupboard, any residual contamination on floors or benches can then be removed.

If the spill involves a large volume of a corrosive liquid *e.g.* the bottom falls out of a large glass Winchester, then corrosive or noxious vapours will make clean-up difficult without specialist equipment to protect against inhalation *e.g.* hydrochloric acid or ammonium hydroxide. In this situation evacuate the area, warn other staff and use the large spill response plan.

Spills involving concentrated acids may generate secondary hazards if other chemicals are involved. Concentrated acids can react to create more severe hazards in the form of toxic gases or vapour from chemical reaction *e.g.* reaction of hydrochloric acid and hypochlorite produces toxic chlorine gas.

# Contamination of a Person and First Aid for Chemical Burns

Contamination of a person is a concern in any spill situation and the first priority is to attend to anyone who has been injured or contaminated during the spill. Dealing with contamination and casualties requires care to ensure that those assisting are not placed at risk. Whilst assisting casualties, it is important that they do not contaminate themselves. Gloves and other PPE are necessary used to prevent exposure to the chemical or biological hazard.

- Do not delay decontamination; remove contamination from skin and clothing immediately by flushing the affected area with water. Eyewash stations and emergency showers are available in the laboratory for this purpose.
- If the eyes are contaminated, irrigate with large volumes of clean water continuously, ensure that the contaminated water runs off and away from an unaffected eye or areas of skin.
- Wearing gloves carefully open the eyelid to irrigate the eye fully where possible. Seek medical assistance.
- Irrigate chemical contaminated skin with tepid running water to wash the chemical away. Irrigate the skin <u>for at least 20 minutes.</u>


- Carefully brush any dry powder from the skin before irrigating the area with tap water.
- Take care not to wash the chemical onto unaffected areas of the body and ensure that pools of contaminated water do not collect underneath the casualty.
- Remove any contaminated clothing carefully. Cut items of clothing rather than pulling them over the head to avoid spreading contamination onto unaffected areas.
- Some chemicals cannot be safely diluted, or completely removed with water *e.g.* phenol, hydrofluoric acid and after removal of gross contamination the affected area requires treatment topically with a chemical that will safely neutralise the contamination.
- Phenol burns kits containing PEG 500 are available in the laboratory to treat phenol burns on skin.
- If a casualty needs medical treatment, it is important that information on the chemical involved *e.g.* a copy of the Safety Data Sheet or (COSHH) risk assessment goes with the casualty.

## Spill Kits

Spill kits should always be available in the laboratory to deal with spills and should contain the following items:

- Warning signs to highlight the presence of a spill or slip risk.
- Absorbent in the form of pillows, pads, rolls or sheets or any absorbent that can absorb a liquid.
- Personal Protective Equipment should include laboratory coat, chemically resistant gloves and protective eyewear.
- Scoops, brushes and tongs for handling solids and broken glass.
- Have suitable containers or bags to collect the waste and contaminated materials *e.g.* thick gauge polythene bags, beakers or buckets.

Staff should be familiar with the location of their nearest spill kits. Kits have been located in laboratory weigh rooms in corners, or in under-sink cupboards.




## Waste Disposal

Leave the container with contaminated absorbent & waste chemical in the fume hood. Label the container and post a warning notice to warn other users of the hazard if necessary. Label the waste container with the contents and arrange for disposal as hazardous chemical waste by contacting H&S for assistance.

# Spill Prevention and Mitigation

To reduce the risk of a spill simple measures such as: sensible purchasing of materials *i.e.* minimise quantity, using a less hazardous alternative, working using containment (tray or other), lining the work area with absorbent material *e.g.* Benchkote® as well as storing chemicals safely.

- Purchase hazardous chemical in containers that are unbreakable. For example, concentrated acids and solvents are available in HDPE plastic bottles, or SafeBreak® glass bottles.
- Purchase pre-prepared dilute solutions that are safer to use, store and handle *e.g.* using 5M sodium cyanoborohydride in 1M NaOH rather than preparing it from solid stock. Similarly, using a dilute picric acid solution 1.3% v/v rather than a 60% w/v saturated solution to prepare tissue stains.
- Purchase the minimum quantity necessary and dispose of redundant chemicals when they are no longer required or when they have reached their expiry date.
- The risk of mercury spills can be eliminated by restricting the use of mercury containing thermometers in the laboratory
- Using secondary containment for very hazardous chemicals e.g., safe storage and handling of concentrated acids can be improved and the risk of accidental spills reduced by using secondary containment such as a tray or other compatible plastic container.
- Use a bottle carrier when handling or moving containers from storage to point of use and avoid carrying reagents by hand where necessary.

- Work inside a chemical fume cupboard or other appropriate safety cabinet.
- Work on a plastic tray lined with adsorbent material to contain spills.
- Place Benchkote® with the absorbent surface facing upward or other absorbent onto the work surface.

*Last reviewed/updated: 26th January, 2024*