Safe Use of Microbial Safety Cabinets

Code of Practice

Reviews and Revisions

Action	Date	Reason	Reviewer
Production of new document	**17/5/16**	**Required to set standards**	**LRounds**

INTRODUCTION

Microbiological Safety Cabinets (MSCs) are normally used to protect workers from exposure to biological agents, and, as such, are considered to be "control measures" under the Control of Substances Hazardous to Health (COSHH) Regulations. As a form of Local Exhaust Ventilation (LEV), they require a thorough examination and test at regular intervals.

All users of MSCs must be trained in the proper safe use of each cabinet they work with. They should be able to demonstrate their competence in the use of the cabinet before undertaking work with hazardous biological agents within the cabinet.

This Code of Practice *"Safe use of Microbial Safety Cabinets"* sets out the technical and management requirements relating to the safe use of Microbiological Safety Cabinets when these are used to protect workers from exposure to aerosols of viable biological agents.

GENERAL PRINCIPLES

This guidance instructs users of Microbial Safety Cabinets (MSC) class I, II, and III on how to use them effectively and safely. It should be read in conjunction with:

Control of Substances Hazardous to Health(COSHH) Code of Practice
Safe Use of Fume hoods - Code of Practice
Safe use of Nanomaterials – Code of Practice
Safe use of Ionising Radiation – Code of Practice

Microbiological Safety Cabinets are not designed to protect the user from all hazards e.g. radioactive, toxic or corrosive hazards, and the exhaust HEPA filters will not remove these types of contaminants from the air. Particular care must be taken when using materials with such additional hazards to ensure these are not discharged into the laboratory environment from cabinets that are not externally ducted.

RESPONSIBILITIES

Faculty Responsibilities

Before using a MSC, users must first assess whether there is a safer way to do the work which will eliminate or reduce the risk of exposure to hazardous materials. Only if the hazard cannot be eliminated or reduced by alternative methods should the work go ahead in a MSC.

- Each faculty must identify the location of each MSC under their control, and ensure these are registered with Campus Services.
- Each faculty must maintain copies of records of system inspections, tests and maintenance.
- Each faculty must take any MSC that fails an inspection or test out of use immediately, and must ensure that it is clearly marked as such.
- Users must be trained in correct use, including selection of the correct MSC for the proposed work; function of alarms and gauges; avoiding air flow disturbance; emergency procedures; and good housekeeping.
- Each faculty must conduct and record a weekly inspection of each MSC to ensure correct operation.
- The MSC is made safe before maintenance work is undertaken (i.e. removing hazardous substances, decontamination, fumigation where necessary).

Campus Services Responsibilities

- Must arrange for statutory inspections and tests of ducted MSC, as required under the Control of Substances Hazardous to Health Regulations (COSHH), and in accordance with the relevant British Standards.
- Every MSC must undergo thorough examination and testing at least every 14 months. If this period is exceeded the MSC must be taken out of use until it has been tested.

- Persons carrying out inspections and tests must mark any MSC that fails with a red 'Fail' label. Campus Services will inform Faculty of any systems that fail an inspection or test.

- Will maintain records of inspections, tests and maintenance of MSC and will advise Faculty of the need to undertake repairs or maintenance.

- Maintain a record of the location of all MSC, with identification/asset tags.

TYPES OF MSC

The principle of operation of any MSC is to create a working area that is held at negative pressure relative to the surrounding laboratory, and to protect the worker by ensuring that air contaminated by an aerosol of a viable biological agent is directed away from the worker's breathing zone.

All MSCs consist of a physical "containment chamber" in which work with the potential to disperse hazardous biological agents is performed. Any aerosol is removed from the cabinet by extracting the air from the cabinet, and filtering it through a High Efficiency Particulate Air (HEPA) filter before discharge.

There are three main types of MSC, open-fronted (Class I and Class II) or closed (Class III).

Class I	Are effectively fume cupboards with the addition of a High Efficiency Particulate Air (HEPA) filter on the exhaust, and are designed to prevent dispersal of contaminated aerosols into the environment of the laboratory or outside the building. The exhaust air is ducted to outside air. They offer worker protection, but do not protect the work from contamination as they pull in a flow of unfiltered air which passes over the working area, which is then is discharged, normally through a single HEPA filter to the exterior of the building.
Class II	Combine the worker protection benefit of a working environment held at negative pressure, with the work protection benefit of bathing the work area in a flow of "sterile" (HEPA filtered) air. Class II cabinets may either be ducted or discharge filtered air into the laboratory.
Class III	Protect both the worker and the work by ensuring that the work is undertaken in a "sealed box" which is held at negative pressure and where the work is also bathed in a flow of sterile air. The operator has to use arm-length gloves which are sealed to the front of the cabinet. The exhaust air is ducted to outside air.

There are various classes of HEPA filter, normally manufacturers of MSCs would install filters to class H14, designed to retain not less than 99.995% of challenge particles.

Care must be taken when selecting the correct choice of cabinet and ducting arrangements for the type of activity it is going to be used for.

In some designs of cabinet, the filters are designed for easy replacement without the risk of exposure to organisms retained on the filter. Such "safe-change" filter installations are recommended in cases where fumigation of the cabinet might be ineffective or difficult to achieve.

Cabinets should be sited so as to minimise disturbance of the airflow at the front of the cabinet. BS 5726 and the main text and Appendix 6 in the “Management, design and operation of microbiological containment laboratories” give recommendations on siting. Particular care must be taken in locating recirculating cabinets where the exhausted air may cause air disturbance at the front of the cabinet, adversely affecting containment performance. The key issues are a) that the cabinet is located with sufficient clearance from walls, corners and doorways; b) that no obstacles are placed where they may interfere with the airflow and c) that sufficient room is provided for the operator to avoid interference with other workers.

Once the key requirements are met, the location is fixed and the cabinet passes the in situ tests, the position of the cabinet must not be changed unless full repeat tests are carried out.

Making the right choice

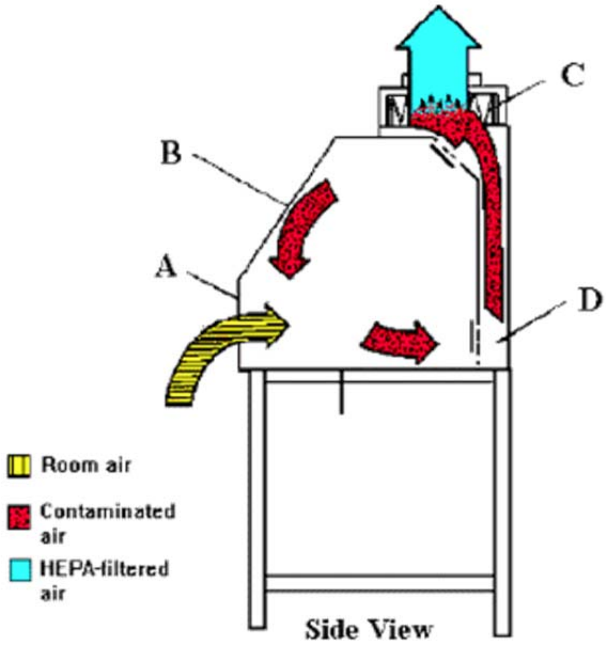
Class I

This is the cabinet of choice when the key requirement is the protection of the worker. It is the traditional cabinet of microbiology and clinical diagnostic laboratories. Its construction is simpler than the other types and is therefore cheaper to produce and buy.

These cabinets have un-recirculated airflow away from the operator that is discharged to the atmosphere after filtration through a HEPA filter. They provide good operator protection but do not protect the material within the cabinet (the product) from contamination.

The inward air velocity should be between 0.3 and 1.0 m/sec. over the whole of the front aperture of the cabinet.

- Open front (250mm)
- In-flow air
- Usually with a fixed sash



A – front opening
B – sash
C – exhaust HEPA
D – exhaust plenum

Class II cabinets

Class II cabinets protect both the worker, and the work being done. Contamination of the work is prevented by a sterile curtain (down flow) of HEPA-filtered air from the ceiling of the cabinet. This sterile air bathes and protects the work from airborne contaminants. Non-sterile makeup air is drawn in through the front of the cabinet at a relatively low velocity (to avoid disrupting the air curtain), and is directed, via special baffles and perforations in the front lip of the cabinet, below the main working platform of the cabinet. In most European designs, all of the air is then passed through a HEPA filter, with about 70-80% of the air being recirculated within the cabinet (as the down flow of "sterile" air). 20-30% of the air is discharged, either directly outside (ducted) or back into the laboratory. Some cabinets are fitted with two in-line HEPA filters as an additional precaution against filter penetration. If this is the case, the cabinet design must be such that the filters can be tested independently of each other.

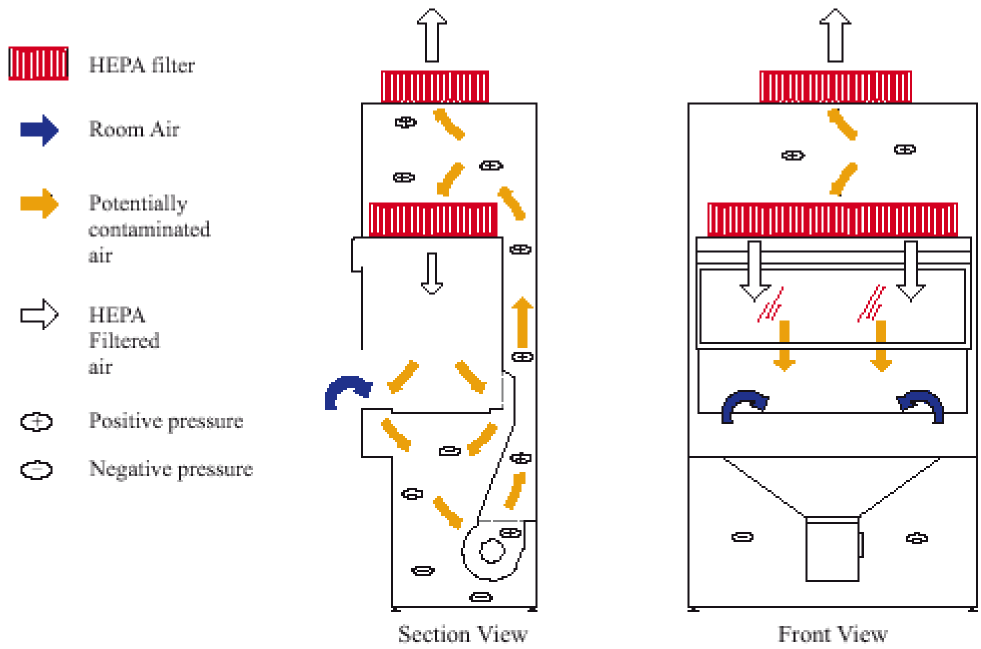
All Class II cabinets are designed for work involving micro-organisms assigned to Hazard groups 1, 2 and 3.

Class II cabinets provide the microbe-free work environment necessary for cell culture propagation, and also may be used for work involving non-volatile chemotherapeutic drugs.

Personnel protection is provided by the inward airflow as long as a minimum velocity of 0.5 m/s is maintained through the front opening. The velocity must not exceed 1.0m/s this will cause turbulence.

Bunsen burners should **never** be used in a Class II safety cabinet.

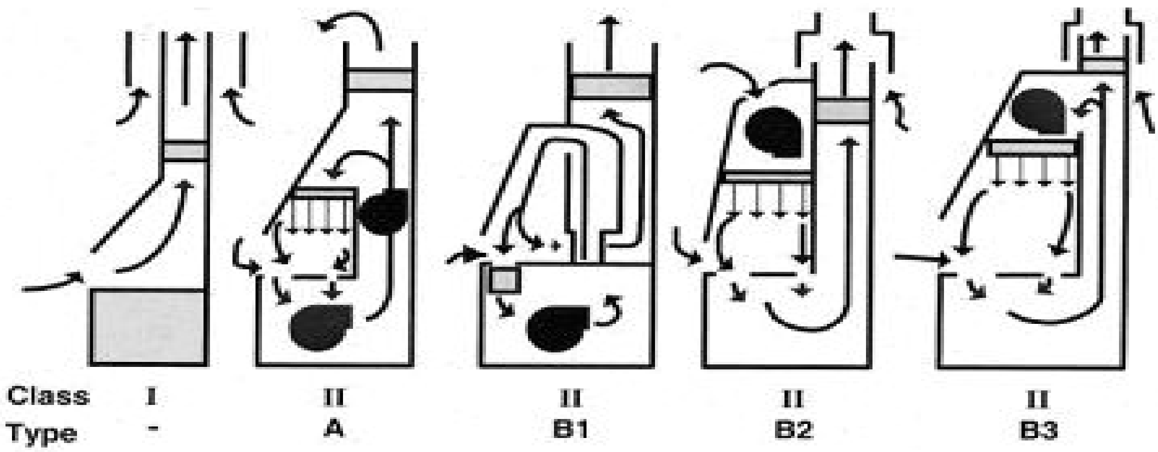
Class II cabinets are also very sensitive to their position within the laboratory. Other cabinets fume cupboards, air inlets and extraction points can seriously degrade their performance if they are too close. Other places to avoid include through routes and frequently-opened doors, where frequent movement of personnel can create excessive air movements.



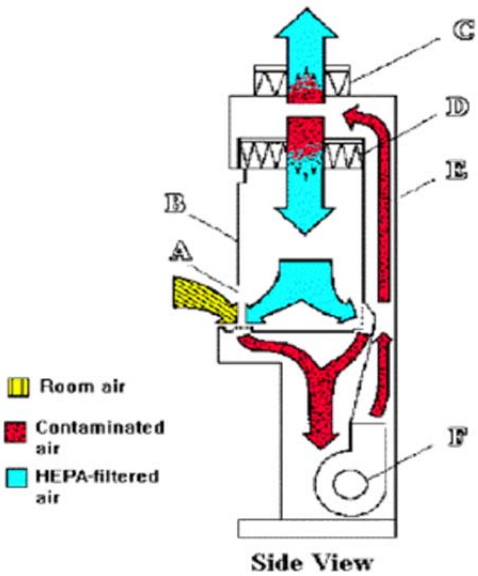
Like fume hoods, Class I MSC's rely on room airflow to protect the user from hazards in the cabinet. Class II MSCs depend on fans to create a tightly balanced, laminar airflow to prevent contamination.

Class II cabinets are designed for personnel, product and environmental protection. They are designed for work involving microorganisms in containment levels 2, 3 and 4 laboratories and are divided into two types (A and B) on the basis of construction type, airflow velocities and patterns, and exhaust systems.

Within type (A), there are two subtypes, A1 (formerly designated type A) and A2 (formerly designated type B3). Within type (B), there are two subtypes, B1 and B2. Class II cabinets are most commonly used in biomedical research laboratories because of their characteristics.



Class II Type A Cabinet



A - front opening

B - sash

C - exhaust HEPA filter

D - supply HEPA filter

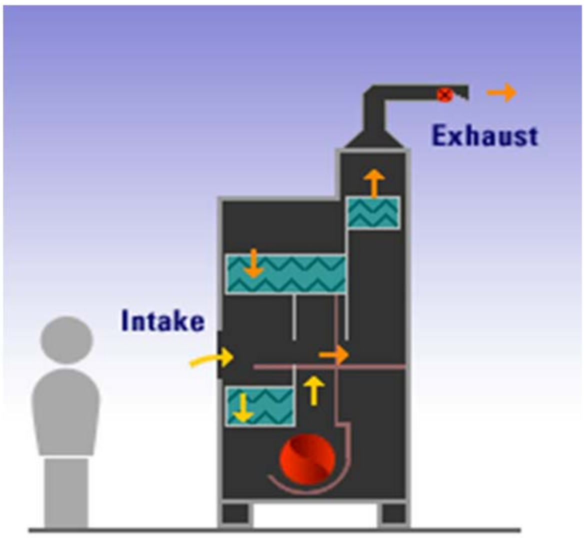
E - rear plenum

F - blower

Inward air velocity:

0.38-0.51 m/s

Class II B1 Cabinet



Class II Type A1	Class II Type A2	Class II Type B1	Class II Type B2
0.35 m/s face velocity	0.5m/s face velocity	0.5m/s face velocity	0.50 m/s face velocity
70% recirculated air, 30% exhausted (thru HEPA)	70% recirculated air, 30% exhausted (thru HEPA)	30% recirculated air, 70% exhausted (through HEPA)	Exhaust 100% of the air to the outside after filtration through a HEPA filter
Exhaust to room or thimble connected to external exhaust duct	Exhaust to room or thimble connected to external exhaust duct	Air in the back of the cabinet is exhausted to the outdoors through a dedicated exhaust plenum and the air in the front is recirculated	Must be hard ducted to the outside. Sometimes called "Total Exhaust"
Potentially contaminated ducts and plenums under positive pressure to the room	Potentially contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums	Must be hard ducted to the outside for the cabinet to function	All contaminated ducts and plenums under negative pressure, or surrounded by (directly exhausted non-recirculated through the work area) negative pressure ducts and plenums
Not suitable for work with volatile toxic chemical and volatile radionuclides	May be used for work with <u>minute</u> quantities of volatile toxic chemicals and tracer amounts of radionuclides if they are exhausted through properly functioning exhaust canopies	All biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums	May be used for work with volatile toxic chemicals and radionuclides required as an adjunct to microbiological studies
		Minute quantities of volatile toxic chemicals and tracer amounts of radionuclide permitted if work is done in the direct exhausted portion of the cabinet	

Class III cabinets

Class III cabinets consist of a sealed “box" fitted with access ports and arm-length rubber gloves to allow the worker to manipulate material in the cabinet. The cabinet provides complete isolation of the work from the worker, and protects the work being done, provided that the seals and integral gloves are intact.

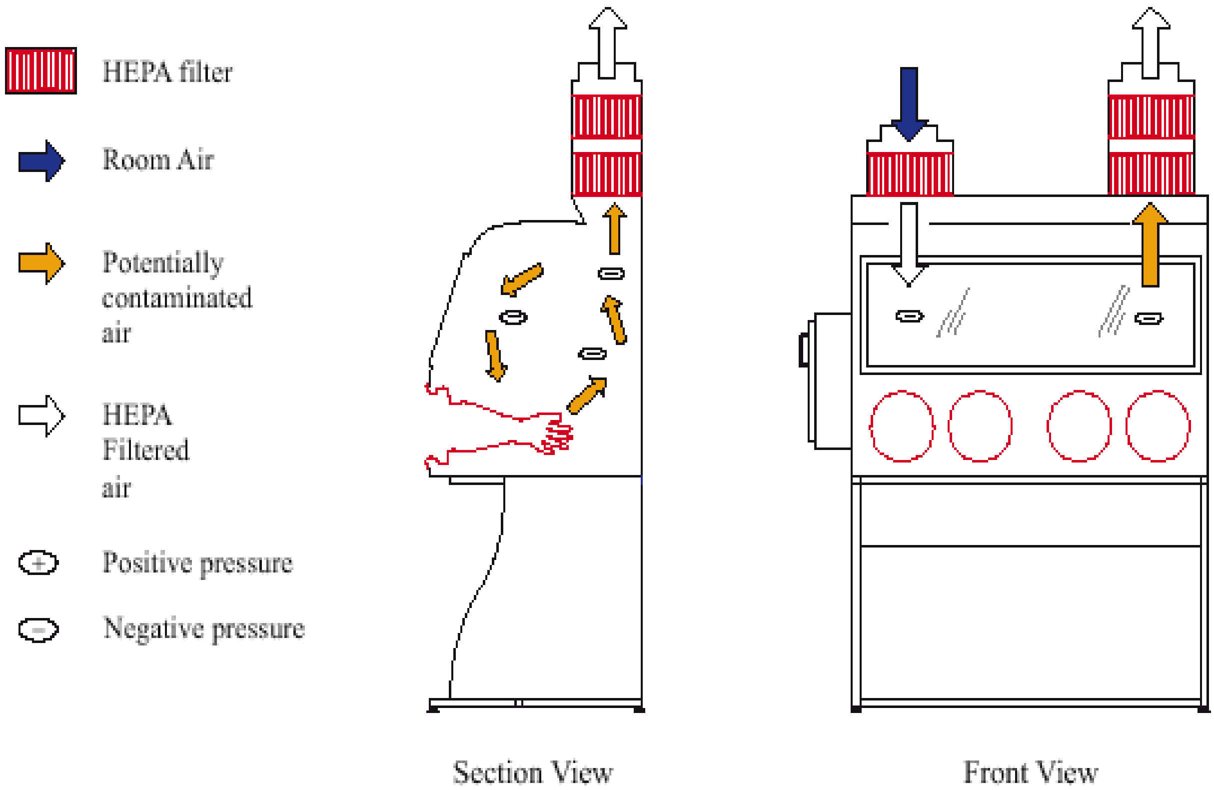
Glove box is an incorrect terminology for a Class III MSCs, which can be a cost-effective technology for a wide range of applications.

Class III MSC has significantly lower air flow than exhausted biosafety cabinets and improves control of laboratory space conditioning, typically 0.3m/s.

Class III cabinets are totally enclosed and gas-tight with HEPA filtered supply and exhaust air. Work is performed with attached long-sleeved gloves. The cabinet is kept under negative pressure of at least 120 Pa and airflow is maintained by a dedicated exterior exhaust system.

Class III cabinets protect the worker and the product. Cabinet lines consisting of several Class III cabinets (e.g., for centrifuges, animal cages, incubators, refrigerators) and transfer devices joined together are traditionally custom built.

The exhaust air is double HEPA filtered or treated by HEPA filter and incineration.



Class III cabinets are used mainly for work with hazard group 4 organisms or work with hazard group 3 organisms deemed to be at high risk, for example where highly concentrated samples are being handled. They offer the greatest protection to the worker and work, but movements are more restricted and may affect dexterity.

USER CHECKS

It is essential that MSC's are effective at extracting contaminants from the worker's breathing zone. Users must check that the MSC that they intend to use can meet the University standards– this will normally be indicated on the test label and in the MSC log book. They must also check the MSC face velocity indicator before use to check the MSC is operating within safe parameters (>0.3m/s).

If there is any doubt, additional smoke visualisation test, a containment test, or monitoring of the worker's breathing zone may be required to verify that the MSC is capable of extracting the hazardous material from the worker's breathing zone.

User guide key points

- Complete the weekly check list for the MSC and if you are a new user check it has been done. (see appendix 1)
- Before and after using a MSC, make sure your work area is clean and uncluttered.
- Ensure the MSC type is the correct one for your work.
- Check the MSC flow meter to establish if there is an air flow within the MSC.
- The MSC average face velocity should be between 0.3 – 1.0 m/s.
- Do not use the MSC if it is not working properly.
- Verify the date on the inspection sticker on the MSC, inspection must be done annually.
- Never put your head inside a MSC
- Never use the MSC to store chemicals and equipment between procedures. Solvent cabinets to be used for storage of chemicals.
- Keep all apparatus at least 15 centimetres inside the MSC.
- Avoid swift arm and body movements in front of or inside the MSC. These actions may increase turbulence and reduce the effectiveness of the MSC
- Avoid too many labels/writing on the sash - it's meant to be transparent so that you can see through it.

The performance of any MSC can be severely compromised by incorrect use, in particular anything that disturbs the flow of air into the enclosure. Any of the following could cause interference to airflow and cause powders or biological agents from within the enclosure to enter the worker's breathing zone:

- External draughts (caused by the user's sudden movements, by people walking past the front of the MSC, by doors opening, by air conditioning units or by other fans)

- The use of naked flames, hot air funs, ovens, hotplates, fans or centrifuges, all of which may cause turbulence

- Large items placed too close to the front opening or too close to the back baffle

- The use of screens for protection against ionising radiation or explosion.

Use of specific materials

Radioisotopes

The use of open sources must be closely monitored and co-ordinated, if users wish to use radioisotopes it must be approved by the University Radiation Protection Supervisor (see guidance on "Safe use of Ionising Radiation – Code of Practice").

Nanoparticles

Anyone proposing to work with nanoparticles must consult HSS in the first instance about safety precautions and the suitability of extract systems. (See guidance "Safe use of Nanomaterials - Code of Practice)

SAFE USE OF MSC

Before starting work in a MSC

Any process involving the use of hazardous substances must have been subject to risk assessment before starting the work. In addition to considering the use of a MSC it must also have considered whether it is practical to:

- Use less hazardous materials
- Change the process to eliminate the production of hazardous substances
- Totally enclose the process
- Reduce the quantities of the substances used
- Reduce the amount of substance released into the airflow e.g. use a condenser, watch glass cover etc.
- Apply simple controls such as fitting lids

Ensure you are using the correct type of MSC

- Check that the MSC has a test sticker fixed to the front of the cabinet to confirm that it has been tested/examined within the last 14 months, and has passed the test. Check that the retest date has not been passed. Do not use the MSC if it is outside the 14-month period.
- Confirm that the MSC is working satisfactorily by a visual check of function lights; air flow gauge is in safe zone (normally above 0.3 m/s)

Preparing to use the MSC

- Switch the MSC on and allow 5 minutes for the air to balance itself before starting work

- Always clean and decontaminate the work surface before beginning work, whenever there is a spill, and at the end of work

- Ensure that you have enough space to conduct your work safely and that all unnecessary items of equipment and chemicals not required in the process are removed.

- Where practical, ensure that all items for the operation are available in the MSC.

- Position equipment, apparatus, and materials in the centre and back of the MSC to minimise disturbance to the airflow. Do not obstruct the rear baffle.

- Equipment in the MSC should be kept to a minimum and sited at least 150mm inside the plane of the sash to ensure efficient containment. Keep items away from the sash opening to allow instant closure in an emergency.

- Avoid placing large pieces of equipment in a MSC - they spoil the aerodynamic flow and may reduce the containment of materials. If their use cannot be avoided they should be raised up about 10cm using lab jacks, in order to allow air to pass unimpeded across the work surface.

- Once all work materials are in the cabinet, let the cabinet run another five minutes before starting work. This will allow for further cleaning of the air that has been disturbed and contaminated by placing materials from the room in the cabinet

During use

- Try to avoid sudden rapid movements in front of the MSC. These can cause turbulence that may draw the airborne hazardous material out of the MSC.

- Do not use naked flames as they will have a serious adverse effect on the air flow.

- Hotplates must be kept to a minimum and be aware that they might adversely affect the airflow. If hot plates are used, these should be placed at least 10 cm from the side and back of the MSC to avoid damage to the MSC structure.

- Any accidental spill of chemicals must be cleaned up immediately (i.e. as soon as it is safe to do so).

- If an experiment is left running out of hours, a contact name and telephone number must be prominently displayed. Do not leave potentially hazardous work unattended.

After use

- At the end of your experiment remove equipment and clean the surfaces. Leave the fume hood in a clean, tidy and safe state.

- Dispose of waste in a safe appropriate manner as identified by the risk assessment and in accordance with laboratory rules.

- If permitted by local rules/lab risk assessment, switch off the MSC.

Emergencies

- If the ventilation system fails, immediately stop working. If safe to do so, replace lids on containers and terminate any ongoing processes.
- Move away from the MSC. Warn other workers there is a problem.
- Deal with spillages immediately, using the correct absorption materials. Dispose of as hazardous waste.
- Treat fires with extreme caution. The use of high pressure CO2 may spread flames and eject items out of the fume hood. Only tackle fires if you have the correct firefighting equipment and have been trained to use it. Raise the alarm by activating the fire alarm (press red manual call point) and phone the emergency services (Ext. 3200). Evacuate the building.

A GOOD CABINET CAN NEVER BE A SUBSTITUTE FOR GOOD PRACTICE OR GOOD MICROBIOLOGICAL TECHNIQUE.

TRAINING, INSTRUCTION AND INFORMATION

- Users of MSC must be trained in correct use, not only in order to understand how the MSC works but also because poor technique can compromise the operation protection afforded by the MSC. See appendix 2
- Training should cover:
- Principles of how MSC work, the airflow and limitations of MSC performance
- How to work at MSC safely
- Operation and function of all controls and indicators
- Operating MSC in an energy efficient manger, whilst maintaining safety standards
- How to check if the system is extracting all the hazardous materials
- Actions to be carried out in the event of a system failure/what to do if something goes wrong

Records of all training, including refresher training, must be kept and only those trained are authorised to use the system. This applies to all users (whether staff or students).

If the extraction system changes (removal of MSC on the system, change in extract routes or fans), the system must be re-commissioned and the users re-trained. Consideration must also be given to the possible need to clean the system of any residues from previous uses.

In mixed or shared extract stack systems, an assessment of the need to restrict the use of certain substances must be undertaken to prevent the mixing of incompatible substances in the extract ducting and stack.

Appendix 1. Weekly check list

Weekly visual Inspections: to be carried out by Technical staff and checklist completed. Where there are any observations or comments arising from any operational issues, the cabinets are to be taken out of service until further checks are carried out and resolved. This should be done by contacting the Helpdesk on email: eahelpdesk@northumbria.ac.uk

Room Reference:	RSA Serial Number:		Clean Air Ref. No.:
WEEKLY CHECKLIST	**YES**	**NO**	**OBSERVATIONS/COMMENTS**
Any signs of damage, internal or external			
Cracking or deterioration of sealant at edges			
Build-up of debris on ventilation grille to the rear of the cabinet			
Where an air flow rate reading is possible, record this			
No internal or external obstructions to air flow into the cabinet			
Lights are functional			
Gas tap operational – No leakage (press finger over outlet with tap shut and check for any build-up of pressure)			
Inspect external ductwork from cabinet, to room exit point for any damage, cracks or breaches			
Inspectors name (print):	Inspectors signature:		Date of Inspection:

Logs should be kept with the cabinet and should be available for inspection.

Appendix 2. Training requirements for MSC users

Subject	Item covered		Competency assessed	
	Yes	No	Yes	No
This guidance has been read				
Principles of how MSC work, the airflow and limitations of MSC performance, Control panel, alarms and indicators – what they all mean				
Safe operating parameters for air velocity				
How to turn the MSC on and off and how to work at MSC safely?				
Techniques to avoid disrupting the airflow				
Local rules on whether the MSC can be left on or off				
Permitted equipment allowed within the MSC				
Dealing with waste within the MSC, do not let it accumulate or use the MSC for waste storage.				
Restrictions on what work can be carried out in a MSC				
Dealing with spillages within the MSC				
Emergency actions – what to do if the power or airflow fails				
Routine cleaning of the MSC after use				
Principles of airflow, performance testing and containment testing				
Who to report to if the MSC is "out of test date"				

Both trainer and trainee agree that the above training has been fully completed and that the trainee is considered to be competent to use the MSC for the specific project/work

Position	Name	Signature	Date
Trainer			
Trainee			

This document was updated on 17th May 2016 and will be reviewed by 16th May 2018