ADVISORY NO. 8.6: LABORATORY VENTILATION

GENERAL

The primary functions of laboratory ventilation systems are to provide safe, comfortable, conditioned breathable environments for all employees and the public, and to minimize exposures to hazardous air contaminants. Each laboratory module is an integral part of the entire building and requires careful planning, designing, and maintaining air supply and exhaust devices and equipment to accomplish these goals. A carefully designed laboratory ventilation system must maintain constant hood face velocities and constant room pressure relationships between laboratory and non-laboratory areas, regardless of air exhausted from the room.

All laboratory spaces shall have mechanically generated and conditioned supply and exhaust air. Supply air shall be “once through” (100% outside air); it shall not be re-circulated outside of the laboratory room. All laboratory rooms shall exhaust 100% of the air outside of the building. There shall be no return of fume hood or laboratory exhaust back into the building. Building ventilation systems will provide laboratories with at least six (6) air changes per hour (ACH) of fresh (outside) air. The volume of airflow reduces possible employee exposure to airborne contaminants and removes excess heat. It also directs airflow from areas of low hazard to areas of high hazard, which helps to keep odors, dusts, and vapors out of hallways and other public areas. Laboratories shall be maintained at a negative pressure relative to all surrounding spaces that are non-laboratory areas (hallways, offices, conference rooms, etc.).

LOCAL EXHAUST SYSTEMS AND FUME HOODS

A local exhaust system is a device that captures fugitive emissions and contaminants at their source before they are released into the workroom environment. Drafts, traffic, and heating sources can impair the effectiveness of a local exhaust system. These systems are required to be certified annually as to their effectiveness.

- **Chemical Fume Hoods** contain hazardous dusts, gases, vapors, and fumes that are generated within them and remove the contaminants via the building’s ventilation system. When used properly, these hoods are extremely effective at protecting lab workers and the work environment. Fume hoods must not be used with biohazardous materials or where sterility of the product is a concern.
- **Wash Down Fume Hoods**, or perchloric acid fume hoods, are designed with a wash down feature that will remove damaging corrosive residues, and in the case of perchloric acid, potentially explosive perchlorate salts from the fume hood, ductwork, and fan.
- **Hydrofluoric Acid Fume Hoods (HF)** are specifically designed to be acid resistant. HF fume hoods have Lexan^{tm} sashes which prevent fogging of the sash and are produced out of non-metallic materials.
- **“Snorkel” or “Elephant Trunk”** exhaust systems are flexible arms with cones on the end that can be positioned directly over your work. Intended for small areas or machines, each snorkel exhaust should have its own air damper. The effective range of snorkel exhaust hoods is typically less than 10 inches and must be reviewed by EHS prior to installation.
- **Ductless Fume Hoods** are **NOT** permitted at the University of Cincinnati.
There are 2 types of fume hoods in use at the University of Cincinnati:

Constant Air Volume Hoods

The constant air volume (CAV) fume hood exhausts the same amount of air all the time, regardless of the sash position. As the sash is lowered and raised, the velocity at the face of the hood changes. EHS tests all fume hoods annually and marks the sash height that provides the acceptable face velocity of 100 FPM (+/-20%) on constant air volume hoods.

Variable Air Volume Hoods

The variable air volume (VAV) fume hood is used in most labs on UC campuses and is the primary type of fume hood installed in new laboratory construction/renovations. These fume hoods utilize a moveable damper in the ductwork to maintain a constant face velocity by varying the air flow. These hoods rely on the position of the hood's sash to change the air volume to maintain a safe and constant face velocity. EHS tests VAV hoods and marks the sash at the normal operating working position of 18 inches and gives a face velocity of approximately 100 FPM (+/-20%).

VAV fume hoods are equipped with a monitor that indicates whether the hood is in "standard operation" or "standby operation" mode. The fume hood monitor also has an "emergency purge" button, which increases airflow through the fume hood to maximum and can be used to quickly remove air contaminates from the laboratory.

VAV fume hoods are equipped with flow sensors that activate an audible alarm when malfunctions occur. These fume hoods are energy efficient when used properly, and the sashes should be closed when the fume hood is not in use. Contact Facilities Management (513) 558-2500, if your fume hood alarm sounds.

BIOLOGICAL SAFETY CABINETS (BSCS)

A biological safety cabinet (also called biosafety cabinet) is an enclosed, ventilated laboratory workspace for safely working with materials contaminated or potentially contaminated with pathogens.

BSCs use HEPA filters to protect lab workers and the environment from aerosols or droplets that could spread biohazardous material. Biosafety cabinets are required to be certified annually. The Principal Investigator or the Researcher is responsible for arranging service and ensuring their BSCs are certified in accordance with NSF/ANSI Standard 49.

There are three kinds of biological safety cabinets, designated as Class I, II, and III, have been developed to meet varying research and clinical needs.

EHS recommends Class II, Type A2 cabinets for University of Cincinnati Facilities.

- **Class II Cabinets** are designed to protect personnel, the environment, and the research product. The airflow velocity at the face of the work opening is at least 75 linear feet per minute (lfpm). Both supply air and exhaust pass through a HEPA filter. There are four (4) Types of Class II cabinets.
- **Class II, Type A2** cabinets (formerly labeled Type A/B3) have design features that make them more useful in research laboratories than other Class II cabinets. In addition, if a Type A2 cabinet is vented to the building exhaust system via a properly functioning canopy (thimble) connection, it can be used with minute amounts of toxic chemicals.
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Class I and Class III cabinets are rarely used at UC.

Class I cabinets do **NOT** protect the research product, and **Class III cabinets** (also called glove boxes) are maximum containment cabinets that require workers to wear arm-length gloves attached to a front panel.

Contact UC Biosafety if your department needs one of these varieties.

Animal Transfer Station

Animal transfer and cage changing stations are portable downdraft-filtered laminar flow benches (clean benches) that have been specifically modified for small rodent handling and cage changing. These stations provide improved laboratory animal allergen control from dust and dander while performing animal husbandry activities. These units are not designated as biosafety cabinets and should not be used for work with potentially infectious materials, toxins, or volatile chemicals. Please coordinate the use of this equipment with UC Laboratory Animal Medicine (LAMs) Animal Care Program.

Glove Boxes

Glove boxes are airtight boxes with two (2) or more heavy rubber gloves and an airlock.

Gloves boxes are used when working with known carcinogens and highly toxic substances, or to provide an inert atmosphere for compounds that are sensitive to water or air.

Gas Cabinets

Gas cabinets are fully enclosed, non-combustible, exhausted enclosures used to store or use gas cylinders. They operate at negative pressure in relation to the surrounding area and are connected to the exhaust ventilation system. In the event of a leak or rupture, a gas cabinet prevents the gas from contaminating the laboratory.

Laminar Flow Clean Bench

A clean bench is a ventilated workspace designed to prevent contamination of the product or semiconductor wafer from the laboratory environment or workers. These devices are often referred to by many different names, including cell culture hoods, laminar flow hoods, PCR hoods and clean benches. Air is drawn through a HEPA filter and delivered in a laminar (non-turbulent) flow across the work surface towards the worker.

Clean benches do **NOT** protect people or the environment. Laminar Flow Hoods should only be used for work with non-infectious materials or non-volatile chemicals. They should never be used with potentially infectious materials, toxins, volatile chemicals, or materials that may cause hypersensitivity to the worker, such as animal dander. For work with hazardous materials, use a fume hood or a biosafety cabinet.

Downdraft Tables

Downdraft tables are workstations with built-in ventilation that pulls air, odors, vapors, and aerosols down and away from the worker's face. They are used primarily for dissections of formaldehyde preserved specimens and for capturing dust, vapors, or other contaminants from fabrication activities.

Downdraft tables can be quite large and difficult to access from all sides. The capture efficiency can be affected by changing conditions in the room. Keeping the filtration system clean and operating properly can be difficult.

CERTIFICATION

UC's chemical fume hoods are inspected and tested annually by EHS for functionality and condition. A certification sticker is placed on the front of each fume hood indicating the measured face velocity. Deficiencies are immediately reported to Facilities Management for service.

During the certification testing, inspectors do the following:

- Remove old certification stickers.
- Confirms that the sash moves easily.
- Test both the audio and visual alarms.
- Confirm the face velocity is within the required specifications of 100 linear feet per minute (lfm) and post the measured face velocity on the front of the hood.
- Check the overall condition of the fume hood interior and hood sash.