VII. BIOLOGICAL SAFETY CABINETS

Exposure to airborne microorganisms can result in infection of laboratory workers or contamination of research materials. Danger to personnel and to the success of scientific investigation from carelessly or improperly used equipment cannot be overly emphasized.

The biological safety cabinet (BSC) is designed to prevent escape of pathogens into the workers' environment and to bar contaminants from the research work zone. Escape of pathogens into the workers' area is prevented by an air barrier at the front opening and the cleaning action of the HEPA air filter, which removes airborne biological contaminants which may be released in the BSC, but **does not** remove chemical or radiological contaminants.

A. BSC Certification/Maintenance

1. The CDC/NIH publication *Biosafety in Microbiology and Biomedical Laboratories* states "It is imperative that Class I and II biological safety cabinets (BSC) are tested and certified in situ at the time of installation within the laboratory, at any time the BSC is moved, and at least annually thereafter." Only qualified personnel using approved test methods and equipment should provide performance certification.

    a. Since the BSC is a piece of equipment owned by the department or laboratory, it is the department's responsibility to ensure current certification and maintenance of the BSC.

    b. Purchasing has established a contract with a qualified vendor to perform certifications and decontamination for all OU campuses. Contact the EHSO for instructions on utilizing this contract.

2. Many BSCs have gauges to indicate pressure differential across the supply filters. If the filters must be replaced, the BSC **must** be decontaminated first using procedures that follow those outlined in the National Sanitation Foundation Standard Number 49. After decontamination, only an approved contractor should replace filters. Upon completion of filter replacement, the BSC should be recertified.

3. Some applications of the BSC require that the unit operate continuously. When used to prepare cytotoxic drugs, for example, the unit should operate continuously, to prevent toxic residue from migrating out of the cabinet ductwork and into the laboratory. If the BSC is not used in such an application, there is no requirement to leave it operating continuously. This will only reduce the life of the cabinet blower and HEPA filters.

4. Unless the BSC is hard-ducted to an outside exhaust system, do not use noxious, toxic or corrosive chemicals which create a hazardous atmosphere in the BSC since the BSC recirculates filtered air into the laboratory space but does not remove gas or vapor state contaminants. In addition, the BSC and its HEPA filters are constructed of materials that

may be damaged by corrosive chemicals.

B. **General Information**

1. Hands and arms should be washed well with germicidal soap before and after work in the BSC.

2. Wear long sleeve gowns with knit cuffs and rubber gloves. This minimizes the shedding of skin flora into the work area and protects the hands and arms from contamination by viable agents.

3. Interior surfaces of the work area should be disinfected by wiping them thoroughly with 70% alcohol. Do not light an open flame immediately after this occurs due to the flammability hazard.

4. Everything needed for the complete procedure should be placed in the BSC before starting so that nothing passes in or out through the air barrier until the procedure is completed.

5. Do not place anything over the front intake or rear exhaust grill in units having a solid work surface. As a general rule, keep equipment at least four inches inside the cabinet window and perform transfer of viable materials as deeply into the BSC as possible.

6. After all materials have been placed in the BSC, wait 2-3 minutes before beginning work. This will allow sufficient time for the cabinet air to purge airborne contamination from the work area.

7. Minimize room activity which can create disruptive air currents. The ideal location for a BSC is in a quiet end of the laboratory, removed from doorways, and air conditioning/heating vents. Opening and closing laboratory doors can cause drafts that allow microorganisms to penetrate the air barrier.

8. Minimize the movement of objects (including hands and arms) into and out of the BSC. Such movement causes turbulent air currents which disrupt the air barrier and allow escape and entrance of airborne contaminants.

9. The BSC should not be overloaded. Large objects placed in the BSC may impede the airflow in the work area, reducing the efficiency of the BSC. Electrical appliances like centrifuges, blenders, etc., will often disrupt the airflow around them when they operate, due to rotating parts or cooling fans. This may be sufficient for contaminated air to escape into the laboratory. If a centrifuge must be used in the BSC, do not perform other research activities in the BSC while the centrifuge is operating.

10. Normal laboratory contamination control procedures and aseptic techniques are still necessary while working in the BSC.

11. Contaminated equipment or materials such as pipette tips, glassware, and waste material should not be removed from the BSC until enclosed in a biohazard bag or labeled container and the surface of such bag or container is decontaminated. For example, trays of discarded pipettes or pipette tips must be covered and biohazard bags must be sealed before removal from the BSC.

12. If an accident occurs which spills or splatters the biological agent in the work area, all surfaces in the BSC must be decontaminated before being removed. See Section XII., "Spill Control/Emergency Response" for details.

13. Do not use a Bunsen burner in a BSC. The flame can cause turbulence in the air stream and the heat generated may damage the HEPA filter. If a procedure requires a flame, use a burner with a pilot light and place it to the rear of the work space to minimize air turbulence. A flameless (electric) incinerator or disposable inoculating loops are possible alternatives.

14. Do not mouth pipette.

15. Do not use the BSC to store excess laboratory equipment.

16. Following completion of work, the following steps must be performed.

    a. Allow the BSC to run 2-3 minutes with no activity. This will allow sufficient time for cabinet air flow to purge airborne contaminants from the work area.

    b. Decontamination of the interior surfaces should be repeated with 70% alcohol after removal of all materials, cultures, apparatus, etc. A careful check of the work area should be made for spilled or splashed nutrients. They may support fungal growth and result in spore liberation that contaminates the protected work area.

    c. Shut down by turning off the fan and lights.

17. Be careful when cleaning the underside of the work surface and the basin of the BSC that wipes are not pulled into the riser on the backside of the BSC. In order to remove the wipes, the BSC will have to be decontaminated with formaldehyde gas and recertified. Recommendations include:

    a. Use a heavy cleanwipe or disposable towel instead of a lightweight wipe.

    b. Soak the wipes or towels with the disinfectant solution before use. That way they will be too heavy to be drawn up the riser.

c. While newer BSCs have a paper catch in the back, do not place anything in front of the intakes as this can interfere with the airflow and violate the certification. Contact the manufacturer for information on retrofitting older units with a grate or similar trap.

C. **UV Lights**

UV lamps are often installed in a BSC as an aid in decontamination of the work area. The lamps are similar in construction to fluorescent lights, except they emit ultraviolet light with a wavelength of 237 nm. This wavelength of light is disruptive to DNA molecules, resulting in a broad spectrum disinfection.

1. While UV light is effective when it strikes a microbial cell directly, it is ineffective when the cell is protected by dust, dirt or organic matter. In the same manner, the intensity from the lamp is affected by the accumulation of dust and dirt on it. Therefore, the lamp should be cleaned frequently by turning off the UV light and wiping off the surface of the bulb with 70% alcohol.

2. UV irradiation of the work area should only be used as a optional method of maintaining the disinfected status of a cabinet; it should never be relied on alone to disinfect a contaminated work area.

3. The UV lamp should never be on while an operator is working in the cabinet, as exposure to UV light can cause painful skin and eye burns.

   a. Eye protection against direct or indirect (reflected from surfaces or clothing) UV exposure is required when UV light is in use.

   b. If the cabinet has a stainless steel interior, a UV light placed in almost any location within the upper part of the cabinet will bounce potentially hazardous illumination around the inside and out of the opening of the cabinet. Care should be taken to ensure that persons in the room are adequately protected against the UV illumination that can be emitted from the BSC.

4. Signage is highly recommended which indicates the presence of UV hazards, eye protection requirements, and the means of determining when the UV light is in use.

Sources: *Laboratory Safety: Principles and Practices*, 2nd, ASM Press, Washington, D.C., 1995
Primary Containment for Biohazards: Selection, Installation, and use of Biological Safety Cabinets, U.S. Department of Health and Human Services Public Health Services, Centers for Disease Control and Prevention and National Institutes of Health, September 1995
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