Microbiological Safety Cabinets

1. Introduction

Microbiological safety cabinets (MSC) are an important type of safety equipment used for the prevention and control of exposure to hazardous biological substances and are frequently required for work in laboratories. They are a type of local exhaust ventilation (LEV) equipment designed to contain and capture potentially hazardous aerosols to control the risks of exposure to biological hazards by inhalation, and in certain cases, also prevent release to the environment. MSC often also have other types of associated LEV systems which are integral to their proper and safe operation. Therefore, MSC and any associated LEV equipment are covered by the range of statutory requirements under the Control of Substances Hazardous to Health (COSHH) Regulations.

This guidance provides a brief overview of the management and technical requirements for the safe use and maintenance of MSC. It also summarises the selection, installation, commissioning, use, maintenance and testing of the microbiological safety cabinet. Detailed guidance can be found in Health and Safety Executive (HSE) guidance and in the relevant British Standards.

There must be a process for identifying, recording and reviewing COSHH and general risk assessments involving the use of MSC. There must also be suitable arrangements for contractor management in relation to hazards, risks and controls related to MSC purchase, installation, commissioning and maintenance, as part of the process of planning, communications, inductions, exchange of relevant safety information with suppliers, contractors and those with responsibility for organising the contractor services.

2. Guidance Sources for Microbiological Safety Cabinets

Detailed regulatory guidance on the safe use and maintenance of MSC in laboratories for work with biological hazards, biological agents and genetically modified organisms is available from the HSE as well as in the relevant standards. Please see the links below to key guidance documents and online resources.

2.1 Guidance and British Standards

- HSE ACDP Management and operation of microbiological containment laboratories
- HSE SACGM Compendium of guidance
- BS EN 12469 Series (Parts 1-5) – Biological safety cabinets (Available from the University Library)

2.2 Websites

- HSE Biological Safety
- HSE Local exhaust ventilation

The HSE Advisory Committee on Dangerous Pathogens (ACDP) Management and operation of microbiological containment laboratories and the HSE Scientific Advisory Committee on Genetic Modification (SACGM) Compendium of guidance provide the main regulatory guidance on the use and testing of MSC in laboratories. HSE also provides general guidance on local exhaust ventilation. British Standards and international standards can be found on the British Standards Online Library (BSOL) service that can be accessed through the University Library.

2.3 Management of LEV Systems

The University has detailed guidance on the management of LEV systems that must be complied with and these are set out in the University Code of Practice for LEV.

- CS CoP004 Local Exhaust Ventilation

3 Classification and Selection of Microbiological Safety Cabinets

Microbiological safety cabinets and associated LEV equipment are intended to provide protection to the user and in some cases the environment, including other people in the laboratory, from the aerosol hazards arising from the handling of hazardous biological material in certain activities. Some types of these cabinets are designed to also protect the materials from environmental contamination. The HSE ACDP Management and operation of microbiological containment laboratories and HSE SACGM Compendium of guidance provide important practical guidance on the selection, installation, use, maintenance and testing of MSC in laboratories. The need for MSC and their use in laboratories is based on the regulatory requirements as well as the outcomes of BA / GM risk assessments and any relevant licences.

The British Standards, BS EN 12469 Biological safety cabinets (Parts 1-5) are based on internationally agreed standards that cover the more detailed requirements for the design, construction, selection, installation, maintenance and testing of microbiological safety cabinets. Note that the common term used in the UK and HSE guidance for these types of equipment is microbiological safety cabinets (MSC) whereas the British Standards use the term biological safety cabinet (BSC). They both mean exactly the same thing and it makes no real difference. An MSC is defined in the British Standards (BS EN 12469), as a ventilated enclosure intended to offer protection to the operator and the environment from the aerosols, arising from the handling of potentially hazardous and hazardous microorganisms, with air discharged to the atmosphere being filtered. The BS EN 12469 biological safety cabinet series is comprised of these five connected standards:

- Part 1: BSC (MSC) Classes, terminology and basic requirements
- Part 2: BSC (MSC) Class II
- Part 3: BSC (MSC) Class III
- Part 4: BSC (MSC) Class I
- Part 5: BSC (MSC) Installation, commissioning and routine testing

Many of the very detailed requirements set out in these approved standards are primarily intended for manufacturers, suppliers and type certifiers, while other requirements are aimed at engineering maintenance contractors etc, or for purchasers and users of these equipment. New MSC should be manufactured in accordance with BS EN 12469 and other relevant standards, and be CE / CA Marked with a certified type test certificate to demonstrate they meet the essential technical requirements of the relevant safety laws and standards. Please note that this BSU guidance is not intended to provide all the relevant details included in these British Standards and Schools will need to refer to the standards for full details with various regulatory requirements the purchase, installation, maintenance and testing of cabinets used in laboratories.

3.1 Classes of Microbiological Safety Cabinets

There are three main classes of MSC defined in the British Standards and they differ significantly in design and mode of operation. These are referred to as Class I, Class II and Class III cabinets. All provide protection to the user (operator protection), with Class II and Class III cabinets also providing a clean working environment to protect the work from contamination (termed product protection). A diagrammatic representation of the airflow patterns for these classes of cabinet can be found in the HSE guidance and the British Standards.

Briefly, MSC operate by drawing air into the cabinet over the working area and passing it through a high efficiency particulate absorption (HEPA) filter, designed to capture and contain very small particles (eg microorganisms and fine dusts). The filtered air is then discharged from the cabinet either exhausted directly back into the laboratory air ('recirculated'), or a hard ducted local exhaust ventilation system to the air outside of the building.

MSC do not necessarily protect the user from all hazards involved in a process, since there may be other types of hazards present such as radioactive, toxic or corrosive substances present that may require additional control measures. Similarly, the exhaust HEPA filters will not remove all of these types of contaminants from the exhaust air and particular care must be taken to ensure these are not discharged into the laboratory environment from recirculating cabinets where they could pose a risk to laboratory users.

A suitable and sufficient risk assessment should be undertaken to determine the class of safety cabinet appropriate for a particular work activity. This should take into

account the nature of the potential hazards in terms of not only the materials involved and their route of exposure, but also the techniques being carried out and whether the protection of workers, products or both are needed.

Note that the class of MSC is not directly linked to the hazard group or risk class of the biological materials involved, or the containment level assigned to the work. It is a common mistake to think these are connected and it can lead to inappropriate selection of cabinet. MSC should also not be confused with laminar flow cabinets or fume cupboards. Specialist MSC are also available for certain activities where required.

3.2 Class I MSC

A Class I MSC is a safety cabinet with a front aperture through which the worker can carry out manipulations inside the cabinet. It 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 filtration of the exhaust air through a HEPA filter before being discharged to the outside of the cabinet.

This type of MSC is used for working with biological agents and infectious materials where there is the likelihood of the production of infectious aerosols, but it is not designed to provide protection to the work itself, only the person undertaking the work. Generally, at least some hard ducted Class I MSC should be installed into biological research buildings because they may be required for certain activities where the more commonly used, recirculating Class II MSC, are not suited.

3.3 Class II MSC

A Class II MSC is a safety cabinet with a front aperture through which the worker can carry out manipulations inside the cabinet. It 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 filtration of the exhaust air through a HEPA filter before being discharged to the outside of the cabinet. In addition, inward air is directed downwards below the work surface and is filtered before being redirected into the work area as a downward flow of clean air. The balance of this down flow air with the incoming air provides an air curtain at the front and therefore provides worker protection as well as protection to the work being undertaken. However, the performance of Class II MSC can be strongly affected by factors such as operator movement and air movements inside and outside the MSC.

This type of MSC is used for working with biological agents and infectious materials where there is the likelihood of the production of infectious aerosols, and it is designed to provide protection to the work as well as the person undertaking it. Class II MSC are particularly useful because they maintain a clean environment inside

the cabinet so are particularly valuable for many types of work where the sterility of materials is an important requirement. It is therefore the most commonly used MSC in the University since it is useful for many different types of work and materials.

3.4 Class III MSC

A Class III MSC is a fully enclosed MSC and is designed to provide worker protection and protection for the work. It is constructed so that the worker is protected with the working area that is completely sealed and air is drawn in through a HEPA filter and exhausted out of the cabinet through another HEPA filter. The worker is separated from the work by this physical barrier and using integrated rubber gauntlets that are physically attached to the cabinet.

This type of MSC is used mainly for high hazard work and offer the greatest protection to the worker and work, but movements are more restricted and this may affect dexterity. In practice this level of protection tends only to be required for the most hazardous work.

3.5 Specialist Types of MSC

There are many variations of Class I, II or III MSC as well as many types of isolators that are used for specialist purposes and activities. Some manufactures also produce a hybrid Class I/III cabinet but this is not described specifically within the British Standard. The hybrid, as the name suggests, can be used in a similar way to that of either a Class I or a Class III MSC by the use of a removable port that attaches to the front aperture of the cabinet.

There are also a broad range of specialist cabinets and isolators that are used for controlling biological hazards (eg pathogens, allergens, toxins, carcinogens) or for the protection of the work and materials in relation to microbial, animal, plant or other activities. Isolators are generally constructed to provide a fully enclosed working area in the equipment with HEPA filters or other types of filters. Examples include animal containment isolators, individually ventilated cages, plant isolators and propagators. There are also all kinds of specialist, anaerobic, gas-controlled cabinets and isolators etc that are used by scientists and engineers but generally for all kinds of research or other purposes as opposed to safety or protection of workers.

There are of course many types of fume cupboards and chemical safety cabinets and various types of LEV that are designed to capture and contain chemicals and dusts and generally these should not be used to provide protection against biological hazards. There are various specialist types of MSC that combine the functions of biological safety as well as chemical safety cabinets. These cabinets have both HEPA filters for biological agents, as well as chemical filters (eg activated carbon) for various substances that are available for certain activities so they will be useful where protection is required from both biological as well as certain chemical hazards.

There are other types of cabinets available but these do not provide operator protection. Examples of such types of cabinet include clean cabinets or laminar flow cabinets which are used to work with or protect non-hazardous materials. Laminar flow / clean cabinets may use either horizontal or vertical laminar flow. These types of cabinet must not be used for protection against biological hazards. Since horizontal laminar flow cabinets blow air from the back of the cabinet across the work and into the face of the user it is entirely inappropriate to use this type for work handling anything other than clean, non-hazardous materials.

Finally, MSC may be used to contain small pieces of equipment as well as biological materials, but note that some equipment may disrupt airflows and so can affect the safety performance of cabinets. MSC may also be required for the containment of large specialist equipment (such as cell sorters) where these are required for work involving pathogens or infectious materials.

4 Installation and Commissioning of Microbiological Safety Cabinets and Associated LEV

MSC must be properly installed and commissioned before first use and any significant change of operation or location. The purpose of this is to ensure that they will meet the requirements set out in the COSHH Regulations for adequate control of potential exposure to substances in the workplace. The HSE ACDP Management and operation of microbiological containment laboratories, HSE SACGM Compendium of guidance and the British Standards give recommendations and detailed guidance on what is required for selection, installation and commissioning of MSC and any other associated LEV.

The British Standards set out the minimum performance criteria for the various types of MSC used with biological materials and specifies test procedures with respect to protection of the worker and the environment, product protection and cross contamination. They give detailed information on airflow measurements, airflow patterns, HEPA filter testing and also tests for determination of worker protection, product protection and leak tightness. In major and minor projects, the installation of MSC should be discussed in detail by the Project Manager and the School to help ensure that the right equipment is selected for the intended purposes, the equipment will be properly installed and commissioned and integrated with relevant building systems particularly general ventilation and LEV.

4.1 Installation and Commissioning of MSC and LEV

The installation of an MSC is generally carried out by a supplier or relevant contractors. The installer should do a site survey first to carry out an assessment of the local installation and operation conditions prior to the installation. Setting up and positioning of MSC within laboratories should meet the guidelines set out in the HSE guidance and British Standards. Broadly the factors to be considered include the proximity of the MSC to doors, windows, ventilation ducts and to movement routes.

MSC should be located with sufficient clearance from walls, corners and doorways, somewhere where there will be no obstacles placed where they may interfere with the airflow, and there is sufficient room for the operator to avoid interference with other workers. MSC should be installed in positions that minimise disturbance of the airflow at the front of the cabinet since that could adversely affect containment performance. Air currents and movement of people in the laboratory can adversely affect the performance (operator protection) of a cabinet. MSC may exhaust directly from the cabinet into the room or they may be taken by ducting to the final exhaust point outside of the building. The discharge point should meet recognised standards and be distant from air intakes of building general ventilation.

Commissioning is proving that the MSC and any related LEV system is capable of providing adequate control to protect people from exposure and must be undertaken at first installation, re-installation at another location, or after any other significant changes to the equipment or its environment that may have an impact on the safe operation of the equipment or any maintenance certification.

Prior to use, the MSC must pass the performance tests specified in the British Standard. The test requirements are quite detailed, need specialist equipment and competent persons to undertake the work properly. This usually forms part of the service provided by the supplier or relevant contractor. Schools should note however that the same requirements apply when cabinets are moved or relocated and so a specialist contractor will need to be appointed to undertake such works. If a School chooses to install and commission an MSC itself then the requirements of the British Standard must be met. A specialist contractor must be appointed to undertake the relevant tests including the operator protection (KI Discus) test prior to use. It is strongly recommended that Schools ask the contractor to comment on the installation at that time, specifically as to whether it meets the requirements of the British Standard.

Preliminary tests with smoke tubes may help select the optimum position of the MSC. Once installed, commissioning tests should be conducted to verify the performance of the MSC. The importance of proper installation testing cannot be over emphasised; it demonstrates the performance and level of protection achieved in practice and the equipment is working correctly. It may also be necessary to carry out additional thorough inspection and testing when changes have been made to the laboratory that could affect the containment performance of the MSC.

No MSC or LEV system should be utilised in any way until commissioning has taken place and arrangements made to ensure the cabinet is properly inspected and maintained. If a repair to a major part of equipment or relocating of the MSC is deemed necessary following its installation, then the MSC should be recommissioned prior to returning it to service after the repair has been completed. Schools, users and safety advisers must check the relevant commissioning documents prior to using the cabinets. Suitable records of installation and commissioning must be kept by the relevant persons and systems.

4.2 Ventilation of Exhaust Air from MSC

The air discharged from the exhaust of MSC is HEPA filtered to remove microbial contamination and is then either ducted to outside of the building through an associated LEV system, or it is recirculated directly into the laboratory. Generally, the preferred option for venting MSC is to discharge the double HEPA filtered exhaust air to the exterior of the building through LEV system with ducting that is powered by fans to final exhaust points on top of the building away from air intakes and other systems that might draw it back into the workplace. In laboratories where it is clear that the hazards used are microbiological and there are no significant quantities of hazardous chemicals, and particularly no toxic chemicals are involved in the work, it is acceptable for recirculating MSC to discharge the exhaust air into the room. Bear in mind that MSC need to be fumigated to disinfect them before maintenance, testing or being decommissioned so there must be a safe method of fumigating cabinets.

The advantages of external venting of MSC exhaust includes that it can provide a simple method of keeping a containment laboratory under negative pressure; the discharge of fumigant gas after decontamination of the room or the MSC is made significantly easier; and, there may be occasions when a worker needs to treat cultures with small amounts of volatile toxic chemicals in which circumstances discharging the exhaust air back into the laboratory would not be acceptable.

5. Maintenance, Examination and Testing of MSC

The HSE ACDP Management and operation of microbiological containment laboratories, HSE SACGM Compendium of guidance and the British Standards give guidance and recommendations on what is required for routine and non-routine maintenance, examination and testing of MSC as well as user checks. The British Standards set out a range of detailed checks and tests to verify that the MSC is working to achieve the required safety standards. An appropriate safety induction and permit to work system should be in place with the required credentials issued to engineers before they are permitted entry to the lab to undertake any work on MSC.

5.1 Statutory Requirements and Standards

The COSHH Regulations require that MSC and any associated LEV are subject to a range of requirements that includes the provision of regular maintenance and carrying out suitable inspections and tests to ensure they continue to perform their function properly and are safe to use, as well as for the keeping of suitable records. Any LEV equipment and systems must be properly managed and meet HSE COSHH and LEV requirements as well as the University standard for the management of LEV systems in the Code of Practice for LEV (CS CoP004 Local Exhaust Ventilation). MSC and associated LEV must be subject to thorough examination and testing (TExT) maintenance carried out by a competent person at intervals of not more than 14 months. In practice this should be undertaken on at least an annual basis for MSC in

containment level 1 and 2 laboratories and at least a six month basis for MSC in containment level 3 laboratories, or more frequently where required. The TExT for any LEV associated with an MSC is typically done on an annual basis. In addition, the maintenance requirements for MSC and associated LEV will include periodic monitoring and checks as well as servicing and repairs. The British Standards for the various types of MSC and other LEV provide the details of the various tests that are required and will not be repeated in this document.

5.2 Thorough Examination and Test (TExT)

The objective of the thorough examination and test of MSC is to prove the equipment and its performance meets the required safety standards. The TExT is carried out according to the British Standard BS EN 12469 (1-5) which set out the detailed requirements for performance of the various types of MSC including parameters such as volumetric airflow rate measurements, airflow patterns, HEPA filter testing and also tests for determination of product protection and leak tightness as well as various checks on the equipment controls and displays. The TExT on each Class I or II MSC must include the full operator protection factor with KI test to be done at commissioning, and thereafter routine testing at least annually at containment level 1 and 2 (CL1 / 2) or six monthly at containment level 3 (CL3). Certain types of specialist safety cabinets like Class III MSC or certain types of isolators must also meet the same schedules but may require a pressure and leak detection test instead of the KI test to prove containment of aerosols.

MSC in containment laboratories and facilities may either transfer exhausted air directly from the HEPA filters into the room, or they may be physically attached to exhaust air through an additional LEV system. Where any MSC is connected to a fixed duct to exhaust the air from the cabinet to the outside the building, or there is any associated room LEV, then the maintenance schedule must also include a periodic TExT of the entire LEV system (eg ducting, dampers, fans, final exhaust, controls etc) in addition to the cabinet tests. It may also be necessary to carry out additional testing when changes have been made to the laboratory that could affect the containment performance of the MSC.

Briefly, the TExT includes a range of tests including volumetric airflow measurements and airflow patterns, exhaust HEPA filter test and an Operator Protection Factor Test. These include various measurements of face velocity (inward airflow) at the front aperture and, in Class II cabinets, the velocity of the laminar downflow. For Class I cabinets the measured face velocity is typically between 0.7 m/s and 1.0 m/s at all points. For Class II cabinets this velocity is typically not less than 0.4 m/s. The downflow in a Class II cabinets (not applicable in a Class I) is typically between 0.25 m/s and 0.5 m/s. However, it is important to note that the British Standards allow for variation in these airflow parameters based on the manufacturer validation and certified type test for the CE mark, and so the exact velocities will depend on the manufacturer's specification for the cabinet.

The HEPA filters on the exhaust are there to ensure that any contamination in the airstream is filtered prior to discharge. It is therefore important to check the integrity of the filters to ensure there are no holes and the filter is properly located so there are no leaks around the edges. The test is undertaken by introducing an aerosol challenge to the airstream upstream of the filter and testing to see if there is any penetration downstream. Filters should have an efficiency of at least 99.995% (or penetration of <0.005%).

As part of the TExT, a containment test for operator protection should be undertaken. This is usually by the KI Discus method where an aerosol of potassium iodide is generated within the operating cabinet and sampling devices are placed in front of the cabinet to capture any aerosol escaping from the working area. The operator protection factor (OPF) is defined as the ratio of exposure to airborne contamination generated on the open bench to the exposure resulting from the same disposal of airborne contamination generated within the cabinet. When tested in accordance with the British Standard all cabinets in use should have an operator protection factor of at least 1.0×10^5. The OPF is a test of the adequacy of containment of aerosols by the cabinet.

All cabinets must have an operator protection (KI Test) test included as part of the commissioning process for new or relocated cabinets, and all cabinets must be routinely tested for operator protection (KI Test) within the relevant planned routine schedule for CL1, 2 or 3 laboratories. More frequent testing may be required in some circumstances such as after repairs. Operator protection tests are to be carried out in such a way as to ensure the cabinet and the laboratory are representative of normal working conditions. This may include having ventilation systems, air conditioning units, other safety cabinets and fume cupboards in the laboratory switched on, the cabinet loaded with typical equipment and samples, people moving around the laboratory, particularly if any pedestrian traffic is near the cabinet; and with doors (eg laboratory, nearby incubators and fridges etc) being opened and closed.

The British Standard also specifies a requirement to carry out an airflow visualisation test to provide visual evidence of the protection functions. This is done using a smoke test in the front opening and has to be done at type testing, commissioning and routine testing by the competent contractor or person in addition to the other tests. This should be done as part of the TExT using various types of smoke generating equipment including a smoke pencil.

Competent contractors and persons must meet the requirements for TExT that are set out in the COSHH Approved Code of Practice (ACoP), in addition to the detailed requirements of the British Standards. Schools must check that their MSC and LEV contractors and their maintenance reports for MSC and any associated LEV, do actually meet the requirements for thorough examination and test of LEV under COSHH that are specified in COSHH Regulation 9, ACoP 9 as set out in paragraph 185-189 (pages 45-47), and the TExT reports should typically include especially those points listed in paragraph 186. Reports should also include a photograph of

equipment and a diagram of the LEV system etc. The following information contains the broad details extracted from the COSHH ACoP.

The examination and test should ensure that the LEV plant can meet its intended operating performance for adequately controlling hazardous substances for the purposes of regulation 7. This applies whether the LEV is fixed or portable; it includes microbiological safety cabinets, external high efficiency particulate arrester (HEPA) filters fitted as part of extraction systems in laboratories and on-tool extraction systems. By following the guidance set out in HSE Guidance on controlling airborne contaminants at work, employers can help to ensure that the examination and testing of their LEV systems are carried out in accordance with the requirements of regulation 9(2).

A suitable employer record (TExT) in respect of each thorough examination and test of LEV should normally contain the following details:

- Name and address of the employer responsible for the LEV.
- Date of the thorough examination and test.
- Date of the last thorough examination and test.
- Identification and location of the LEV, and the process and hazardous substances concerned.
- Operating conditions at the time of the test and whether this was normal production or special conditions.
- Simple diagram of the LEV layout and location, with test points.
- General condition of the LEV system, including hood serial numbers and, where appropriate, photographs of relevant parts.
- Information about the LEV plant which shows:
    - Its intended operating performance for adequately controlling the hazardous substance for the purposes of regulation 7. (Note: If there is no information available on this, it indicates a need for a further assessment in accordance with regulation 6 to show compliance with regulation 7).
    - Whether the plant is still achieving the same performance.
    - If not, the adjustments, modifications or repairs needed to achieve that performance.
- Methods used to judge performance and the action to be taken to achieve that performance, eg visual, smoke test, airflow measurements, pressure measurements, dust lamp, air sampling, tests to check the condition and effectiveness of the filter.
- Results of any air sampling relevant to LEV performance.
- Information on the way operators use the LEV.
- Information on general system wear and tear and whether components may need repair or replacement before the next test.
- Name, job title and employer of the person carrying out the examination and test.

- Signature of the person carrying out the examination and test.
- Details of any minor adjustments or repairs carried out to make the LEV system effective.
- Details of any critical defects identified.

Employers should address critical defects immediately to ensure adequate control. The list above is not definitive and inclusion of all points may not be appropriate for all types of LEV.

Schools should discuss this with the MSC / LEV maintenance contractors and persons to check that their TExT maintenance and reports do actually meet these requirements and discuss with them if you have any concerns or questions. Schools must also check the actual TExT reports to ensure the contractors maintenance and reports clearly show that they meet the COSHH ACoP. HSE expects the maintenance reports to include the relevant elements.

5.3 User Checks of MSC

Schools and users should carry out suitable routine checks on MSC and other LEV, and there must be reporting systems for any faults. There should be regular, at least monthly, checks carried out on MSC airflows using a calibrated anemometer and keep records of the readings. Suitable measurements are usually taken using a vane or hot wire anemometer, according to the methods detailed in the HSE ACDP Management and operation of microbiological containment laboratories and British Standard.

This typically involves taking anemometer readings at five positions at the face of a Class I MSC. The measured airflows at all points within the Class I MSC should be between 0.7 and 1.0 m/sec with no individual measurement differing from the mean by more than 20%. This typically involves taking anemometer readings at three positions at the face of a Class II MSC. The measured inflows of the Class II MSC at all positions should be over 0.4 m/sec. (Downflow measurements, typically only done by the maintenance engineers as part of the TExT, for Class II MSC at all positions should be between 0.25 and 0.5 m/sec with no individual measurement differing from the mean by 20%). The anemometer readings can be compared to those in the MSC TExT reports. These MSC face airflow checks are in addition to the airflow measurements that are made by the engineer during the thorough examination and test. Records of local airflow measurements must be kept by Schools.

User checks of MSC and accessories should be undertaken before, during and after using the equipment. Written operating instructions should be supplied to users and checklists can be used that list the standard checks to be carried out. Some types of checks are common to all types of cabinets, whereas others will depend on the class or make of cabinet. The relevant SOPs and checklists should detail the various types of checks needed, who should carry them out and any relevant training provided to workers.

5.4 Fumigation of MSC

MSC, isolators and associated LEV may need to be fumigated to decontaminate these types of equipment in containment laboratories and facilities. MSC should normally be fumigated before maintenance, testing or repair work on the cabinet, and may require to be fumigated after a spillage inside a cabinet. Fumigations of MSC, isolators and other relevant equipment may be carried out by Schools or by competent contractors.

There must be suitable General and COSHH risk assessments and a safe system of work in place and permit to work arrangements for carrying out fumigations of MSC and other relevant equipment. There should also be written standard operating procedures in place for routine and emergency fumigations of the MSC. The manufacturer's instructions need to be taken into account where relevant when developing or using any fumigation methods and protocols. The methods used for routine and emergency fumigation need to be developed and fully validated to prove they work effectively. The validations must be done by the party which is carrying out the fumigations (eg School of contractor). The efficacy of fumigation should be validated in normal working conditions and the results documented and records kept. This should be repeated if changes are made which significantly affect efficacy. There must be suitable emergency procedures in place in case anything goes wrong with the fumigation and these should be included in the associated risk assessment.

Fumigations need to be performed safely so they do not expose workers or other persons to danger or hazardous substances. There are many fumigant chemicals used for various purposes in laboratories and facilities. All fumigant chemicals are hazardous substances since their purpose is to kill microorganisms, but their use is reasonable where it is required, as long as it is adequately controlled. The choice of fumigant is determined based on the requirements for the activity and related safety aspects taking into account the hierarchy of risk control under COSHH. Hydrogen peroxide is the most commonly used chemical for fumigation of MSC.

Note that formaldehyde (formalin) should not be generally used by Schools for fumigation of MSC, since it is a category I human carcinogen and powerful sensitizer, unless there is a specific requirement and no reasonable alternative where other safer fumigants are not suitable for the work.

Fumigation must be carried out only by a trained competent person with adequate knowledge of the procedure and the precautions. The written procedure must identify those individuals competent and authorised to carry out the fumigation process. Before any maintenance activities are carried out, contractors will usually require a written assurance that the cabinet has been decontaminated where it has been used for work with any hazardous material.

HEPA filters must be replaced when it is identified to be required following the manufacturers guidance, routine maintenance, testing or checks of the MSC. The filters are usually decontaminated by fumigation before disposal and they should be handled with appropriate PPE even after fumigation. HEPA filters should be disposed of using the relevant waste packaging and hazardous waste route.

6. Information, Training and Assessment of Competence

The effectiveness of MSC depends on good design, selection, installation, regular maintenance, and correct use. Information, instruction and training should include: the principles of how the different classes of cabinets work including airflow patterns; suitability of different cabinets for particular types of work; principles of airflow, operator protection factor and filter penetration tests; limitations of cabinet performance; how to work at cabinets safely; operation and function of all controls and indicators; how to decontaminate the cabinet after routine use; and the requirements for full decontamination and fumigation. The HSE ACDP Management and operation of microbiological containment laboratories and HSE SACGM Compendium of guidance documents provide detailed guidance and recommendations on what is required for safe use of MSC. University biological safety training courses provide some general information about the use of MSC.

Schools must ensure that all users of MSC are suitably trained and competent in their safe use. Schools should ensure that adequate practical training (and refresher training) is provided to all users so they understand how to safely use MSC and the procedures to follow if there are any faults. All workers should complete the relevant biological safety training courses and local practical training before starting work with MSC. Competence should be demonstrated prior to undertaking any independent work with biological materials within the MSC. The records of individual training and assessment competence must be kept locally. Schools need to establish the appropriate information, instruction, training and assessment methods, but here are some general comments that are useful to consider about the safe use of MSC bearing in mind that different types of cabinets, such as Class I, II or III MSC, may involve some specific operational and user requirements in addition to the common safety arrangements. There should be written instructions provided for the safe operation of each MSC such as in the SOPs and simple instructions can be put up on display.

The correct use of MSC is important for their safe performance in protecting workers, the work and the environment. The incorrect use of microbiological safety cabinets can compromise their performance and adversely affect the level of operator protection afforded by the cabinet. Some of the most common factors that users should pay attention to are explained below.

6.1 Prior to Use

Here are examples of the types of safety precautions to be taken prior to work in the MSC:

- Make sure the particular cabinet is suitable for your work based on your risk assessment and SOPs.
- MSC should always be installed in appropriate locations to ensure any traffic movement within the laboratory does not cause draughts to disturb the airflow patterns at the front of the cabinet and affect performance. Users should be aware of this requirement and should ensure the 1 metre clear behind rule is observed when they are using the cabinet.
- Organise and plan your work.
- Ensure the laboratory door and windows are closed since open windows and doors and other changes in air pressure may significantly affect safety performance of the cabinet and the level of protection for the operator.
- Keep the inside of the cabinet free of clutter.
- Put on the appropriate protective clothing according to the level of containment and the risk assessment for the work.
- Check the indicators show it is safe to use.
- Sit comfortably at the cabinet centre.
- Remove the night door or open the sash.
- Ensure that the MSC is switched on and running for sufficient time to allow airflow stability before starting work.
- Do not use unless the airflow indicator is registering in the 'safe' zone and no alarms are sounding.
- Prepare thoroughly and ensure any equipment required for the work is available and ready for use (eg number or tubes, flasks, dishes, media, solutions, pipettes, waste containers etc.
- Ensure the appropriate disinfectants are available according to arrangements and in the relevant containers.
- Ensure the inside of the MSC is clean and free of clutter. Follow local practices on any preliminary decontamination cabinet (eg ethanol solution is often used).
- Place work items in the MSC, ensuring clean and dirty materials are kept separate.
- Care must be taken in the selection of equipment in order to minimise the disruption to the air flow.

- Centrifuges, including microfuges, should not be used in a safety cabinet unless an operator protection factor (KI) test has been carried out with it running in situ and it shown not to compromise operator protection.

6.2 During Use

Here are examples of the types of safety precautions to be taken during work in the MSC:

- The level of protection against aerosol hazards provided by an MSC relies heavily on good working practices.
- Always use good microbiological practice.
- If the cabinet has a UV light, then this should be switched off when its in use by an operator.
- Never use an MSC if its operational safety is in doubt. If the alarm sounds, make the work secure, for open fronted MSC place the front on the cabinet or close the sash, and inform the appropriate responsible person according to local arrangements.
- Do not overcrowd the MSC.
- The user should avoid sudden and sweeping movement of their arms to minimise disturbance of the air flow patterns.
- For open fronted MSC, always work as near to the centre of the work area as possible, but at least 15 cm from its front.
- Do not obstruct the cabinet opening, air inflow grill or any exhaust grills.
- Obstructions will adversely affect performance and in particular the tested operator protection.
- Large and bulky equipment should not be placed in the cabinet, nor should equipment be placed on air grilles as both these will disturb air flow patterns.
- Equipment like centrifuges should not be used within an open fronted MSC unless appropriate testing has been done to establish that containment performance is maintained.
- Avoid use of bunsen burners if possible because they may cause damage to the cabinet, HEPA filters or affect airflows. However, if they are really needed, then a micro burner or other types of flaming devices, such as electric devices, might be still be useful but less potentially damaging or disruptive to the cabinet. Such equipment should though be included in the testing of the MSC to prove it does not cause damage or affect the operator protection.
- Do not put any paperwork in the cabinet since it may become contaminated.
- All other workers in the facility should be discouraged from making movements that may affect the performance of the MSC.

- Avoid passing potentially infected material over clean material.
- Clean any spills up immediately and according to training.
- Material should generally be discarded in a waste container located towards the rear of the MSC workspace. Do not discard materials in containers outside of the MSC, avoiding moving hands out of and back into the MSC.
- Dispose of equipment and contaminated material appropriately after use following the relevant risk assessments and SOPs.

6.3 After Use

Here are examples of the types of safety precautions to be taken after completion of work in the MSC:

- Always clean up and decontaminate after use following the relevant procedures as detailed in the local safety instructions, risk assessments and SOPs.
- Decontaminate equipment, flasks, plates etc where needed with an appropriate disinfectant before removing from the MSC.
- Ensure that all containers for autoclaving and other waste disposal routes are labelled correctly and secured.
- Let fans run for at least 5 minutes before next user.
- Allow the cabinet to purge before switching off.
- If there is any fault conditions, then render safe any work and discontinue use of the MSC.
- Report any faults promptly to the responsible person as detailed during training. Discontinue use of the MSC until the fault has been investigated and rectified.

7. Decommissioning of MSC

MSC must be effectively decontaminated prior to an engineer carrying out maintenance, servicing, thorough examination and testing, and also where an MSC is to be decommissioned. Decontamination is subject to risk assessment but often involves using a validated method of fumigation of the MSC, HEPA filters and associated LEV. Once decontaminated the MSC must be labelled as such by displaying a certificate of decontamination in a clearly visible location on the MSC and no further work undertaken in the cabinet until the engineer has fully completed any work required. Written assurance is usually required to be provided to contractors and engineers, prior to maintenance being carried out, to show that the cabinet has been appropriately decontaminated. MSC and any associated LEV can be removed from service following any other the required building and safety arrangements if they are to be decommissioned.

8. Records

A record should be kept of all commissioning, maintenance and testing work done on MSC and it is useful to indicate on each cabinet, the type of cabinet and when servicing is due to be done. This involves a range of tests of the MSC including the KI Test. Copies of TExT maintenance and test certificates must be kept for at least 5 years. Maintenance and testing reports and records need to be checked by the responsible persons in Schools. Safety Managers / Coordinators need to ensure that there are suitable local systems in place for monitoring and checking reports and records. Irrespective of which department actually manages maintenance and testing activities, Safety Managers / Coordinators will need to regularly monitor local systems and check at least a sample of documents and reports periodically to ensure that the relevant procedures are being followed in practice and they are satisfied that the safety arrangements are effective and being followed correctly by users. Suitable training records must also be kept. HSE Inspectors will often request to see maintenance reports and training records during inspections and visits to the University.

9. Further Information and Guidance

Please contact your School Biological Safety Adviser if you need advice on any aspect of biological safety or safe use or maintenance of MSC. Further information and guidance on biological safety matters is given on the Biosafety Unit (BSU) website.

If you require this document in an alternative format please contact The Health and Safety Department on health.safety@ed.ac.uk or call (0131) 651 4255

Document version

Version number	Summary of change	Date and by whom
3.0	Update with changes and details of new British Standards	12/06/2026 P. Walsh