

## Biosafety Cabinets

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## Definitions

**Containment:**

*“the act, process or means of containing”*

**Contain:**

*“to keep within limits, hold in, control”*

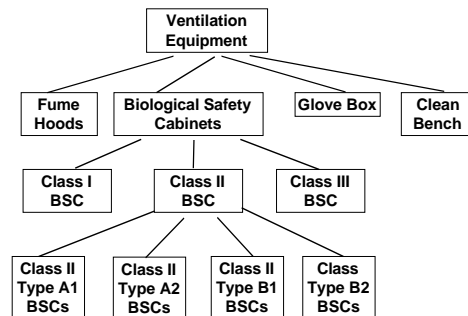
## Containment (Barriers)

- Primary Containment
  - Protects personnel and immediate lab environment
  - Combination of practices AND safety equipment
  - Reduces exposure

**“The most important element of containment is strict adherence to standard microbiological practices and techniques.”**

**BMBL, 5<sup>th</sup> Edition**

## Primary Containment



## Fume Hoods ≠ Biosafety Cabinets

- Fume hoods are used for volatile chemicals-not biohazardous materials



Chemical Fume Hood



Class II BSC Front Grille

## Primary Barriers

	Personnel	Product	Environment
Chemical Fume Hoods	X		X
Laminar Flow Clean Benches		X	
Class I BSC	X		X
Class II BSC	X	X	X
Class III BSC	X	X	X
Isolators	X	X	X

## State of the Art Safety Practices: 1954



## Class II BSC

Most clinical labs use A1 or A2

- Reduces exposure, does not eliminate (risk is never zero)
- Containment provided by balanced directional airflow and filtration

## Class II Biosafety Cabinetry NSF/ANSI 49 - 2002

NSF International Standard 49-1992	NSF International Standard 49-2002
Class II Type A	Class II Type A1
Class II Type A/B3	Class II Type A2
Class II Type B1	Class II Type B1
Class II Type B2	Class II Type B2

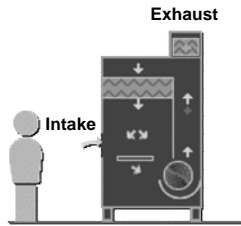
## Class II Type A1 BSC

“Type A1 cabinets are not suitable for work with volatile toxic chemicals and volatile radionuclides”.

Because they recirculate 70% of the HEPA filtered air back into the lab (NSF/ANSI Std. 49-02 )

## Class II Type A1 Airflow

Type A1 Cabinet without canopy

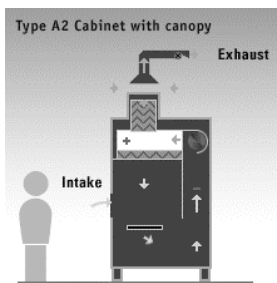


## Class II Type A2 BSC

“Type A2 cabinets used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies must be exhausted through properly functioning exhaust canopies.”

*(NSF/ANSI Std. 49-02 )*

## Class II A2 Airflow

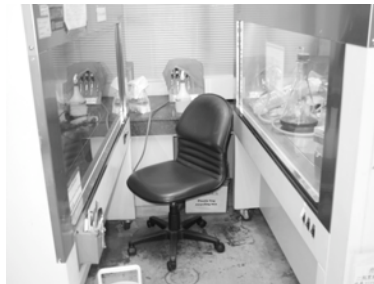


## BSC Preferred Operating Location

- Isolated from other work areas
- Removed from high traffic areas
- Away from airflow ducts
- Away from laboratory entry doors
- 12-14” away from ceiling and walls

- Face velocity at the sash for A2 BSC is 100 fpm
- $100\text{ft}/\text{min} \times 60 \text{ min}/\text{hour} \times 1 \text{ mile}/5280 \text{ ft} = 1.14 \text{ mi}/\text{hr}$
- At a walking rate of 1.14 mi/hr, you can pull air out of the BSC

## What is wrong with this picture?



## BSC Operating Procedure

Written SOP's  
Employees must be trained!

## SOP's

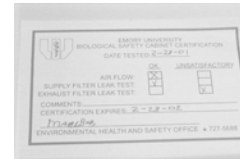
- How it works
- How you work in it
- How to decontaminate prior to repair
- How to maintain work area
- What do alarms and gauges mean
- Document training!

## Prior to BSC Operation

- Plan ahead
- Schedule uninterrupted work time when not in use by others (if possible)
- Keep doors closed
- Assemble all materials needed
- Turn BSC on and allow to run for 10 minutes (if not running continuously).

## Prior to BSC Operation

- Check expiration date on certificate
- Must be certified when installed, whenever moved, and at least annually
- Usually conducted by safety office or outside vendor



## Prior to BSC Operation

Disinfect interior surfaces of BSC and all supplies that will be needed.

- What disinfectant?
- Bleach will pit the stainless steel
- Rinse bleach off with water or alcohol



## Prior to BSC Operation

- Work surface, rear wall, sides, inside front window
- Use a “swiffer” to reach the back wall-don't put your head inside the BSC



### **Prior to BSC Operation**

- Check sash height, inward airflow (tape or Kimwipe), pressure gauge, and make sure alarms are ON
- Load BSC with all needed supplies before work.

**Before each use and after any power fluctuation this indicator should be observed.**



### **Pressure Differential Gauge**

- Measures pressure drop across HEPA filter
- Look for large change up or down from previous day
- Increase in gauge when filter loads or blockage-resistance up
- Decrease in gauge when hole or tear in filter-resistance down

**HEPA Filter  
High  
Efficiency  
Particulate  
Air  
Filter**

**HEPA Filters  
DO NOT  
filter out  
gases and vapors**

**They only filter out  
particulates**

### **Working in a BSC**

- Both chemicals and flames can compromise the integrity of the filter

## Working in a BSC

Do not

- Use NFPA 4 flammables-
  - Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily (e.g., propane). Flash point below 23°C (73°F).

## Working in a BSC

Do not

- BSC fans NOT spark proof- chemical use may result in fire/ explosion

## Working in a BSC

*Bunsen burners*

- Fire hazard
- Can damage HEPA
- Interferes with proper airflow
- Microincinerator preferred
- Burner with pilot light not recommended



## Ultraviolet Germicidal (?) Lights

- Not recommended for decontamination
- UV lamps should have an output of not less than 40 microwatts per cm<sup>2</sup> at 254 nanometers
- UV has limited penetrating power - surface or air only

## Ultraviolet Germicidal (?) Lights

- Intensity decreases with time -check with meter Intensity decreases with dirt and dust-clean weekly
- Intensity decreases with distance from the lamp
  - $I=1/d^2$

## Working in a BSC

Do not

- Use upright pipette collection containers
- Go in and out
- Tape the biohazard bag to the outside
- Overload cabinet
- Block front or rear grilles
- Work inside with 2-3 people

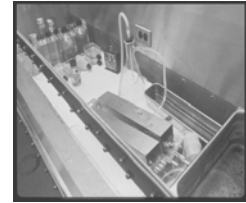


Any comments?

## Working in a BSC

*Do*

- Use horizontal pipette discard trays within the BSC
- Minimize disruption of airflow (turbulence)



## Working in a BSC

*Do*

- Work in center of work area (or at least 4 inches from the front grille)



## Working in a BSC

*Do*

- Separate clean from dirty
- Adjust chair height so that your face is above the front sash opening and the bottom of the glass screen is even with your underarms

## Working in a BSC

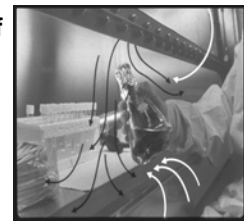
*Do*

- Limit side to side and in to out motion while working in the BSC
- Protect vacuum lines or pump

## Working in a BSC

*Do*

- Move arms in and out slowly, perpendicular to the face opening of the BSC
- Collect waste within the cabinet
- Clean up spills promptly



### **Spill inside a BSC**

- Leave BSC on to filter air
- Cover spill with absorbent
- Carefully pour effective disinfectant (such as 10% bleach solution) onto absorbent starting at the outside edge and moving toward the center

### **Spill inside a BSC**

- Wipe all reachable surfaces with disinfectant
- Flood catch basin if contaminated (close drain valve!)

### **Spill inside a BSC**

- Allow 20 minute contact time-rinse surfaces if bleach used
- Wipe objects within BSC with disinfectant before removal. Autoclave if possible, including gloves, lab coat and contaminated towels.
- Allow BSC to run for 10 minutes before resuming work.

### **After Work is Completed**

- Disinfect materials before removal from BSC
- Seal and remove biohazardous waste
- Disinfect work surface, rear wall, sides, inside front window
- Leave cabinet running if possible

### **BSC Maintenance**

- Routine housekeeping
- Daily, weekly, monthly, semi-annually cleaning
- Don't store materials on top of BSC

### **BSC Safe Operation**

- In general, not designed for chemical use
- Volatile chemicals NOT retained by HEPA filter- exposes personnel if not exhausted
- Both chemicals and flames can compromise the integrity of the filter
- BSC fans NOT spark proof- chemical use may result in fire/ explosion-never use NFPA 4 flammables



## BSC Safe Operation

- The air curtain at the front opening can be easily compromised
- As with any piece of lab equipment, personnel must be trained in the proper use of it and what to do if the BSC fails (power outage, fan failure)
- If you have equipment, it must be maintained.



## References

- NSF/ANSI Std. 49-02
- CDC/NIH's Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets
- CDC/NIH BMBL

