BIOSAFETY CABINETS

(For assistance, please contact EHS at (402) 472-4925, or visit our web site at http://ehs.unl.edu/)

Biosafety Cabinet Classification
Biological Safety Cabinets (BSCs) decrease the risk of airborne infection by passing exhaust air through a High Efficiency Particulate Air (HEPA) filter. All classes of BSCs are equipped with exhaust HEPA filters which distinguishes them from clean benches. Most biological safety cabinets (Class II and III) and clean benches protect the products/cultures within from environmental contamination by using a supply air HEPA filter. Class I BSCs are not equipped with supply HEPA filters. The exhaust on a clean bench is not equipped with a HEPA filter. Exhaust design and other factors are used to classify BSCs, as indicated in the following table.

BSC Class post-2002	Design	Product protection
Class I	Minimum face velocity of 75 lfpm. Exhaust is HEPA-filtered and may be recirculated to the room or exhausted from the building. Often used for containment of aerosol-generating equipment (i.e., centrifuges, homogenizers, etc.) or operations (i.e., cage cleaning).	No (no HEPA filtration of supply air)
Class II, Type A1	Minimum face velocity of 75 lfpm. 70% of the air is re-circulated in the cabinet. Exhaust is HEPA-filtered and may be re-circulated to the room or exhausted from the building via a thimble/canopy connection.	Yes (HEPA filtration of supply air)
Class II, Type B1	Minimum face velocity of 100 lfpm. 30% of the air is re-circulated in the cabinet. Exhaust is HEPA-filtered and discharged from the building via a hard duct.	Yes (HEPA filtration of supply air)
Class II, Type B2	Minimum face velocity of 100 lfpm. No air is recirculated in the cabinet. Exhaust is HEPA-filtered and discharged from the building via a hard duct.	Yes (HEPA filtration of supply air)
Class II, Type A2	Minimum face velocity of 100 lfpm. No air is recirculated in the cabinet. Exhaust is HEPA-filtered and may be re-circulated to the room or discharged from the building via a thimble/ canopy connection.	Yes (HEPA filtration of supply air)
Class III	Totally enclosed, gas-tight, glove ports for manipulation of pathogens. Supply air and exhaust flows through two HEPA filters. No air recirculation within the cabinet. Dedicated, independent exhaust required to maintain negative pressure in the cabinet. Air flow through the cabinet can be turbulent (not based on a laminar/even flow design).	Yes (HEPA filtration of supply air)

Chemical and Radioisotope Use in BSCs
In general, BSCs are not designed for use with volatile chemicals or radionuclides because HEPA filters will not “trap” chemical vapors. Therefore, cabinets that exhaust

into the laboratory can discharge chemical vapors resulting in exposures to laboratory workers and others in the building when the vapors are picked up by the general building ventilation system.

- HEPA filters, gaskets, and their housing assemblies can also be damaged by some chemicals thereby compromising worker and environmental protection.
- BSCs are not designed with intrinsically-safe electrical components (i.e., switches, lights, etc.). If sufficient concentrations of flammable vapors are present in the cabinet (e.g., at or above the Lower Explosive Limit), a fire or explosion may result.
- The low face velocity of Class I and IIA1 BSCs is insufficient to contain chemical vapors.
- Relatively small amounts of non-volatile chemicals and radionuclides can be used in all BSCs, but amounts should be restricted to minute quantities when using a Class II A1 BSC.
- Small quantities of volatile chemicals can be used in a Class IIB2 and Class III BSCs. The amount in process should never be in a quantity that can generate vapor concentrations at or near the LEL.

Using Biological Safety Cabinets

- Read the operator's manual and follow all manufacturer's recommendations.
- When designing the laboratory, locate the cabinet in an area where it will not be adversely affected by air currents:
    - Away from pedestrian traffic and doors.
    - Away from other room ventilation devices (e.g., supply diffusers, fans, fume hoods, etc.).
- Stool height should be adjusted so that the investigator's face is above the front opening.
- Movement of arms into and out of the cabinet can disrupt airflow and affect cabinet performance. It is advisable to use a checklist to ensure that all necessary items for a specific activity have been placed in the cabinet prior to starting a procedure. Only materials needed for the particular procedure should be in the hood since many items in a hood can cause turbulence and disruption of the airflow.
- If it is necessary to move arms in and out of the cabinet, this should be done slowly and with movement perpendicular to the face of the cabinet. Do not block the front grille by resting arms on them or by putting notes or any other materials on them.
- Manipulation of materials should be delayed for one minute after putting arms in hood to allow the hood environment to stabilize.
- Work at least 4" to 6" from the opening of the cabinet. Work as far back in the cabinet as is feasible since exhaust air is primarily drawn from the back of the cabinet.
- Do not use a bunsen burner in a biosafety cabinet. The flame can produce eddy currents, which can push infectious agents out of the cabinet towards the worker. In addition, build-up of flammable gases can result in a fire or explosion.
- Personal protective clothing such as a laboratory coat and gloves must be worn when working at the hood. A solid front, back closing gown provides the best

protection. Gloves should be pulled over the knitted wrists of the gown. If two pairs of gloves are worn, put the first pair under and the second pair over the wrist of the gown. Elasticized sleeves can also be worn to protect the investigator's wrists.

- Carry out work on an absorbent pad to contain small spills. Ensure that the pad does not cover the front grille opening.
- Clean up spills as soon as they occur. Remove and disinfect the grill if contaminated.
- When working in a Class III cabinet, ensure that contaminated items or spill clean-up components are immediately removed to the decontamination module or dunk tank as soon as possible.
- Work from "clean" to "dirty" areas. Place contaminated materials toward the rear of the cabinet.
- Place used pipettes in horizontal trays containing appropriate disinfectant. Dropping pipettes into vertical receptacles creates aerosols.
- Disinfect the cabinet surfaces after use with a disinfectant that is appropriate for the agent in use.
- Never attempt to remove or change the HEPA filters.
- Leave the fan blower on in the cabinet for a short period of time (5 to 10 minutes) after finishing work to allow the system to purge. Some safety cabinets should be left on at all times. Check with your supervisor for operation procedures.
- Ensure that the cabinet is certified upon installation, modification, movement, and annually.

Germicidal Benefits of UV Light in Biological Safety Cabinets

The Centers for Disease Control (CDC) and the National Institute of Health (NIH) agree that UV lamps are not recommended nor required in biological safety cabinets[5]. The activity of UV lights for sterilization/decontamination purposes is limited by a number of factors, including[7]:

- ***Penetration*** - In a dynamic air stream (e.g. biological safety cabinet), UV light is not penetrating. Microorganisms beneath dust particles or beneath the work surface are not affected by the UV irradiation. UV irradiation can cause erythema that may damage both the skin and eyes of laboratory employees. The surface and outer tissue layers of eyes and skin are primarily involved because UV does not penetrate deeply into tissue. These effects are generally not permanent but can be quite painful.
- ***Relative Humidity*** - Humidity adversely affects the effectiveness of UV. Above 70% relative humidity, the germicidal effects drops off precipitously.
- ***Temperature and Air Movement*** - Optimum temperature for output is 77°-80°F. Temperatures below this optimum temperature result in reduced output of the germicidal wavelength. Moving air tends to cool the lamp below its optimum operating temperature and therefore results in reduced output.
- ***Cleanliness*** - UV lights should be cleaned weekly with an alcohol and water mixture as dust and dirt can block the germicidal effectiveness of the ultraviolet lights.

- ***Age*** – UV lamps should be checked periodically (approximately every six months) to ensure the appropriate intensity of UV light is being emitted for germicidal activity (UV C). The amount of germicidal wavelength light emitted from these bulbs decreases with age and bulb ratings (hours of use) may vary by manufacturer.

The information provided in this SOP supplements the UNL Bloodborne Pathogen Exposure Control Plan and UNL Biosafety Guidelines. Please refer to the full program documents for more information.
References: Use of UV lights in BSC- ABSA.