Ventilation

Section 1 - Laboratory Ventilation Policy

General room ventilation does not provide adequate protection against hazardous gases, vapors, and aerosols. *All work with corrosive, flammable, maloderous, toxic, or other dangerous materials must be conducted in a properly operating chemical hood, gas cabinet, or glovebox.* In special situations, vacuum systems are acceptable, if approved by EH&S. Ductless chemical hoods are not acceptable. When it is not possible to meet the above requirements, EH&S, the faculty member and the department head must evaluate hazards and do a risk assessment together to determine if work can be conducted safely. (See Chapter 10 section 2 Prior Approval / Risk Assessment).

Section 2 - Chemical Hoods

Chemical hoods are checked annually for proper air-flow by Physical Plant and/or EH&S. The velocity of the air at the face of the hood is measured with the sash fully open and at 16-18 inches opening. The resulting air-flow is posted on a sticker attached to the lower right-hand corner of the sash. On most hoods, green arrows are placed 16-18 inches from the bottom of the hood to meet the minimum acceptable face velocity. EH&S recommends that researchers work with the sash lowered to the "green arrow level" to protect themselves from potential splashes, explosions or other dangerous reactions. , Researchers should have the sash lowered as much as possible when conducting experiments.

Hoods that do not meet the minimum exhaust requirements during EH&S inspections are posted "Warning Do Not Use." Physical Plant is then notified to repair the hoods. After repairs have been made, EH&S will retest the hoods to verify their proper operation.

Variable air volume hoods (VAV) maintain a constant face velocity at different sash heights. VAV hoods also provide significant energy saving by reducing the flow rate when the hood is closed.

Constant air volume hoods (CAV) increase or decrease the airflow/face velocity into the hood depending on the sash opening (e.g., closing the sash would increase the air face velocity; opening the sash would decrease the face velocity). *Work with the sash at least at the half sash level or lowered as much as possible.*

Low flow or High performance chemical hoods
These hoods, when newly installed need to pass the NIH modified ASHRAE 110 1995 standard at a face velocity of 80FPM at *any sash opening* for research laboratories and 70FPM for teaching laboratories. These hoods tend to be deeper than the traditional laboratory chemical hoods and have internal or external airfoil and or movable baffles. Due to their design differences from traditional chemical hoods, laboratory personnel need to be made aware of their proper use ie proper sash height to reduce exposures to hazardous chemicals. Contact EH&S for more information on the use of these hoods.

Procedures for Proper Use of Chemical Hoods

- Before using a hood, make sure air is entering the hood and the hood is functioning properly.
- Report any problems with chemical hood operations to EH&S at 413.545.2682 or Physical Plant at 413.545.0600.
- Do not block baffle openings or place bulky items in the hood that will prevent air from entering the baffle opening.
- Avoid opening and closing the hood sash rapidly and avoid swift arm movement in front or inside the chemical hood.
- Conduct work at least six inches in from the edge of the hood.
- Lower the sash to "green arrow settings" to protect yourself from dangerous reactions and/or chemical splashes.
- Keep the hood clean and uncluttered. Wipe up spills immediately.
- Be aware that drafts from open windows, open doors, fans, air conditioners, or high traffic walkways may interfere with normal hood exhaust.
- Do not attach "Kim-wipes" or other similar material to the hood sash.
- Use perchloric acid only in a perchloric acid hood designed specifically for the hazards of the vapors produced (See: Perchloric Acid Hoods, this Section)
- Keep the hood sash closed whenever the hood is not actively in use or is unattended to conserve energy.

Chemical hood monitor

Most newly installed chemical hoods at UMass should have a hood monitor installed near the face of the hood, usually on the upper right corner. The hood monitor indicates the air-flow into the hood at a certain hood sash opening. It could be a digital readout or just an indicator light of high, low and proper flow (green). *Notice the air flow monitor before doing work in the hood.* The monitor should indicate 80-120 FPM and will go into alarm if the flow is lower than 60FPM or higher than 150 FPM at 18 inches sash opening. Contact EH&S (413.545.2682) or Physical Plant (413.545.0600) if the hood goes into alarm.

Chemical Hood Alarms

Hood alarms indicate substandard operation of chemical hoods and are now installed on every new and upgraded hood system. The hood alarm (audio/visual) will indicate an exhaust flow malfunction by an audible and visual alarm. If the hood alarm sounds, close the sash and notify EH&S. Do not use the hood until repairs have been made and EH&S has removed the "**Warning Do Not Use**" sign. Do not mute the alarm and continue working in the hood.

Chemical Hood Purge Button

In some buildings the hood monitor contains a red purge button. When pushed, this button will open the pneumatic valve to allow a very large opening in the ductwork for maximum hood exhaust (e.g., in the event of a spill). Turn off the purge button about 2 hours after activating as a result of a spill. *Do not work with the purge button on.*

Perchloric Acid Hoods

Regular chemical hoods must never be used for perchloric acid. Special perchloric acid hoods must be used. When perchloric acid is heated above ambient temperature, vapor is formed which can condense in the ductwork and form explosive perchlorates. The perchloric acid hood and ductwork must be equipped with a water wash down system, which needs to be operated after each use of perchloric acid. The hood must be labeled clearly and used only for perchloric acid or other mineral acids such as nitric, hydrochloric, and hydrofluoric. ***No organic solvents should be stored or used in a perchloric acid hood.*** Contact EH&S for locations of perchloric acid hoods on campus and training for their proper use.

Section 3 - Glove Boxes

Glove boxes can be used for work with particularly hazardous substances including select carcinogens, reproductive toxins, air-reactive chemicals, and substances that have a high degree of acute or chronic toxicity. Glove boxes equipped with HEPA-filters prevent particulates – including toxic dust, bacteria, and viruses -- from escaping into the laboratory. Some glove boxes are also equipped with activated carbon filters that remove harmful gases and vapors from the exhaust air. Glove boxes should be tested for leaks before each use. A method to monitor the integrity of the system such as a shutoff valve or a pressure gauge is required. Glove box contents *shall be re-inventoried* on an annual basis. Spills within glove boxes need to be cleaned immediately.

Section 4 - Gas Cabinets

Toxic and flammable gases such as arsine, phosphine, silane, hydrogen chloride, ammonia, hydrogen phosgene, hydrogen selenide, boron gases, chlorine trifluoride, hydrogen sulfine, methyl chloride, silyl halides, and nickel carbonyl must be used only in an approved gas storage cabinet. In a gas cabinet, hazardous gases are vented through a scrubbing system containing neutralizing alkali, which allows inert gases to be exhausted to the atmosphere. In addition, gas cabinets are equipped with monitoring devices and alarm systems that sense hazardous conditions, warn employees of a malfunction, and automatically shut-off the gas flow.

Section 5 - Biological Safety Cabinets

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 (i.e., the most penetrating particle size) with an efficiency of 99.97 percent. Particles with aerodynamic diameters both smaller and larger than 0.3 microns are removed with nearly 100 percent efficiency. However, HEPA filters do not collect / remove vapors or gases.

To ensure safety, BSCs must be used correctly with good microbiological techniques and be in proper mechanical working order. Cabinets should be certified for performance upon installation using the National Sanitation Foundation (NSF) Standard 49, Section 6. Recertification should be conducted annually or during the interim, if the cabinet is moved or if a performance problem is suspected. The University has contracts with several companies to service and certify BSCs. Information on certification is available from the Biological Safety Services Manager / Biosafety Officer at EH&S.

The following general rules apply to biological safety cabinets at UMass Amherst

- BSCs are certified annually by an outside company.
- BSCs must be decontaminated frequently and after work is complete.
- Gas lines are prohibited in newly-installed BSCs.
- Open flames are not recommended for use inside BSCs
- Toxic and volatile chemicals are prohibited inside Class II, Type A BSCs. Small quantities of these materials may be used in Class II, Type B BSCs.
- Ultraviolet lights are not recommended for use in BSCs.

Section 6 – Other Local Exhaust Systems

6.1 Horizontal Laminar Flow Hoods (i.e., 'clean benches')

Horizontal laminar flow "clean benches" are devices that look similar to biosafety cabinets, but only protect the product from contamination. These devices provide a very clean environment, but must be used only for the manipulation of *non-hazardous* materials. Since the operator sits in the downstream exhaust from the clean bench, this equipment must never be used for the handling of toxic, infectious, or sensitizing materials. Contact EH&S for yearly testing by an outside contractor for laminar flow benches.

6.2. Elephant trunks, snorkels or extractor

An 'elephant trunk' or 'snorkel' is a flexible duct or hose connected to an exhaust system. It is used often to capture the discharge from a gas chromatograph or other contaminants at the source such as: small weighing scale or alcohol swabbing.

Do not use elephant trunks for chemical reaction work involving flammable or very toxic chemicals! A working chemical hood should be used for those operations.

The face velocity of a snorkel is usually 150-200 fpm but drops down sharply with a larger distance from the intake. Therefore, keep contaminant source at the most 2 inches away to assure an efficient capture. EH&S will test the face velocity of newly installed snorkels (and yearly thereafter) with a smoke test for evaluating efficient capture in accordance with the American Conference of Governmental Industrial Hygienists' (ACGIH) recommendations.

6.3. Slot hoods

Slot hoods are local exhaust ventilation hoods specially designed to capture contaminants generated with a specific rate, distance in front of the hood and release velocity for specific ambient flow. Slot hoods have been used on the UMass campus to capture odor releases from: hazardous waste stored in trays. To be effective the slot hood must be designed by a ventilation engineer taking into consideration; the proper geometry, flow rate and static pressure of the hood. Consult EH&S for the proper use of slot hoods.

Section 7 - Vacuum Systems

Vacuum systems may become inadvertently contaminated with hazardous materials. When this happens, vacuum pump exhaust may present a potential airborne exposure risk, and, therefore, must be properly vented so that air in the laboratory is not contaminated. A trapping device or collection/overflow flask must be used to protect the vacuum system. In addition an inline HEPA filter must be used when manipulating biohazardous materials. Pumps and pump oils may also become contaminated with hazardous materials, and appropriate personal protective equipment should be worn when repairing pumps or changing pump oil.