BIOLOGICAL SAFETY CABINETS

Properly maintained and utilized biological safety cabinets (BSC) provide effective containment for the safe manipulation of potentially infectious agents and provide a sterile work environment for the protection of experimental material. High Efficiency Particulate Air (HEPA) filters are installed on the exhaust plenum of BSCs to protect the environment and the worker. HEPA filtering of the supply air within the BSC protects the research materials from room contaminants.

1. Only biological safety cabinets listed in the latest edition of the *National Sanitation Foundation (NSF) Standard 49* (Class II Laminar Flow Biohazard Cabinetry)[14.1] shall be purchased. EH&S is available to consult on BSC selection and location.

2. Biosafety Cabinet Terminology

   2.1. Class I BSCs are no longer manufactured on a regular basis. Usage of existing Class I BSCs should be limited to low risk biological agents in which protection of experimental material is not necessary.

   2.2. A Class II BSC is a front-opening cabinet with inward air flow to protect personnel, HEPA-filtered vertical laminar air flow to protect the work, and HEPA-filtered exhaust for environmental protection. Class II BSCs are divided into Types A or B.

      2.2.1. Class II Type A1 cabinets (formerly designated as Type A) utilize a design in which 70% of the cabinet air is recirculated to the cabinet work area through a HEPA filter; and the balance of the air can be exhausted through a HEPA filter back into the room or to the outside via a canopy exhaust connection.

      2.2.2. Class II, Type A2 cabinets (formerly designated as Type B3) function the same as Class II Type A1, except all biologically contaminated ducts and plenums under negative pressure are surrounded by negative pressure ducts and plenums.

      2.2.3. Class II Type B1 cabinets function in a manner in which 30% of the cabinet air is recirculated to the cabinet work area through a HEPA filter. The 70% balance of the air is exhausted through a dedicated duct to the atmosphere after passing through a HEPA filter.

      2.2.4. Class II Type B2 cabinets have HEPA filtered downflow air drawn from the laboratory, and exhaust 100% of the inflow and downflow air to the atmosphere after filtration through a HEPA filter. There is no recirculation of air in the cabinet or air returned to the laboratory

   2.3. Class III biological safety cabinets are totally enclosed with leak-tight construction. Operations in the cabinet are conducted through durable gloves attached to the cabinet, hence the term glove box. The cabinet is maintained under negative air pressure. Downflow air is drawn into the cabinet through HEPA filters. The exhaust air is treated

by HEPA filtration. Class III BSCs are not recommended or necessary for most biomedical research that involves BSL 2 materials.

3. Biosafety Cabinet Selection

3.1. Where biosafety cabinet applications will consist primarily of microbiological work and only minute or trace amounts of volatile hazardous chemicals will be utilized, a Type A2 cabinet with an exhaust canopy for discharge into the building exhaust system is recommended.

3.2. It is permissible under the 2002 NSF 49/ANSI Guidelines to exhaust Type A2 cabinets back into the laboratory provided that NO volatile or toxic chemicals and/or radionuclides are utilized in the BSC.

3.3. Where BSC applications could include work with more than minute quantities of volatile chemicals, or work with chemicals for which the physical properties or hazards are unknown or are known to present special hazards, a Type B2 cabinet is recommended. These cabinets provide 100% exhaust with no recirculation into the room or BSC. Exhaust from Type B2 cabinets must be interlocked with the blower or building exhaust system to prevent pressurization of the BSC.

3.4. If the primary use of the BSC will be to contain volatile or hazardous chemicals, and protection of the research product is not required, a chemical fume hood should be considered. For applications that require product protection, such as transgenic animal or *in vitro* work, a chemical fume hood with not offer the necessary product protection.

4. Installation of UV Lights in Biosafety Cabinets

4.1. **The CDC[14.2] and EH&S do not recommend installation of UV lights in biosafety cabinets.**

4.2. Ultraviolet (UV) lamps should not be used as the primary method for decontamination of the BSC. Chemical disinfection is the primary, and sufficient, method for BSC decontamination.

4.3. UV light is a known carcinogen and exposure leads to skin and corneal damage.

4.3.1. Since UV lights are not a sufficient primary method of surface decontamination for BSCs, ordering BSCs without UV lights is a method to avoid potential personnel exposures to a known carcinogen.

5. All biological safety cabinets shall be certified annually per the testing specifications found in NSF 49 and the manufacturer's specification.

6. All new BSCs shall be certified following installation, and before initial use.

7. Type A2 biological safety cabinets in BSL-3 facilities should be installed with a thimble/canopy connected to the exhaust air system.

8. Performance tests/certifications are to be conducted by a NSF-certified contractor experienced in BSC testing. Arrangements for performance testing and certifications are initiated by the Investigator or department owning the equipment.

9. Before disassembling or moving a biological safety cabinet, appropriate decontamination by an experienced contractor is required. Relocated BSCs shall be re-certified following re-installation before resuming use.

10. When maintenance work, filter changes, and/or performance tests require access to the sealed, potentially contaminated portion of the cabinet, appropriate decontamination of the entire BSC is required.

11. All BSCs must be clearly labeled with the class and type, the date of the last certification, the name of the person performing the test, and the company name.

12. Use Aseptic Technique to Maintain Sterile Work Environment and Containment of Biological Agents

    12.1. Minimize movement in and out of the biosafety cabinet. Place all working materials inside the biosafety cabinet before beginning work to preserve the air barrier in the front of the biosafety cabinet.

    12.2. Work from clean to dirty, by placing all contaminated materials on one side of the biosafety cabinet.

    12.3. Collect all wastes such as contaminated plastic ware in a bag in the biosafety cabinet and then dispose it in a larger biohazard bag outside of the cabinet when work is completed.

13. Use of Gas Burners or Open Flames in Biosafety Cabinets

    13.1. **The NSF/ANSI Standard 49[14.1], CDC[14.2] and EH&S do not recommend use of gas burners, open flames, or equipment that generates high temperatures in biosafety cabinets.**

    13.2. The use of gas burners or open flames compromises the function of the biosafety cabinet[14.4]. The biosafety cabinet provides worker protection and a sterile work environment by drawing air into the cabinet and filtering microorganisms out through a HEPA filter. The heat produced from a gas burner disrupts the fragile air barrier inside the biosafety cabinet leading to potential worker exposure and contamination of workspace and materials.

    13.3. Use of gas burners in biosafety cabinets has led to fires, destroyed cabinets, and injured workers.

13.3.1. Motor blowers in BSCs are not spark proof and if gas leaks out of a gas valve it can accumulate inside the cabinet and ignite when BSC is turned on or when lighting a burner.

13.3.2. Excess latex tubing can loop over the flame and be burned, causing a flame to shoot out of the gas valve.

13.4. Eliminate use of gas burners within BSCs.

13.4.1. Use only sterile disposable plastic ware instead of glassware that must be flamed.

13.4.2. Rely upon good chemical disinfection, such as bleach or other commercial disinfectants, to clean equipment and surfaces.

13.4.3. Use proper work practices to maintain a sterile environment inside cabinet to eliminate the need for flame sterilization whenever possible.

13.4.4. If high heat applications cannot be avoided, use an electric device such as a Bacti-cinerator or substitute a burner with safety features that uses self-contained gas cartridges. Additional examples include:
Cole-Parmer Bunsen Burner (compatible with butane and propane cartridges if the proper adapter is purchased)
Cole-Parmer Electric Bunsen Burner
Neutec Group LabFlame IR Activated Safety Bunsen Burner

13.4.5. **Do not leave gas burners or equipment that generates high temperatures unattended in the BSC.**

14. Additional Information and References:

14.1. National Sanitation Foundation/American National Standards Institute Standard No. 49, Biosafety Cabinetry – Design, Construction, Performance, and Field Certification. American National Standards Institute, (2020).

14.2. Biosafety in Microbiology and Biomedical Laboratories, US Dept. of Health and Human Services Publication No. CDC 300859, 6th Edition (2020). Center for Disease Control, Atlanta, GA.

14.3. Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets, 3rd ed., US Department of Health and Human Services, 2007.

14.4. Held, K.F., Thibeault, R., and J. Boudreau. Heat sources in a biosafety cabinet compromise experimental and user protection. BSC MythBusters white paper, Baker Company, 2019. https://bakerco.com/images/uploads/assets/Heat-sources-BSC-Comp-Exp-User-Protection-WP.pdf. Accessed March 10, 2022.