The biosafety cabinet (BSC) is an essential piece of safety equipment for many biological laboratories. The BSC, an engineering control, is designed to provide personnel and environmental protection from potentially infectious materials and human pathogens.

BSCs are manufactured in three different classes (Class I, II and III). The common element in all biosafety cabinets is the high efficiency particulate air (HEPA) filter. HEPA filters can remove particles down to 0.3 microns with 99.97% efficiency and will trap most bacteria, viruses and spores. Vapors and gasses will not be captured by a HEPA filter.

**CLASS I BIOSAFETY CABINETS** provide personnel and environmental protection, but do not provide a sterile work surface. Air flow in a Class I BSC is similar to that of a chemical fume hood, with air being drawn away from the worker and across the work surface. A HEPA filter on the cabinet exhaust protects the environment. Class I cabinets are useful for work that requires containment but not product sterility.

**CLASS II BIOSAFETY CABINETS** provide personnel, product and environmental protection. Air is drawn around the worker into the front grill of the BSC, providing operator protection. HEPA filtered sterile air flows down onto the work surface, minimizing the potential for cross-contamination. Exhaust air passes through another HEPA filter before being released into the environment. Class II units are divided into four types: A1, A2, B1, and B2.

- Type A1 units exhaust 30% of their air and recirculate 70% through HEPA filters. Type A1 units exhaust sterile air to the room atmosphere.
- Type A2 units also exhaust 30% and recirculate 70% of their air through HEPA filters. HEPA filtered exhaust from type A2 BSCs may vent to the room atmosphere, or may be connected to the building exhaust system.
- Type B1 cabinets exhaust 60% of their air and recirculate 40%. Exhaust air must be processed through a dedicated facility exhaust duct that leads to the roof.
- Type B2 cabinets exhaust 100% of their air. No air is recirculated in a type B2 unit. Exhaust air must be ducted to a dedicated facility exhaust channel.

**CLASS III BIOSAFETY CABINETS** are designed to provide maximum protection to the worker and the environment. Sometimes called Class III glove boxes, these units are gas-tight enclosures with a non-opening view window. Intake air is filtered through a HEPA filter, and exhaust air passes through two HEPA filters before being exhausted to the outdoors.

**HORIZONTAL LAMINAR FLOW CLEAN BENCHES** are not biosafety cabinets. These devices provide product protection, but do not protect the worker or the environment. HEPA filtered air is discharged across the work surface and toward the user, effectively blowing any pathogens or contaminants into the user’s breathing zone. These units are not a substitute for a biosafety cabinet, and should never be used when working with pathogens. They may be used for pouring media or other clean applications. The OEHS does not recommend the use of horizontal laminar flow clean benches for work with biological agents.
Workers should follow this procedure when preparing to work in a BSC:

1. **Plan your experiment.** Prepare a written checklist of the items you will need for your experiment. Gather these materials before you begin working, and be sure to include your personal protective equipment and waste disposal containers.

2. **Turn on the cabinet.** If the cabinet is not running when you wish to begin work, turn on the power and let the cabinet run for at least 15 minutes. This cycle will purge the work area of any particles before you begin working.

3. **Disinfect the work surface.** Use a disinfectant appropriate for the work being conducted in your lab. If using a disinfectant such as bleach, wescodyne, vesphene, or another commercial preparation, it is helpful to follow up your wipe with a 70% ethanol rinse. Ethanol can help the disinfectant to evaporate cleanly.

4. **Prepare to begin work.** Line the work surface with plastic backed absorbent towels, or work over a tray. Place your supplies into the cabinet, as far away from the sash as possible. All operations should be performed on the work surface at least four (4) inches from the inside edge of the front grill. Try to keep the work surface as neat as possible.

5. **Work from clean to dirty.** Organize your supplies so that you can segregate your work from the clean side of the cabinet to the dirty side. Avoid moving dirty items over clean ones to prevent cross-contamination of your experiment.

6. **Protect vacuum lines.** If you will be using a vacuum, be sure to use a HEPA filter and in-line disinfectant flasks to protect your vacuum system from contamination. The in-line flasks will catch any overflow, and the HEPA filter will prevent aerosols and particles from entering the vacuum line.

7. **Collect waste materials.** Workers using infectious materials should collect their wastes inside of the cabinet. Repeatedly moving arms in and out of the cabinet to deposit waste in a container outside of the BSC will compromise the air flow and containment provided by the BSC. Removing waste from the BSC that is untreated or not packaged in a leak-proof container can also spread contamination. Be sure to seal any bags and cover open containers before removing them from the cabinet.

8. **Clean up.** Wipe down all materials with disinfectant before removing from the BSC. After the cabinet is emptied, wipe down the interior cabinet surfaces with disinfectant. Allow the BSC to run for 15 minutes before turning it off.
Common Errors to Avoid

- Keep the front and rear grills clear. Covering them with supplies or paper will compromise the cabinet’s airflow.

- Do not store supplies on top of the BSC. The HEPA filter is located there, and it is easily damaged.

- Do not use an open flame in the BSC. It can create turbulence that disrupts airflow. If the gas to a Bunsen burner is accidentally turned on without the burner being lit, the concentration of gas will build up due to recirculation of cabinet air. The fan motor can act as an ignition source resulting in a serious explosion and fire. Use sterile disposable supplies or an electric bacticinerator instead. If an open flame is unavoidable, use a Touch-O-Matic Bunsen burner equipped with a microburner pilot light. The Touch-O-Matic provides flame on demand.

- Avoid moving your arms in and out of the cabinet during your experiment, and try to minimize activities that can cause eddy currents (opening doors, personnel walking near cabinet, etc.). Small pockets of turbulence can compromise air circulation in the BSC.

BSC Purchase, Certification and Repairs

Selection of biosafety cabinets is based on the required level of personnel and environmental protection. Detailed information on the types of biological and chemical agents must be provided by the primary investigators in order to determine what type of BSC is appropriate. Because selection of the proper BSC is so critical, all purchase requisitions for biosafety cabinets are submitted to OEHS for review and approval.

Biosafety cabinets require regular certification and maintenance. All units must be certified after initial installation and then annually or whenever they are moved or after internal maintenance work such as HEPA filter replacement. A certification/inspection sticker is placed on each unit to show its certification status. Contact the OEHS to arrange for BSC certification.

BSCs require both internal and work surface decontamination prior to moving, disposal, and maintenance work. Work surface decontamination is performed by lab personnel using appropriate chemical disinfectants. Internal decontamination involves paraformaldehyde gas sterilization which must be arranged by the OEHS. Repairs to BSCs are also arranged by the OEHS.

Please contact Kim Chapital at (504) 988-2870 if you would like more information about BSCs.

References


OEHS Contact Information

BSC Questions Kim Chapital (504) 988-2870
OEHS General Information Kim Chapital (504) 988-5486
OEHS Website http://www.som.tulane.edu/oehs