



BIOLOGICAL SAFETY CABINET

PLAN

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Biological Safety Cabinet Plan

Purpose

The purpose of the biological safety cabinet plan is to ensure the health and safety of students, faculty, and employees in the teaching and research laboratories. This program will establish requirements and procedures for biological safety cabinet maintenance, surveys, work practices, and certifications.

Types of Biological Safety Cabinets

Biological safety cabinets are intended to protect the user and environment from the hazards associated with the handling of infectious material and other biohazardous material. Some types also protect the materials being handled in them from contamination.

Class I BSC

The Class I BSC provides personnel and environmental protection, but no product protection. It is similar in air movement to a chemical fume hood, but has a HEPA filter in the exhaust system to protect the environment. In the Class I BSC, unfiltered room air is drawn 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 through the front opening. In many cases Class I BSCs are used specifically to enclose equipment (e.g., centrifuges, harvesting equipment or small fermenters), or procedures (e.g. cage dumping, aerating cultures or homogenizing tissues) with a potential to generate aerosols.

The Class I BSC is hard-ducted to the building exhaust system, and the building exhaust fan provides the negative pressure necessary to draw room air into the cabinet. Cabinet air is drawn through a HEPA filter as it enters the exhaust plenum. A second HEPA filter may be installed at the terminal end of the exhaust.

Class II (Types A, B1, B2, and B3)

The Class II (Types A, B1, B2, and B3) biological safety cabinets provide personnel, environmental and product protection. Airflow 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 (environmental protection), and may be re-circulated back into the laboratory (Type A BSC) or ducted out of the building (Type B BSC).

All Class II cabinets are designed for work involving microorganisms assigned to biosafety levels 1, 2 and 3. Class II cabinets provide the microbe-free work environment necessary for cell culture propagation, and also may be used for the formulation of nonvolatile antineoplastic or chemotherapeutic drugs.

Class II, Type A BSC

An internal blower draws sufficient room air through the front grille to maintain a minimum calculated or measured average inflow velocity of at least 75 lfpm at the face opening of the cabinet. The supply air flows through a HEPA filter and provides particulate-free air to the work surface. Laminar airflow reduces turbulence in the work zone and minimizes the potential for cross-contamination.

The downward moving air "splits" as it approaches the work surface; the blower draws part of the air to the front grille and the remainder to the rear grille. Although there are variations among different cabinets, this split generally occurs about halfway between the front and rear grilles, and two to six inches above the work surface.

The air is then discharged through the rear plenum into the space between the supply and exhaust filters located at the top of the cabinet. Due to the relative size of these two filters, approximately 30% of the air passes through the exhaust HEPA filter and 70% re-circulates through the supply HEPA filter back into the work zone. Most Class II, Type A cabinets have dampers to modulate this 30/70 division of airflow.

Class II, Type B1

The cabinets supply blowers draw room air (plus a portion of the cabinet's re-circulated air) through the front grille and then through the supply HEPA filters located immediately below the work surface. This particulate-free air flows upward through a plenum at each side of the cabinet and then downward to the work area through a backpressure plate. In some cabinets there is an additional supply HEPA filter to remove particulates that may be generated by the blower/motor system.

Room air is drawn through the face opening of the cabinet at a minimum inflow velocity of 100 lfpm. As with the Type A cabinet, there is a split in the down-flowing air stream just above the work surface. In the Type B cabinet, approximately 70 percent of the down flow air exits through the rear grille, passes through the exhaust HEPA filter, and is discharged from the building. The remaining 30 percent of the down flow air is drawn through the front grille. Since the air, which flows to the rear grille, is discharged into the exhaust system, activities that may generate hazardous chemical vapors or particulates should be conducted towards the rear of the cabinet.

Type B1 cabinets must be hard-ducted, preferably to their own dedicated exhaust system, or to a properly designed laboratory building exhaust. As indicated earlier, blowers on

laboratory exhaust systems should be located at the terminal end of the ductwork. A failure in the building exhaust system may not be apparent to the user, as the supply blowers in the cabinet will continue to operate. A pressure-independent monitor should be installed to sound an alarm and shut off the BSC supply fan, should failure in exhaust airflow occur. Since this feature is not supplied by all cabinet manufacturers, it is prudent to install a sensor in the exhaust system as necessary. To maintain critical operations, laboratories using Type B BSCs should connect the exhaust blower to the emergency power supply.

Class II, Type B2 BSC

This BSC is a total-exhaust cabinet; no air is re-circulated within it. This cabinet provides simultaneous primary biological and chemical containment. The supply blower draws in room air or outside air at the top of the cabinet, passes it through a HEPA filter and down into the work area of the cabinet. The building or cabinet exhaust system draws air through both the rear and front grilles, capturing the supply air plus the additional amount of room air needed to produce a minimum calculated or measured inflow face velocity of 100 lfpm. All air entering this cabinet is exhausted, and passes through a HEPA filter (and perhaps some other air-cleaning device such as a carbon filter) prior to discharge to the outside. Exhausting as much as 1200 cubic feet per minute of conditioned room air makes this cabinet expensive to operate.

Class II, Type B3 BSC

This biological safety cabinet is a ducted Type A cabinet having a minimum inward airflow of 100 lfpm. All positive pressure contaminated plenums within the cabinet are surrounded by a negative air pressure plenum. Thus, leakage in a contaminated plenum will be into the cabinet and not into the environment.

Class III

The Class III biological safety cabinet was designed for work with biosafety level 4 microbiological agents, and provides maximum protection to the environment and the worker. It is 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 (such as an autoclave) that can be decontaminated between uses. Reversing that process allows for safe removal of materials from the Class III biosafety cabinet. Both supply and exhaust air are HEPA filtered. Exhaust air must pass through two HEPA filters, or a HEPA filter and an air incinerator, before discharge to the outdoors. Airflow is maintained by a dedicated independent exhaust system exterior to the cabinet, which keeps the cabinet under negative pressure (usually about 0.5 inches of water pressure).

Long, heavy-duty rubber gloves are attached in a gas-tight manner to ports in the cabinet and allow for manipulation of the materials isolated inside. Although these gloves restrict movement, they prevent the user's direct contact with the hazardous materials. The trade-off is clearly on the side of maximizing personal safety. Depending on the design of the cabinet, the supply HEPA filter provides particulate-free, albeit somewhat turbulent, airflow within the work environment.

Horizontal Laminar Flow "Clean Bench"

Horizontal laminar flow clean air benches are not BSCs. They discharge HEPA-filtered air 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. These benches should never be used when handling cell culture materials or drug formulations, or when manipulating potentially infectious materials. The worker can be exposed to materials (including proteinaceous antigens) being manipulated on the clean bench, which may cause hypersensitivity. Horizontal clean air benches should never be used as a substitute for a biological safety cabinet in research, biomedical or veterinary laboratories and/or applications.

Vertical Laminar Flow "Clean Bench"

Vertical laminar flow clean benches also are not BSCs. They may be useful, for example, in hospital pharmacies when a clean area is needed for preparation of intravenous drugs. While these units generally have a sash, the air is usually discharged into the room under the sash, resulting in the same potential problems as the horizontal laminar flow clean benches.

Safe Operating Procedures

- The BSC blower must be turned on at least five (5) minutes before starting work in order to purge the air and remove any particulates in the cabinet.
- Prior to performing work be sure the biological safety cabinet is exhausting properly. If cabinet is not working properly then notify laboratory supervisor or the educating professor. The laboratory supervisor or educating professor shall contact the Department Chemical Hygiene Officer and the Department of Environmental Health and Safety.
- Laboratory personnel shall wear a closed-front laboratory coats (or a surgical gown) and gloves. The gloves should overlap the cuffs.
- All materials needed for the manipulations shall be placed in the cabinet before the work is initiated to minimize in-and-out motions. The rapid movement of a worker's arms in a sweeping motion into and out of the cabinet will disrupt the air curtain and may compromise the partial barrier containment provided by the BSC. Moving arms in and out slowly, perpendicular to the face opening of the cabinet will reduce the

risk. Other personnel activities in the room (e.g. rapid movement, open/closing room doors, etc.) may also disrupt the cabinet air barrier.

- Manipulation of materials should be delayed for approximately one minute after placing hands/arms inside the cabinet. This allows the cabinet to stabilize and to “air sweep” the hands and arms to remove surface microbial contaminants.
- Do not cover air intake grill. Laboratory personnel shall not rest arms on the air intake grill.
- All operations shall be performed at least four (4) inches from the front grill on the work surface.
- Extra supplies (e.g. additional gloves, culture plates or flasks, culture media) shall be stored outside the cabinet. Only the materials and equipment required for the immediate work shall be placed in the BSC.
- Drip pads shall be replaced daily. The old drip pad shall be disposed of as biological hazardous waste.
- Laboratory personnel shall clean up all minor spills in the cabinet immediately. In the case of a larger spill contact the Emergency Operator by dialing “215-762-7110” if Center City Campus or contact Security (895-2222) if at Main Campus or Queen Lane Campus.
- All materials used to clean up spills shall be discarded as biohazardous waste.
- Biohazard collection bags shall not be taped or placed on the outside of the cabinet. The frequent inward/outward movement needed to place objects in these bags is disruptive to the integrity of the cabinet air barrier and can compromise both personnel and product protection.
- Pipette discard trays containing an appropriate chemical disinfectant shall be used within the cabinet.
- Potentially contaminated materials (e.g. containers, equipment, etc.) shall not be brought out of the cabinet until they have been surface decontaminated.
- Contaminated materials can be placed into a closable container for transfer to an incubator, autoclave or for other decontamination treatment.
- Aspirator bottles or suction flasks shall be connected to an overflow collection flask containing appropriate disinfectant. Inactivation of aspirated materials can be accomplished by placing sufficient chemical decontamination solution into the flask to kill the microorganisms as they are collected. Once inactivation occurs, liquid materials can be disposed of appropriately as noninfectious waste.
- Class II BSCs shall not be used for labeling of biohazardous materials with radioactive iodine.
- **Laminar Flow Hoods (Horizontal-flow clean-air bench or Vertical-flow clean-air bench) are designed to protect research experiments only and do not offer any protection to laboratory personnel. Therefore, these units must not be used when working with any form of biological or chemical hazard.**
- Laboratory personnel shall decontaminate the cabinet with the appropriate disinfectant at the end of each work operation.
- Periodic use of 5% household bleach in water is acceptable (70 % ethanol or quaternary ammonium compounds may also be used if effective against agent).
- **Do not use cabinet for any other function for which it was not intended.**

- The cabinet is not a substitute for personal protective equipment. Laboratory personnel shall wear safety glasses, laboratory coat, and gloves at all times when working in the cabinet.
- Laboratory personnel shall dispose of gloves and gowns as biohazardous waste.

Certification

The Department of Environmental Health and Safety will employ an outside contractor to perform all biological safety cabinet and clean air bench certifications. All BSCs and clean air benches shall be certified annually or whenever a significant change has been made to the operational characteristics of the system or as per request or newly installed units or units being moved. The contractor is required to provide a standard operating procedure (SOP) for biological safety cabinet certifications.

Passing Certification

The biological safety cabinet will receive a passing certification upon meeting all the requirements set forth by the contractor's standard operating procedure (SOP). If all the requirements are passing then a certification sticker shall be placed on the biological safety cabinet. The sticker shall include the following information but not limited to:

- Identification Number
- Test Date
- Re-certification Due Date
- Technicians Initials

Failing Certification

The biological safety cabinet will receive a failing certification upon failure to meet all the requirements set forth by the contractor's SOP. The following procedures shall be implemented by the designated party upon receiving a failing certification:

Certification Contractor:

1. The biological safety cabinet is tagged with a label indicating that it is unsafe and should not be used.
2. Notify the user of the status of the hood.
3. Notify the Department of Environmental Health and Safety.
4. Provide a proposal for the repairs.

Department of Environmental Health and Safety

1. The biological safety cabinet is locked out of service until repairs are performed.

2. Notify the Departmental Chemical Hygiene Officer (CHO) or Principle Investigator responsible for the hood.
3. Review repair proposal and pass on to the CHO or PI responsible for the BSC.
4. Schedule repairs and re-certification with the contractor.

Departmental Chemical Hygiene Officer or Principle Investigator

Upon receiving notification of a failed cabinet the CHO or PI will notify all parties affected by this notification.

Surveys

- During laboratory surveys the Department of Environmental Health and Safety will survey the biological safety cabinets in each laboratory. The survey will cover the overall condition of the biological safety cabinet.
- The Department of Environmental Health and Safety shall perform periodic surveys of all laboratories to ensure that the Biological Safety Cabinet Work Practices are being followed.
- All cabinets will have a certification sticker indicating the last date of testing on the front face of the cabinet.
- Appropriately trained contractor personnel shall carry out preventive maintenance only.
- Biological safety cabinets must not be turned off prior to notification of the laboratory supervisor or the Chemical Hygiene Officer/Principle Investigator.
- During maintenance, cabinet will be locked and tagged out to indicate that the cabinet is undergoing maintenance. The worker should verify that the cabinet is not in use and follow the standard Lockout/Tagout procedures prior to performing the work.

Responsibilities

Certification Contractor

The certification contractor is responsible for the following:

1. Provide standard operating procedures (SOP) for biological safety cabinet certification.
2. Provide training documentation for all technicians performing the certifications.
3. All certification paper work shall be faxed (215-895-5926) to the Department of Environmental Health and Safety within 48 hours.
4. All certification requests and proposals must be processed through the Department of Environmental Health and Safety
5. Provide repairs and maintenance to biological safety cabinets.
6. Provide advice on the selection and installation of new biological safety cabinets.

Department of Environmental Health and Safety

The Department of Environmental Health and Safety will be responsible for the following:

- Implementation of all the requirements set forth by this plan.
- Provide advice on the selection and installation of new biological safety cabinets.
- Provide advice on the relocation of existing biological safety cabinets.

Departmental Chemical Hygiene Officer (CHO) or Principle Investigator (PI)

- The CHO/PI is responsible for the implementation of this plan.
- The CHO/PI shall provide training on the biological safety cabinet safe work practices to laboratory personnel, students, and faculty. Training must be provided initially and annually thereafter.
- All laboratory personnel must complete the Biological Safety Cabinet (BSC) Confirmation of Training Form.
- The BSC Confirmation of Training form shall be completed on an annual basis.
- Contact the Department of Environmental Health and Safety's office to obtain a copy of the BSC Confirmation of Training form.
- The BSC Confirmation of Training form shall be completed and returned to the Department of Environmental Health and Safety.
- The CHO/PI will post the biological safety cabinet safe work practices in the laboratory for biological safety cabinet users to view.

Training

Biological safety cabinet users will be trained on the use and safe work practices to be employed prior to their initial involvement in Drexel laboratories. The training will discuss laboratory safety procedures and precautions to take while working in laboratories. A copy of the university safe work practices will be posted on all biological safety cabinets. The practices will also be reviewed during student orientation.

Record Keeping

- A Certification Sheet shall be completed for each biological safety cabinet whether passing or failing the certification tests.
- A copy of the biological safety cabinet's certification sheet and any other information shall be given to the CHO or PI for their records.
- The certification sheets and any other information shall be maintained in the room's specific information file at the Department of Environmental Health and Safety for a minimum of three (3) years.
- All the records of surveys and training shall be maintained for a minimum of three years in the room's specific information file at the Department of Environmental Health and Safety.
- Contractor training documentation shall be maintained for a minimum of three years.

Emergency Contacts

University City Campus - Emergency Contact Numbers

Department	Name	Office Number	Mobile Number	Pager Number
Public Safety		215-895-2222		
Emergency Room	HUP	215-662-3920		
Student Health	Drexel	215-895-5800		
Occupational Health	Worknet	215-487-5800		
Univ. Safety	Jon Chase	215-895-5891	215-669-6122	
Univ. Safety	Martin Bell	215-895-5892	215-778-4278	
Univ. Safety	Phil Leo	215-895-5909	215-768-1624	
Univ. Safety	Jaime Barbaro	215-895-5896	215-768-1623	
Univ. Safety	Joseph Nihill	215-895-1624	267-249-0348	
Univ. Safety	Jeff Nemetz	215-895-5913	215-778-3039	
Univ. Safety	Diana Dukes	215-895-5907	215-778-4279	
Radiation Safety	Kent Lambert	215-255-7860	215-651-2211	4-1260
Facilities		215-895-2808		215-308-1058
Maintenance		215-895-2808		215-308-1058
Environmental Services		215-895-2808	267-446-1086	215-265-0583

Center City Campus - Emergency Contact Numbers

Department	Name	Office Number	Mobile Number	Pager Number
Emergency Operator		215-762-7110		
Emergency Room	HUH	215-762-7963		
Student Health		215-762-8590		
Occupational Health	Worknet	215-762-8590		
Univ. Safety	Jon Chase	215-895-5891	215-669-6122	
Univ. Safety	Martin Bell	215-895-5892	215-778-4278	
Univ. Safety	Phil Leo	215-895-5909	215-768-1624	
Univ. Safety	Jaime Barbaro	215-895-5896	215-768-1623	
Univ. Safety	Joseph Nihill	215-895-1624	267-249-0348	
Univ. Safety	Jeff Nemetz	215-895-5913	215-778-3039	
Univ. Safety	Diana Dukes	215-895-5907	215-778-4279	
Hospital Facilities	Luis Gonzalez	215-762-3519	215-762-3000	
Hospital Safety	Steven Morrissey	215-762-6133	215-779-8901	4-2830
Radiation Safety	Kent Lambert	215-255-7860	215-651-2211	4-1260
Facilities	Patricia Lewis	215-762-6500	215-783-2672	4-1015
Facilities	Brian Lynch	215-255-7318	215-783-2557	
Facilities	John Mahony	215-255-7320	215-668-7114	
Tenet Security		215-762-7110		
Tenet Maintenance		215-762-3000		
Environmental Services		215-762-4700		

Emergency Contacts

Queen Lane Campus - Emergency Contact Numbers

Department	Name	Office Number	Mobile Number	Pager Number
Emergency Operator		215-895-2222		
Public Safety		215-895-2222		
Student Health		215-895-5800		
Occupational Health		215-762-8590		
Univ. Safety	Jon Chase	215-895-5891	215-669-6122	
Univ. Safety	Martin Bell	215-895-5892	215-778-4278	
Univ. Safety	Phil Leo	215-895-5909	215-768-1624	
Univ. Safety	Jaime Barbaro	215-895-5896	215-768-1623	
Univ. Safety	Joseph Nihill	215-895-1624	267-249-0348	
Univ. Safety	Jeff Nemetz	215-895-5913	215-778-3039	
Univ. Safety	Diana Dukes	215-895-5907	215-778-4279	
Radiation Safety	Kent Lambert	215-255-7860	215-651-2211	4-1260
Facilities	Ray Stoffel	215-991-8484	215-651-1321	
Facilities	Brian Lynch	215-255-7318	215-783-2557	
Facilities	John Mahony	215-255-7320	215-668-7114	
Security		215-991-8102		
Maintenance		215-991-8484		
Env. Services		215-991-8145		

PA Biotechnology Center - Emergency Contact Numbers

Department	Name	Office Number	Mobile Number	Pager Number
Security		215-489-2315		
24 Hour Call Center		215-895-2222		
Emergency Room				
Student Health				
Occupational Health				
Univ. Safety	Jon Chase	215-895-5891	215-669-6122	
Univ. Safety	Martin Bell	215-895-5892	215-778-4278	
Univ. Safety	Phil Leo	215-895-5909	215-768-1624	
Univ. Safety	Jaime Barbaro	215-895-5896	215-768-1623	
Univ. Safety	Joseph Nihill	215-895-1624	267-249-0348	
Univ. Safety	Jeff Nemetz	215-895-5913	215-778-3039	
Univ. Safety	Diana Dukes	215-895-5907	215-778-4279	
Radiation Safety	Kent Lambert	215-255-7860	215-651-2211	4-1260
Facilities	Gerald Litschi	215-489-4947	484-767-5779	
Maintenance		215-489-4904	215-778-1184	
Env. Services		215-489-4904	215-778-1184	

Biological Safety Cabinet

Confirmation of Training Form

I, _____, certify that I have received training on the safe work practices relating to biological safety cabinets. In addition, I have read and understood the Biological Safety Cabinet Work Practices protocol set forth by the Department of Environmental Health and Safety and will follow all requirements that are mandated in this protocol.

Please Print Name

Date

Signature

Title

Department Name

Telephone Number

7/26/2010

BSC Confirmation of Training Form 12-07-01