



UNIVERSITY *of* NEW HAMPSHIRE

# Fume Hood Program

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## **I. INTRODUCTION**

This document concentrates on the aspects of fume hood system design and operation that are critical to protecting the health and safety of faculty, staff, students, and visitors. Properly designed systems function to capture contaminants from the work area and disperse them in the outside environment. Exhaust stacks function to release contaminants from the inside of a building in order to minimize contaminant re-entrainment. The critical design aspects of fume hood systems that are discussed in this document are: the quality of the fume hood enclosure, the quality and quantity of supply air provided to the fume hood, face velocity of the fume hood, exhaust stack height, exit velocity of air being exhausted from the stack. In addition, effluent dispersal is contingent upon factors such as exhaust stack/air intake separation, stack height, stack height plus momentum, topography of the building and surrounding environment, and wind dynamics.

Although system performance depends heavily on the above design elements it must be noted that the fume hood performance in a room is affected by room layout and supply air distribution. System performance depends on the fan and duct layout as well as fan type and discharge conditions. These issues are dealt with in detail in the mechanical design standards developed by UNH Operations and Maintenance.

## II. GOAL

Laboratory exhaust ventilation systems designed, constructed, maintained, and used at the University of New Hampshire shall comply with the specifications set forth in this document and the publications listed in [Appendix A](#). Individuals or groups that fail to comply with this document shall be referred to the Chemical Safety Committee.

New or renovated fume hood systems will be tested using the “Procedures for Testing New or Renovated Fume Hood Systems” in [Section VI](#). Fume hood systems in new or renovated laboratories that do not meet the testing criteria and specifications will not be accepted for use by the Office of Environmental Health and Safety (OEHS) and the University of New Hampshire.

Established fume hood systems will be tested using the “Procedures for Testing Established Fume Hood Systems” in [Section VII](#). When a fume hood fails to meet acceptable performance requirements, the hood will be declared “Out of Service.” Fume hood systems that do not meet these requirements must not be used. UNH Operations and Maintenance will evaluate these systems. See [Appendix C](#) for the “Responsibilities for the Proper Operation and Use of Fume Hoods” at the University of New Hampshire.

### **III. LABORATORY FUME HOODS & BIOLOGICAL SAFETY CABINETS**

#### **A. Laboratory Ventilation Policy**

*All work with hazardous materials must be conducted in an approved fume hood, gas cabinet, or glovebox. All work with hazardous biological agents must be used in an approved biological safety cabinet.*

General room ventilation does not provide adequate protection against hazardous gases, vapors, and aerosols. All work with corrosive, flammable, odoriferous, toxic, or other dangerous materials shall be conducted only in a properly operating chemical fume hood, gas cabinet, or glovebox. Ductless fume hoods are not acceptable. When it is not possible to meet these requirements, OEHS and UNH Operations and Maintenance must evaluate hazards with researchers to determine if the work can be conducted safely.

All personnel using fume hoods, biological safety cabinets, and glove boxes will follow the policies outlined in this document. ANSI/AIHA Z9.5-2003, ANSI/AIHA Z9.2-2006, ASHRAE 110-1995, and ACGIH's Industrial Ventilation Manual, provide additional work practices to minimize emissions and employee exposure when working with fume hoods.

The CDC and NIH publications titled, "Biosafety in Microbiological and Biomedical Laboratories" and "Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets," provide information on the safe and proper use of biological safety cabinets. Please note that laminar flow clean benches are not biological safety cabinets. These clean benches provide a very clean environment for the manipulation of non-hazardous materials and can be used for activities such as the dust-free assembly of sterile equipment or electronic devices. Since the operator sits in the downstream exhaust from the clean bench, this equipment must never be used for the handling of toxic, radioactive, infectious, sensitizing, or otherwise hazardous materials.

#### **B. Procedures for the Proper Use of Chemical Fume Hoods**

1. Before using the chemical fume hood, make sure air is entering the unit and it is functioning properly. Report any problems to a faculty member, supervisor, or the Facilities Support Center.
2. Do not block baffle openings or place bulky items in the hood that will prevent air from entering the baffle opening.
3. Conduct work at least six inches from the edge of the hood.
4. Lower the sash to a reasonable height to protect yourself from dangerous reactions.
5. Keep hood clean and uncluttered. Wipe up spills immediately.
6. Be aware that drafts from open windows, open doors, fans, air conditioners, or high traffic walkways may interfere with normal hood exhaust.
7. Do not attach "Kim-wipes" or other similar material to the fume hood sash.
8. Use perchloric acid only in special perchloric acid hood.
9. Use infectious agents in approved biological safety cabinets.

### **C. Fume Hood Alarms**

Fume hood alarms (i.e. Phoenix™ controls) indicate normal or substandard operation of fume hoods. They are installed on every new fume hood system and any that have been upgraded. The fume hood alarm will indicate an exhaust flow malfunction or a high temperature warning by an audio and visual alarm. If the fume hood alarm sounds, close the sash and notify the UNH Facilities Support Center. Do not use the fume hood until repairs have been made by Operations and Maintenance.

## IV. HOOD TYPES

There are many types of hoods, each with its own design and function. To identify which hood type is present in the laboratory, a list of hoods and their features and advantages/disadvantages is provided below.

### A. Constant Air Volume System

#### 1. Conventional Hood without a Bypass

This term is used to describe a constant air volume (CAV) chemical fume hood, an older, traditionally less elaborate hood design used for general protection of the worker. Because the amount of exhausted air is constant, the face velocity of a CAV hood is inversely proportional to the sash height.

#### 2. Open-Bypass Fume Hood

Open by-pass fume hoods are designed for operation with constant air volume exhaust systems. The air bypass provides for an alternate route for air to enter the hood as the sash is closed. The size of the by-pass is set so that, as the sash is closed, the velocity of the air increases to no more than three and one half times the velocity with the sash fully open. As a result, the static pressure loss through the front opening of these hoods is insignificant when compared to the pressure loss through the rear baffle and duct entry. Since the hood static pressure and the exhaust volume remain essentially constant, regardless of the sash position these hoods are classified as constant volume fume hoods.

#### 3. Auxiliary Air Fume Hoods

This fume hood, sometimes referred to as a makeup air fume hood, was developed as a variation on the bypass fume hood and reduces the amount of conditioned room air that is consumed. The auxiliary fume hood is a bypass hood with the addition of direct auxiliary air connection to provide unconditioned or partially conditioned outside makeup air. Auxiliary air hoods were designed to save heating and cooling energy costs, but tend to increase the mechanical and operational costs due to the additional ductwork, fans, and air tempering facilities. In general, installation of this type of hood is discouraged since the disadvantages usually outweigh the benefits.

#### 4. Low Constant Air Volume Fume Hoods

Low constant volume fume hoods use a restricted sash opening or a lower face velocity, or both to reduce the exhaust quantity of air, measured in cubic feet per minute (CFM), necessary to contain fumes with a typical face velocity of 80-120 FPM. Traditionally, such fume hoods can reduce the exhaust CFM from 40% to 60% from open by-pass levels.

### B. Variable Air Volume System

Variable air volume (VAV) hoods differ from constant air volume (CAV) hoods because of their ability to vary air volume exhausted through the hood depending on the hood sash position. VAV hoods are becoming the preferred hood due to the elimination of excess face velocity that can generate turbulence leading to contaminated air spillage, endangering the

worker. They also reduce the total quantity of supply and exhaust air to a space when not needed, thereby reducing total operating costs.

1. Variable Air Volume (VAV) Hood

A VAV hood maintains a constant face velocity regardless of sash position. To ensure accurate control of the average face velocity, VAV hoods incorporate a closed loop control system. The system continuously measures and adjusts the amount of air being exhausted to maintain the required average face velocity. The addition of the VAV fume hood control system significantly increases the hood's ability to protect against exposure to chemical vapors or other contaminants. Many VAV hoods are also equipped with visual and audible alarms and gauges to notify the worker of hood malfunction or insufficient face velocity.

2. Restricted By-Pass Fume Hoods

Restricted by-pass fume hoods are designed for operation on VAV exhaust systems when used with a fume hood face velocity controller. On standard restricted by-pass hoods, the size of the air by-pass provides sufficient area that, with 100 feet per minute by-pass velocity with the sash closed, the exhaust volume will be 25 CFM per square foot of internal hood work surface. This is the lowest exhaust volume sufficient to dilute and prevent the escape of contaminants (see ANSI/AIHA Z9.5 and NFPA 45). This by-pass size is not appropriate for all VAV applications due to functional differences in face velocity controllers and variations in room exhaust requirements.

If a different by-pass size is required, it should be specified at the time the hood is ordered. Hoods with horizontal and combination sashes may be listed as restricted bypass hoods. In these hoods the size of the by-pass required for constant volume operation and for providing a minimum 25 CFM per square foot of internal hood work surface in VAV operation may be the same.

## **C. Specialty Lab Exhaust Systems**

1. Walk-in Hood

A walk-in hood is a unit which sits directly on the floor and is characterized by a very tall and deep chamber that can accommodate large pieces of equipment. Walk-in hoods may be designed as conventional, bypass, auxiliary air, or VAV. If you have a walk-in hood, contact OEHS for operating protocol and inspection procedures.

2. Fume Exhaust Connections (Snorkels)

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 the area needing ventilation. However, for optimal efficiency, these connections must be placed within three (3) inches of an experiment, process, or equipment. These funnel-shaped exhausts aid in the removal of contaminated or irritating air from the lab area to the outside.

3. Canopy Hoods

Canopy hoods are 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.

#### 4. Glove Boxes

Glove boxes are used when the toxicity, radioactivity level, or oxygen reactivity of the substances under study poses 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.

#### 5. Concentrated Acids/Bases Hoods

Fume hoods that will be used for highly corrosive materials (such as concentrated acids and bases) must be fitted with the appropriate corrosion resistant equipment and connections.

#### 6. Perchloric Acid Fume Hoods

Perchloric acid fume hoods must be constructed of non-combustible material and require a water wash in the stack to prevent the creation of perchlorate esters (i.e. perchlorate crystals). Perchlorate esters have the same explosive effect as nitroglycerine. Transition metal perchlorates are capable of exploding. **Perchlorates shall not be used without prior consultation with OEHS.**

#### 7. Radioisotope Fume Hoods

Volatile radioisotope work requires specific fume hood use protocols. If you have questions or concerns about working with volatile radioisotopes within a fume hood contact the Radiation Safety Officer in OEHS.

#### 8. Biological Safety Cabinets

Class II (vertical laminar flow) biological safety cabinets (BSC) provide a partial containment system for the safe handling of pathogenic microorganisms. To ensure safety, BSCs must be used correctly with good microbiological techniques and be in proper mechanical working order. Cabinets must be certified for performance upon installation using *National Sanitation Foundation (NSF) Standard #49, section 6*. Recertification must be conducted annually or during the interim if the cabinet is moved or if a problem is suspected. Researchers are responsible for maintaining the appropriate certification for each BSC. Additional information about BSC certification is available by calling OEHS.

#### 9. Horizontal Laminar Flow Hoods

Horizontal laminar flow "clean benches" are present in a number of laboratory facilities. These clean benches 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, including volatile chemicals, cell culture materials, or drug formulations.

## 10. Gas Cabinets

Toxic and flammable gases such as arsine, phosphine, silane, hydrogen chloride, ammonia, hydrogen phosphine, selenide and nickel carbonyl should be used in an approved gas storage cabinet. In a gas cabinet hazardous gases are vented through a scrubbing system, 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.

## 11. Vacuum Systems

Hazardous materials may be contained with a vacuum system. Because vacuum pump exhaust may contain hazardous materials it must be properly vented so that air in the laboratory is not contaminated. Pumps and pump oils may also become contaminated with hazardous materials, so personal protective equipment must be worn when repairing pumps or changing pump oil.

## **V. DESIGN & CONSTRUCTION**

### **A. Laboratory Design**

Proper laboratory design is critical to ensure the health and safety of researcher and experiment. The following protocols help to ensure a safe laboratory.

1. Fume hoods must be located so that persons exiting the lab do not have to pass in front of fume hood. The potentially dangerous portion of an experiment is usually conducted in a fume hood. Many lab fires and explosions originate in fume hoods. A fire or explosion in a fume hood located adjacent to a path of egress could trap someone in the lab.
2. There must be two exits from rooms where new fume hoods are to be installed. If this is not feasible, the fume hood must be situated on the side of the room furthest from the door. A fire or chemical hazard, both of which often start in a fume hood, can render an exit impassible. For this reason, all labs with fume hoods are required to maintain two unblocked routes of egress.
3. Fume hoods must not be situated directly opposite occupied work stations.
4. Fume hoods should be so located within the laboratory to avoid cross currents at the fume hood face due to heated, cooling or ventilation supply or exhaust diffuses. Cross currents outside a hood can nullify or divert air flow onto a hood, negatively affecting its capture ability.
5. Sufficient make-up air must be available within the laboratory to permit fume hoods to operate at their specified face velocities. A fume hood exhausts a substantial amount of air. Therefore, additional make-up air must be brought onto the room to maintain a proper air balance.
6. Windows in laboratories containing fume hoods must be fixed closed. Breezes coming in through open laboratory windows can adversely affect the proper functioning of the hood. Turbulence caused by these wind currents can easily carry the contaminated air outside the sash into the operator's breathing area.
7. Safety devices such as deluge showers, eye wash stations, fire extinguishers, and fire blankets should be located convenient to the fume hood operating personnel.
8. New fume hoods will not have an on/off control accessible in the laboratory, unless the lab has an alternate exhaust ventilation system or the exhaust is being filtered through a charcoal or HEPA filter. Fume hoods are an integral part of the entire laboratory's air balancing system which must be maintained. When a fume hood is turned off the laboratory may obtain positive pressure to hallways or corridors. Laboratories must be maintained under negative pressure.

### **B. Ductwork**

1. Gang ducting of fume hoods is not recommended unless required by special conditions. These must be properly designed with final approval from OEHS and UNH Energy and Campus Development. Gang ducting of fume hoods that may be used for radiological materials is not allowed under any circumstances.

2. Design criteria for fume hood duct construction include:
  - Minimum 18 gauge, Type 316 stainless steel. Coated galvanized steel may be considered for use under certain circumstances.
  - Heliarc inert gas with Type 316 welded seams.
  - Follow the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Round Industrial Duct Construction Standards for duct supports and reinforcement using stainless steel material.
  - Follow SMACNA 1985 HVAC Duct Construction Standards using type 316 stainless steel for exhaust stack(s) on the roof.
3. Fire control-type dampers should not be utilized in fume hood exhaust systems.
4. Duct velocities should be maintained between 1600-2000 linear feet per minute (fpm) to minimize noise, static pressure loss, and blower power consumption within a duct system.
5. Slope all horizontal ducts down towards the fume hood (Guideline: 1/8" to the foot). Liquid pools, which result from condensation, can create a hazardous condition if allowed to collect.
6. New duct installation should be tested at negative pressure, 1.5 times its operating pressure. Tests should show zero leakage.

### **C. Exhaust Blower and Stack**

1. New exhaust blowers should be oriented in an up-blast orientation. Any other type of fan orientation increases the work load required from the fan.
2. The exhaust blower should be located at the roof of the point of final discharge to provide a negative pressure in that portion of the duct system located within the building.
3. Hood exhausts on the roof must be located away from air intakes to prevent re-entrainment of exhaust fumes.
4. Fume hood exhaust stacks must extend at least seven feet above the roof or at least two feet above the top of a parapet wall, whichever is greater. Discharge must be directed vertically upward.
5. Discharge from exhaust stacks should have a velocity of at least 3,000 fpm. A sufficient discharge velocity is necessary to adequately disperse contaminants.

### **D. Plumbing**

1. All plumbing utilities must have a shut-off valve or cock adjacent to the hood.
2. If remote control fittings are used for hood utilities, the extension rod shall be solid four-sided stainless steel with a monel coupling and set screw.

3. Hot or cold water supplies must be connected to non-potable industrial water system. If industrial water is not available in the building, then a reduced pressure type back flow device shall be used on each water system. A single device may serve several hoods.

#### **E. Electrical**

1. Electrical outlets must be outside the hood. The atmosphere inside a fume hood may contain flammable gases or vapors which can ignite, resulting in a fire or explosion. For this reason, any activity - including plugging into and unplugging from an electrical outlet - which may produce a spark, must be performed outside the hood.
2. Lighting fixtures should be of the fluorescent type. Fluorescent bulbs give off less heat than conventional bulbs. They help maintain a safe and comfortable work area inside the hood.
3. Light fixtures should be sealed and vapor tight, UL-listed and protected by a transparent impact resistant shield. The potential for flammable or combustible atmospheres requires explosion-proof electrical equipment.

#### **F. Sashes**

1. Sashes may be horizontal, vertical, or a combination, and should have the capability to completely close off the hood face.
2. Sashes should be made of safety glass:
  - Laminated safety glass for standard use when internal temperature is anticipated to be less than 1600 °F.
  - Tempered safety glass when high internal temperatures are anticipated that will result in sash surface temperatures greater than 160 °F.
  - Where hydrofluoric acid is used, sashes will be made of plastic or lexan with a flammability rating of 25 or less when tested in accordance with ASTM E162-76.
3. Horizontally sliding sash panels may not be less than twelve inches, nor more than fifteen inches in width. Such sashes may offer extra protection to lab workers as they can be positioned to act as a blast shield.

## **VI. FUME HOOD PURCHASE SPECIFICATIONS AND EVALUATIONS**

### **A. Hood Purchase Specifications and Evaluations**

A fume hood that is appropriate for the purpose should be chosen. General guidelines on types of hoods and their application are presented in the most recent edition of the ACGIH's "Industrial Ventilation – A Manual of Recommended Practices."

Laboratory fume hoods and associated exhaust ducts should be constructed of non-combustible, nonporous material that will resist corrosion. They should be equipped with vertical or horizontal sashes that can be closed, air foils built into the fume hood at the bottom and the sides of the sash opening, and baffles to attain a uniform face velocity under different conditions of hood use. Combination horizontal and vertical sashes shall be provided unless special conditions dictate otherwise. Additionally, recognized design and construction features are listed in the ANSI/AIHA Z9.5 standard titled, "Laboratory Ventilation," and ANSI/AIHA Z9.2 standard, "Fundamentals Governing the Design and Operation of Local Exhaust Systems."

Fume hoods should be tested before a hood leaves the manufacturer using the ANSI/ASHRAE 110 standard, "Method of Testing Performance of Laboratory Fume Hoods." All new hoods shall meet the ANSI/ASHRAE requirements for Class 1 hoods including a tracer gas performance of AM (as manufactured) 0.05 (parts per million) or better at a tracer gas release rate of 4.0 Liters per minute (lpm). Documentation shall be provided with the results of the test. Performance is measured by specific tests:

1. Flow visualization,
2. Face velocity measurements,
3. Test method for Variable Air Volume (VAV) fume hoods,
4. VAV response test, and,
5. Tracer gas containment.

Flow visualization qualitatively tests a hood's ability to contain vapors. This test consists of a small local challenge (use of a smoke tube), and a gross challenge (use of a smoke candle or smoke generator) to the hood. Smoke is released into the hood to visually determine if a hood or associated duct has a leak.

Face velocity measurements determine the average velocity of air moving perpendicular to the hood face. The measurement is usually expressed in feet per minute (fpm). Face velocities will often provide information concerning the fume hood's ability to properly control contaminants.

A tracer gas leak test will quantitatively determine if the fume hood is properly containing contaminants. A tracer gas is released in the hood and a continuous-reading instrument is positioned outside the hood to monitor the escape of the tracer gas. The preferred tracer gas is sulfur hexafluoride (SF<sub>6</sub>).

## **B. Face Velocity**

Each variable air volume hood shall maintain an average face velocity of 80-120 fpm (100 fpm optimum) at the maximum allowed hood opening. Each constant volume hood shall maintain an average face velocity of 80-120 fpm (100 fpm optimum) in the half open position. Low-flow, or high efficiency fume hoods, shall be operated according the manufacturer's instructions, which are typical 60-80 fpm. A written request for an exception to these requirements must be submitted to OEHS.

Face velocity measurements are to be made with a recently calibrated mechanical or electrical anemometer. Measurements, of 1 square foot areas, should be made across the face of the hood and no single face velocity measurement should be more than plus or minus 20% of the average. For further information, refer to ANSI/ASHRAE 111-1988, "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems."

## **C. Face Velocity Monitoring**

All fume hoods shall include some means of monitoring air flow with a visual and audio alarm.

## **D. Supply Air**

The proper volume, distribution, and quality of supply air shall be provided to laboratories containing fume hoods. ANSI/AIHA Z9.5 and ANSI/ASHRAE 62 provide these standards. Make up air (replacement air) should be equal to at least 95% of the volume exhausted from the laboratory. This air shall not be recirculated from other laboratory areas. Although laboratory supply air seldom requires air cleaning, ASHRAE (HVAC Application Handbook, 1995) provides technical information for the reduction of contamination from atmospheric dust and dirt.

Air supply systems for rooms containing chemical fume hoods shall not create room air drafts at the face of any hood greater than one half (and preferably one third) the face velocity of the hood. For most laboratory hoods, this means 50 fpm or less terminal throw velocity at 6 feet above the floor. ACGIH's "Industrial Ventilation - A Manual of Recommended Practice," provides design criteria to help achieve these standards.

## **E. Variable Air Volume Hoods**

Variable-air volume fume hoods shall be installed unless accepted design practice dictates otherwise. A VAV fume hood is one that is fitted with a face velocity control which varies the amount of air exhausted from the fume hood in response to the sash opening to maintain a constant face velocity. These hoods produce an acceptable face velocity over a relatively large sash opening and also provide significant energy savings by reducing the flow rate from the hood when it is closed. Air velocities must be maintained at or above 25 cubic feet per minute per square foot of work surface inside a VAV fume at all times.

## **F. Constant Flow Hoods**

Constant flow hoods are not encouraged during new construction or renovations. VAV hoods are preferred over constant flow hoods because VAV hoods provide greater flexibility in usage.

## **G. Exhaust Stack Discharge and Exit Velocities**

Exhaust stacks shall be designed and built to prevent recirculation of contaminated air from the fume hood exhaust system into the fresh air supply of the facility or adjacent facilities. The effluent exhaust shall escape the building envelope. The stack shall also provide significant effluent dispersal so that effluent downwash does not occur at ground level. They shall be designed and built with the latest applicable ANSI, ASHRAE, and AIHA standards. The "2001 ASHRAE Fundamentals Handbook," and the publication titled, "Laboratory Stack Height Determination and Evaluation Methods," presents three methods for specification and evaluation of stack heights from laboratory hood exhaust fans.

Effluent discharge shall:

1. Direct to the atmosphere (unless treated for recirculation).
2. Conform to federal, state, and local air emission regulations.
3. Release so that reentry of effluent from the discharging building or a surrounding building is reduced to allowable concentrations inside of the building. (Allowable concentrations shall be determined using information on the nature of the contaminants to be released, recommended industrial hygiene practice, and applicable safety codes.)

Exhaust discharge from stacks shall:

1. Be in a vertical up-draft direction at a minimum of 10 ft above adjacent roof lines and located with respect to surrounding air inlets as to avoid contaminant reentry.
2. Have a minimum exit velocity of 3,000 fpm.

## **H. Recirculating Hoods**

Recirculating or ductless fume hoods are not permitted for the removal of chemical contaminants.

## **I. Special Laboratory Fume Hoods**

ANSI/AIHA Z9.5 and ANSI/AIHA Z9.2 provide standards for non-traditional laboratory fume hoods. These hoods include: perchloric acid fume hoods, walk-in fume hoods, and glove boxes. ACGIH's "Industrial Ventilation – A Manual of Recommended Practices" provides information on perchloric acid fume hoods, biological safety cabinets, and glove boxes. All class II biological safety cabinets must meet the National Sanitation Foundation Standard Number 49, for Class II Biohazard Cabinetry, for design, manufacturing and testing.

## VII. TESTING NEW & RENOVATED FUME HOODS

*Applicability:* This test is to be conducted when new hoods are installed or when existing hoods are included as part of a significant renovation as a condition of acceptance. In addition tests will be conducted annually or whenever a significant change is made to the operating characteristics of the hood. Tests to be performed include face velocity measurements and containment tests (See [Appendix E](#)).

### A. Test Conditions

1. General room ventilating systems, both supply and exhaust, including fume hood exhaust, must meet OEHS and UNH Operations and Maintenance design specifications and shall be in full normal operation. Airflow systems in the laboratory shall be properly balanced and commissioned prior to this test. This includes calibration of airflow controls, calibration of automatic temperature controls, balance of supply air, etc. ("Prudent Practices for Handling Hazardous Chemicals in Laboratories," 1995 and ANSI/ASHRAE 110). Laboratories must be under negative pressure relative to corridor unless special design conditions prevail.
2. Hoods are tested in fully open position, half-open position, and 25% open position.
3. All other hoods in the same room are in half-open position.
4. The hood being tested should be empty.
5. The doors to the laboratory will be closed.
6. When adjustments are made to hood sashes, supply and exhaust air in the room will be allowed to stabilize before testing is done.
7. Hood monitor is calibrated and not in alarm.

### B. Electronic Micromanometer Instructions

1. Turn on AirData™ Multimeter ADM-880C electronic micromanometer.
2. Press MODE until [Velgrid] is displayed.
3. Press STORE until [Store All] is displayed.
4. Place the Flow Sensing Grid at the face of the fume hood with sash half-open.
5. Press READ to start taking a measurement.
6. Wait for face velocity reading.
7. Take three measurements.
8. Press VIEW to view the average face velocity.
9. Press ALT STORE READ to clear data.

**C. Determination of Average Face Velocity for Variable Air Volume Hoods**

1. The open face of the hood shall be divided into imaginary rectangles of equal area approximately 1 square foot and velocity shall be measured in each rectangle. Use a calibrated electronic micromanometer to make measurements.
2. Record face velocity readings.
3. Average face velocity must be 80-120 fpm (100 fpm optimum) for typical VAV units and 60-80 fpm for low-flow/high efficiency hoods, at maximum allowed hood opening. Maximum opening is the point above which the face velocity deteriorates below 80 fpm.
4. Electronic micromanometer readings must be within  $\pm 20\%$  of the average face velocity.
5. Face velocities will also be measured at the one half and one quarter open positions. The average face velocities at these openings should be within  $\pm 10\%$  of the average at the fully open position.

**D. Determination of Average Face Velocity for Constant Air Volume Hoods**

1. The open face of the hood shall be divided into imaginary rectangles of equal area approximately 1 square foot and velocity shall be measured in each rectangle. Use a calibrated electrical micromanometer to make measurements.
2. Record face velocity readings.
3. Average the readings to determine the average face velocity. Average face velocity must be between 80-120 fpm (100 fpm optimum) at the one-half open position or at 18 inches (maximum recommended position).
4. Face velocity readings must be within  $\pm 20\%$  of the average face velocity.
5. Face velocities will also be measured at the full and one-quarter open positions. The average face velocities at these openings should be within  $\pm 10\%$  of the average at the one-half open position.

**E. Smoke Testing To Determine Airflow and Turbulence**

1. Using a smoke tube, puff smoke 6 inches within the face of the hood around the outside edge of the opening. Determine direction of smoke flow. If visible fumes flow out of the front of the hood, make necessary adjustments.
2. Ignite a smoke candle in the hood and visually observe if there is leakage of smoke from the ductwork or if smoke is being drawn back into building or surrounding buildings.

**F. Conditions for Passing Hoods**

1. General room ventilating systems, both supply and exhaust, including fume hood exhaust shall be in full normal operation.
2. Hood must have an acceptable face velocity and must pass the smoke testing.
3. No leakage of exhaust from ductwork and no reentry of hood exhaust into buildings.

## **VIII. REQUIREMENTS FOR TESTING ESTABLISHED FUME HOODS**

*Applicability:* This test is to be conducted annually to check the performance of established fume hoods or whenever a significant change is made to the operating characteristics of the hood. Tests to be performed include face velocity measurements and containment tests (see [Appendix E](#)).

### **A. Test Conditions**

1. General room ventilating systems, both supply and exhaust, including fume hood exhaust shall be in full normal operation. Laboratories must be under negative pressure relative to corridor unless special design conditions prevail.
2. Hoods are tested in the half-open position.
3. All other hoods in the same room are in the half-open position.
4. The hood being tested should be empty.
5. The doors to the laboratory should be closed.
6. When adjustments are made to hood sashes, supply and exhaust air in the room will be allowed to stabilize before testing is done.
7. Hood monitor is calibrated and not in alarm.

### **B. Electronic Micromanometer Instructions**

1. Turn on AirData™ Multimeter ADM-880C electronic micromanometer.
2. Press MODE until [Velgrid] is displayed.
3. Press STORE until [Store All] is displayed.
4. Place the Flow Sensing Grid at the face of the fume hood with sash half-open.
5. Press READ to start taking a measurement.
6. Wait for face velocity reading.
7. Take three measurements.
8. Press VIEW to view the average face velocity.
9. Press ALT STORE READ to clear data.

### **C. Determination of Average Face Velocity for Variable & Constant Air Volume Hoods**

1. The open face of the hood shall be divided into 3 imaginary rectangles of equal area. The velocity measurements shall be performed in the center of each rectangle. Use a calibrated electrical micromanometer to make measurements.
2. Note face velocity readings.

3. Average the readings to determine the average face velocity. Average face velocity must be between 80-120 fpm (100 fpm optimum) for typical VAV units and 60-80 fpm for low-flow/high efficiency hoods, at the one-half open position.
4. Face velocity readings must be within  $\pm 20\%$  of the average face velocity.

**D. Smoke Testing To Determine Direction of Airflow and Air Turbulence**

Using a smoke tube, puff smoke 6 inches within the face of the hood around the outside edge of the opening. Determine direction of smoke flow. If visible fumes flow out of the front of the hood, make necessary adjustments.

**E. Additional Smoke Testing to Determine Re-entrainment**

This testing will be conducted whenever a significant change is made to the fume hood system or if problems have been noted. Ignite a smoke candle in the hood and visually observe if there is leakage of smoke from the ductwork or if smoke is being drawn back into building or surrounding buildings.

**F. Conditions for Passing Hoods**

1. General room ventilating systems, both supply and exhaust, including fume hood exhaust shall be in full normal operation.
2. Hood must have an acceptable face velocity and must pass the smoke testing.
3. There must be no leakage of exhaust from ductwork and no reentry of hood exhaust into buildings.

## **IX. Testing and Repairing Fume Hoods**

### **A. Testing**

EHS will conduct annual inspections of chemical fume hoods at UNH. A yearly schedule has been developed by EHS to allow time to correct any deficiencies found during routine inspections. The schedule is described in the following table:

<b>MONTH</b>	<b>BUILDING</b>
January	James Hall
February	Paul Creative Arts Center Perpetuity Hall
March	
April	Barton Hall Kingsbury Hall Morse Hall Greenhouse
May	Conant Hall Kendall Hall
June	Parsons Hall
July	Jackson Lab Spaulding Hall
August	Rudman Hall
September	Dairy Research Center Gregg Hall
October	Coastal Marine Lab Demeritt Hall
November	
December	University Center

### **B. Work Requests**

Fume hood work requests at UNH are divided into two categories depending on the type of service that is required. Work requests that involve the Phoenix™ control systems, indoor air-balancing, or any hoods in Rudman and Parsons, will be directed to the Energy and Campus Development Energy Efficiency Team. Work requests that involve the sash, motor, pulleys, belts, baffling equipment, or ductwork, will be directed to the Operations and Maintenance – Area Maintenance General Mechanic.

Work requests are activated by calling the Facilities Support Center at 862-1437. Please record the tracking number for each work request submitted.

Operations and Maintenance will dutifully attempt to repair all hoods at UNH. For those hoods that are not capable of being repaired, OEHS will be notified. OEHS will work with Energy and Campus Development to replace the hood.

## **X. TESTING BIOLOGICAL SAFETY CABINET SYSTEMS**

The operational integrity of a new biological safety cabinets (BSC) must be validated by certification before it is put into service or after a cabinet has been repaired or relocated. It is be the responsibility of the faculty member to have the BSC tested and certified annually. The faculty member is also responsible for decontamination of the BSC. Certification will be performed by an accredited *Biohazard Cabinet Field Certifier* using the National Sanitation Foundation (NSF) Standard Number 49 for Class II Biological Safety Cabinets.

## **XI. SPECIAL USE VENTILATION SYSTEMS**

### **A. Special Use Ventilation Systems**

A Special Use Ventilation System (SUVS) is a ventilation system in which highly hazardous materials are employed. The mechanical equipment contained in the SUVS includes the motor and all working parts, the motor cage, air inlets (including fume hoods and canopy ducts), air outlets (including stack) and all associated ductwork. There are three main types of SUVS at UNH:

1. Radiation Ventilation Systems
2. Perchloric Acid Ventilation Systems
3. Infectious Agent Ventilation Systems

### **B. Repair and Maintenance**

When SUVS are scheduled for repair or maintenance, the system must be tested for the presence of radioactive materials or hazardous chemicals. OEHS will determine the need for testing and decontamination of the system, in conjunction with the faculty member. If decontamination is necessary, the system must be decontaminated before maintenance.

Typical approval requirements for SUVS are listed below.

#### **1. *Radiation Ventilation Systems***

Radiation ventilation systems shall have a swipe test to check for the presence of radioactivity prior to performing maintenance work. Contact the Radiation Safety Officer (RSO) at 862-4041 before working on any radiation ventilation systems. Notify the faculty member who uses the system prior to commencing any maintenance. In addition, the following requirements apply to radioisotope fume hoods:

- a. Facilities Service personnel shall contact the person responsible for the lab to schedule service, and shall NOT enter a laboratory or area marked "RESTRICTED" for radiation safety unless accompanied by the authorized user or Radiological Safety Office personnel. Written Radiological Safety Officer (RSO) approval may be posted on the hood by the user prior to servicing.
- b. All radiological hoods shall vent separately to the outside of the building.
- c. The RSO shall provide a list of fume hoods used for radiological materials.
- d. Any person working or assisting with fume hood repairs in radioactive materials laboratories must be under supervision of the authorized user of radioactive materials. The only exception is work which has specific written prior approval of the RSO.
- e. Maintenance personnel are to receive basic radiation safety instruction from the RSO prior to work in active laboratories.

- f. Radioactive materials shall be secured against unauthorized removal, and all surfaces decontaminated and surveyed to assure that no contamination remains when unattended. This is to assure that no radiation hazard is present during routine, non-scheduled maintenance activities.
- g. If radioactive materials are unattended for any reason without direct supervision by the user or trained assistants, the room shall be locked to prevent unauthorized entry and posted "RESTRICTED" for radiation safety purposes.
- h. The authorized user or his assistants shall promptly notify the RSO of any spill, accident, or any operation which may have contaminated the hood or released any contamination through the hood to ductwork or air in an uncontrolled area.
- i. The user shall provide documentation of radiation and contamination surveys of the hood for all scheduled maintenance and repair work, including face velocity calibration.

## 2. *Perchloric Acid Hood Systems*

Perchloric acid hood systems may require a special test to determine the presence of explosive perchlorate crystals prior to performing maintenance work. Contact the Laboratory Safety Officer (LSO) at 862-4041 before working on any perchlorate acid hood systems. Notify the faculty member who uses the system prior to commencing any maintenance. In addition, the following requirements apply to perchloric acid fume hoods:

- a. Laboratory fume hoods designated for use with perchloric acid shall be identified by a label indicating suitability for use with perchloric acid procedures.
- b. All exposed hood and duct construction materials shall be suitable for use with perchloric acid - inorganic, non-reactive, acid resistant, and relatively impervious.
- c. The work surface in the hood shall be water tight and dished or furnished with a raised bar to contain spills and wash down water.
- d. The fume hood and exhaust ducting design shall be provided with a water spray (wash down) system. The baffle must be removable to allow for periodic cleaning and inspection.
- e. Each perchloric acid fume hood must have an individually designated duct and exhaust system. The duct system should be straight, vertical, and as short as possible.
- f. Use only an acid resistant metallic fan.
- g. Do not use lubricants, caulking materials, gaskets, or other materials in the fan which are not compatible with perchloric acid. Use fluorocarbon type grease.
- h. The fan motor must be located outside of the airstream.

### 3. *Infectious Agent Ventilation Systems*

Infectious agent ventilation systems may require decontamination prior to performing maintenance work. There is one infectious agent ventilation system on campus. It is located in Rudman 257A. Contact the Laboratory Safety Officer (LSO) at 862-4041 before working on any infectious agent ventilation systems. Notify the faculty member who uses the system prior to commencing any maintenance. In addition, the following requirements apply to infectious agent ventilations systems:

- a. Infectious agent ventilation systems shall be identified by a label indicating suitability for use with infectious agents.
- b. All exposed ventilation system construction materials shall be suitable for use with infectious agents.
- c. The work surface in the hood shall be constructed of stainless steel or similar material which is chemically resistant (especially to bleach, ethanol, iodophors).
- d. The fan motor must be located outside of the airstream.

### **C. Maintenance Staff Requirements**

The following procedures are to be followed by anyone who services SUVS at UNH.

1. Obtain approval from OEHS prior to performing work on any SUVS.
2. Locate the SUVS blower or motor on the roof to be serviced and the room in which it is housed.
3. Communicate to laboratory personnel the need to service the SUVS and obtain permission to shut down the system. If lab personnel are not available, contact the department office to obtain permission to shut down the hood. **Do not turn off fan without permission from an authorized person.**
4. Fill out an "OUT OF SERVICE" notice and fix it to the hood sash. *Do not complete this step if working on infectious agent ventilation systems.*
5. Shut down the fan and perform appropriate work.
6. After service is completed, restart the fan and remove the notice from the fume hood(s).

### **D. Laboratory Personnel Requirements**

During routine servicing, repair, or dismantling of SUVS, the potential exists for exposure to hazardous substances that have been used or stored in the hood. To protect laboratory personnel and maintenance staff, do not perform any hazardous experiments while SUVS are being serviced.

### **E. Personal Protective Equipment**

Generally, personal protective equipment (PPE) is not necessary during regular maintenance. However, to assure against any potential hazards, the following PPE should be worn when working with SUVS:

1. Respirator (NIOSH-approved).
2. Safety glasses with side shields.
3. Gloves (neoprene or nitrile rubber preferred).

Questions regarding proper PPE should be directed to the Occupational Safety Coordinator at 862-4041.

## **XII. CONTRACTORS WORKING WITH FUME HOODS/FANS/DUCTWORK**

Before beginning work, all contractors and subcontractors, involved with a renovation project involving fume hoods and associated fans and ductwork must consult with OEHS for recommendations for training and personal protective equipment for their employees.

## **Appendix A – References**

ACGIH. "Industrial Ventilation - A Manual of Recommended Practice." American Conference of Governmental Industrial Hygienists, Ed. 22, 1995 (or the most recent edition).

Available from:  
ACGIH  
1330 Kemper Meadow Drive  
Cincinnati, OH 45240  
[www.acgih.org](http://www.acgih.org)

ANSI/ASHRAE 110. "Method of Testing Performance of Laboratory Fume Hoods." American Society of Heating, Refrigeration, and Air Conditioning Engineers. 1995 (or the most recent edition).

Available from:  
ASHRAE  
1791 Tullie Circle, NE  
Atlanta, GA 30329  
[www.ashrae.org](http://www.ashrae.org)

ANSI/ASHRAE 111. "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems." American Society of Heating, Refrigeration, and Air-Conditioning Engineers. 1988 (or the most recent edition).

Available from:  
ASHRAE  
1791 Tullie Circle, NE  
Atlanta, GA 30329  
[www.ashrae.org](http://www.ashrae.org)

ANSI/AIHA Z9.2. "Fundamentals Governing the Design and Operation of Local Exhaust Systems. 2001 (or the most recent edition).

Available from:  
AIHA  
2700 Prosperity Avenue, Suite 250  
Fairfax, VA 22031  
[www.aiha.org](http://www.aiha.org)

ANSI/AIHA Z9.5. "Laboratory Ventilation." American Industrial Hygiene Association. 1992 (or the most recent edition).

Available from:  
AIHA  
2700 Prosperity Avenue  
Suite 250  
Fairfax, VA 22031  
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ASHRAE. "1997 Handbook - Fundamentals Volume." American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. 1997 (or the most recent edition).

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"Biosafety in Microbiological and Biomedical Laboratories." U. S. Department of Health and Human Services. U. S. Government Printing Office. Washington, D.C. 1993 (or most recent edition).

"Laboratory Stack Height Determination and Evaluation Methods - Possible Additions to the ANSI/AIHA Z9.5 Standard on Lab Ventilation." Ratcliff, M., Sandru, E. ASHRAE Winter Meeting. 1998.

NFPA. "Standard on Fire Protection for Laboratories Using Chemicals." Standard 45. National Fire Protection Association. 1996 (or most recent edition).

"Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets." U. S. Department of Health and Human Services. U. S. Government Printing Office. Washington, D.C. 1995 (or most recent edition).

"Prudent Practices in the Laboratory: Handling and Disposal of Chemicals." Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories. National Academy Press, Washington, D.C. 1995 (or the most recent edition).

## **Appendix B – Definitions**

**Building envelope:** the three-dimensional space surrounding a building containing the building's makeup air.

**Downwash:** pollutants discharged from an exhaust stack that travel towards the ground due to insufficient discharge velocities, poor wind dispersion, and physical obstructions.

**Exhaust air:** the air that is removed from an enclosed space and discharged into atmosphere (ANSI/AIHA Z9.5 - 1992).

**Face velocity:** average velocity of air moving perpendicular to the hood face, usually expressed in feet per minute (fpm) or meter per second (m/s) (ANSI/ASHRAE 110 - 1995).

**Glove box:** a boxlike structure provided with tight-closing doors or air locks, armholes with impervious gloves sealed to the box at the armholes, and exhaust ventilation to keep the interior of the box at negative pressure relative to the surroundings (ANSI/AIHA Z9.5 - 1992).

**Hood face:** the plane of minimum area at the front portion of a laboratory fume hood through which air enters when the sash(es) is (are) fully opened, usually in the same plane as the sash(es) when sash(es) is (are) present (ANSI/ASHRAE 110 - 1995).

**Internal condensation:** fumes and vapors that condense into liquids inside of the exhaust stack.

**Laboratory fume hood:** a boxlike structure enclosing a source of potential air contamination, with one open or partially open side, into which air is moved for the purpose of containing and exhausting air contaminants, generally used for bench-scale laboratory operation but not necessarily involving the use of a bench or a table (ANSI/ASHRAE 110 - 1995).

**LPM:** liters per minute (ANSI/ASHRAE 110 - 1995).

**Makeup air:** outside air drawn into a ventilation system to replace exhaust air (ANSI/AIHA Z9.5 - 1992). Makeup air MUST always be provided when any exhaust system is designed and installed.

**Perchloric acid hood:** a fume hood constructed with water wash so it is safe for use with perchloric acid or other reagents that might form flammable or explosive compounds with organic materials of construction (ANSI/AIHA Z9.5 - 1992).

**Recirculation:** air withdrawn from a space, passed through a ventilation system, and delivered again to an occupied space (ANSI/AIHA Z9.5 - 1992).

**Reentrainment:** see reentry.

**Reentry:** The flow of contaminated air that has been exhausted from a space back into the space through air intakes or openings in the walls of the space (ANSI/AIHA Z9.5 - 1992).

**Replacement air:** see makeup air

**Return air:** air being returned from a space to the ventilation fan that supplies air to a space (ANSI/AIHA Z9.5 - 1992).

**Special purpose hood:** an exhaust hood, not otherwise classified, for a special purpose such as - but not limited to - capturing gases from equipment such as atomic absorption, gas chromatographs, liquid pouring or mixing stations, and heat sources (ANSI/AIHA Z9.5 - 1992).

***Variable air volume fume hood:*** a fume hood designed so the exhaust volume is varied in proportion to the opening of the hood face by changing the speed of the exhaust blower or by operating a damper in the exhaust hood (ANSI/AIHA Z9.5 - 1992).

***Velocity:*** speed and direction of motion (ANSI/AIHA Z9.5 - 1992).

***Walk-in hood:*** a fume hood designed to be floor mounted with sash and/or doors for closing the open face (ANSI/AIHA Z9.5 - 1992).

## **Appendix C – Responsibilities for the Proper Operational Use of Fume Hoods**

### **Office of Environmental Health and Safety (OEHS)**

1. Inspects the entire fume hood operating systems including the fume hood, associated ductwork, exhaust blowers, and stacks.
2. Places a certification sticker on fume hoods with average face velocity and other pertinent information about the hood.
3. Places an “OUT OF SERVICE” sign on the hood sash if the hood operating system does fails certification.
4. Puts in a work order on behalf of the Department Chair to UNH Operations and Maintenance for repair.
5. Notifies the Department Chair or UNH Operations and Maintenance of any hoods that fail certification.

### **UNH Operations and Maintenance**

1. Make all necessary repairs/modifications, in a timely manner, to the fume hood operating system, and any associated equipment which affects the fume hood operating system in order to make the entire system safe to use.
2. Notify OEHS after all repairs/modifications are completed. OEHS will then retest the system.
3. Notify OEHS on a monthly basis in writing as to the status of repair/replacement of fume hoods based on work orders/work requests submitted.

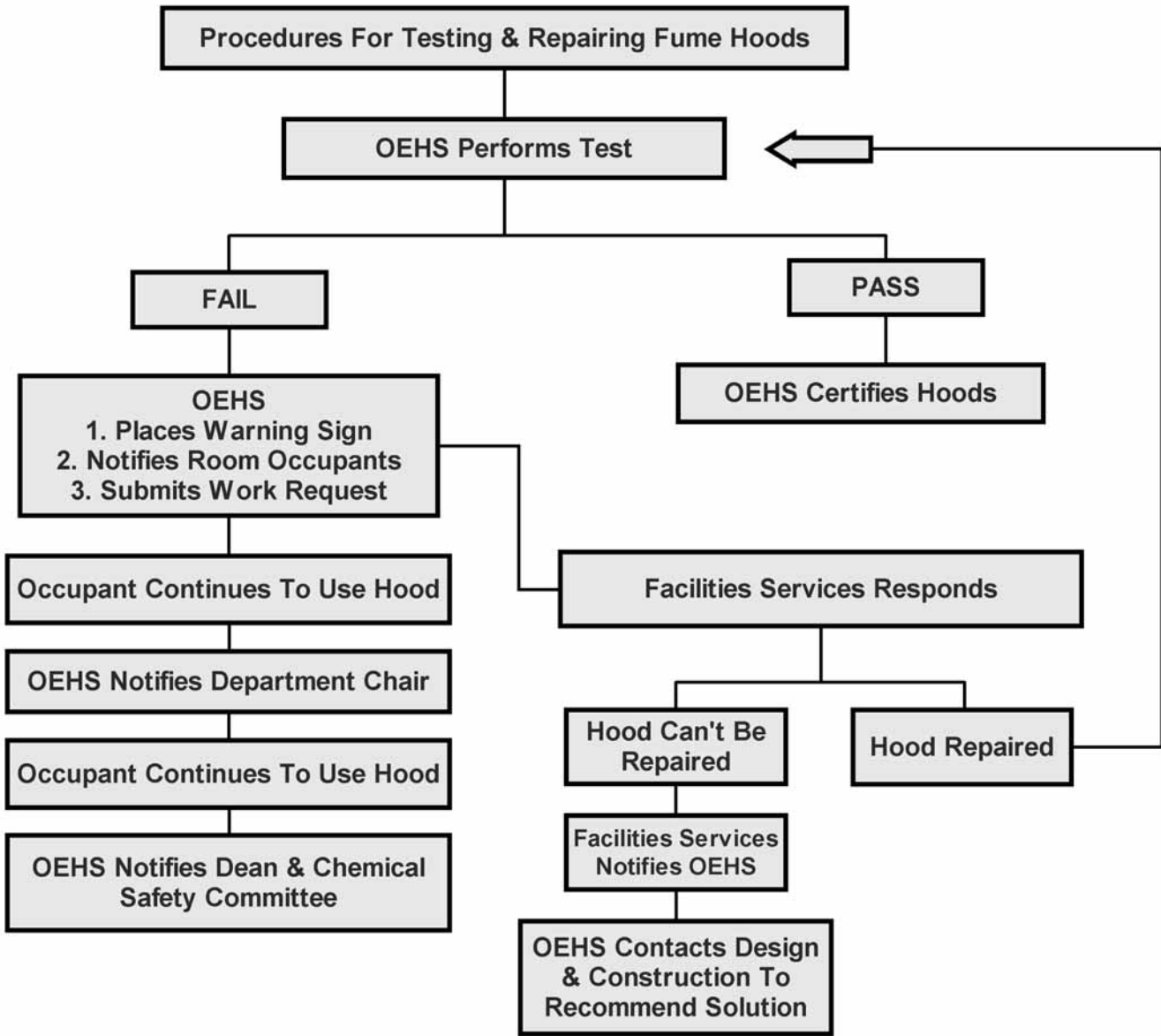
### **Department Chair**

1. Ensure that any fume hoods that fails certification not be used until notified by OEHS that the hood can be used.
2. Ensure that repairs/modifications are completed in a timely manner to any fume hoods that fail certification.
3. Notify OEHS and UNH Operations and Maintenance of any fume hoods which are not operating properly.

### **Personnel Using Fume Hoods**

1. Follow all safety and health procedures specified in the Laboratory Safety Plan and by the faculty member or supervisor in the laboratory.
2. Attend all required health and safety training sessions.
3. Do not use fume hoods which have failed certification.
4. Report fume hoods which are not operating properly, accidents, unhealthy, and unsafe conditions to the faculty member or supervisor.
5. Notify faculty member or supervisor of any pre-existing health conditions that could lead to serious health situations when using a fume hood.

**Appendix D – Diagram of the Procedures for Testing and Repairing Fume Hoods**



## Appendix E – Chemical Fume Hood Performance Test Report

<i>Chemical Fume Hood Performance Test Report</i>		<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Initial Test <input type="checkbox"/> Re-test
<b>Building</b>		<b>Type of Hood</b>	<input type="checkbox"/> Constant Volume <input type="checkbox"/> Variable Air Volume <input type="checkbox"/> Auxiliary Air <input type="checkbox"/> Low Flow/High Efficiency
<b>Department</b>			
<b>Room #</b>			
<b>Hood Serial #</b>			
<b>Manufacturer</b>		<b>Model of Hood</b>	<input type="checkbox"/> Walk-in <input type="checkbox"/> Bench <input type="checkbox"/> Distillation <input type="checkbox"/> California
<b>Fan Location</b>			
<b>Fan #</b>			
<b>Inspection Date</b>			
<b>Last Inspection Date</b>		<b>Hood Use</b>	<input type="checkbox"/> General Chemicals <input type="checkbox"/> Radioisotopes <input type="checkbox"/> Perchloric <input type="checkbox"/> Other:
<b>Last Inspected By</b>			
<b>Physical Damage</b>	<input type="checkbox"/> Broken Sash <input type="checkbox"/> Missing Panel(s) <input type="checkbox"/> Corroded Interior <input type="checkbox"/> Corroded Exterior <input type="checkbox"/> Other (please describe): _____ _____ _____	<b>Sash Type</b>	<input type="checkbox"/> Vertical <input type="checkbox"/> Horizontal <input type="checkbox"/> Combination
		<b>Sash Present</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
		<b>Sash Airfoil Present</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
		<b>Work is conducted 6" into hood?</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No

<i>Hood Measurements – VAV, CAV, LF</i>		
<i>Sash Open at 50%</i>		

<b>Average Face Velocity at 50% Open:</b>	<b>FPM</b>
<b>Highest measurement:</b>	<b>FPM</b>
<b>Lowest measurement:</b>	<b>FPM</b>

<b>Smoke Testing</b>		
<b>Turbulence apparent:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>Smoke escape:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please indicate locations on the following grid:		

Appendix F – Failure Notice

**THIS HOOD DOES NOT MEET AIR VELOCITY GUIDELINES\* (70-130 ft/min)**

A work order has been submitted to correct this deficiency.  
*Do not use this hood until this notice is removed.*  
This notice will be removed once hood meets air velocity guidelines.  
Operations Technician please call 862-5038 when repair is completed.

Call Facilities Services if this notice is not removed in 10 working days: **862-1437**.  
For more info call the Office of Environmental Health and Safety at **862-4041**.

<b>Average Face Velocity:</b>  <b>full</b>	<b>1/2 open</b> <b>3/4 open</b>	<b>Comments:</b>
<b>Inspector:</b>		<b>Date:</b>

**\* Conventional-style chemical fume hoods below 70 ft/min may not draw enough air to safely remove all contaminants in the hood. Hoods above 130 ft/min may cause turbulence in the hood, causing contaminants to blow back out under the sash. Always use caution when working in a hood. Remember to keep the sash as low as possible to reduce risk of injury.**

## **Appendix G – High Efficiency/Low Flow Fume Hood Label**



### **LOW FLOW FUME HOOD**

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This chemical fume hood is an energy-efficient, low-flow fume hood with a face velocity between 60-80 linear feet per minute (lfpm). Please follow these procedures and all manufacturer's instructions when working in this energy efficient, low-flow fume hood:

- Do not use highly flammable, reactive, corrosive, toxic, or radioactive materials.
- Allow the hood to operate unobstructed for 5 minutes on startup.
- Keep all chemicals at least 6 inches inside of sash.
- Avoid using techniques or procedures that disrupt airflow.
- Do not obstruct the front airfoil, or rear baffles.

## **Appendix H – *Inspection Checklist***

The following list contains recommended equipment and materials for a chemical fume hood inspection:

1. Electronic micromanometer,
2. Evaluation sheets or electronic forms, failure notification sheets, and evaluation stickers,
3. Tape measure,
4. Smoke tubes and bulb, and,
5. Airfoil (located nearby).