Laboratory Fume Hood/Canopy Plan

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REVISION HISTORY

Revision Number	Revision Date	Revised By	Description of Change
00	2019-10-09	Charles Cherrito	Initial plan creation and implementation.
01	2021-02-08	Selvin McLean	Document review; review against federal register for updated; weblinks added.
02	2022-07-08	Charles Cherrito	Annual review.

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PURPOSE

This plan is designed to assist all Florida Tech personnel in ensuring the safety of individuals who work in areas that have fume hoods or canopy-style units. Understanding the capabilities of fume hoods, their operating functions, purpose, and limitations is vital for fostering a safe work environment.

SCOPE

This plan applies to all Florida Tech locations that house fume hoods or canopy-style units designed and intended to mitigate exposure to vaporized hazardous substances.

RESPONSIBILITIES

Environmental Health & Safety (EHS)

Addresses safety needs of faculty, staff, and students through safety assessments and laboratory inspections. Develops and communicates protocols for laboratory and fume hood usage. Conducts risk assessment for lab design and accident investigations. Provides training assistance for fume hood use. The EHS Office will also conduct periodic fume hood surveys for airflow compliance.

Facilities Department

Responds to service requests regarding fume hood operations. Completes routine maintenance repairs of fume hoods and fume hood systems. Seeks the advice and approval from the EHS Office before installation of any fume hood.

Principal Investigator (PI)

Maintains user safety within the laboratory by monitoring that personnel are following procedures and that lab equipment are functioning properly; requests repair work orders from the Facilities Department to address malfunctioning systems. Maintains accurate and current information of the chemicals used in the lab and the Chemical Hygiene Plan. Ensures their employees are properly trained in fume hood usage.

All Fume Hood Users

Follows all safety procedures specified by EHS, their supervisor and the Chemical Hygiene Plan, this Plan, and all other pertinent SOP's/Safety Plans. Attends all required safety training sessions. Does not use fume hoods which have failed certification. Does not use fume hoods in a way they were not specifically designed. Reports fume hoods which are not operating properly, accidents, unhealthy, and unsafe conditions to the PI or supervisor.

DEFINITIONS

Air Volume

When passing through a fume hood, is generally equal to the area of the sash opening multiplied by the average velocity desired. For example, if 100 feet per minute (fpm) is required and the hood has a sash opening of 7.5 square feet, then the hood's air volume is 750 (7.5 x 100) cubic feet per minute (CFM).

Air Foil

Found along the bottom and side edges airfoils streamline air flow into the hood, preventing the creation of turbulent eddies that can carry vapors out of the hood. The space below the bottom airfoil provides source of room air for the hood to exhaust when the sash is fully closed. This area should never be blocked.

Baffle

The BAFFLE controls the pattern of the air moving into and through the fume hood. They are typically moveable partitions used to create slotted openings along the back of the hood body. Baffles keep the airflow uniform across the hood opening, thus eliminating dead spots and optimizing capture efficiency.

Exhaust Plenum

An important engineering feature, the exhaust plenum helps to distribute air flow evenly across the hood face. Materials such as paper towels drawn into the plenum can create airflow blockage and/or turbulence in this part of the hood, resulting in areas of poor air flow and uneven performance.

Face

The imaginary plane running between the bottom of the sash to the work surface.

Face Velocity

Air travels in a hood at a certain speed or "velocity". The velocity of a fume hood is measured in the plane of the sash, and referred to as the face velocity, measured in feet per minute (fpm). The face velocity is related to the amount of air being pulled through the fume hood, or the volumetric rate (typically measured in cubic feet per minute (CFM)). The more air that is pulled through a fume hood's openings, the faster the air will travel.

Fume Hood

A device enclosed except for necessary exhaust purposes on three sides and top and bottom, designed to draw air inward by means of mechanical ventilation, operated with insertion of only the hands and arms of the user, and used to control exposure to hazardous substances. These devices are also known as "laboratory" fume hoods.

Hood Body
The visible part of the fume hood that serves to contain hazardous gases and vapors.

Sash
The sash controls the area of the fume hood which is open. It protects the operator and *may* control hood face velocities. Glass options include tempered or laminated.

Work Surface
Generally, a laboratory bench top, but also the floor of a walk-in hood, this is the area under the hood where manipulation is conducted.

TYPES OF HOODS

Acid Digestion Hoods

These units are typically constructed of polypropylene to resist the corrosive effects of acids at high concentrations. If hydrofluoric acid is being used in the hood, the hood's glass sash should be constructed of polycarbonate which resists etching. Hood ductwork should be lined with polypropylene or coated with PTFE (Teflon) or Lexan.

Bypass Hoods

Similar to a CAV hood (see below). The only difference is that it has an air bypass that provides an additional source of ambient air when the sash is closed.

Canopy Hoods

Horizontal enclosures having an open central duct suspended above a work bench or other area. Canopy hoods are most often used to exhaust areas that are too large to be enclosed within a fume hood. The major disadvantage with the canopy hood is that the contaminants are drawn directly past the user's breathing zone. Canopy hoods are only used for ventilation of heat, steam or nontoxic materials with low vapor density and not for storage or mixing of hazardous chemicals.

Conventional Fume Hoods (also known as "constant air volume hoods (CAV)")

Where the exhaust flowrate or quantity of air pulled through the hood is constant (hence, volume of airflow within the hood is maintained constantly). In this configuration, when the sash is lowered and the cross-sectional area of the hood opening decreases, the velocity of airflow (face velocity) through the hood increases proportionally. Thus, the velocity of air at the hood face is increased with the lowering of the sash.

They vent a constant amount of air over a 24-hour period. The volume of air passed is controlled by the sash; the higher it is opened, the higher the volume of air and the lower the face velocity. Another type of conventional hood uses a bypass to keep air volume and face velocity constant, regardless of sash height. Reduced flow fume hoods: like conventional fume hoods, also vent a constant volume of air. However, they vent air at volumes up to 50% lower than conventional fume hoods. This increases the safety of the user and reduces energy consumption.

Ductless Fume Hoods

Ductless hoods use activated carbon filtration to adsorb chemical vapors. Rather than the fumes be vented to the exterior of the building, they are recirculated back into the laboratory after being filtered through the carbon filter. Use of these requires approval from Florida Tech EHS.

Explosion Proof (EP) Hoods
An EP hood is modified in a fashion to reduce spark potential outside the hood. This reduces the chances of igniting a flammable atmosphere in the room. They have specially designed EP electrical components, (switches, receptacles, and internal wiring) that are installed on site by a licensed electrician (not the manufacturer). ***NOTE: EP Hoods are NOT actually explosion proof!***

Fume Exhaust Duct Connections
Commonly called snorkels, elephant trunks or flex ducts, are designed to be somewhat mobile allowing the user to place it over a small area needing ventilation. However, for optimal efficiency, these connections must be placed within six (6) inches of an experiment, process, or equipment. These funnel-shaped exhausts aid in the removal of contaminated or irritating air from a point source to the outside.

Perchloric Acid Hoods
Concentrated or hot perchloric acid is highly oxidizing and extremely corrosive. In addition, the fumes can settle and form shock-sensitive crystals. Perchloric Acid Hoods have wash-down capabilities to prevent the buildup of explosive perchlorate salts within the exhaust systems.

Variable Air Volume (VAV) Hoods (also known as "constant velocity hoods")
Uses a feedback system of controls to constantly adjust the volume of air being adjusted based on sash height. The result is a constant face velocity across the front of the hood. There are several benefits to this type of hood, including decreased turbulence, increased user safety, and significantly decreased energy use. The exhaust flowrate or quantity of air pulled through the hood varies as the sash is raised or lowered in order to maintain a constant face velocity. Therefore, when the sash is lowered and the cross-sectional area of the hood opening decreases, the velocity of air flow (face velocity) through the hood remains constant, reducing the total air volume exhausted.

Radioisotope Hoods
This fume hood is made with a coved stainless-steel liner and coved integral stainless-steel countertop that is reinforced to handle the weight of lead bricks. If research is planned with radioisotopes contact the Florida Tech Radiation Safety Officer at ehs@fit.edu.

MISC. NON-FUME HOODS

Although the below hoods are not considered "fume hoods", they are common devices used in research; and their usage and purpose are widely misunderstood. Therefore, they will be briefly discussed so that their functions can be distinguished.

Biosafety Cabinets (BSC's)

BSC's are enclosed, ventilated laboratory workspaces for safely working with materials contaminated with (or potentially contaminated with) pathogens requiring a defined biosafety level. They use HEPA filtration and specific airflow as a means of protection. There are many sub-types of BSC's, with each having specific characteristics as to what type of hazard can safely be manipulated in them. These devices are NOT intended to filter vapors.

Laminar Flow Hoods (LFH's)

LMF's are enclosures in which air flow is directed to prevent contamination of sterile materials. They are NEVER suitable for work involving any type of hazards.

FACE VELOCITY

Face velocity of a very important factor in fume hoods. Airflow into a hood is achieved by an exhaust blower which "pulls" air from the laboratory room into and through the hood and exhaust system. This "pull" at the opening of the hood is measured as *face velocity*. Average face velocity is calculated by dividing the sash opening into one-foot squares. Velocity readings (feet per minute (FPM)) are taken in each grid area and averaged.

WHAT DO THE INDUSTRY STANDARDS SAY ABOUT FACE VELOCITY?

- **Occupational Safety and Health Administration (OSHA):**
  "General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas; air flow into and within the hood should not be excessively turbulent; hood face velocity should be adequate. (Typically, 60-110 fpm.)"

- **ANSI/AIHA/ASSE Z9.5)**
  American National Standards Institute (ANSI)
  American Industrial Hygiene Association (AIHA)
  The American Society of Safety Engineers (ASSE)
  "Each hood shall maintain an average face velocity of 80-120 fpm with no face velocity measurement more than plus or minus 20% of average."

- **Scientific Equipment and Furniture Association (SEFA):**
  "Face velocities of laboratory fume hoods may be established on the basis of the toxicity or hazard of the materials used or the operations conducted within the fume hood. Note: Governmental codes rules and regulation may require specific face velocities. A fume hood face velocity of 100 fpm is considered acceptable in standard practice. In certain situations, face velocity of up to 125 fpm or as low as 75 fpm may be acceptable to meet required capture velocities of the fume hood."

Aside from the external blower/motor unit pulling air, the face velocity is also dependent on sash height. The higher the sash height will result in less velocity (less FPM). Conversely, the lower the sash will result in an increase in velocity. This appropriate height is known as "Operating Height" and is approximately 18 inches from the base of the fume hood.

PERIODIC SURVEYS

As a part of due diligence and to ensure the safety of personnel, the EHS Office will conduct periodic surveys of all fume hoods at Florida Tech annually, at minimum.

The face velocity will be measured with the sash placed at the designated, proper working height (typically no higher than 18 inches) to achieve proper airflow. A calibrated, National Institute of Standards and Technology (NIST) traceable hot wire anemometer will be utilized.

If a fume hood is not performing to standards, it will be placed out of service and the Facilities Department will be notified for addressing the issue. Upon the airflow being rectified, another survey will be performed to ensure the hood is operating as designed.

- **Using Fume Hoods as Storage**
  It is okay to keep chemicals in a fume hood that are being used during a procedure, but fume hoods are not designed for permanent chemical storage. Items placed in the hood can interfere with the air flow, causing turbulence which will allow contaminants to be drawn out of the hood into the room. Fume hoods are not flammables cabinets. They offer no protection from a fire occurring outside the hood in the laboratory.

- **Exhausting Vapors**
  Fume hoods exhaust vapors into the atmosphere untreated, so it is not appropriate to use a fume hood for waste disposal. Evaporation is considered treatment of hazardous materials and is not allowed by the EPA without a permit.

- **Shutting Sashes Closed**
  Fume hoods are designed for their sashes to be shut all the way. The airfoil sill at the base of the hood will still allow for air to be pulled into the fume hood even with the sash fully closed.

- **Too High of Face Velocity**
  While it is important to have a face velocity between 80 fpm and 120 fpm, a higher face velocity will make the fume hood less efficient. High face velocities can create eddy (turbulent) currents that will allow for contaminants to be drawn out of the hood into the room and increase the worker's exposure.

- **Working Distance**
  Work at least 6 inches into the hood from the face to minimize the potential for fumes to escape. As a useful reminder, place a strip of tape at this six-inch limit.

- **Reducing Draft**
  Keep laboratory doors and windows closed and limit movement in front of the hood. Most laboratory ventilation systems are designed for labs to have all doors and windows closed. Open doors and windows can alter the air balance in the room and disrupt the airflow in the hood. Also, open doors and windows and traffic or movement in front of the hood can create turbulence resulting in vapors flowing out of the hood's interior.

- **Reduce Airflow Issues**
  Reduce obstruction in the fume hood to improve its effectiveness by allowing adequate air flow across the working surface with minimum turbulence.

- **Hazard Notification**
  Consider good practice of placing a high hazard sticker on the fume hood when working with:
    - ✓ High acute toxicity
    - ✓ Human carcinogens
    - ✓ Reproductive hazards
    - ✓ Extremely low permissible exposure level or immediately dangerous to life or health

- **Alternative Engineering Controls**
  Recognize that a fume hood may not be sufficient protection for extreme hazards. Isolators or glove boxes may be options for high hazard work or materials.

SPECIAL NOTES

- Re-circulating or ductless fume hoods REQUIRE permission before purchase and use.
- Fume hood systems **are not designed for use of biological pathogens** since they lack HEPA filtration. No biological hazards are allowed in fume hoods without EHS approval.

REFERENCES

Florida Tech Chemical Hygiene Plan
https://www.fit.edu/office-of-environmental-health-and-safety/chemical-safety/

29CFR 1910.1450: OSHA's
Occupational Exposure to Hazardous Chemicals in Laboratories
https://www.osha.gov/chemical-hazards

ANSI/ASHRAE 110-2016:
Method of Testing Performance of Laboratory Fume Hoods

ANSI/AIHA Z9.5
The American National Standard for Laboratory Ventilation

American Conference of Governmental Industrial Hygienists (ACGIH),
"Industrial Ventilation - A Manual of Recommended Practice"

The American National Standard for Laboratory Ventilation (NFPA)
"Standard on Fire Protection for Laboratories Using Chemicals." Standard 45

CDC
https://www.cdc.gov/niosh/index.htm