Biological Safety Cabinets

Biological Safety Cabinets (BSC) are designed to provide personnel, environmental, and product protection when appropriate microbiological practices and procedures are followed. There are three classes of BSCs (I, II, III) which have been developed to meet varying research and clinical needs.

Class I

The Class I BSC provides personnel and environmental protection, but no product protection. It is similar in terms of air movement to a chemical fume hood, but has a HEPA filter in the exhaust system to protect the environment. Unfiltered room air is drawn in through the work opening and across the work surface. Personnel protection is provided by this inward airflow as long as a minimum velocity of 75 linear feet per minute (lfpm) is maintained. Because product protection is also provided in Class II BSCs, general usage of the Class I BSC has declined. However, Class I BSCs are still commonly employed to enclose equipment (e.g., centrifuges, harvesting equipment or small fermenters), or for procedures with potential to generate aerosols (e.g., cage dumping, culture aeration, or tissue homogenation).

Class II

The Class II (Types A1, A2, B1 and B2) BSCs provide personnel, environmental and product protection. Airflow is drawn into the work opening, providing personnel protection and downward flow of HEPA-filtered air also provides product protection by minimizing the chance of cross-contamination across the work surface of the cabinet.

Class II cabinets are designed for work involving microorganisms assigned to any of the four biosafety levels, though BSL-4 work requires the user to wear a positive pressure protective suit. BSCs in this class provide the microbe-free work environment necessary for cell culture propagation and may be used for the formulation of nonvolatile antineoplastic or chemotherapeutic drugs.

Class II BSCs have HEPA filters that are effective at trapping particulates effectively removing all potentially infectious agents but they do not capture volatile chemicals or gases. The BSC exhaust air may be recirculated back to the laboratory in Type A1 or A2 BSCs and this is preferred because it saves energy while also minimizing the potential for flow disturbances that may be transmitted via the laboratory general exhaust system. Small amounts of chemical use may be done in Type A2-exhausted BSCs, but this requires the cabinet to be exhausted from the space via a canopy or "thimble" connection where it joins the laboratory exhaust duct to afford similar protection from flow perturbations. Exhaust air from Types B1 and B2 BSCs must be discharged directly to the outdoors via a hard ducted connection as these BSCs are designed for both biological and chemical use. Therefore, only Type A2-exhausted, B1, or B2 BSCs can be used when the work also requires the use of some volatile or toxic chemicals. Chemical use should be minimized to the greatest practical extent.

Class III

The Class III BSC was designed for work with highly infectious microbiological agents and for conducting hazardous operations as these provide maximum protection for the environment and worker by utilizing a gas-tight enclosure with a non-opening view window. Access for passage of materials into the cabinet is through a dunk tank, that is accessible through the cabinet floor, or double-door pass-through box (e.g., an autoclave) that can be decontaminated between uses. Reversing that process allows materials to be removed from the Class III BSC safely. Both supply and exhaust air are HEPA filtered on a Class III cabinet. Exhaust air must pass through two HEPA filters, or a HEPA filter and an air incinerator, before discharge directly to the outdoors. Class III cabinets are not exhausted through the general

laboratory exhaust system. Airflow is maintained by an exhaust system exterior to the cabinet, which keeps the cabinet under negative pressure.

Several Class III BSCs can be joined together in a "line" to provide a larger work area. Such cabinet lines are custom-built; the equipment installed in the cabinet line (e.g., refrigerators, small elevators, shelves to hold small animal cage racks, microscopes, centrifuges, incubators) is generally custom-built as well.

Laminar Flow or "Clean Benches"

Laminar flow or "clean benches" are not BSCs. These pieces of equipment discharge HEPA-filtered air from the back of the cabinet across the work surface and toward the user. These devices only provide product protection. They can be used for certain clean activities, such as the dust-free assembly of sterile equipment or electronic devices. Clean benches should never be used when handling cell culture materials, drug formulations, potentially infectious materials, or any other potentially hazardous materials. The worker will be exposed to the materials being manipulated on the clean bench potentially resulting in hypersensitivity, toxicity, or infection depending on the materials being handled. Horizontal airflow "clean benches" must never be used as a substitute for a biological safety cabinet. Users must be aware of the differences between these two devices.

Proper Use of BSCs

Always follow the manufacturer's instructions when using a BSC to maximize the protection of personnel, the material on the work area, and the environment. Individuals using BSCs **should** be properly trained and safety instructions **should** be posted on or near the location of the unit. **BSCS SHOULD NOT BE USED AS STORAGE!** The following are general guidelines for proper operation of a BSC.

- Startup
    - If necessary, turn off ultra violet sterilizer as soon as you enter the room.
    - Turn on all blowers and cabinet illumination lights.
    - Allow five minutes of operation to purge system; check flow alarm system and audiovisual alarm function (depending on system).
    - Decontaminate readily accessible interior surfaces with disinfectant appropriate for the agents or suspected agents present before use.
- Shut Down
    - Decontaminate and remove all unnecessary items from interior work area.
    - Decontaminate readily accessible interior surfaces with a disinfectant appropriate for the agents or suspected agents present after use.
    - Turn on ultraviolet sterilizer (if provided).
    - Allow five minutes of operation to purge the system.
    - Turn off the cabinet blower.

Moving and Installing BSCs

The operational integrity of a new BSC must be validated by certification before it is put into service or after a cabinet has been repaired or relocated. Relocating a BSC may break the HEPA filter seals or otherwise damage the filters or the cabinet. BSCs must be decontaminated prior to being moved. Certified professionals usually handle the decontamination of the BSCs motor and filters.

Certification

BSCs used on campus for handling of biohazards must be certified annually. As a service, the Biological Safety Office will pay for the annual certification of the BSC. For additional information, contact the Biological Safety Office.

General Guidelines

- Class II Type A1 or A2 recirculating BSCs are preferred for use at FSU. These are not connected to the building HVAC system and are not directly subjected to failures or flow anomalies induced by transients in the laboratory exhaust system. If these are connected to the exhaust system this must be done through a special canopy or thimble type connection provided by the manufacturer.
- **Gas lines shall not be plumbed into any BSC.**
- **Open flames are prohibited inside any BSC.**
  Contact the Biological Safety Office if flame sterilization is needed.
- Germicidal ultraviolet lights must be routinely checked for proper operation
- BSCs used for pathogens must be routinely decontaminated during extended operations and after work is completed
- If hazardous chemicals must be used within a BSC, a Type B1 or B2 device must be used. These BSCs require hard-ducted connections to specifically designed laboratory exhaust systems. Please consult with the University Biological Safety Office if this type of work is anticipated.
- A BSC shall never be used to provide the negative pressure differential required within a containment area; they should be allowed to function independently from the general ventilation system serving these areas.

Additional Information and Resources

- http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5_appendixA.pdf