Introduction

Welcome to Biosafety Cabinets and Fume Hoods (BIO304). This training is a requirement for anyone conducting work or research in a Biosafety Cabinet (BSC), Fume Hood, or Clean Air Station.

Objectives

After this course, participants should be able to:

1. Understand the difference between Fume Hoods, Biosafety Cabinets (BSC), and Clean Air Stations.
2. Explain the consequences that could happen if improper use of equipment is happening.
3. Implement the correct ventilation equipment.
4. Recognize the meaning of the various signage and postings in your area.
5. Know how to protect yourself and your surroundings by using sound work practices properly.

Fume Hoods

The primary purpose of laboratory fume hoods is to keep toxic or irritating vapors out of the general laboratory working area. A secondary purpose is to serve as a shield between the worker and the equipment used when there is the possibility of an explosive reaction or to protect the specimen.

Types

Conventional Hoods

Represent the original and most straightforward of the hood design styles. With a traditional hood, the volume of air exhausted is constant, regardless of sash height. Thus, the face velocity increases as lowering the sash.

There are different types of fume hoods on campus at UAB. However, UAB's Department of Environmental Health and Safety (EHS) does not recommend Ductless Fume Hoods.

Bypass Hoods

An air bypass hood incorporated above the sash provides an additional source of room air when closing the sash.

Auxiliary Air Hoods

This type of hood has an attached duct dedicated to supplying outside air to the face of the bypass hood. The main advantage of an auxiliary air hood is the energy savings realized by reducing the amount of heated or air-conditioned room air exhausted by the hood.

Variable Air Volume (VAV) Hoods

VAV's are the most sophisticated hood type, requiring technically proficient design, installation, and maintenance. The primary characteristic of VAV Hoods is their ability to maintain a constant face velocity as sash height changes.

Ductless Fume Hoods

Ductless Fume Hoods have a conventional hood design but are self-contained to recirculate air back into the lab after filtration occurs. These hoods use either High-Efficiency Particulate Air (HEPA) filters or Activated Carbon Filtration (ACF) technology to remove contaminants from the hood air. Their use is limited to nuisance vapors and dust that do not present a fire or toxicity hazard.

High-Performance Chemical Fume Hoods

This type of hood is designed to operate with a lower intake face velocity for use with chemicals or radiological agents and are also known as Low-Flow Chemical Fume Hoods. The Low Flow Hoods fail containment because they are more vulnerable to traffic, placement, several hoods, and sash position.

Specialty

Walk-In Hood

This type of hood sits directly on the floor and characterized by a very tall and deep chamber accommodating large pieces of equipment. Walk-In Hoods may be designed as Conventional, Bypass, Auxiliary Air, or Variable Air Volume.

Snorkelers

Fume exhaust dust connections, commonly called snorkelers, elephant trunks, or flex ducts, are designed to be somewhat mobile, allowing the user to place it over the area needing ventilation.

Canopy Hoods

Canopy Hoods are horizontal enclosures having an open central duct suspended above a workbench or other areas and are most often used to exhaust areas too large to be enclosed within a fume hood. The capture zone for a canopy hood is only a few inches below the opening and best used for capturing water vapor or heated air. The major disadvantage with the canopy hood is that heat, odor, and contaminants can be drawn directly past the user's breathing zone.

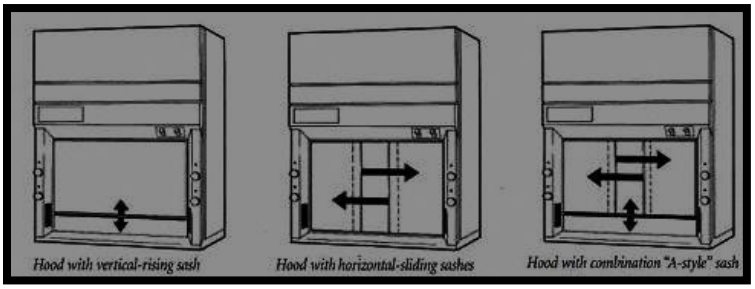
Glove Boxes

Use Glove Boxes when the toxicity, radioactivity level, or oxygen reactivity of the substances under study pose too great a hazard for use within a fume hood. The major advantage of the glove box is protection for the worker and the product. Two commonly sought out specialty types include Radioisotope and Perchloric Hoods. Radioisotope Hood Systems are ideally made from welded stainless steel to ensure against the absorption of radioactive materials. To comply with most licensing requirements, Radioisotope Hoods require a face velocity of 125 fpm. Perchloric Acid Hoods have wash-down capabilities to prevent the buildup of explosive perchlorate salts within the exhaust systems.

Considerations

Sashes

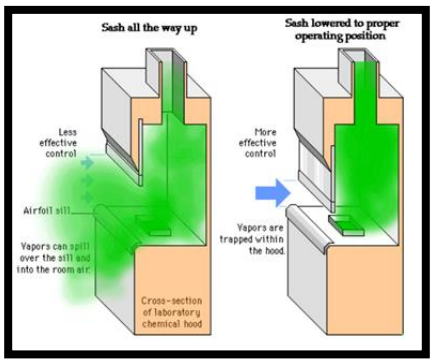
The sash is the term used to describe the movable glass panel covering the face area of a fume hood. Sashes can be vertical, horizontal, or a combination of the two.



Things to remember:

- Working at least six inches back from the face of the hood. A stripe on the bench surface is a good reminder.
- Preventing items from blocking the sash closure (this affects airflow).
- Keeping the sash height at the level marked for safe use or the level specified in your labs Standard Operating Procedure (SOP).
- Closing the sash when not working in the fume hood acts as an extra layer of protection should there be an explosion or fire inside the hood.
- Working slowly and removing your arms slowly reducing the creation of eddy current disrupting the containment ability of the hood.

Airflow



When a person walks by a fume hood, turbulence can be created, causing contaminants to be drawn outside the hood. Also, if the air diffuser is located directly above the fume hood, air turbulence may be created, causing contaminants to escape into the room.

The airflow into the room affects the fume hood. Close all doors maintaining the negative pressure of the lab concerning the corridor. This ensures that any contamination in the lab will be exhausted through the fume hood and not escape into the hallway.

Alarms

Many of the newer VAV hoods are installed with alarms, sensors, controls, and gauges. Hoods usually go into alarm mode either because the sash has been raised to a height at which the hood can no longer exhaust a sufficient amount of air, the building air exhaust system is not working properly, or there has been a power outage.

When a hood alarms, no chemical work should be performed until the exhaust is increased. Additionally, lab workers should not attempt to stop or disable hood alarms. Contact UAB's Department of Environmental Health and Safety (EHS) at (205) 934-2487, and they will come and analyze the cause of the alarm and resolve the issue.

Testing

Periodic Fume Hood Testing

Conduct regular performance testing at least annually or whenever making a significant change to the operational characteristics of the hood system. A hood that is found to be operating with an average velocity more than 10% below the designated average velocity shall be labeled as out of service, or restricted and corrective actions shall be taken to increase the flow. There is no charge for annual testing.

Fume Hood Tracer Gas Testing

The benchmark velocity is established by ANSI/ASHARE 100 Fume Hood Testing Requirements. All new fume hood installations require AI (as installed) testing, and old new hoods require AU (as used) testing. These requirements also standards for permanent airflow monitors and proper standards for permanent airflow monitors and proper air sill installation when handling hazardous materials inside the hood. A decrease in the average velocity below 90% of the benchmark velocity and face velocity increases in excesses exceeding 20% of the benchmark shall be corrected before continued use.

Out of Service Notice

When taking a fume hood out of service for any reason, post a "Restricted Out-of-Service Notice." The restricted use notice shall state the necessary precautions concerning the type of materials permitted or prohibited for use in the hood. Do not remove Out-of-Service Tags! Do not use a fume hood for storage because it is out of service. This posting is there for the health and safety of you and those in the area.

Working Inside

While working inside a fume hood, there are practices that you should always follow.

- Never stick your face, body, or head into a fume hood. This defeats the purpose of the fume hood so that you and the product are not protected.
- Never use a fume hood as a canopy hood to draw away heat. This will create airflow disruptions.
- Never over pack a fume hood. Air must be able to flow around objects.
- Never use the fume hood to store chemicals. This prevents the hood from being used.
- PPE
    - EHS recommends the PPE listed below. However, your lab's SOP determines the appropriate PPE.
        - Wear the proper work clothes – shoes that cover the entire foot, long pants, and long sleeves if the lab coat does not cover from shoulder to wrist.
        - Don a clean, buttoned lab coat, or disposable gown and the appropriate gloves for the work.
        - Always use splash goggles, and wear a full-face shield if there is the possibility of an explosion or eruption.
- The Hood Surface
    - You should:
        - Keep the hood surface free of stored chemicals and paper towels/Kimwipes
        - Place instruments two inches above the hood surface to allow airflow under the instrument
        - Avoid placing items so that the back baffles are blocked

Positioning

The location of the fume hood affects its efficiency.

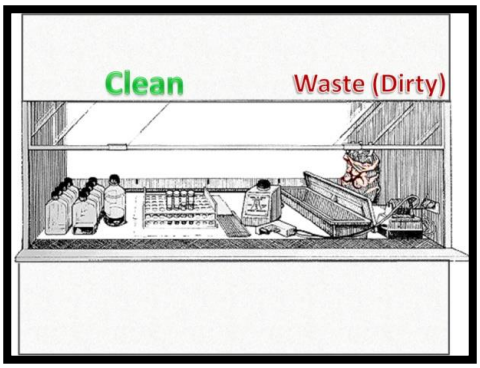
More is not always better! At velocities greater than 125 fpm, studies have demonstrated that the creation of turbulence causes contaminants to flow out of the hood and into the user's breathing zone.

- When a person walks by a fume hood, turbulence can be created, causing contaminants to be drawn outside the hood. Also, if the air diffuser is located directly above the fume hood, air turbulence may be created, causing contaminants to escape into the room.
- The airflow into the room affects the fume hood. All doors should be closed to maintain the negative pressure of the lab concerning the corridor. This ensures that any contaminants in the lad will be exhausted through the fume hood and not escape into the hallway.
- Face velocity is a measurement of the average velocity at which air is drawn through the face to the hood exhaust. The acceptable range of the average face velocity is 60-100 feet per minute (fpm). If using non-carcinogenic materials, the adequate face velocity for minimally hazardous materials is 60 fpm. The ideal average face velocity is 100 fpm for most operations. If using a carcinogen, reproductive toxin, or acutely toxic material, it is recommended that the face velocity range from 60 to 125 fpm.

Biological Safety Cabinets (BSC)

Biosafety Cabinets are required when working with infectious materials. BSC's are designed to keep personnel from catching something. However, humans carry organisms that could severely affect the outcome of the product. In varying degrees, a laminar flow Biological Safety Cabinet is designed to provide three basic types of protection.

- **Personnel** protection from harmful agents inside the cabinet.
- **Product** protection to avoid contamination of the work, experiment, or process.
- **Environmental** protection from contaminants contained within the cabinet.



Always designate a clean side and a dirty side. Work from clean to dirty, and work on the centerline of the work surface. Note the location of discard trays and how other items are positioned to avoid compromising the airflow.

Classifications

- Class I: Personnel and environmental protection only
- Class II: Product, personnel, and environmental protection

Class II

NSF Classification	Protection	General Description
Type A Type A2	If exhausted to room, none; not for use with vapors and gases. If exhausted to a treated facility exhaust system, protects personnel. If exhausted to a treated facility, an exhaust system protects personnel, work area, and the environment.	70% air recirculated; 30% exhausted from a common plenum to the room. 75 LFPM intake May have biologically contaminated positive pressure plenum
Type B1	Offers more protection to personnel and the work area, the closer the vapor source is located toward the rear of the work area. Offers protection to the environment if exhausted to the treated system.	70% is recirculated, 30% exhausted from a common plenum to the room. 100 LFPM intake Biologically contaminated plenum under negative pressure or surrounded by negative pressure
Type B2	Offers protection to personnel. Offers protection to the environment if exhausted to the treated system.	40% air recirculated; 60% exhausted from cabinet Exhaust air pulled through dedicated exhaust duct into the facility exhaust system 100 LFPM intake All biologically contaminated plenums are negative to the room

Air Cleanliness

Air Cleanliness, Federal Standard No. 209 E	
Class 100	Particle count not to exceed a total of 100 particles per cubic foot of a size 0.5 micron and larger.
Class 10,000	Particle count not to exceed a total of 10,000 particles per cubic foot of a size 0.5 micron and larger, or 65 particles per cubic foot of a size 5.0 micron and larger.
Class 100,000	Particle count not to exceed a total 100,000 particles per cubic foot of a size 0.5 micron and larger, or 700 particles per cubic foot of a size 5.0 micron and larger

Care and Maintenance

Decontamination

Decontaminating a biosafety cabinet is not preferred regularly. Use Paraformaldehyde Gas or vaporized Hydrogen Peroxide (VHP) when decontaminating. There are three reasons for decontamination:

1. Moving a Biosafety Cabinet
2. Repairing a Biosafety Cabinet
3. If a Biosafety Cabinet is suspected, contaminating work. However, eliminate all other sources causing contamination first.

Certification

Certification procedures assure the user that the protection factors of personnel, product, and environment are maintained by verifying that the downflow velocities, in-flow velocities, and HEPA filters are within specification. The National Sanitation Foundation (NSF) regulates Class II Biosafety Cabinets. They have mandated the certification procedures **listed here**.

UAB's Department of Environmental Health and Safety (EHS) recommends that certification should be performed initially after receiving any new and used ventilation equipment. However, there is a charge for certification.

If you are considering the purchase of a new Biosafety Cabinet or obtaining one from another department, contact EHS at (205) 934-2487 first. We can help you determine the risk factors as to which type of Biosafety Cabinet would best suit your needs.

Checklist

Pre

Before you begin your work inside the Biosafety Cabinet, you should:

- Always wash your hands.
- Next don the appropriate PPE (determined by your labs SOP)
- Load supplies first lowering airflow and possible contamination
- Turn the Biosafety Cabinet on and allow it to run for 10 to 15 minutes
- Check the inward airflow by securely attaching a piece of tissue to the face hood. As you can see in this picture, the lab coat appears to be pulled in toward the cabinet.
- Make sure the sash is at the certification levels posted on the BSC.
- Adjust the seat height so that the bottom edge of the sash is level with your underarms.

Post

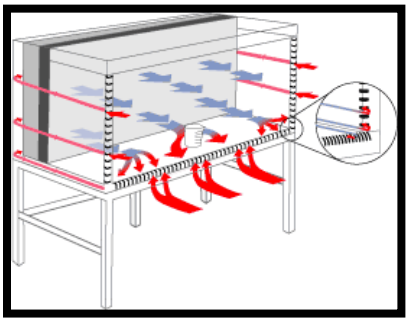
When you have completed your work inside the BSC:

- Disinfect all of the items to be removed from the cabinet
- Remove all waste products and place in appropriate receptacles
- Wipe down the interior of Biosafety Cabinet with an appropriate disinfectant
- Allow the cabinet to run 10-15 minutes before shutting off.
- If you are using a UV light, make sure you still follow proper procedures. A UV light will not destroy all microbes, so use an appropriate disinfectant. UV lights should be wiped down at least once per week when the light is off.

Clean Air Work Bench

The clean bench provides product protection by ensuring that the work in the bench is exposed only to HEPA-filtered air. The clean bench is recommended for work with non-hazardous materials where clean, particle-free air quality is required. It does not protect personnel or to the ambient environment. It is not designed to contain aerosols generated by the procedure; the user is exposed to these aerosols.

The laminar flow clean air workbench is a workbench or similar enclosure, which has its filtered air supply. The bench is recommended for work with non-hazardous materials where clean, particle-free air quality is required. The bench is recommended for work where clean, particle-free air quality is required.



The bench provides product protection by ensuring that the work in the bench is exposed only to HEPA-filtered air.

- It does not protect personnel or the ambient environment.
- It is not designed to contain aerosol generated by the procedure; the user is exposed to these aerosols.
- The clean bench provides product protection by ensuring that the work in the bench is exposed only to HEPA-filtered air.
- It does not protect personnel or the ambient environment. It is not designed to contain aerosols generated by the procedure; the user is exposed to these aerosols.

Signage and Postings

Read and follow all signage and postings in an area to protect everyone in the area, whether inside or outside the lab. Please read these carefully and follow them vigilantly. They are posted for everyone's health and safety.

Conclusion

This concludes the Biosafety Cabinets and Fume Hoods (BIO304) Training Course. Please take the assessment at this time. You must score 80% or higher to pass. You have three chances to pass. If you fail all three times, you will have failed the course and must re-register for the course. This means that you will have a failed course on your transcript. When you pass, please print and retain the certificate. You may be asked to present proof of your training.

EHS Decision Tree

EHS has many training courses available to all UAB active employees and students. This includes topics such as in-depth radiation training, biosafety, bloodborne pathogens, chemical safety, controlled substances, building life safety, hazardous and medical waste, universal waste, PPE, hazard communication, etc.

EHS developed a **decision tree** to assist you in choosing the right course to match the knowledge/skills you may need at work every day as well; if you have any questions or comments contact EHS at (205) 934-2487.