Biosafety Cabinet Standard

Section:	**Biosafety Manual**	Issued By:	Environmental Health and Safety
		Issued Date:	2006-01-01
Part:		Revised Date:	2017-01-18
		Reviewed Date:	
Pages:	**7**	Revision #:	1
		Issued/Revised By:	EO

SCOPE

This Standard applies to all persons requiring the use of a Biosafety Cabinet (BSC) under the auspices of the University of Calgary.

PURPOSE

This Standard describes requirements regarding responsibilities, selection, placement, certification, maintenance, and operation of BSCs. When properly maintained and used in conjunction with good laboratory techniques, BSCs provide primary containment for work with biohazards and protection for personnel, the product and the environment.

RESPONSIBILITIES

Supervisors

- Follow the requirements of this Standard
- Identify on the laboratory Hazard Assessment and Control Form that work may involve a BSC
- Ensure that BSCs are certified on initial installation, after a move or repairs, and at least annually
- Ensure worksite-specific training is received and documented
- Ensure that a BSC is used for procedures involving open vessels of biohazards that may produce infectious aerosols or aerosolized toxins (when aerosol generation cannot be contained through other methods) or involving high concentrations or large volumes of biohazards

Workers

- Follow the requirements of this Standard
- Use a BSC for procedures involving open vessels of biohazards that may produce infectious aerosols or aerosolized toxins (when aerosol generation cannot be contained through other methods) or involving high concentrations or large volumes of biohazards
- Ensure certification is current by checking the label on the BSC; if certification is not current, notify supervisor. Service requests are to be sent to biosafety.cabinets@ucalgary.ca
- Complete worksite-specific training

Environmental Health and Safety (EHS)

- Provide information on appropriate legislation, codes, standards and best practices for BSCs
- Assist affected parties with interpretation of this Standard
- Review and update this Standard
- Provide annual recertification service
- Retain a copy of the annual recertification report

BIOSAFETY CABINET SELECTION

All BSCs must comply with the Canadian Biosafety Standard and be certified in accordance with the

National Sanitation Foundation (NSF)/American National Standards Institute (ANSI) Standard 49 *Biosafety Cabinetry*, or, where not applicable, comply with manufacturer's specifications. A listing of NSF Certified BSCs is accessible at the National Sanitation Foundation website.

A risk assessment is to be conducted prior to BSC selection. The risk assessment should include considerations such as using the BSC for work with chemicals or radiological hazards.

The most commonly used BSC for work involving biohazards at the university is a Class II, Type A2 Biosafety Cabinet that provides personnel, product and environmental protection. These BSCs:

- maintain a minimum average inflow velocity of 100 ft/min (0.51m/s) through the work access opening
- have HEPA filtered downflow air that is a portion of the mixed downflow and inflow air from a common exhaust plenum
- may exhaust HEPA filtered air back into the laboratory or to the environment through an exhaust canopy
- have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums

FACILITY AND ENGINEERING REQUIREMENTS

BSCs must be installed in accordance with the requirements outlined in the NSF/ANSI Standard 49 *Biosafety Cabinetry* and the Canadian Biosafety Standard.

- Class II, Type A2 BSCs must be exhausted through properly functioning exhaust canopies (i.e. thimble-connected) if used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies
- The University Biosafety Officer must be consulted prior to ordering a BSC that requires a canopy
- All BSCs to be supported by emergency power when used in a Containment Level 2 small animal facility
- BSCs shall be positioned so that they are out of the normal flow of traffic pattern and away from interfering air currents, such as those caused by doorways or general ventilation devices. BSCs must not be located directly across from, or adjacent to, seated work stations, other BSCs or fume hoods
- Room air exhaust and supply diffusers must be at least 1.5 meters (in the horizontal plane) from the work access opening of BSCs. The distance can be reduced if using velocity controlled diffusers with a maximum throw velocity as specified in the University of Calgary Design Standards
- A minimum 40 cm clearance must be provided between the exhaust outlet on top of the BSC and any overhead obstructions.
- A minimum of 30 cm must be provided on each side of the BSC
- Provision of natural gas into a BSC is prohibited

For further information on BSC design, installation, electrical and architectural requirements see the University of Calgary Design Standards.

CERTIFICATION AND MAINTENANCE

The NSF/ANSI Standard 49 *Biosafety Cabinetry* defines the tests for which a BSC must comply to become NSF Certified. In addition, the standard includes detailed test procedures and informational annexes, including recommendations for field certification tests, and decontamination procedures.

Certification is required prior to initial use, annually, and after repairs or relocation. Tests include the downward velocity profile, the work access face velocity, the HEPA filter leak test and the airflow smoke patterns. These tests are performed on-site by NSF-accredited field certifiers. A label (see image) indicating the date of certification, the date of the next certification, to what standard the tests were performed and the name of the certifier must be affixed to the exterior of the BSC. A copy of the annual recertification report is provided to the university and managed centrally.


CERTIFICATION LABEL

REPORT No.: _____ DATE TESTED: _____

NSF #: _____ SERIAL No.: _____

NEXT CERTIFICATION DUE: _____

CERTIFIED TO

☐ IEST - RP - CC - _____

☐ NSF/ANSI STANDARD #49

☐ MFG SPECIFICATIONS

☐ OTHER (See Report)

NSF

NSF ACCREDITED BIOSAFETY CABINET FIELD CERTIFIER

TECHNICIAN: _____

BIOLAB AIR QUALITY SERVICES

Division of B.G.E. SERVICE & SUPPLY LTD.

OFFICE: 403-243-5941 CELLULAR 403-660-1754

biolab@thefiltershop.com

Biosafety Cabinet (BSC) Safety Notice

Decontamination of the BSC is required prior to:

1. decommissioning and salvage
2. physically moving the cabinet
3. maintenance work, filter changes or performance tests.

Recertification is required annually and/or after relocation. BSCs are designed for work by one person at a time.

Email **biosafety.cabinets@ucalgary.ca** to schedule any of the above requests with a qualified contractor.

Date: _____ Bldg: _____ Room No: _____

ucalgary.ca/safety

BSCs are required to be decontaminated by a certified technician prior to decommissioning and salvage, physically moving the cabinet, maintenance work, filter changes or performance tests. A BSC Safety Notice (see image) must be affixed to BSCs owned by the university. Service requests are to be sent to biosafety.cabinets@ucalgary.ca

Routine maintenance is to be performed by laboratory personnel:

- disinfect the work surface with a disinfectant whose concentration and contact time has been shown to be effective against the biohazard used, with the fan running
- with the fan turned off, remove the work surface and disinfect the drip tray beneath it
- wipe the surface of the lights within the BSC; request light replacement, as required

All other maintenance should be performed by a certified technician.

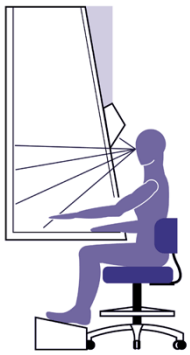
WORK PRACTICES AND PROCEDURES

If working with chemicals or radiological hazards in the BSC, appropriate protective measures should be employed.

Important Notes:

- Work in a BSC must only be conducted by one person at a time
- Equipment creating air movement (e.g. vacuum pumps, centrifuges) may affect the integrity of the airflow and must not be used within the BSC
- Windows that open must be kept closed when the BSC is in use
- Pipettes must be discarded in an appropriate waste container in the BSC and removed upon completion of work
- If a corrosive disinfectant is used, the work surface must be rinsed with water after disinfection to avoid corrosion of stainless steel surfaces
- Paper towels and tissues can get drawn under the work surface; these can be safely removed by lifting the work surface. Older cabinets do not have a paper catch under the work surface and paper towels and tissues can get drawn into the fan.
- Open flames in the BSC create turbulence, disrupt airflow patterns, and can damage the HEPA filter. Consequently, sustained open flames in BSCs are prohibited. Non-flame alternatives (e.g. sterile disposable inoculation loops) must be used whenever possible.

Start-Up Considerations



1. Check certification label to ensure certification is current.
2. If present, test the airflow alarm and ensure it is switched to the “on” position.
3. Ensure that the sash is at the appropriate height. Adjust stool height so that underarms are level with the bottom of the sash (see image).
4. Check the pressure gauges to ensure that readings are within the acceptable range determined by manufacturer.
5. Disinfect the work surface with a disinfectant effective against the biohazards in use. If a corrosive disinfectant must be used, the work surface should be rinsed with water after disinfection.
6. Assemble all materials required for manipulation and load into the BSC. Care must be taken not to overcrowd or block the front or rear grilles to ensure that the appropriate airflow patterns are not compromised.
7. When there is significant potential for splatter or splashes to occur during manipulations of infectious material or toxins, the work surface should be lined with a plastic-backed absorbent pad.
8. Place aerosol generating equipment (e.g. a vortex) towards the back of the BSC, without blocking the rear grille.
9. After loading material in the BSC, allow at least one minute for the airflow to stabilize before initiating work.

Working in the BSC

1. Don personal protective equipment (PPE), including lab coats and gloves, as appropriate.
2. Perform operations as far to the rear of the work surface as comfortable. Ensure that elbows and arms do not rest on the grille or work surface.
3. Avoid excessive movement of hands and arms through the work access opening. Such movements disrupt the air curtain at the work access opening of the BSC, which can allow

contaminants to enter or escape the BSC. Arms should enter/exit the BSC slowly and perpendicular to the work access opening.

4. Keep an appropriate disinfectant in the BSC while work is performed to avoid having to move hands outside of the BSC.
5. Segregate non-contaminated ("clean") items from contaminated ("dirty") items. Work should always flow from "clean" to "dirty" areas.
6. Material should be discarded in a waste container located towards the rear of the work surface. During work, do not discard materials in containers outside of the BSC.
7. Decontaminate the surface of all objects in the BSC in the event of a spill. The work surface should be decontaminated while the BSC is still in operation.

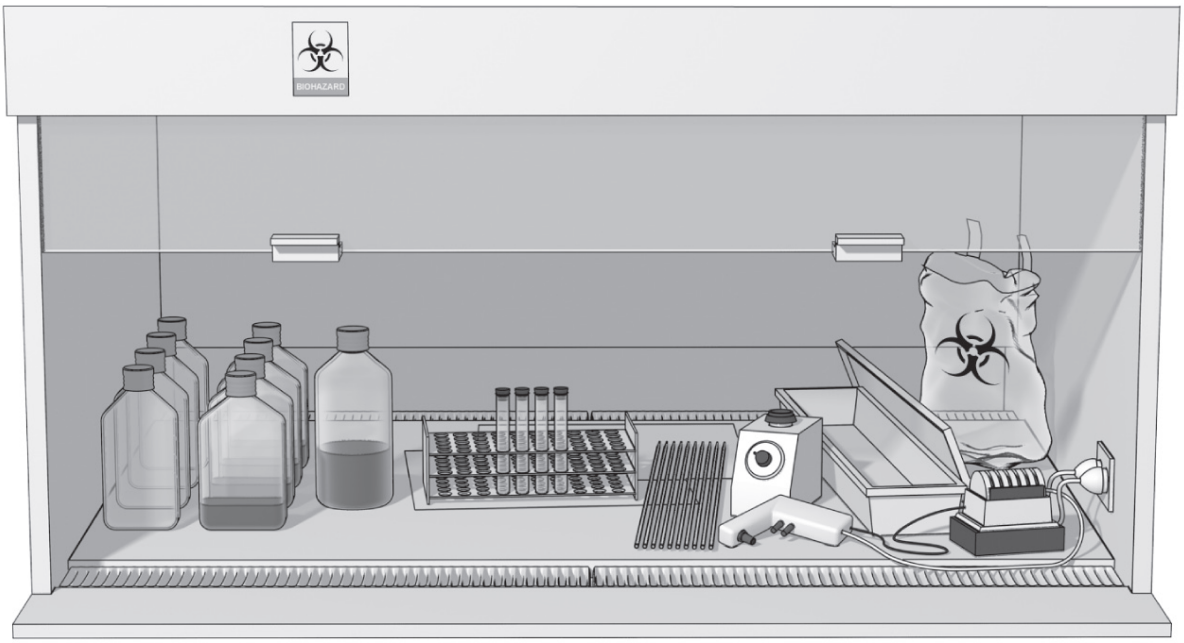


Figure 1.

A typical layout for working "clean to dirty" within a Class II BSC recommended by the Centers for Disease Control and Prevention. Clean cultures (left) can be inoculated (centre); contaminated pipettes can be discarded in the shallow pan and other contaminated materials can be placed in the biohazard bag (right). This arrangement is reversed for left-handed persons.

Completion of Work in the BSC

1. Close/cover all containers.
2. Surface decontaminate items before removing them from the BSC.
3. Upon completion of work, allow sufficient time for the air in the BSC to pass through the filter before disrupting the air curtain by removing hands or unloading material from the BSC.
4. Remove gloves before exiting the BSC. In containment zones where two pairs of gloves are worn when handling biohazards, the outer pair is removed prior to exit from the BSC to avoid the spread of contamination.
5. Disinfect the interior surfaces of the BSC, including sides, back, and interior of the glass, with a disinfectant effective against the biohazards in use.

Ultraviolet Light

The use of UV irradiation germicidal lamps is strongly discouraged due to their limited effectiveness at disinfecting the interior surfaces of BSCs. This is based on findings from Public Health Agency of Canada, National Sanitation Foundation, Centres for Disease Control and Prevention, National Institutes of Health and the American Biological Safety Association.

Numerous factors affect the activity of the germicidal effect of UV light, which require regular cleaning, maintenance and monitoring to ensure germicidal activity. In addition, there are safety hazards associated with UV light exposure, which include cornea burns and skin cancer.

Personnel wishing to use UV irradiation in BSCs should receive training on the safe work practices required and the hazards of UV radiation beforehand, including the following elements:

- UV irradiation of the work surface should only be used as a secondary method of maintaining the disinfected status of a BSC. Never rely on UV irradiation alone to disinfect a contaminated work surface
- UV irradiation requires that all materials be removed from the BSC so that shadow areas are eliminated
- UV irradiation is ineffective if a microorganism is protected by dust, dirt, or organic matter. A liquid chemical disinfectant should be the primary method of cleaning and disinfecting the interior of a BSC
- UV irradiation does not penetrate into cracks or through the grilles of a BSC
- UV irradiation can cause deterioration of various materials, including certain plastic and tubing
- Never touch a UV bulb with bare hands as the natural oils from hands may leave a fingerprint and create a filter or poor irradiation space on the bulb's surface
- UV bulbs should be cleaned frequently with an appropriate disinfectant
- The UV lamp should be routinely tested with a UV meter to ensure that the proper intensity (i.e., 40 µW/cm2) is being delivered at the appropriate wavelength (i.e. 254 nm) in the centre of the work surface

Vacuum systems

When using a house vacuum system, it is important to take precautions to protect the system from infectious fluids. The Center for Disease Control and Prevention recommends the following method as a means of avoiding contamination during aspiration (see image). The left suction flask (A) is used to collect the contaminated fluids into a suitable decontamination solution; the right flask (B) serves as a fluid overflow collection vessel. An in-line HEPA filter (C) is used to protect the vacuum system (D) from aerosolized microorganisms.

Centrifugation

Centrifugation can create aerosols. Centrifugation of biohazards where inhalation is the primary route of infection or intoxication requires the use of sealed safety cups or rotors that are unloaded in a BSC.

Other considerations

Contaminated bedding from animal cages is to be removed at a ventilated cage changing station or within a certified BSC prior to decontamination of animal cages.

Supporting BSCs on emergency power ensures that containment is maintained during emergency situations such as power loss.

EMERGENCY RESPONSE

In the event of a power failure while working in a BSC, close/cover all containers and wait until power returns. Start-up procedures must be performed again. Alternatively, closed containers can be safely moved to a functional BSC to continue work.

If a spill occurs within a BSC, it is considered contained; the next steps is to disinfect equipment and interior surfaces, as required. Refer to the Spill Response Procedures for further information. If an exposure occurs while using a BSC, refer to the Post-Exposure Protocol for Biological Hazards.

In case of emergency, contact Campus Security at 403-220-5333.

DEFINITIONS

Aerosol	A suspension of fine solid particles or liquid droplets in a gaseous medium (e.g. air) that can be created by any activity that imparts energy into a liquid/semi-liquid material.
Biohazards	Biohazards include, but are not limited to, infectious material (e.g. bacteria, viruses, fungi, cell lines, blood, prions, animal pathogens, aquatic animal pathogens, vector-borne pathogens & plant pests) and microbial toxins (e.g. botulinum toxin, cholera toxin & diphtheria toxin).
Biosafety Cabinet (BSC)	A primary containment device that provides protection for personnel, the environment and the product (depending on BSC class), when working with biological material.
Containment	The combination of physical design parameters and operational practices that protect personnel, the immediate work environment, and the community from exposure to biological material. The term "biocontainment" is also used in this context.
Personal Protective Equipment (PPE)	Equipment and/or clothing worn by personnel to provide a barrier against infectious material or toxins, thereby minimizing the risk of exposure. PPE may include, but is not limited to, lab coats, gowns, full-body suits, gloves, protective footwear, safety glasses, safety goggles, masks, and respirators.

REFERENCES AND RELATED DOCUMENTS

University of Calgary Laboratory Safety Manual
University of Calgary Biosafety Manual
University of Calgary Design Standards
Public Health Agency of Canada – Canadian Biosafety Standard
National Sanitation Foundation/American National Standards Institute Standard 49 *Biosafety Cabinetry*
Centers for Disease Control and Prevention - Biosafety in Microbiological and Biomedical Laboratories
National Institutes of Health
American Biological Safety Association