SITE SAFETY HANDBOOK - BIOLOGICAL LABORATORIES & BEAMLINES

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DOCUMENT HISTORY

Issue	Date	Comment
4	12 Apr 2013	Full revision – Joint document
4.1	22 Jan 2016	Minor revision – changed format of front page, clarification regarding the use of virkon tablets and updated the contact details.
4.2	20 Mar 2019	Minor corrections – updating of links.
4.3	23 April 2019	Minor revision – clarified information regarding the use of liquid nitrogen
4.4	20 December 2021	Review and update – updates include information regarding disposal of dry ice, addition of RFI, inclusion of detailed information on Microbiological Safety Cabinets

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(See Sharepoint (Diamond) for latest version)

Contents

1 PURPOSE AND SCOPE

To define the common procedures for working in biological laboratories and beamlines at Diamond, the Research Complex at Harwell, The Rosalind Franklin Institute and the Science and Technology Facilities Council (STFC, ISIS and CLF).

2 DEFINITIONS

BioCOSHH	COSHH assessment carried out on biological work
BSO	Biological Safety Officer
CL (1,2,3)	Containment Levels (1, 2, 3) (relating to the area requirements for working with the corresponding hazard group of biological agents (HG 1, 2, 3))
COSHH	Control of Substances Hazardous to Health Regulations
Defra	Department for Environment Food and Rural Affairs
FERA	Fera Science Limited
GMOs	Genetically Modified Organisms
HG	Hazard Group
HSE	Health and Safety Executive
MSC	Microbiological Safety Cabinet
PI	Principal Investigator
PPE	Personal Protective Equipment (specify BS EN type)
Person responsible	Senior scientist, Principal Beamline Scientist (PBS), Project supervisor, Sample Safety Team, Lab Manager
RCaH	Research Complex at Harwell
RFI	Rosalind Franklin Institute

3 RESPONSIBILITIES

Area Managers To ensure appropriate personnel are trained in the use of this procedure.

4 PROCEDURE

4.1 Policy

This is a joint Biological Safety document coordinated by Diamond Light Source Ltd, the Research Complex at Harwell (RCaH), RFI and the Science and Technology Facilities Council (STFC, ISIS Neutron & Central Laser Facilities-CLF), hereafter referred to as 'these organisations'. 'On site' refers to the site as a whole and includes all organisations. This document must be reviewed at least annually. It is the policy of these organisations to comply fully with the most current requirements of UK legislation. Below is a list of relevant legislation but is not an exhaustive list:

- Health and Safety at Work etc Act (HSWA)
- Management of Health and Safety at Work Regulations (MHSWR)
- Control of Substances Hazardous to Health Regulations (COSHH)
- Genetically Modified Organisms (Contained Use) Regulations (GMO(CU))
- Human Tissue Act (HTA)

- Specified Animal Pathogens Order (SAPO)
- Plant Health (England) Order
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations
- Anti-Terrorism, Crime and Security Act (ATCSA)

All persons (staff, users, visitors and tenants) working with biological agents at these organisations are required to follow this handbook as part of this policy. It provides a guide to the general rules and codes of good practice that must be adopted when working in a standard biological laboratory or beamline. Further information is referenced throughout this document in the form of local policies and procedures. Should this information be required, contact the local responsible person(s). The guidance contained in this handbook is sufficient for work with hazard group 2 (HG2) biological material handled in containment level 2 (CL2) facilities. It also applies when working with hazard group 1 (HG1) material in containment level 1 (CL1) facilities.

All new substances, including biological agents (wild type and genetically modified) must be risk assessed in accordance with COSHH and GM(CU) regulations before first use on site. All work must be assessed prior to starting the work on site. Biological Activity Risk Assessment forms are available for each site as follows:

Diamond:	HAS-FRM-0029 Biological Activity Risk Assessment form and HAS-PRC-0054 Biological Activity Risk Assessment form completion guidance.
STFC:	STFC SHE form and guidance STFC SHE Code 16: Biological Safety
RCaH and RFI:	Biological Activity Risk Assessment form Biological Activity Risk Assessment form completion guidance

Completed and approved biological risk assessments should be kept locally. A copy may be kept centrally.

4.2 Good Microbiological Practice (GMP) (Containment Levels 1 and 2)

- All biological work must be risk assessed and approved by an appropriate person and Biological Safety Officer (BSO) before the work starts.
- Laboratory access is restricted to authorised personnel only. Local procedures should be followed to gain access authorisation.
- Workplace and environmental exposure to any biological material should be kept to the lowest reasonably practicable level.
- Signs should be displayed where required e.g. mandatory PPE, biohazard warning etc.
- Local codes of practice should be formulated and implemented for the safety of personnel, as required.
- Open toed shoes / sandals must not be worn in laboratories. Long hair must be tied back.
- Mouth pipetting, eating, chewing, drinking, smoking/vaping, storing food and medicines, applying cosmetics etc. are explicitly forbidden in all biological laboratories / beamlines.
- Laboratory coats with overlapping front, tight cuffs must be worn at all times in labs over all clothing including any headscarves, hijab etc. They should be worn properly fastened and changed weekly (or when contaminated.) Dedicated lab coats for CL2 work shall be removed before leaving the CL2 laboratory.
- As identified by risk assessment or if mandatory, disposable gloves must be worn within the laboratory and removed when leaving the containment area. No gloves must be worn outside the containment area. Other PPE, including eye protection, should be worn when required e.g. whether mandatory or as per risk assessment.
- Aerosol production should be minimised and where an aerosol risk has been assessed by risk assessment, all work with HG2 agents shall be carried out in a Microbiological Safety Cabinet (MSC).
- Hands must be washed before leaving labs and when contamination is suspected.
- All biological material being transferred between laboratories must be carried within a secondary container. The outer container must be decontaminated before leaving the laboratory. Therefore no gloves must be worn outside of the laboratories.
- Keep the work area clean, tidy and clutter free at all times. Benches must be cleaned and disinfected after each work activity and at the end of day.
- All vessels containing substances must be clearly labelled at all times with contents, date and owner. Where possible, plastic storage containers should be used in preference to glass ones.
- Glass pipettes and sharps must not be used unless there is no suitable plastic alternative.
- Accidents, incidents, safety concerns and near misses must be reported to the person responsible for the work area, for example the Laboratory Manager and then the relevant Health and Safety person(s).
- Equipment manuals and local instructions must be followed at all times.
- Used glass / plastic ware must be rinsed before being put to wash. Refer to COSHH assessments for disposal of rinses.
- Any breakages must be reported to person responsible for the work area and the experiment for example the local contact and/or Laboratory Manager. See Appendix II for contact details.
- All spills must be contained and disinfected immediately (see spillage section 4.20).

4.3 Personal Protective Equipment (PPE)

Laboratory Coats
Fully fastened, Howie style (overlapping front and tight cuffs) laboratory coats must be worn at all times when in the laboratory. This protective clothing must be removed and left in the laboratory area before leaving.

Laundry Procedures
All protective clothing is maintained by the relevant organisation; PPE must never be taken home by personnel. Laboratory coats must be changed and laundered regularly or when contamination is evident or suspected.

Gloves
Disposable gloves must be worn within biological laboratories either as identified by risk assessment or if mandatory (e.g. in CL2 areas). The choice of glove material must be matched to the substance being used and the task being completed. Door handles, light switches etc. must not be touched, unless specified whilst wearing protective gloves.
Gloves must be changed regularly throughout the day and disposed of when:

- Overtly contaminated.
- The integrity of the glove is compromised.
- Work with hazardous materials is completed.

Hands must be washed following removal of gloves.

Safety Glasses, Masks and Face visors
Eye protection is mandatory and must be appropriate for the task. Tasks can be assessed to determine suitable type of eye protection. Any exceptions to the mandatory eye protection must be risk assessed. Personal glasses are not sufficient eye protection.

Other PPE
Footwear that properly protects the foot from chemical splashes must be worn at all times in the laboratory.
Ear protection is available and must be worn in areas designated as ear protection zones.

Latex Policy
The use of latex is discouraged. Gloves made from alternative materials are available to provide protection against hazardous substances and the task being undertaken. If latex gloves are required to be used, powder free brands must be used.

4.4 Working on Beamlines at Diamond and ISIS

All biological samples will be classed into their defined Hazard Groups (HG), see Appendix I for further details. All samples brought to Diamond or ISIS must have been reviewed by authorised persons at either Diamond or ISIS respectively.

ISIS beamlines: Samples must be validated by ISIS and the Principal Beamline Scientist (PBS) before ERA approval. If work with HG2 agents is required, contact ISIS to discuss facilities.

Diamond beamlines: Facilities exist at Diamond to receive HG2 and HG3 samples. These samples must be validated by Diamond beforehand.

4.5 Lone Working

Lone working should be minimised where at all possible and ideally it should be restricted to those tasks that have a low inherent risk. However, given the 24-hour nature of the facilities on site, it is recognised that this is not always possible. Given this, all out-of-hours work must be discussed with managers beforehand and subject to appropriate risk assessment. Where possible every attempt should be made to ensure that the person working in the laboratory is checked on a regular basis by e.g. Security, EHCs. See Appendix II for contact details.

4.6 Storage of Biological Material

All biological material must be stored such that their containment cannot be breached. The containers should be labelled, leak-proof and their outer surfaces cleaned and/or decontaminated.

Refrigerators and freezers in which biological materials are kept must be labelled with biohazard labels.

An up to date inventory shall be maintained. A list, with references to the location of hazardous biological material in fridges and freezers, should be held in the laboratory.

If moving or transporting biological material on site, adequate precautions must be taken to minimize the risk of leakage and spillage. If there is a requirement to transport hazardous materials to or from site, contact the local Health and Safety department. See Appendix II for contact details.

4.7 Cell Culture Laboratories (CCL)

The space allocated for CCL are dedicated to cell culture functions exclusively, in order to minimize the introduction of potential contaminants.

Staff or users cannot carry out work in the CCL until they have signed off that they have read and understood the Risk Assessments and the Laboratory Code of Practice for the use of the laboratories.

No cell culture work shall be completed without a Risk Assessment being carried out.

Microbiological Safety Cabinet (MSC) will be used to protect the cell culture. While not all cell cultures are hazard group 2 material, the use of CL2 measures will be followed at all times.

No user of the CCL shall culture cells from their own or fellow workers body.

No user of the CCL shall deliberately cultivate biological agents without first co-ordinating with the lab manager and completing an appropriate risk assessment.

A record of all cell lines in cryostorage shall be maintained.

Any queries should be directed to the Laboratory Manager.

4.8 Exposure to Biological Agents

In the event of an exposure to an infectious agent or material, a first aider must be contacted. Use the Biological activity assessment (or BioCOSHH) form if available. The following guidelines must be used:

Intact skin
Remove any contaminated clothing.
Wash contaminated skin for 1 minute with soap and water. Do not scrub.

Broken, cut or damaged skin or puncture wound
Remove any contaminated clothing.
Encourage bleeding.
Gently wash contaminated skin for 5 minutes with soap and water.
Seek medical attention.

Eye contamination
Immediately flush eyes for at least 15 minutes with eyewash. If no eyewash is available, pour water on the eye(s) for 15 minutes, rinsing from the nose outward to avoid contamination of the unaffected eye. Hold eyelids away from your eyeball and rotate your eyes so that all surfaces may be washed thoroughly.
Seek medical attention.

Ingestion or Inhalation
Do not induce vomiting unless advised to do so by a competent health care professional.
Seek medical attention.

Note. When seeking medical attention take the Biological activity (or BioCOSHH) assessment. Details on where to obtain these forms is in Policy Section (4.1).

4.9 Laboratory Equipment

All equipment must be checked, including checking if PAT (Portable Appliance Testing) testing is in date, to ensure it is safe to use. Any faulty equipment must be immediately taken out of use and reported to the Laboratory Manager.

Prior to use all transformers and power leads must be inspected visually for damage.

For all laboratory equipment, follow the local instructions to be found adjacent to or attached to the piece of equipment or can be provided by the lab manager.

Any equipment to be serviced or repaired must be thoroughly disinfected and decontaminated before access by either external or internal personnel. These personnel may request a signed declaration of decontamination status.
Certificates of decontamination are available for each site as follows:

Diamond:	HAS-PRC-0053 – Appendix 2
STFC:	ISIS Biolab Decontamination Form
RCaH:	An updated log on requests are kept on the R: drive
RFI:	Decontamination shall be confirmed in writing by the lab manager.

Any queries should be directed to the Laboratory Manager.

Balances
Balances must be cleaned after each use.

Electrophoresis Rigs
Modifications or other alteration must NOT be carried out on any electrophoresis equipment or power packs.
Power supplies must be connected with the correct polarity.

Sharps including microtomes and scalpels
The use of sharps should be avoided where possible**.** Extreme care should be taken with all sharps. All sharps must be disposed of in designated sharps bins. Individual risk assessments for hazardous equipment including microtomes should be read prior to use.

Microwave Ovens
Sealed containers must never be microwaved, as there is significant risk of explosion. Some items, including metal items and flammables must not be microwaved.
Liquids continue to rise in temperature after completion and thermal gloves must be worn. All items must be attended at all times during the heating process.
Microwaves must not be used to heat food for personal consumption.

Shaking Incubators
All flasks or tubes used for growing cultures must be appropriately sealed and labelled with initials, date and contents.

Flasks must be evenly distributed / balanced on the tray.

Shaking incubators must be cleaned frequently and promptly after a spillage.

In case of a spill of HG2 agents, shaking must be stopped and the doors kept closed for 30 minutes before disinfecting and cleaning up the spill (see 'Spillages').

Autoclaves
Must only be operated by competent and trained personnel.
Ensure items are suitable to be autoclaved e.g. DO NOT autoclave corrosives, flammables, or radioactive materials. Ensure any liquids to be autoclaved are in containers with loosened lids.
Routine inspection, maintenance and validation should be carried out on autoclaves.

4.10 UV Light Sources

The use of UV light poses a risk of injury to the eyes or the skin. There are also electrical and fire hazards associated with the use of UV light sources.

Some chemicals may also react in the presence of UV light. Keep flammable and combustible materials a suitable distance away from the light source.

When using a UV light, a lab coat, gloves and eye protection (appropriate eye protection for UV exposure) must be worn.

Exposure time with UV light sources must be minimized. Burns can be caused by contact with a hot UV lamp, so always label appropriately to warn others in the laboratory that the unit may still be hot.

Gel Doc Systems
In order to eliminate exposure to UV, all set-up, focusing etc. of the gel must be carried out under white light.

Transilluminators

Full face shields must be worn when working with UV sources.

Avoid bare skin by wearing long cuff gloves.

After cutting out bands, dispose of the sharps directly into a sharps bin.

4.11 Working with Radiation

Ionising Radiation
A separate document specifically covering radiation is issued to all employees working with radioactive sources and must be read prior to any work being done with, or in the presence of, ionising radiation. Reference must be made to the local rules before any work is carried out. Before working with radioactive material authorisation MUST be obtained in writing. See Appendix II for contact details.

Lasers
All lasers of classes 3B & 4 must be registered with the Laser Safety Officer (LSO). All lasers must be used in accordance with relevant legislation and in accordance with the manufacturer's guidelines.

4.12 Microbiological Safety Cabinets (MSC)

- Only trained personnel may operate MSCs. Operate according to instructions.
- Check MSC is clean and working properly before use. MSC are subject to annual testing and validation.
- Allow for purge cycles before and after working in MSC.
- Wear PPE (as a minimum this will include lab coat, eye protection and gloves).
- Do NOT use MSCs for hazardous incompatible materials (e.g. some solvents).
- Do NOT operate the MSC if any of the alarms are activated.
- Work within the safe area of the MSC (i.e. the centre of the work area) and where applicable set sash to correct working height.
- Do NOT use MSCs for storage.
- Do NOT obstruct airflow grills in cabinet.
- Minimise movement (e.g. moving of hands) in and out of the MSC.
- Always segregate contaminated and 'clean' materials.
- Clean and disinfect MSC after every use.
- All waste should be placed into a sealed bag within MSC before removal.
- For any spillages in the MSC, refer to the Spillages section for details of how spillages should be dealt with.

See Appendix III for further MSC guidance and information.

4.13 Centrifuges

Only use centrifuges designated for the Containment Level that you are working at. If in doubt, check with Laboratory Manager.

Always inspect the rotor before use. Do not use the rotor if any abnormalities (e.g. cracks, rough spots, pitting) are present.

Centrifuge rotors can be heavy or awkward loads and care should be taken when lifting of moving these. Good manual handling techniques must be observed.

Always ensure that loads are evenly balanced.

Centrifuge lids must be used at all times.

Always observe the manufacturers maximum speed and sample density ratings for each rotor.

Do NOT attempt to move the centrifuge while it is in operation.

Clean and decontaminate all accessible parts after the end of each work period or where potential contamination occurs.

Following potential spillage with Hazard Group 1 material in floor standing centrifuges, where rotors are too heavy to move to an MSC, open with care following the guidance in Spillages (section 4.20).

All floor standing centrifugation work with Hazard Group 2 microorganisms should be double contained. For example, use of the largest 1000ml centrifuge bottles can be carried out using the HarvestLine system. All containers must be opened in a MSC.

If there is a spillage or suspected spillage in centrifuges, follow instruction on clean up in the Spillages section.

4.14 Chemical Safety

A COSHH assessment must be carried out on work involving all chemicals.

All spills must be dealt with immediately with an appropriate chemical spill kit.

Chemicals must be kept to a minimum and stored appropriately.

All chemical waste must be disposed of in accordance with local hazardous waste policy as follows:

Diamond: Waste Disposal procedure HAS-PRC-0044

STFC and ISIS: Safety Code SC31: Controlled and Hazardous Waste

RCaH: General Laboratory Waste Disposal Schematic

RFI: Laboratory Waste Disposal schematic

If you have any queries regarding the route of any chemical waste, contact the local Health and Safety team.

Chemical Spillage First Aid

Contact First Aider. Follow information / instruction on Safety Data Sheet and COSHH assessment. Ensure to take these with the casualty when further medical attention is required.

Heavy Atom Salts

Only the minimum possible amounts of heavy atom salts must be used on site.

All contaminated waste must be disposed of in accordance with the local hazardous waste disposal procedures.

Guidance on chemical safety is available at each site as follows:

Diamond: Chemical laboratories – Safety Handbook HAS-PRC-0056

STFC, ISIS, RCaH and RFI: Safety Code SC31: Controlled and Hazardous Waste

4.15 Use of Sensitizers

Any sensitizing risk from substances being used will be assessed in the BioCOSHH assessment and subsequent control measures must be adhered to in order to minimise the contact with sensitizers. Some spores and moulds may have a sensitizing risk. Some antibiotics, only in powder form, may also have a sensitizing risk.

Persons working with sensitizers must be aware of the sensitizers they are working with and early warning signs of sensitisation (e.g. skin irritation, runny itchy nose, prickly eyes - symptoms improve when away from work). Persons working with sensitizers should consult Occupational Health via line management.

4.16 Liquid Nitrogen and Dry Ice

Liquid Nitrogen

Liquid nitrogen work must be included in the area risk assessment. Only trained staff can handle liquid nitrogen.

The hazards arising from the use of cryogenic liquids are:

- Asphyxiation due to oxygen deficient atmosphere.
- Combustion and explosion hazard from oxygen enrichment.
- Cold burns, frostbite and hypothermia.
- Over-pressurisation.
- Embrittlement.

On hearing an oxygen depletion alarm, leave the area immediately and contact the relevant personnel. Never enter an alarming area even to rescue a casualty, as there is a risk you will become a second casualty.

When handling liquid nitrogen the following must be worn

- Safety goggles or full face shield according to local procedures
- Gloves with tight fitting cuffs
- Suitable footwear where liquid nitrogen cannot become trapped inside (e.g. mesh trainers, boots that gape, etc.)

Do not overfill dewars.

Samples in liquid nitrogen must be stored in cryogenic containers designed for -196°C.

Excess nitrogen in open vessels should be disposed of by leaving the nitrogen to boil off in a well ventilated area. Nitrogen must not be poured down sinks.

Excess nitrogen in dewars should be disposed according to local procedures. See Waste Disposal (section 4.22)

Dry-Ice

Dry ice is solidified carbon dioxide (CO_2) and is extremely cold, -79°C (-109°F). It sublimates (changes directly from solid to gas), releasing CO_2. Carbon dioxide vapour is substantially heavier than air. In confined, poorly ventilated spaces it can displace air, causing asphyxiation.
Always wear PPE, including appropriate gloves when handling dry ice. Never store dry ice in a sealed container as this can result in a rupture or explosion of the container from over-pressurization. Never store dry ice in confined areas as dry ice releases heavy carbon dioxide vapour that can cause rapid loss of consciousness and asphyxiation.
To dispose of dry ice allow it to sublimate or evaporate to the atmosphere in a well-ventilated area where no build-up of carbon dioxide vapour can occur. Even if well ventilated, do not leave in a sink to sublimate/evaporate as this will damage the sink and its related pipework.

Emergency First Aid - Cryoburns

Defrost the affected skin in cold to tepid water for at least 10 minutes. Gently remove any clothing and jewellery from the affected area, unless sticking to the skin. Seek medical attention.

4.17 Gas Cylinders

A COSHH risk assessment must be carried out on work involving hazardous gases.

Any work involving gas cylinders must be carried out by trained and competent personnel.

Keep the absolute minimum in laboratories.

Hazards
The main hazards associated with compressed gas cylinders are: manual handling, high pressure release, cold burns, hazardous or flammable substances and explosion in the event of fire.
Handling cylinders: Do not move or use gas cylinders unless trained and always wear safety footwear.

Gas cylinder safety is available from each entity as follows:

Diamond:	Compressed gas cylinder safety: Code of practice for handling HAS-PRC-0030
STFC, RCaH and RFI:	STFC SHE Safety Code SC33 Safety of pressure and vacuum systems

4.18 Accidents and Incidents

Any incident or accident must be reported immediately to the appropriate responsible person such as the area/lab manager, work supervisor, host of the injured person or witness to the dangerous occurrence via the local reporting system. Local reporting systems as follows:

Diamond:	Incident reporting and investigation HAS-PRC-0003
STFC and RCaH:	STFC SHE Safety Code SC05 Incident Reporting and Investigation
RFI:	Report to SHE@rfi.ac.uk (proforma in alignment with SC05)

The Health and Safety Team will review all accidents and incidents and carry out an investigation if necessary.

Certain categories of accident and incidents will be reported by the Health and Safety Team to the "Competent Authority" (RIDDOR).

Before an employee starts working in a new area on site, he or she should familiarise themselves with the location of:

- The nearest fire alarm
- The nearest first aid box
- The nearest fire extinguisher
- The various escape exits

4.19 Laboratory access for non-laboratory staff

All personnel working on site, including maintenance work, equipment installation, cleaning work etc or visiting the site must follow the local rules and procedures for each organisation as described below. In addition to adhering to local procedures, some groups of people must be risk assessed for the laboratory on an individual basis. These groups include people with special requirements or disabilities, children or young persons i.e. less than 18 years old, new and expectant mothers and immunocompromised individuals.

Diamond and RCaH

Access for non-laboratory staff into laboratory areas, permission procedures must be followed as detailed in documentation below. In summary, personnel requiring entry to an area must contact the person responsible for this area, who will be able to give information about the requirements for access, which may include an induction and will help to co-ordinate the visit. A SHE induction should be undertaken and further inductions may be required.

Diamond: Access Management for Diamond Controlled Premises HAS-PRC-0032
Permit to work (PTW) procedure HAS-PRC-0021
RCaH: RCaH Laboratory Access Policy
STFC: SHE Code 15 Management of Contractors

ISIS

Laboratory access must be given prior approval from the Authorised Trainers (see ISIS contacts Appendix II). A lab induction is required and training records are signed before access is granted. Non laboratory worker training includes instruction on waste disposal requirements, laboratory hazards, procedures and emergency protocols.

For personnel and visitors working in and using the laboratory a more detailed induction is required as detailed in the access policy referenced below.

ISIS Biological Laboratory Access Policy.

RFI

Access to lab areas shall be under the agreement of Lab managers. Visitors shall be hosted at all times. Contractors shall be inducted and managed by their host under delegated responsibility from the lab manager. All staff, visiting scientists and collaborators shall be sufficiently inducted and trained in relation to lab requirements by the lab manager or delegate. RFI shall develop these protocols as lab areas evolve. Note – all RFI labs are CL2 capable

4.20 Spillages

The individual(s) who causes a biological spill is/are responsible for the ensuring the clean-up is completed promptly.

Assistance should be sought from the Laboratory Manager for larger spills.

Small Spill of Biological Material (<500ml) Outside of a MSC
Wearing gloves cover the spill with paper towels and gently apply Virkon (or other suitable and effective disinfectant), proceeding from the outer edge of the spill to its centre, and leave in place for at least 30 minutes.

Pick up the towels and discard into a biohazard container. Pick up any pieces of broken glass with forceps and place in a sharps container.

Re-wipe spill area with disinfectant and thoroughly wash hands after glove removal.

Large Spill of Biological Material (>500ml) Outside of a MSC

Leave the area immediately alerting others in area to do the same.

Remove any contaminated clothing and put into a biohazard bag for later autoclaving.

Wash hands and exposed skin and inform the Responsible person (e.g. PI/Supervisor/Laboratory Manager) of the spill.

Isolate the room and warn others to stay out of the spill area; post a sign stating: "DO NOT ENTER, BIOHAZARD SPILL", contact (name and phone number) for information".

Wait at least 30 minutes before re-entering contaminated area to allow aerosol dissipation.

Put on protective clothing (lab coat, gloves, eye protection and, if indicated, suitable face mask and shoe covers) and assemble clean-up materials.

Cover the spill with paper towels and gently apply Virkon powder (or other suitable disinfectant), proceeding from the outer edge of the spill to its centre. Leave in place for at least 30 minutes.

Collect all treated material and discard in a biohazard container. Pick up any broken glass with forceps and place them into a sharps container.

Re-wipe the spill area with disinfectant.

Carry out final wipe down with 70% ethanol to remove corrosive Virkon traces.

Wash hands thoroughly after completion of clean-up.

The incident must be reported to the responsible person(s) as soon as possible in accordance with the local incident reporting process. For further details Accidents and Incidents (Section 4.18)

Biological Spills inside a MSC

LEAVE THE MSC TURNED ON

With **large biological spillages** (>50 ml), or where liquid spills through the vents, leave the MSC running for at least 10 minutes before cleaning up the spillage with suitable disinfectant solution. Cleaning and decontamination of the spillage must include removal, cleaning and replacement of vents.

With **small biological spillages** (<50ml), while wearing gloves, spray or wipe MSC walls, work surfaces, and equipment with disinfectant solution.

Soak up disinfectant and spill with paper towels. Remove and clean underneath grills. Discard materials into biohazard container.

Carry out a final wipe down with 70% ethanol in order to minimize the corrosive action of agents such as Virkon.

Wash hands and any exposed surfaces thoroughly after the clean-up procedure.

Biological spillages in centrifuges and shaking incubators

If a spillage is found once centrifuge/shaker door is opened, immediately close the centrifuge lid/shaker door with the samples remaining inside and turn the centrifuge/shaker off. If spillage suspected, do not open centrifuge lid/shaker door.

It may be necessary to vacate the lab depending on the nature of the spilled material and its ability to generate an aerosol. If the lab needs to be vacated, secure the room such that others cannot gain access. Post signage indicating restricted entry.

Notify Lab Manager, Principal investigators, supervisors and co-workers of the spillage as quickly as possible.

Wait at least 30 minutes before entering the lab to allow aerosols to settle. Transfer intact centrifuge bottles/flasks to MSC and then treat as per spillages described above.

Spillages must be reported to the responsible person(s) immediately and to the local Health & Safety Team in accordance with local reporting procedures (see section 4.18- Accidents and Incidents) as soon as possible.

Radioactive Spills

This type of spill must be dealt with in accordance with the procedures set out in the Local Rules. The local Radiation Protection Advisor must be advised.

Diamond:	Local Rules for Protection of Persons from Ionising Radiations Radio-Chemical Laboratory TDI-HP-LR-0006
STFC, RCaH and RFI:	STFC SHE Safety Code 14 Radioactive sealed sources STFC SHE Safety Code 21 Management of radioactive waste STFC SHE Safety Code 28 Radioactive open sources STFC SHE Safety Code 29 Management of ionising radiation at work ISIS Local Rules for Protection of Classified Workers

4.21 Decontamination and Disinfection

All material and equipment contaminated with or containing biological agents must be decontaminated:

In most cases, decontamination is accomplished by **steam heat sterilisation in an autoclave**, or by surface decontamination using an appropriate disinfectant. The appropriate decontamination/disinfection method must be determined and described in the relevant Biological activity (or BioCOSHH) risk assessment. If in doubt, contact the Laboratory Manager.
For further guidance, refer to the local Disinfection and Decontamination policy.

Diamond:	Diamond Disinfection and Decontamination policy for Biological Containment Levels 1-2 (HAS-PRC-0053)
STFC:	ISIS Biolab Disinfection Policy ISIS Biolab Waste Disposal Policy
RCaH:	Disinfection and Decontamination in the RCaH
RFI:	Shall follow the guidance within Section 4.21 and as referenced in Biological Activity or BioCOSHH assessments

Virkon is the disinfectant of choice (where effective) and where possible, tablets of virkon (as opposed to powder) should be used. For most applications, a final concentration of 1% virkon is effective, although there are some circumstances when this disinfectant/concentration of disinfectant may not be the best option. The effectiveness of any disinfectant must be validated before the start of any work.

Ensure that validated disinfectant solutions are always available. Each container should be marked with its identity, concentration and date of preparation.

Surfaces can be either sprayed directly with a suitable liquid disinfectant (e.g. 1% virkon) and wiped with a paper towel or wiped down with a paper towel pre-soaked in disinfectant. Surfaces (especially floors) should be dried with fresh paper towels.

It is sometimes desirable to remove residual disinfectant from treated surfaces in order to protect the surface. This can be achieved by wiping down a treated area with 70% ethanol or detergent.

Where there is substantial contamination, affected clothes will need to be removed and disinfected either by the application of 70% ethanol (for small areas) or by autoclaving. Disposable one piece boiler suits are available as a temporary replacement.

Whilst suitable chemical disinfection is not 100% effective, it must reduce the number of viable micro-organisms present. This reduction is dependent on many factors including the titre and infectious dose of the micro-organisms, as well as other factors. All these factors must be taken into account when determining an effective disinfectant. Where chemical disinfection is not possible a gelling agent must be used and the solidified waste consigned for incineration.

4.22 Waste Disposal

These organisations have core facilities for waste disposal - the following is a brief outline of current practices.

If in doubt about any of the information below please contact the Health and Safety Team. More detailed explanations can be found in the local waste disposal policies/procedures.

Diamond:	Waste Disposal Procedure HAS-PRC-0044
STFC and RFI:	STFC SHE Safety Code 31 Controlled and hazardous waste
	ISIS Biolab Waste Disposal policy
RCaH:	General Laboratory Waste Disposal Schematic

All waste arising from biological work must be inactivated by validated means.
All solid waste must be decontaminated, autoclaved or disposed of in designated waste bins.

All liquid waste must be decontaminated by disinfection with Virkon (or other suitable disinfectant). Once decontaminated the liquids may be disposed of via a sink, flushing with copious amounts of water. Flasks, bottles or containers can then be washed in the laboratory dishwashers.

Only authorized persons may operate the autoclave.

When preparing waste for disposal, consideration must be given to any potential hazards, biological or otherwise, to those who carry out the immediate disposal procedures or who might be exposed to discarded items outside the facility.

Sharps must be disposed of in designated sharps bins. Fill these bins to the line indicated, close bins securely, and follow local procedures to send for incineration.

Discard any unused dry ice by leaving the container in a well ventilated area to let the dry ice evaporate. Do not dispose of dry ice in sinks.

Waste contractors must be licensed to transport and store, prior to incineration, biological waste, including both wild type and genetically modified material. Documents verifying the suitability of a waste contractor will be held by the Health and Safety Team (who will be responsible for “duty of care”).

4.23 Ergonomics

Take time to set up your workstation before starting.

Ensure that your chair is set to the correct height. This is where you can keep your lower arms parallel to the bench when using a pipette.

Ensure that you have sufficient leg room.

Set up items that you will frequently use in front of you, and place other, less commonly used items further away.

Do not sit on chair without supporting feet. This places strain on the lower back.

Frequently change your sitting position and relax your arms and shoulders.

Only wear PPE when required by the risk assessment or if mandatory, or when required to protect the work from contamination.

Wherever possible, switch frequently between different types of work when carrying out repetitive tasks.

Pipetting

Select the most suitable pipette for the task to be undertaken.

The wrist should be maintained in a relaxed, neutral position, not flexed, extended or rotated. The shape of the pipette hilt will have some bearing on the posture of the wrist, but the person may be using the pipette in such a way that the wrist is not relaxed.

Release the pipette from time to time and give the fingers/hand a break.

Avoid using a tall narrow discard pot for used pipette tips.

5 REFERENCED DOCUMENTS

Diamond

- HAS-PRC-0024- Liquid Nitrogen and Liquid Helium - Code of practice for handling
- HAS-PRC-0044- Waste Disposal Procedure
- HAS-PRC-0053- Diamond Disinfection and Decontamination Policy for Biological Containment Levels 1-2

STFC

- See STFC Codes https://www.she.stfc.ac.uk/Pages/Codes.aspx

RCaH

- RCaH Good Working Practices
- RCaH Lone working Policy
- RCaH Spill Response SOP
- Shaking Incubator spillage
- Managing Centrifuge Spill in the RCaH
- General Laboratory waste disposal schematic
- RCaH Safe System of Work _Cryogens

Further Reading

A list of documents for further reading can be obtained from your local Health and Safety Team

6 RECORDS

Specifically for biological containment facilities, a list of records to be retained is listed below, although this list is not exhaustive.

Records to be held by each organisation.

- Where service contracts exist, validation and service records for
  - Autoclaves
  - Microbiological Safety Cabinets
  - Centrifuges
- Health surveillance and monitoring
- Training records
- Accident / near miss reports and investigations
- Biological Activity (BioCOSHH and GM) risk assessments
- Records of notifications to HSE relating to use of pathogens and genetically modified organisms
- Special Animal Pathogen and Plant Health Licences from Defra /Human Tissue Act licences from HTA/ FERA and any other licenses and permissions held
- GMSMC and Biological Safety Committee agenda and minutes
- Codes of Practice

- Risk assessments / COSHH assessments
- Audit reports
- Standard Operating Procedures

Records to be held by User Organisations.

Research Ethics Committee (REC) approval letters / Consents
Safety Inspections

APPENDIX I: HAZARD GROUPS (HG)

The COSHH Regulations define four Containment Levels (CL) for laboratory work, with each being appropriate to work involving Biological Agents from the equivalent Hazard Groups (HG). For example, organisms categorised as HG1 (lowest hazard rating) will normally be handled in Laboratory CL1 facilities, while those categorised as HG4 (highest hazard rating) must be handled in CL4 facilities. The purpose of containment is to prevent the exposure of laboratory workers, other people and the outside environment to biological agents.

Hazard Groups 1 to 4 are defined as follows;

Hazard Group 1: A biological agent unlikely to cause human disease.

Hazard Group 2: A biological agent that can cause human disease and may be a hazard to employees; it is unlikely to spread to the community and there is usually effective prophylaxis or effective treatment available.

Hazard Group 3: A biological agent that can cause severe human disease and presents a serious hazard to employees; it may present a risk of spreading to the community, but there is usually effective prophylaxis or treatment available.

Hazard Group 4: A biological agent that causes severe human disease and is a serious hazard to employees; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available.

APPENDIX II: CONTACT DETAILS

Diamond Light Source Ltd.

Experimental Hall Co-ordinators (EHCs) on site 24/7	x8787

Safety, Health and Environment (SHE) Team

Contact Telephone numbers: Guy Thomas (Head of SHE)	x8140
Valerie Loughry (BSO)	x8641
Matthew Channon (Senior Safety Advisor)	x8429
Email:diamondshe@diamond.ac.uk	

Health Physics (HP) Team

Contact Telephone Numbers: Richard Doull (RPA)	x8269
Sanjeev Faruk (Health Physicist)	x8875

Research Complex at Harwell

Operations Manager	x7702
Life Sciences Support	x7707
Physical Sciences support	x7708
SHE Group	x8288

STFC (RAL)

ISIS

Main Control Room (Out of hours / Emergency)	x6789
Biology Lab Manager	TBC
email: TBC	

CLF

Stan Botchway (Senior scientist and Biomedical Lead)	x6260
Brian Wyborn (Departmental Safety Contact)	x5589

STFC (DL)

BID

Mark Roberts (BID Safety Officer)	07917638148
Theresa Hillon (ITAC- Bio technician)	07500097143

RFI

Sheera Abdulla (laboratory manager)	sheera.abdulla@rfi.ac.uk
Chelsea Norman (senior laboratory support technician)	Chelsea.Norman@rfi.ac.uk
Andy Huckstep (Building & Safety Manager)	andy.huckstep@rfi.ac.uk
Gordon Perry (SHE advisor)	TBC

APPENDIX III: MICROBIOLOGICAL SAFETY CABINET (MSC) GUIDANCE

What is a MSC?

A MSC is a piece of biocontainment equipment that allows users to safely work with microorganisms that generate aerosols that are hazardous to users and/or the environment. The MSC does this by containing aerosols, directing aerosols away from the user and releasing "clean" filtered air into the environment. Some MSCs also provide product protection from contaminated air. MSCs are only effective if

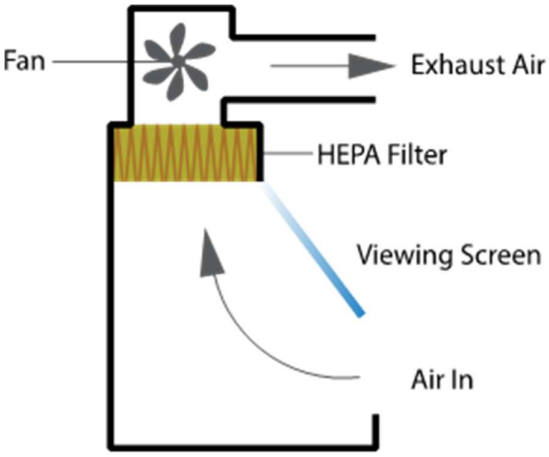
i. the correct type of MSC is used for your needs
ii. it is operated properly
iii. it is sited and installed correctly and
iv. it is maintained.

This guidance explains this.

Types of MSC and uses

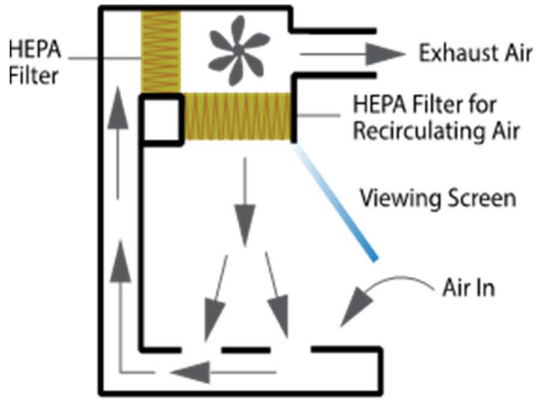
There are three types of MSC: Class I, II and III. There is also a Class I/III hybrid.

Class I



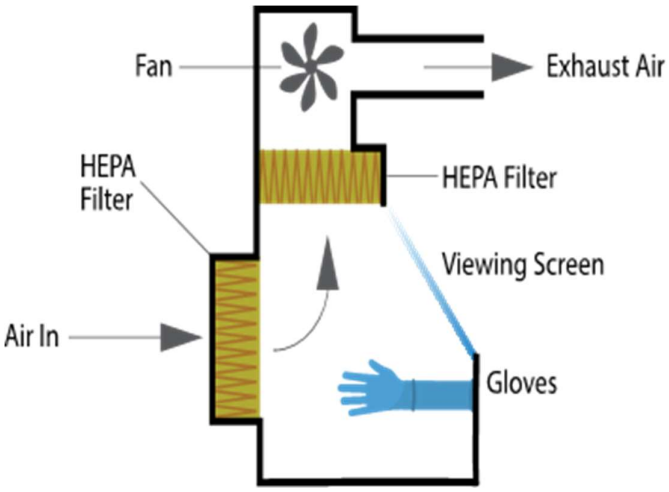
Class I MSCs are open fronted (aperture). Inward "dirty" air flows through the aperture away from the user, over the work surface and upwards through at least one high efficiency particle absorbing (HEPA) filter out of the MSC. Exhaust air is filtered by the HEPA filter(s) and "clean" air enters the environment. The operator is protected from infectious aerosols, but the sample is not protected from contamination in the air.

Class II



Class II MSCs are open fronted. Inward "dirty" air moves through the aperture away from the user, down through the perforated grille at the front of the MSC, under the work surface and is then directed either downwards onto the work surface or exits the MSC. Both downflow air onto the work surface and exhaust air pass through HEPA filters and are "clean". The operator is protected from infectious aerosols and the sample is protected from contamination in the air.

Class III



Class III MSCs are completely enclosed and provide a barrier between the samples and the user. Gloves are inserted into the front to enable manipulation of the MSC's contents. Air flows into the MSC through a HEPA filter in the back/side of the MSC, over the work surface and upwards through a HEPA filter out of the MSC. Air that flows over the work surface and into the environment is "clean". The operator is protected from infectious aerosols and the samples are protected from contamination in the air.

Class I/III hybrid

Class I/III hybrid has a detachable front and can be used in Class I mode or Class III mode. Either mode must demonstrate satisfactory user protection before use.

MSC types, limitations and uses.

Type	Operator protection?*	Product protection?	Limitations	Uses***
Class I	Yes	No	Not 100% aerosol protection. Not protected from splashes. Contamination to arms and hands. Airflow disruptions effect operator protection. Workspace clutter affects airflow and, therefore, operator protection.	≤ Hazard Group (HG) 3 pathogens
Class II	Yes	Yes	Not 100% aerosol protection. Not protected from splashes. Contamination to arms and hands. External factors affect air flows and, therefore, operator protection. Workspace clutter affects airflow and, therefore, operator protection.	≤ HG3 pathogens. Tissue culture when want to keep the cells sterile.
Class III	Yes	Yes	Cumbersome and time consuming to use.	HG3 pathogens e.g. larger scale production, e.g. high titres. HG4 pathogens.
Class I/III hybrid	Yes	**		

* The operator is only protected if the MSC is functioning correctly (correct type, maintenance, siting) and the operator is working using best practise (training).
** Product protection depends on if the MSC is being used in Class I or Class III mode.
*** The activity in the MSC must also be considered when deciding what MSC to use, for example a large scale production of a pathogen producing infectious aerosols.

Laminar Flow Cabinets and fume cupboards.

Laminar Flow Cabinets and fume cupboards must not be confused with MSCs. Laminar Flow Cabinets do not protect the operator from the contents of the cabinet. Air flows from inside the cabinet towards the operator. Therefore, they are unsuitable for ≥HG2 agents or HG1 agents spread by aerosol. Fume cupboards are suitable for handling volatile chemicals but not infectious aerosols. This is because even though there is directional airflow away from the user there is no HEPA filter to remove infectious aerosols.

Types of extraction.

There are two types of extraction:

i. ducted
ii. recirculating

Ducted: Air from the MSC is extracted directly to the outside and does not enter the laboratory. This is best practise, but it is not always possible from an engineering perspective. In this circumstance, a recirculating MSC can be installed instead. Volatile chemicals can be used in ducted MSCs, if deemed safe by risk assessment. There are three types of ducted extraction systems: hard-ducted, thimble or by-pass that are selected when designing the laboratory. The health and safety department will advise.

Recirculating: Air from the MSC is extracted through two HEPA filters and the filtered air enters the laboratory. This offers redundancy if one HEPA filter fails. Recirculating MSC used to handle ≥HG2 agents must be fitted with a double HEPA filter on the exhaust that can be tested independently. Volatile chemicals must never be used in recirculating MSCs.

How to work safely in an MSC

There are no Class III MSCs at STFC, RCaH, Diamond or RFI, so this section will focus on Class I and Class II MSCs only. To ensure their safety from infectious aerosols, users must understand how to work in the MSC without disturbing the directional airflow and to ensure the MSC is functioning correctly.

1. Turn on the MSC. Check that
    i. the fan is on
    ii. all indicators are within their expected range
    iii. the alarms turn off
    iv. the MSC has a label saying that it has passed its servicing test and
    v. it has not exceeded its next service

    If the MSC is not working properly then it must not be used and reported for repair.

2. Minimise clutter and do not use bulky equipment in the MSC to allow air to circulate correctly.

3. Do not use equipment that cause air disturbances, like centrifuges or hot plates. Unless they have passed the in-use operator protection factor test (see below for details). It is possible to use certain types of Bunsen burners in an MSC. These must be risk assessed and approved by the safety department before use.

4. Position shakers, mixers and ultrasonic disruptors to the rear of the MSC to minimise air disturbances.

5. Work as far to the rear as possible to limit airflow disturbances and to reduce the likelihood of spills coming out the aperture.

6. For Class II MSCs, keep the grates free of obstruction, for example do not cover with a waste bag.

7. Clean up any spills immediately and thoroughly. Remember to clean under the work surface inside the MSC to ensure all the spill is removed.

8. Ensure people traffic routes are ≥1m behind the MSC when it is in use to reduce airflow disturbances.

9. Reduce the speed of arm movements to limit airflow disturbances.

10. Clean the MSC before and after work with a suitable disinfectant for the sample being used. Then wipe up the disinfectant with 70% ethanol or water to prevent corrosion of the metal or slippery surfaces.

11. At the end of work, leave the MSC to run for 5 minutes before turning off to allow aerosols to be exhausted from the MSC

Siting

Class I and Class II MSCs rely on directional airflow to provide operator protection. Strong air currents external to the MSC can adversely affect the operator protection provided. Therefore, when choosing the location for the MSC in the laboratory things that disturb air currents must be considered:

- Site the MSC away from a window unless the window is sealed. Windows are normally only sealed at ≥CL3.
- If MSCs are positioned opposite each other then they must be far enough apart for airflows to not affect each other (normally ≥3m).
- Site the MSC away from an opening door.
- Site the MSC away from a thoroughfare and limit pedestrians walking behind the MSC when in use (distance of ≥1 m).
- Site far enough away from other sources of air disturbances like fume cupboards, laminar flow hoods and centrifuges.

Before purchasing and siting the MSC discuss with Health and Safety.

Installation and commissioning

MSCs must be installed and commissioned by trained personnel. MSC must meet the standards in BS EN 12469 Biotechnology: Performance criteria for microbiological safety cabinets 2000. At installation and commissioning, a user manual, a logbook listing schedules of checks and results and a commissioning certificate will be provided. During commissioning the Operator Protection Factor will be determined using the Operator Protection Factor Test (OPFT). This test uses aerosols (biological spores or potassium iodide (KI)) inside the MSC to ensure that only an acceptable amount escape through the aperture. An Operation Protection Factor of ≥ 1.0×10^5 is required. An in-use OPFT may be required for higher risk work. This test confirms that the MSC operates safely under normal operating conditions, for example with large pieces of equipment inside.

MSC checks and maintenance

It is a legal requirement that MSCs are serviced and maintained. The user must carry out routine checks whenever using the MSC. These checks include,

i. ensuring that alarms/indicators are working
ii. the fan is on
iii. the airflow indicator demonstrates that air is extracted through the MSC
iv. the MSC is not damaged and

v. the MSC has not exceeded its next service date.

Air velocities should be checked regularly, see the air velocities section (next section) for details.

MSCs must be thoroughly serviced at least every 14 months under COSHH regulations. At CL3 MSCs must be serviced every 6 months. The service must be carried out by a trained person testing against the standards listed in the Commissioning Report. Records of servicing and repairs must be kept for 5 years.

The risk to the person servicing the MSC must be kept to a minimum. Therefore, all MSCs must be thoroughly cleaned before a service (disinfecting the inside of the MSC including the sides and under the grate). MSCs used to handle HG1 agents do not require fumigation. MSCs used to handle HG2 pathogens do not require fumigation unless a risk assessment of the work decides there is a requirement. The purpose of fumigation is to disinfect areas that cannot be reached by the usual surface disinfection. For example, formaldehyde is a carcinogen that is dangerous to the users and the engineer. In contrast, it is unlikely that there is any infectious aerosol remaining on the HEPA filter that the engineer will be able to breathe in and cause disease in an immunocompetent individual. MSCs used to handle HG3 or higher pathogens must be fumigated prior to servicing (by formaldehyde or hydrogen peroxide).

It is possible to fumigate both ducted and recirculating MSCs. Fumigation must be carried out by a competent individual. The health and safety office will advise.

Table of types of tests and frequencies for Class I and Class II MSCs

Test	Class I MSC	Class II MSC
Alarms/indicators	Daily	Daily
Inflow velocity (at aperture)	Monthly	Monthly
Inflow/downflow	N/A	Annual for HG2
OPFT	Annual	Annual
In-use OPFT	As required by risk assessment	As required by risk assessment

Airflow velocities

The flow of air entering the MSC (inflow velocity) and flowing downwards on to the work surface in a Class II MSC (downflow velocity) can be measured using a suitable anemometer, such as a vane anemometer, to ensure the velocity is within acceptable range. This is useful when determining that the MSC is operating correctly between services or when carrying out a new piece of work in the MSC with different equipment.

Table showing the acceptable airflow velocities for Class I, II and III MSCs.

Class	Mean inflow velocity (m/s)	Mean downflow velocity (m/s)
I	> 0.7 – 1.0	N/A
II	≥ 0.4	0.25 – 0.5
III	≥ 0.7 with one glove removed	N/A

To measure inflow velocities:

1. Class I MSCs: hold the vane anemometer vertically, measure at least 5 velocity readings at different positions across the aperture for a minimum of 1 minute and calculate the average

(mean) reading. Volume flow rate can be calculated by multiplying the mean velocity by the open area.

2. Ducted Class II MSC: measure in the extract duct cross sectional area (m^3/s) and divide by the open area to calculate the mean inflow velocity. It is possible but less accurate to measure at the aperture of the MSC. The extract duct measurement is usually carried out during annual service.
3. Recirculating Class II MSC: hold the vane anemometer vertically, measure at velocity readings at 3 different positions across the central plane of the aperture for a minimum of 1 minute and calculate the average (mean) reading. Volume flow rate can be calculated by multiplying the mean velocity by the open area.

To measure downflow velocities:

1. Not applicable for Class I and III MSCs.
2. Class II MSC: hold the vane anemometer in the horizontal plane, measure at least 8 velocity readings throughout the MSC for a minimum of 1 minute and calculate the average reading.

Training

The operator is only protected by the MSC when the MSC is used correctly. Therefore, users must be trained to understand how an MSC functions and operate it correctly.

SAFETY HANDBOOK – BIOLOGICAL LABORATORIES & BEAMLINES: TRAINING RECORD

I have read and understood this document and agreed to abide by the rules.

Name (Printed): ……..

Signature: ……

Date: ……

End of document.