

9. ENGINEERING CONTROLS

9.1 Biological Safety Cabinets

Biological safety cabinets (BSC's) provide an integral part of primary containment when working with potentially hazardous biological materials. It is important that ALL users of biological safety cabinets are aware of the limitations of the equipment and work practices to assure a safe work environment for themselves and others in the area.

BSC's are divided into 4 different types depending on the design of the individual piece of equipment and how it is exhausted. Each type has unique features which allow the PI and others to use the BSC for his or her unique needs.

In 2002 the National Sanitation Foundation issued a change in its performance based standard #49. Standard #49 establishes performance criteria and provides minimum requirements for BSCs used for personnel, product, and environment protection in the US. Listed below is a chart to help the reader distinguish the difference between the 1992 standard and the revised standard of 2002 that is currently in use.

Risk Assessment	Protection Provided							Applications (Can be used with the following)		Duct Necessary	Air Tight Isolation Damper	Duct Connection
	Person	Prod.	Environ.	BSC Class	BSC Type (2002)	BSC Type (1992)	Min. Face Velocity	Nonvolatile Toxic Chemicals and Radionuclides	Volatile Toxic Chemicals and Radionuclides			
BSL 1-3	Yes	No	Yes	I	n/a	n/a	75	Yes	Yes	Yes	Yes	Hard
BSL 1-3	Yes	Yes	Yes	II	A1	A	75	Yes*	No	No	No	n/a
BSL 1-3	Yes	Yes	Yes	II	A2	B3	100	Yes	Yes*	Yes	Yes	Thimble
BSL 1-3	Yes	Yes	Yes	II	B1	B1	100	Yes	Yes*	Yes	Yes	Hard
BSL 1-3	Yes	Yes	Yes	II	B2	B2	100	Yes	Yes^	Yes	Yes	Hard
BSL 4	Yes	Yes	Yes	III	B1, B2	B1, B2	n/a	Yes	Yes^	Yes	Yes	Hard

- * minute amounts
- ^ small amounts

Definitions: BSL - an acronym for BioSafety Level as currently defined in the CDC/NIH publication [Biosafety in Microbiological and Biomedical Laboratories \(BMBL\)](#). The BSL represents the starting point for the risk based assessment of facilities, procedures and practices, and safety equipment under which a particular organism can be manipulated or stored. The Institutional Biosafety Committee may increase or decrease the BSL for individual projects/protocols depending on adequate justification and review.

Personnel protection – the individuals manipulating a particular organism at a particular time will achieve a particular protection factor afforded by the individual piece of equipment.

Product Protection – protection of the material with which the scientist is working.

Environmental Protection – any space outside the confines of the Biosafety cabinet. This could mean the lab space proper or the area with which the equipment is located in. It could also mean the outside of the building space in the case of a unit which is ducted to the outside.

BSC Class – There are three categories in which a biosafety cabinet can be placed (I, II, III). This is sub defined by the protection factors afforded by the equipment.

BSC Type – The subdivision of the different classes and is defined by air flow characteristics and methodology of exhaust flow connection if applicable.

Face Velocity – The speed of the air flowing around the operator sitting at the front of the equipment and flowing into the biosafety cabinet; usually expressed as feet per minute.

Duct necessity – dictated by the type of material being manipulated in the unit as well as HVAC dynamics of the laboratory. Careful attention must be placed on duct material and type of connection.

Air Tight Isolation Damper – a special damper used to facilitate gaseous decontamination of the equipment. Can also be used to make minor adjustments to face velocity and air flow balance.

Duct Connection – dictated by the class and type of biosafety cabinet. This can be a hard or gasketed, air tight connection or a thimble or canopy connection. Some units will not operate properly if the connection is not air tight.

The capability of a biological safety cabinet (BSC) to protect laboratory personnel and the environment from exposure to potentially hazardous material, as well as protecting the work being performed, is primarily dependent on proper functioning of the cabinet. No biological safety cabinet should be used to contain hazardous materials unless it has been demonstrated by appropriate test procedures to meet the minimum safety specifications given in APPENDIX P (recommended minimum performance specifications of BSC's)

The procedures to be used for the certification of biological safety cabinets at UAB shall be those recommended by the National Sanitation Foundation Standard #49 (NSF 49) and described in the NIH Laboratory Safety Monograph. To that end, only those units bearing the NSF 49 seal can be used to contain potentially hazardous aerosols of a biological origin, subject to the following exception applicable when cabinet units with the NSF 49 seal are not available:

9.1.1 BSCs and the NSF Seal

9.1.1.1 BSCs bearing the NSF 49 seal can be used to contain potentially hazardous aerosols of a biological origin.

9.1.1.2 Acceptable for use are biological safety cabinets that have no NSF seal, but whose manufacturers have represented to the Institutional Biosafety Committee (IBC) that using test procedures equivalent to those of NSF 49, they have demonstrated that the cabinets provide personnel, product, and environmental protection. A list of the units that have been approved is available through the Department of Occupational Health and Safety Biosafety Program

9.1.1.2.1 The typical unit within this exception is designed to maintain a twelve (12) inch sash opening, rather than the usual eight (8) or ten (10) inch sash opening.

9.1.1.2.2 If future unit(s) are approved by NSF 49 and therefore display the NSF 49 seal, then only those units can be purchased and used for potentially biologically hazardous material

9.1.1.2.3 These units will be certified according to the manufacturer's standard only.

9.1.2 Certification Requirements for Biological Safety Cabinets

When BSC are used for personnel protection, certification is required (1) before a newly installed cabinet is used, (2) after a cabinet is moved, relocated or partially dismantled for cleaning and/or repair, and (3) at least annually.

9.1.2.1 Annual recertification of BSCs is required if used in conjunction with material of human origin, human pathogens, primary animal or human cell/tissue culture, animal husbandry, or for processes that would create an infectious aerosol.

9.1.2.2 Biological Safety cabinets used for containment of organisms used at Biosafety Level 3 (BSL 3) must be recertified at least every six (6) months.

The Department of Occupational Health and Safety's Biosafety Program has established a mechanism of periodic inspection and certification for biological safety cabinets installed in buildings on the UAB campus.

The Department of Occupational Health and Safety maintains a current file on performance and certification data for each BSC. The responsibility for maintaining a current certification for each BSC lies with the principle investigator.

In order to minimize interference with laboratory work schedules, investigators responsible for BSCs may be contacted by individuals in the Biosafety Program Laboratory Ventilation Program to arrange a time suitable for certification. The PI is responsible for assuring that all work surfaces are effectively disinfected with a suitable disinfectant and that all procedures are suspended prior to the technicians' arrival in the lab. In certain instances it may be required to decontaminate the BSC with paraformaldehyde gas prior to the certification or repair process. The PI will be informed beforehand of the additional time required for this precautionary measure.

After the unit has been certified a certification label will be placed on the unit describing what standard or criteria was used to certify the equipment and the date recertification should take place.

If the unit fails to meet performance standards during the certification process, the responsible person in the lab will be informed as to the nature of the problem and what actions should take place to rectify the problem. In some cases the unit may require replacement filters. The responsibility for the purchase of these filters lies with the PI. The Biosafety Program's Laboratory Ventilation Program maintains a list of filter vendors and prices. The PI is responsible for contacting the Laboratory Ventilation Program when the filters arrive so arrangements can be made to repair and certify the equipment.

For repairs other than filter replacement, the PI will be consulted by personnel in the Biosafety Program as to the nature of the repair and the procurement of the parts necessary for the repair.

9.1.3 Decontamination of Biological Safety Cabinets

Prior to changing HEPA filters, accessing the dirty side of the cabinet, or other events determined by risk assessment, decontamination of the BSC by paraformaldehyde gas or other approved methods may be required.

9.1.4 Working safely in a biological safety cabinet

In addition to the biosafety cabinet functioning properly the user must also work in the unit appropriately in order to maintain a safe work environment and protect the integrity of the work performed. There are several "rules-of-thumb" that apply to all biosafety cabinets to help accomplish this goal. The owner's manual for the unit must always be consulted prior to working in a BSC. Listed below are some suggestions.

1. Start-up
 - a. Turn off the UV light, if applicable.
 - b. Turn on fluorescent light.
 - c. Check air intake grills for obstructions.
 - d. Start blower and allow the unit to operate for 15 minutes.
2. Wipe down
 - a. Wipe interior with appropriate disinfectant.
 - b. Avoid the use of sodium hypochlorite on stainless steel unless it is followed up with ETOH.
3. Loading materials and equipment
 - a. Load only the materials needed for that particular procedure.
 - b. Do not obstruct the grills (front or rear).
 - c. After loading wait 2-3 minutes to purge contaminants from the work area.
4. Work techniques
 - a. Keep all materials at least 4 inches inside sash.
 - b. Separate clean from contaminated materials in the work area.
 - c. Work should progress from clean to contaminated.
 - d. Keep and use contaminated materials in the rear of the work area.
 - e. Avoid arm movements in and out of the unit.
5. Final purge and wipe down
 - a. Allow the unit to operate 2-3 minutes after work and before unloading materials.
 - b. Wipe interior surfaces with appropriate disinfectant.
6. Shut down
 - a. Turn off fluorescent light.
 - b. Turn on UV light if desired and equipped.

CAUTION: AVOID DIRECT EXPOSURE TO UV LIGHT