	Biological Safety Cabinet Management Program	Document Number: EHS.BSC.08.01
		Effective Date: 05/28/2008
		Revision Date: 06/10/11

1.0 Purpose and Applicability

1.1 The following document describes the proper procedures for working in a biosafety cabinet as well as the annual certification requirements. These procedures must be followed properly by all who own and work in a biosafety cabinet.

1.2 This document covers the types of cabinets and the proper techniques for in working in them.

1.3 The following document also offers guidance in selecting new cabinets and decommissioning old biological safety cabinet equipment as well as several important safety topics specific to this equipment.

2.0 Definitions

2.1 A **biological safety cabinet** (BSC) is the primary barrier protection for individuals working with biohazardous materials. Laboratory procedures that could create airborne biohazards should always be performed in a BSC as it protects the laboratory workers and the environment from aerosols or droplets that could spread biohazardous material. The common element to all classes of biological safety cabinets is the high efficiency particulate air (HEPA) filter. This filter removes particles with aerodynamic diameters of 0.3 microns (the 'most penetrating particle size') with an efficiency of 99.97 percent. Particles with aerodynamic diameters both larger and smaller than 0.3 microns – which includes the majority of bacteria and viruses – are removed with virtually 100 percent efficiency. It is important to note, however, that HEPA filters are 'particle filters' that do not remove vapors or gases.

2.2 **Laminar flow/clean benches** are devices that look similar to a biosafety cabinet, but only protect the product from contamination. These devices direct air towards the operator and should never be used for handling biological, hazardous, toxic or sensitizing materials.

2.3. **Chemical** (Fume) **hoods** are designed for working with chemicals.

2.4 **Certification** involves performance and safety tests that are conducted annually by an NSF-49 certified outside contractor to ensure that the cabinet is working according to the NSF-49 Safety Standard. These tests include measurement and/or correction of air velocities, patterns, balance, leakage and filtration system efficiency.

2.5 **Environmental Protection** – Means that any aerosol generated within the unit is removed from the air by HEPA filters before the air from the cabinet is discharged either inside or outside the facility.

2.6 **Personnel Protection** - Means that any aerosol generated within the cabinet is contained within the cabinet and away from the person doing the work.

2.7 **Product Protection** – Means that the air at the work surface of the cabinet has been filtered so that it is free of airborne particles and organisms that could contaminate the work.

2.8 **Air Curtain (Barrier)** – The unidirectional movement of air past and parallel to the plane of an opening and at a velocity greater than that on either side, thereby creating an impedance to transverse movement of airborne particulates through the opening.

3.0 Roles and Responsibilities

3.1 **Principal Investigator** – Individual responsible for ensuring that biosafety cabinets are certified annually and that all researchers working in the laboratories are informed on biosafety cabinet use procedures.

3.2 **Biosafety Officer at EH&S** – Is the staff member responsible for advising researchers on biosafety cabinet purchasing, certifications, locations, and procedures for use.

3.3 **Institutional Biosafety Committee (IBC) –** This committee reviews, sets policy and provides oversight of recombinant DNA work and biohazardous materials used on campus.

3.4 **Facilities & Campus Planning** –Responsible for notifying EH&S before purchasing or moving BSC's. If any BSC's are being moved, they must be taken out of service until recertified.

4.0 Procedures for Use

4.1 **Biosafety Cabinet Operational Procedures:**

1. Ready the work area. Operate cabinet blowers for five minutes before beginning work to allow the cabinet to purge or remove particulates from the cabinet.
2. Disinfect the work area. Wipe the work surface, interior walls and surface of the window with a suitable disinfectant such as 70% ethanol, 10% bleach solution, an iodophor, or quaternary ammonium compound.
3. Assemble material. Introduce only those items that are required to perform the procedures and arrange in a logical order. Each item should be wiped with a disinfectant prior to placing it into the cabinet in order to reduce the introduction of contaminants. The flow of work should proceed across the work surface from clean to contaminated areas. Similarly, pipette tip discard trays containing disinfectant, biohazard bags, sharps containers, etc., should be placed to one side inside the BSC.
4. Wear protective clothing. Laboratory coats or solid front gowns should be worn over street clothing and long-cuffed latex or other appropriate gloves (e.g., nitrile, vinyl) should be worn for hand protection. The cuffs of the gloves should be pulled up and over the cuffs of the coat sleeves.
5. Perform procedures slowly by moving items in and out of the cabinet using a straight in and out motion and avoiding side to side motions. Avoid rapid movements. After placing arms/hands inside the BSC, manipulations should be delayed to permit the cabinet to stabilize and allow the flow of air to remove surface contaminants from your arms/hands.
6. Do not block the front grille with papers, equipment, etc., as this may cause air to enter the work space area instead of being drawn through the front grille and into the HEPA filter. Arms should be raised slightly and operations should be performed on the work surface at least four inches from the front grille. The middle third area is ideal. Likewise, no operations or equipment should block the rear exhaust grille. Any equipment generating aerosols such as a microcentrifuge, vortex or blender should be placed near the rear of the cabinet. A disinfectant-soaked towel can be placed on the work surface to contain any spills or splatters that may occur.
7. Open flames inside the cabinet create turbulence that can disrupt the pattern of air and compromise the safety of the operator and affect product protection (i.e., cause contamination). Flames can also damage the interior of the cabinet as well as the HEPA filters. If a burner is necessary to sterilize tools such as a loop or needle, consider the use of a touch plate burner that provides a flame on demand, and place it to the rear of the cabinet. Alternatively, electric furnaces or disposable, sterile tools can be used. (See Section 4.8)
8. If culture media or other fluids need to be aspirated, suction or aspirator flasks should be connected to an overflow collection flask containing disinfectant (the aspirated materials can then be discarded as noninfectious waste). (See section 4.9)
9. When work is completed all items within the cabinet should be wiped down with disinfectant and removed from the cabinet. Do not use the interior of the BSC as a storage area since stray organisms may become "trapped" and contaminate future experiments. The interior surfaces of the cabinet should

be cleaned with a disinfectant. Let the blowers operate for five minutes with no activity inside the cabinet to purge the cabinet of contaminants.

10. Investigators should remove their gowns and gloves and thoroughly wash their hands before exiting the laboratory.

4.2 **Registration of Biosafety Cabinets**

Please notify us of new equipment. The form in *Appendix B* can be faxed to EH&S Biosafety at 413-545-2600.

4.3 **Biosafety Cabinet Annual Certification**

All biosafety cabinets at the University must be certified annually by an authorized contractor. The Biosafety Department of EH&S coordinates this testing annually. Currently, the biosafety cabinets on campus are certified by B&V Testing (800) 851-9081. The certifications follow the NSF-49 Safety Standard for biosafety cabinets. The contractor will test down flow and inflow velocities, air flow patterns, the HEPA filter and perform a cabinet leak test to ensure that the BSC is working properly. The Biosafety Office at EH&S maintains a complete inventory of safety cabinets which records the historical certification and repair of each cabinet, so it is important to ensure all biological safety cabinets are registered. Should you have any questions, please call us. 545-7293.

Guidelines for when a Biosafety Cabinet certification must be performed:

1. Before initial use to verify the cabinet is effective
2. After moving a BSC from one location to another, even if it is just a few inches, as it is very easy to compromise a containment system
3. After replacement of high efficiency particulate air (HEPA) filter(s)
4. At least annually to assure that filters are not plugged, damaged or leaking
5. After possible contamination
6. Following a large spill or accident inside the BSC
7. When requested by the Biosafety Officer

Guidelines for when a Biosafety Cabinet Testing Results in a Failure:

1. The BSC must be placed out of service and have appropriate signage on it
2. The Biosafety Department of EH&S will obtain a quote for repairs/remediation ASAP
3. The cabinet owner will obtain a purchase order for the repairs ASAP (verbal is usually ok)
4. Biosafety will give the PO to the repair company and schedule the repair visit ASAP
5. Repairs/remediation will be done and testing
6. If equipment is to be removed from service indefinitely, it will be gas decontaminated and removed from the laboratory.
7. Records of these actions are to be made in the EH&S database

4.4 **Training – Use of Biological Safety Cabinets**

- Since biological safety cabinets are one of the most critical pieces of equipment to protect the user, as well as the product and the environment, it is important to understand how BSC's function and their limitations. The effectiveness of the cabinet depends heavily on proper use, appropriate work practices, continued maintenance and annual certification. To support the BSC training provided by your supervisor, the Biosafety Office at EH&S also provides information during their biosafety training sessions. In addition, the following DVD is available for your viewing: "*Safe Use of Biological Safety Cabinets*" by the Eagleston Institute, Sanford, Maine.

4.5 **Helpful Tips for Biological Safety Cabinet Use**

DO:

- Do place containment trays or absorbent drapes under experiments to catch spills and to ease clean-up.
- Do operate the BSC sash at the manufacturers design criteria.
- Do operate the BSC for approximately 5 minutes prior to use.
- Do wipe down unit work surfaces with appropriate disinfectant prior to using BSC for sterility purposes, and after the completion of work, but before unit has been turned off.
- Do monitor alarms, pressure gauges or flow indicators for any major fluctuation or changes possibly indicating a problem with the unit.

DON'T:

- Don't use a BSC unless there is a current certification label attached.
- Don't overload the containment area or block front, side or rear air grills which will reduce or restrict air flow and compromise product protection and /or personnel protection.
- Don't use the BSC for storage.
- Don't change baffle, damper, speed control settings.
- Don't lean into the BSC so that the user's head is inside the plane of the BSC face.
- Don't operate an ultraviolet light while working in the BSC.
- Don't operate an ultraviolet light when occupants are in the laboratory unless the sash is closed completely and it is known to block UV light.
- Don't use gas in cabinets.
- Don't use open flame in cabinets.

4.6 **Classification – Biological safety Cabinets**

There are three main classes of biological safety cabinets (I, II & III). Each type of cabinet provides protection through different configurations of HEPA filtered laminar air flow into and within the cabinets as well as HEPA filtered exhaust air.

Class I BSC's are not used very often but tend to be used to enclose equipment or procedures which have the potential to generate aerosols. They provide an inward flow of unfiltered air, similar to a chemical fume hood, which protects the worker from the material in the cabinet. The environment is protected by HEPA filtration of the exhaust air before it is discharged into the laboratory or to the outside via the building exhaust.

Class II BSC's are the most common type of BSC and can be used with biosafety level 1, 2 and 3 agents. Class II (Types A, B1, B2, and B3) biological safety cabinets provide personnel, environment, and product protection. Air is drawn around the operator into the front grille of the cabinet, which provides personnel protection. In addition, the downward laminar flow of HEPA-filtered air provides product protection by minimizing the chance of cross-contamination along the work surface of the cabinet. Because cabinet air has passed through the exhaust HEPA filter, it is contaminant-free (environment protection), and may be recirculated back into the laboratory (Type A) or ducted out of the building (Type B).

Class III BSC's are designed for work with level 4 agents and provide maximum protection. The cabinet is gas-tight with a non-opening view window, and has rubber gloves attached to ports in the cabinet that allow for manipulation of materials in the cabinet. Air is filtered through one HEPA filter as it enters the cabinet, and through 2 HEPA filters before it is exhausted to the outdoors. This type of cabinet provides the highest level of product, environmental, and personnel protection.

Horizontal laminar flow "clean air benches" are not BSCs. They discharge HEPA-filtered air across the work surface and toward the user, providing only product protection. They can be used for certain clean activities,

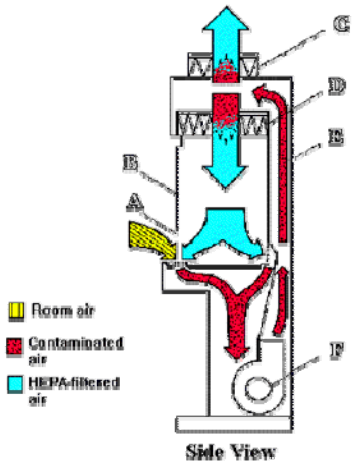
such as pouring media, plant tissue culture, and dust-free assembly of sterile equipment or electronic devices. However, they should not be used when handling human cell culture materials or potentially infectious materials, or as a substitute for a biological safety cabinet in research laboratories.

Comparison of Biological Safety Cabinets (from NIH, BMBL)

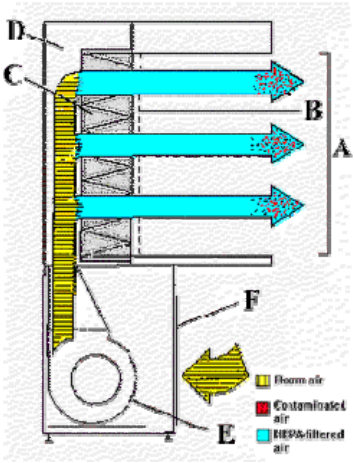
Type	Face Velocity (1fpm)	Airflow Pattern	Radionuclides /Toxic chemical	Biosafety Levels	Product Protection
Class I open front	75	In at front; rear and top through HEPA filter	No	2,3	No
Class II, Type A	75	70% recirculated through HEPA; exhaust through HEPA	No	2,3	Yes
Class II, Type B1	100	30% recirculated through HEPA; exhaust via HEPA and hard ducted	Yes (low levels, volatility)	2,3	Yes
Class II, Type B2	100	No recirculation; total exhaust via HEPA and hard ducted	Yes	2,3	Yes
Class II, Type B3	100	Same as IIA, but plena under negative pressure to room and exhaust air is ducted	Yes	2,3	Yes
Class III	NA	Supply air inlets and exhaust through 2 HEPA filters	Yes	3,4	Yes

Airflow Diagrams:

Class II, Type A BSC:



Horizontal Flow "Clean Bench"



4.7 **Biosafety Purchasing Guidelines**

All biosafety cabinets purchased at the University must meet the NSF-49 Safety Standard. The most common BSC on campus is Class II/A2. There are a wide variety of biosafety cabinets on the market that are suitable for all types of research involving biohazardous materials (see table on page 5). Before purchasing a biosafety cabinet, you will need to assess and evaluate the type of cabinet that would be suitable for the work conducted in your laboratory. Please contact the Biosafety Officer at EH&S for biosafety cabinet purchase recommendations at: 545-2682.

4.8 Location of Biological Safety Cabinets within the Laboratory

The ideal location for the biological safety cabinet is remote from the entry (i.e., the rear of the laboratory away from traffic), since people walking parallel to the face of a BSC can disrupt the air curtain. The air curtain created at the front of the cabinet is quite fragile, amounting to a nominal inward and downward velocity of 1 mph. Open windows, air supply registers, portable fans or laboratory equipment that creates air movement (e.g., centrifuges, vacuum pumps) should not be located near the BSC. Similarly, ***chemical fume hoods must not be located close to BSCs.***

4.9 **Dangers of natural gas use in a BSC:**

Biological safety cabinets (BSC's) are designed to protect workers, their products, and their environment. Certain biological safety cabinets (BSC's) recirculate air within the cabinet. Most BSC's at UMass Amherst are recirculating. Open flames are not required in the near microbe-free environment of a biological safety cabinet. On an open bench, flaming the neck of a culture vessel will create an upward air current which prevents microorganisms from falling into the tube or flask. An open flame in a BSC, however, creates turbulence which disrupts the pattern of HEPA-filtered air supplied to the work surface. The use of natural gas or other flammable gases within these BSC's may allow flammable gases to concentrate, potentially leading to an explosive atmosphere.

The use of open flames within a BSC may alter the airflow pattern used to protect product and personnel. This communication outlines which BSC's recirculate air and the procedures to increase safety and prevent flammable gas explosions within BSC's.

BSC Type	Former Name(s)	% Recirculated Air
Class II Type A1	Class II Type A	70
Class II Type A2	Class II Type A/B3	70
Class II Type B1	N/A	30
Class II Type B2	N/A	0

BSCs that recirculate air are commonly found at UMass Amherst. To determine the type of cabinet, locate the unique serial number on the cabinet. This area should also contain the BSC type. If unable to locate this information, contact EHS for further assistance (545-2682).

4.9.1 Use of gas in BSC's has led to fires, compromised HEPA filters, destroyed cabinets and injured workers.

4.9.2 Certain types of BSCs are designed to contain, not exhaust, most of the air within a cabinet. This makes them prone to the buildup of materials within the cabinet.

4.9.3 If a gas leak occurs (e.g. valve left on or tube leak) inside a recirculating biological safety cabinet, over time the gas would become more concentrated and could reach explosive levels. Since it is within a BSC, the user may not detect the leak and, upon ignition, it could explode. Therefore, natural gas or other flammable gases should not be used within recirculating biological safety cabinets.

4.9.4 The high efficiency particulate air (HEPA) filters, responsible for providing a sterile environment in the cabinet, can act as a dense mass of combustible material during an uncontrolled fire inside the cabinet.

4.9.5 The heat convection currents generated by the open flame compromise the carefully controlled airflow pattern responsible for protecting product and personnel.

4.9.6 Heat generated by an open flame can damage the HEPA filter and/or the filter's adhesive. This can produce leaks in the filter, adverse flow patterns in the cabinet, and potential user exposure.

4.9.7 Use of an open flame within the BSC inactivates manufacturers' warranties on the cabinet: cabinet manufacturers will assume no liability in the event of fire, explosion or worker exposure due to the use of a flammable gas in the cabinet. Additionally, the **UL™** (Underwriters Laboratories) approval will automatically be voided.

4.9.8 Cited Regulations or Quotes from Manufacturers:

NIH/CDC: National Institutes of Health and the Centers for Disease Control and Prevention: "Open flames are not required in the near microbe-free environment of a biological safety cabinet. On an open bench, flaming the neck of a culture vessel will create an upward air current which prevents microorganisms from falling into the tube or flask. An open flame in a BSC, however, creates turbulence which disrupts the pattern of HEPA-filtered air supplied to the work surface."

WHO: World Health Organization's Laboratory Biosafety Manual:
Open flames should be avoided in the near microbe-free environment created inside the BSC. They disrupt the airflow patterns and can be dangerous when volatile, flammable substances are also used. To sterilize bacteriological loops, micro-burners or electric "furnaces" are available and are preferable to open flames.

Public Health Agency of Canada; The Laboratory Biosafety Guidelines:
The provision of natural gas to BSC's is not recommended. Open flames in the BSC create turbulence, disrupt airflow patterns and can damage the HEPA filter. When suitable alternatives (e.g., disposable sterile loops, micro-incinerators) are not possible, touch-plate micro-burners that have a pilot light to provide a flame on demand may be used.

NSF/ANSI Standard 49 – 2009 published by NSF International, Annex G; Section G.3.3.1:
Service valves allow inert gases, air, or vacuum lines to be plumbed into the BSC. Although many users connect gas to a service valve in the cabinet, this practice should be avoided because open flames in a Class II BSC disrupts the airflow, and there is the possibility of a buildup of flammable gas in BSC's that recirculate their air.

The Baker Company (BSC manufacturer): The Baker Company does not endorse the use of flammable gasses within BSC's under any conditions. There are alternatives to open flames such as small electrical incinerators, use of disposables, and proper aseptic technique.

NuAire (BSC manufacturer): NuAire doesn't recommend the use of natural gas within the BSC and assumes no liability for its use. USE AT YOUR OWN RISK. The Bunsen burner flame within the BSC not only contributes

to heat build-up; it also disrupts the laminar air stream, which must be maintained for maximum efficiency. If the procedure demands use of a flame, a Bunsen burner with on demand ignition is strongly recommended. Do not use constant flame gas burners. During use, the Bunsen burner should be placed to the rear of the workspace where the resulting air turbulence will have a minimal effect.

4.9.9 **Policy for gas and flame in BSC's:**
The University of Massachusetts at Amherst concurs with the national and international agencies mentioned above, and does not support natural gas being plumbed to biological safety cabinets unless the cabinet is fitted with 100% exhaust air.
BSC's that currently do not meet the 100% exhaust requirement, and are fitted for natural gas use, are discouraged from continuing to use natural gas and are encouraged to switch to safer alternative methods. However, should a situation arise where an investigator feels that natural gas is a necessity for their process the investigator may contact EH&S for a risk assessment and possible approval for future use.

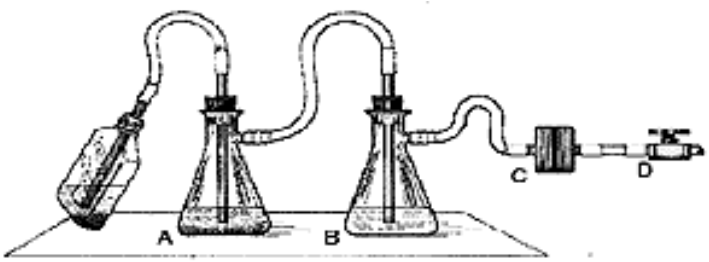
4.9.10 **Alternatives to Gas Use and Alcohol Burners**:

a. Touch-plate burners that require a hand or foot switch for the flame to be engaged and gas cartridges vs. gas lines
b. Electrical incinerators
c. Glass bead sterilizers
d. Electric Bunsen burners
e. Mini propane torches
f. Use sterile disposable plastic ware instead of glassware that must be flamed
g. Rely upon good chemical disinfection (such as bleach) to clean equipment and surfaces
h. Appendix A lists some suggestions for equipment above

5.0 Protection of Vacuum Systems Used in Tissue Culture Work

When laboratory vacuum is used to manipulate biohazardous materials, a suitable trap should be employed to insure that building vacuum lines do not become contaminated. When house vacuum is used, the system should include in-line HEPA filter as near as practical to each point of use or service cock. An approved reservoir and filtration apparatus for vacuum systems is described below:
Vacuum filtration or aspirating supernatants into collection flasks are common laboratory procedures. During vacuum filtration or aspiration procedures building and/or laboratory vacuum systems should be protected.
A simple bench-top aerosol/fluid trap can protect building/laboratory vacuum systems. The basic vacuum trap consists of a disposable cartridge-type filter or equivalent installed in-line with a collection/overflow vacuum flask system.
The aerosol/fluid trap consists of two vacuum flasks, preferably plastic, (size dependent on amount of fluid that may accidentally be aspirated out of the collection flask), thick walled plastic tubing (to prevent tubing collapse), rubber stoppers, a filter (prevents unwanted potentially biohazardous fluid and aerosols from entering vacuum systems), and a ceramic sparger (ceramic fish tank bubbler) immersed in disinfectant. The sparger disperses aerosols passing out of the collection flask into small bubbles so that adequate contact is made with a disinfectant solution. Use an appropriate disinfectant solution shown to be effective on the biohazardous material under study.
When the filter or overflow flask require routine changing, they can be safely removed by clamping the line between the filter and the vacuum source before disconnecting the tubing from the source. The filter and vacuum flask should be decontaminated by autoclaving if they have been in contact with potentially biohazardous material.

This is one method to protect a house vacuum system during aspiration of infectious fluids. The left suction flask (A) is used to collect the contaminated fluids into a suitable decontamination solution; the right flask serves as a fluid overflow collection vessel. A glass splarger in flask B minimizes splatter. An in-line HEPA filter (C) is used to protect the vacuum system (D) from aerosolized microorganisms. See diagram:



CDC: Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets 2nd ed.

Suggested Product:

Whatman HEPA-Vent Filter

Assure sterile air for mixing, filling, storing, fermenting and transporting with this Whatman filter. Glass fiber filter is treated to be mildly hydrophobic; repels moisture, prevents bacterial growth; 0.3 µm particle retention unaffected by autoclaving. Bidirectional flow. 16 cm2 filter area.

Inlet/Outlet	Whatman #	Fisher Cat. #	Pack of 10	
1/4-3/8" tapered hose barb	6723-5000	09-744-79		$96.48 (Jan 2010)

5.1 **Use of UV Light in a Biosafety Cabinet**

We recommend that biosafety cabinets be disinfected with the appropriate disinfectant (i.e., 10% bleach or 70% ethanol), instead of using a UV light. Ultraviolet (UV) lamps in Biological Safety Cabinets (BSCs) are intended to destroy microorganisms in the air or on exposed surfaces. However, relying on UV lamps may give personnel working in BSCs a false sense of security.

The UV lamps attract dust and debris and thus reduce the transmission of the germicidal effect. UV lights have limited penetrating power and are only effective when the lamps are properly cleaned, maintained, and checked to ensure that the appropriate intensity is being emitted. If UV lights are used, they must be tested yearly to ensure that the appropriate wavelength for decontamination is emitted (254nm). NSF, the certifying agency for BSC's stopped requiring the testing of UV lights in 2003 as they do not consider them an effective decontamination source. If you want your UV light tested, you need to make arrangements with B&V Testing at the time of your cabinet's certification testing. In addition, many people allow the lamps to surpass their effective life span. When the terminal ends are blackened even slightly, they have lost their effectiveness even though they still glow blue-violet.

If not used properly, UV light can also cause serious eye and skin injury. If UV lamps are used it must be remembered that UV light can be harmful to the eyes and skin and should therefore be turned off when occupying the room. UV light can bounce off the reflective surfaces inside the cabinet and affect people and materials around the outside of the cabinet.

5.2 **Biosafety Cabinet Decontamination and Decommissioning**

BSCs shall be decontaminated before the cabinet is:

1. relocated;
2. repaired; or
3. taken out of service.

Decontamination is recommended as a prudent practice (1) after a gross spill of infectious material or (2) before the cabinet activity is changed from work with moderate-risk or high-risk infectious materials to work with noninfectious materials.

All biological safety cabinets must be decontaminated prior to disposal. EH&S should be contacted to determine whether B&V Testing needs to be called to do a chemical gas-decontamination of the HEPA filter and cabinet. If this is the case, the BSC will need to be placed in a room with a fume hood so that the gas can be vented out

through it. The room will also need to be vacant (no personnel access) while the gas decontamination is underway (allow 24 hours). Once the decontamination is complete the cabinet is evaluated by EH&S staff for the presence of hazardous materials (i.e.: mercury, oil, asbestos, etc.). Once the cabinet is cleared for disposal a sticker will be placed on it, it will be removed from inventory, and you may call Building Services for disposal.

5.3 **Biological Safety Contact Information**

- Judy LaDuc, Biological Safety Services Manager, Department of Environmental Health & Safety, 117 Draper Hall, University of Massachusetts/Amherst, (413) 545-7293/Fax: (413)545-2600.
- B and V Testing, 222 Calvary Street, Waltham, MA 02453 Phone: 800.851.9081

5.4 **Key References**

- Institute of Environmental Sciences and Technology, Arlington Place One, 2340 S. Arlington Heights Rd., Suite 100, Arlington Heights, IL 60005-4516 Phone (847) 981-0100
- University of Ottawa, Biological Safety Cabinets & Laminar Flow Cabinets, EH&S Website, Ottawa, Ontario, Canada
- U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention *and* National Institutes of Health. *2nd Edition Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets***.** Washington: US Government Printing Office, 2000.
- University of Maryland, College Park, MD. Environmental Health and Safety Website: Biological Safety Cabinets Manual; http://www.des.umd.edu/biosafety/rest/manual.pdf#page=31
- CDC-NIH Guidelines, 2nd Edition of Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets: http://www.cdc.gov/od/ohs/pdffiles/BSC-3.pdf
- World Health Organization's Laboratory Biosafety Manual
- Public Health Agency of Canada; The Laboratory Biosafety Guidelines: 3rd Edition 2004; Chapter 9, Biological Safety Cabinets
- NSF/ANSI Standard 49 – 2009, Biohazard Cabinetry; published by NSF International, P.O. Box 130140, Ann Arbor, Michigan 48113-0140, USA
- Stanford University, Environmental Health and Safety; Memo: Use of open flames in Biosafety Cabinets/Tissue Culture Hoods, May 29, 2003 From: Ellyn Segal, Ph.D., Biosafety Manager
- NFPA 54, National Fuel Gas Code
- NFPA 45, Standard on Fire Protection for Laboratories using Chemicals

Appendix A: Suggested Gas/Flame Alternatives

FIREBOY Bunsen burner by Integra Biosciences
A mobile Bunsen burner with non-touch sensor ignition.
Has flame monitoring, over-temperature and burning time limitation
Operates in three modes:
- Foot switch: Flame stays as long as the foot switch is pressed
- Continuous: Manually switch On/Off
- Sensor: The sensor registers your hand movement and ignites the flame automatically
Timer: 10 to 60 minutes

Bacti-Cinerator IV
- Sterilizes platinum loops and needles safely and conveniently
- Prevents infectious spatter and cross contamination
- The Bacti-Cinerator IV utilizes infrared heat to incinerate organic material deep within the ceramic funnel. Sterilization takes only 5 to 7 seconds at optimum sterilizing temperature of 1500°F.
- Unit can be used in anaerobic chambers

Glass Bead Sterilizer
Ideal for sterilizing surgical instruments. To use, simply insert the cleaned surgical instrument, leave for 5 seconds, and remove. Within 30 seconds, the surgical instruments are cool enough to use. The chassis stays cool, even at the end of a full day of operations. The air above the unit is cool enough to insert an instrument into the well without discomfort. Sterilization of the inserted parts by dry heat (250° C) takes 3-5 seconds. The working end is sterile before the handles get hot. The sterilizer's small size fits conveniently into the back corner of a hood or surgical table.

Electric Bunsen burner
- Combines gas efficiency with precision electric control
- Radiant heat is concentrated directly at top where required
- Combines gas efficiency with precision electric control
- Radiant heat is concentrated directly at top where required

Burner concentrates heat at top making it ideal for heating test tubes, crucibles, small flasks and beakers, or for sterilizing inoculating needles for microbiological work. 400-w. element produces temperatures of 800-1000°C.

- Specially formed, replaceable element is mounted in the top of a cylindrical housing which has ventilation holes at the bottom for cooling. The unit may be handheld at the base for direct heating. Removable cowl deflects heat away from hand. Corrosion-resistant metal housing. CSA certified. 7-in. high, 4.5-in. diam. at base.

FLAMEBOY Portable flame sterilizer
The FLAMEBOY is a handy, portable flame sterilizer with piezo-electric ignition for safe flame sterilization. Compatible to a wide range of common gas cartridges including, Camping Gaz CP250, CV270, CV360 and CV470 or other butane cylinders, the FLAMEBOY is independent of any gas distribution system. The gas cartridge adapters are very easily mounted by means of an intelligent 'click and go' mechanism.
Features and benefits:
- Piezo-electric triggered ignition for immediate use
- Pistol grip for convenient holding.
- Various gas cartridge adapters for independent and portable use.

Shandon Mini Hot Plate

- Used in histology for removing stubborn wrinkles from sections and for reorientating embedded tissue.
- Can be used to heat-fix bacterial smears while avoiding cell damage through overheating in microbiology applications.
- Manufactured to operate over a fixed temperature range of 70-80° C.
- Lower casing is made from stainless steel; top is matte-black epoxy-coated aluminum.
- Dimensions (H x W x D): 2.36" x 5.78" x 5.78"
- Heated surface area: 5.5" x 5.5"

Appendix B

Biological Safety Cabinet Registration

❒ **Biological safety Cabinet** **or** ❒ **Laminar Flow Cabinet**

❒ **Mr.** ❒ **Ms.** ❒ **Dr.**

Status: _____

First Name: _____

Last Name: _____

Faculty/Service: _____

Department: _____

Cabinet Manufacturer: _____

Cabinet Model Number: _____

Cabinet Serial Number: _____

Cabinet Class: _____

Cabinet Type: _____

UMass Number: UMA_____

Facilities Tracker Number: _____

Telephone Number: _____

Email: _____

Comments/Questions: