STONY BROOK STATE UNIVERSITY OF NEW YORK	Environmental Health and Safety Manual Policy Number: EH&S **4-5**	
Title: **Laboratory Hood Safety**		
Effective Date: 10/91	Revision: 2/97	Number of Pages: 10

PURPOSE: To establish the safe use of laboratory fume hoods and biological safety cabinets. This includes performance testing of laboratory fume hoods, a mechanism for reporting and responding to fume hood outages and scheduled maintenance, the appropriate steps necessary to safeguard workers who may be responding to the repair, certification of biological safety cabinets and the responsibility for implementation of this policy.

SCOPE: University wide.

DEFINITIONS:

Face Velocity: Average air velocity into the exhaust system (i.e. fume hood) measured at the opening into the hood or booth.

PROCEDURES:

I. Laboratory Fume Hoods

Hazardous chemicals, radioactive materials and biohazardous material must be controlled in the laboratory to protect the health and safety of the University community. In order to prevent inhalation of vapors, gases, and aerosols, the contaminants must be captured, contained and removed by the use of hoods, enclosures, or local exhaust ventilation. There are three basic categories of hoods: chemical fume hoods, biological containment hoods, and chemical carcinogen hoods. This procedure will outline the design face velocity requirements and test procedures for chemical fume hoods. Biological containment hoods and chemical carcinogen hoods are tested and certified by independent contractors.

A. Design

1. Location

Hoods should be located more than 10 feet from any door or doorway (emergency exits excepted), and should not be located on a main traffic aisle.

2. Face Velocity

A prime factor in determining the effectiveness of a fume hood in capturing and removing materials emitted within it, is the hood face velocity. The average face velocity is the total air passing across the face divided by the face area.

In operation, hood face velocities maintained at specific points on the hood face are often less than design because of velocity gradients over the hood face, depending on the hood's air distribution characteristics, and on maintenance and wear factors such as dirt accumulation in the ducts, fan belt slippage, and fan wheel corrosion and deterioration. Minimum face velocity is the minimum acceptable velocity at any point on the operating opening. This should not be less than 80 percent of the average design face velocity.

Maximum design face velocity is the maximum acceptable velocity at any point of the operating opening for any intermediate position of the hood door. Maximum velocities of 100 to 150 fpm will prevent disturbance to screened flames and most test materials. Velocities up to 300 fpm are used for evaporation purposes.

3. Flow Measuring Devices

New and remodeled hoods shall be equipped with a flow measuring device, such as a Hood Static Pressure measuring device, which can be related to flow. This method measures the static suction in the exhaust duct close to the hood throat and, if there are no adjustable dampers between the hood and the measuring station, is related to the flow volume. Other methods include various exhaust volume or flow velocity sensors. Contact the Department of Environmental Health and Safety for additional information.

4. Lockout Device

All new and remodeled fume hoods shall be equipped with a locking device for lockout/tagout purposes during fume hood maintenance and failures.

Facilities Engineering must include locking devices (e.g. hasps) for all proposed fume hoods designed in-house. They must also ensure that locking devices are included for all proposed fume hoods designed by outside contractors.

B. Work Practices

1. The user shall establish work practices that minimize emissions and employee

exposure.

2. The following list concerns only those work practices related directly to hood performance and applies only when hazardous materials are to be used in the hood:

   a. The worker shall not lean into the hood so that his/her head is inside the plane of the hood face without adequate respiratory and personal protection, except for setup work or hood maintenance;

   b. Equipment in the hood should not block airflow to slots in the baffle;

   c. Equipment that might be a source of emission (including in case of breakage) should not be placed closer than 6 inches from the plane of the hood face;

   d. Flammable liquids should not be stored permanently in the cabinet under the hood unless that cabinet meets the requirements of ANSI/NFPA 30 and 45 for flammable liquid storage. Storage of flammable or otherwise hazardous materials (including compressed gas cylinders) in the active work areas of the laboratory should be kept to a minimum. Normally, a one or two day supply should be sufficient;

   e. The hood sash or panels shall not be removed except for setup work without hazardous chemicals in the hood;

   f. The hood sash or panels should be closed to the maximum position possible while still allowing comfortable working conditions;

   g. A hood that is more than 10% below standard in exhaust volume shall not be used unless its condition is labeled and the maximum sash opening marked clearly.

3. Each hood shall be posted with a notice giving the date of the last periodic field test. If the hood failed the performance test, it shall be taken out of service until repaired, or posted with a restricted use notice. The notice shall state the partially closed sash position necessary and any other requisite precautions concerning the type of work and materials permitted or prohibited.

4. Each laboratory hood shall be evaluated for catastrophe potential in terms of the maximum credible accident, involving the properties and quantities of the chemicals used and the nature of the operations. Examples of such a catastrophe would be:

a. explosion
b. violent ejection of life threatening chemicals into the room
c. overheating of the exhaust duct

If the potential for a catastrophe is present, special designs to prevent the event or limit the consequences should be implemented. Examples of such provisions would be:

a. special hood design
b. fire or explosion suppressing systems
c. redundant installed spare exhaust blowers
d. emergency power supply

C. Performance Testing Procedure

1. Performance tests for hoods require:

   a. measured exhaust air rate by a calibrated orifice;
   b. a traverse of face velocity reading in the plane of the face opening for maximum, intermediate and minimum openings; or
   c. heavy and light smoke tests under varying door positions.

   Of these three tests, the second is the most critical for protection of laboratory occupants, and is the most accurate for documentation of performance, and is the one used by the Department of Environmental Health and Safety for its testing. It additional problems are suspected with a particular hood, all three performance tests are then done.

2. A traverse of face velocity readings in the plane of the face opening for maximum, intermediate and minimum openings is determined as follows:

   a. The plane of the face opening is divided into quadrants.

   b. The face shield is placed in its lowest workable position, usually between twelve and sixteen inches.

   c. Air velocities for each quadrant are measured using a velometer.

   Any hood with a face velocity of less than 80 feet per minute in any one quadrant is considered unacceptable for use with toxic substances.

d. The face velocity of the hood is the average of all quadrants.

For general laboratory use, this average should be 100 feet per minute and 150 feet per minute for highly toxic or radioactive materials. Hoods that do not meet design specifications with their free air space reduced as low as practical are determined to be unacceptable for use with toxic substances. Hoods that fail are marked "Do Not use With Toxic Substances".

e. The face shield is then raised and air velocities measured until the maximum shield height is attained maintaining the design specification. The shield height is then marked with a label indicating "Maximum Shield Height for Use With Toxic Substances".

3. The data collected from hood performance testing is recorded, stored and filed by date. The hoods will be tested annually by the Department of Environmental Health and Safety or whenever a significant change has been made to the operation characteristics of the system. Hoods in high-hazard operations will be tested more frequently.

4. For hoods found not suitable for toxic substances, a work request will be submitted by the Department of Environmental Health and Safety and submitted to the Physical Plant.

D. Fume Hood Failure Procedures

1. User Responsibility

a. If it is noted by the users that their fume hood is not drawing enough air, they should:

1. Immediately stop all work in the hood.
2. Report the problem to:
    a. Their supervisor
    b. Physical Plant (East Campus 2-6400; West Campus 4-2400)
    c. Environmental Health and Safety (2-6410)

b. Notify others in the area and on additional shifts that the fume hood is not operating and cannot be used. This may be done by posting the hood with a sign. **This must be strictly enforced.**

c. Seal off any opened/exposed containers of chemical or radioactive materials currently under the hood, or remove any supplies or equipment which may be required as access to hood may be denied due to repair.

d. Work with the supervisor and other departments to either arrange for the use of other fume hoods which are operating properly or postpone work until repairs are made.

e. The fume hood must not be returned to use until retested and approved for use by the Department of Environmental Health and Safety.

2. Physical Plant Responsibilities

a. **Lockout and tagout individual hoods prior to conducting investigations if exposure potential exists.**

b. Investigate outage through a review of the entire system (e.g., motor, belts, fan unit and electrical connections).

c. Notify the users, the Department of Environmental Health and Safety, and the affected Department Chair/designee that a hood problem exists and give them an estimated time for repair.

d. Once the unit is back on-line, remove lock-out of hoods and inform the Department of Environmental Health and Safety.

e. The Physical Plant is to install locking devices (e.g. hasps) on all existing fume hoods.

3. Department of Environmental Health and Safety Responsibilities

a. Post hood with "Do Not Use" signs, if it has not already been done or locked out.

b. Assist in the communication between Physical Plant and users on status of investigation or repair.

c. Reevaluate user's hood after repairs are made. If acceptable, give clearance for use.

E. Fume Hood Scheduled Maintenance

1. The Physical Plant will notify user departments as to the planned outage of their fume hood at least 1 week in advance, but no less than 24 hrs notice in writing, preferably to the supervisor and on the fume hood itself. During this time period, if users cannot adjust their schedule to accommodate this time, they will contact HVAC to inform them of their problem and attempt to work out a mutually convenient time for this maintenance to be conducted.

2. Department of Environmental Health and Safety must also be contacted.

3. Information included on this document should include:

    a) Date of shutdown
    b) Time of shutdown
    c) Fume Hood Exhaust Motor No. to be shutdown
    d) Reactivation time
    e) Reactivation date
    f) Number to call for further information

4. Once scheduled, users will make the necessary arrangements with their staff and others to accommodate those procedures which require fume hoods or not conduct this type of work during the outage.

5. Physical Plant will lockout and tagout hoods so that they cannot be used during this downtime. All materials under the hoods must be either sealed or removed.

6. Once the Physical Plant have completed their maintenance, they will remove the lockout device from the hoods and notify the Department of Environmental Health and Safety.

7. Once notification is received, the Department of Environmental Health and Safety will reevaluate users hoods and give clearance for use.

II. Biological Safety Cabinets

A. Types of Cabinets

Biological safety cabinets, or laminar flow hoods, can be separated into three categories: Class I, Class II, and Class III hoods.

1. Class I hood is a partial containment cabinet with a minimum inward face velocity of 75 to 100 fpm. It will remove particulate contamination from within the cabinet, pass it through a HEPA (high efficiency particulate air) filter for decontamination and out through a fume hood exhaust system. However, this unit is not appropriate for work which requires a contamination-free atmosphere as "microbiologically contaminated" room air will infiltrate the system.

2. Class II cabinet consists of two types; A and B. They are also partial containment devices developed, however, to protect the worker and the agent or material used within the hood. Workers are protected by the curtain of room air entering the grill at the forward edge of the opening of the work surface. This air joins the recirculating air stream. Part of it passes through a HEPA filter downward toward the work surface, providing a contamination free zone. Particles are removed from the exhaust air by other HEPA filters. The Type "A" cabinet has a fixed opening with a minimum inflow velocity of 75 linear feet per minute. The average minimum vertical air velocity is 75 linear feet per minute. This design provides the recirculation of 70% of the total cabinet air. Therefore, it is not recommended for use with flammable solvents, toxic agents, or radioactive materials. The exhaust air from the cabinet can be directed to discharge into the room air or, preferably, to an exhaust system outdoors.

   The Type "B" cabinet has a vertical sliding sash and is designed to maintain an inward airflow of 100 linear feet at a work opening of 8 inches. The average downward vertical air velocity is 50 linear feet per minute. This design requires separate exhausting of approximately 70% of the air flowing through the work area, therefore, it may be used with a wider range of chemicals. The Type "B" cabinet, however, is not recommended for use with explosive vapors. This unit can be used with aerosol generating processes, low risk oncogenic viruses and for all procedures with moderate risk oncongenic viruses and Class 3 (CDC) etiologic agents. It is also suitable with some modification for work with dilute preparations of chemical carcinogens.

3. A Class III biological safety cabinet is a gas tight, negative pressure containment system that provides a physical barrier between the agent and the worker. Of all biological safety cabinets, this one provides the highest degree of personnel protection.

Work is performed through arm length rubber gloves attached to a sealed front panel. Room air is drawn into the cabinet through HEPA filters. Particulate materials entrained in the exhaust air are removed by HEPA filtration before discharge into the atmosphere. These units are used to contain highly infectious materials such as those classified as Class 4 agents by CDC.

4. Horizontal and vertical laminar flow clean benches, which force air out of the front opening and into the room should not be used in a biomedical laboratory. They are designed for product protection and not for the safety of the worker. The use of this hood could subject users to potentially hazardous or allergenic substances.

B. Biological Safety Cabinet Requirements

1. Class I or II cabinets should be used for Biosafety Level 2 work: if the aerosolization potential increases the risk of exposure and disease to unacceptable levels.

2. Class I or II cabinets must be used for Biosafety Level 3 work: all manipulations of infectious materials.

3. Class III containment hoods must be used for all procedures and activities of Biosafety Level 4 work.

C. Installation

1. Biological safety cabinets shall be used only after certification has been completed by a qualified outside contractor.

2. Biological safety cabinets shall be recertified at least yearly, or as deemed necessary by the hazards involved.

3. All biological safety cabinets must also be recertified if relocated, repaired or HEPA filters are changed. If filters are to be changed, it will require formaldehyde decontamination of the cabinet. To facilitate this process, all vented Type I, II, and III cabinets must be installed with seal-tight dampers to prevent premature escape and contamination of the formaldehyde gas as it will require the complete shut-down of the fume hood exhaust system.

4. All biological safety cabinets shall be posted with a "Certificate of Certification" will be posted on the unit displaying required certification dates.

D. Implementation

1. It will be the responsibility of the area supervisor to ensure that these hoods be appropriately inspected and certified. Personnel have been instructed not to use those units which have yet to be or are late in receiving certification.

E. Safety Devices

1. Any new or remodeled biological safety cabinets shall be equipped with a flow monitor to determine if the day-to-day use of the equipment (between certifications) is provided with safe working conditions. This can be used to determine if the unit and/or the fume exhaust system is functional.

F. Equipment Failure

1. In the event of equipment failure, the cabinet must not be used. Place a sign on the equipment notifying others not to use the cabinet.

2. If there is a problem with the unit itself, the user shall contact an appropriate contractor to expedite the repairs.

3. If a problem is suspected with the fume hood exhaust system, notify the Department of Environmental Health and Safety immediately. This will enable them to investigate the problem, notify others users of hoods on that system and the Physical Plant.

4. If a fume exhaust motor is taken out of service, Physical Plant must notify the Department of Environmental Health and Safety along with those labs affected. The hoods will be labeled as to their condition.

INQUIRIES/REQUESTS:

Environmental Health and Safety
110 Suffolk Hall
Zip 6200
Main Office: 632-6410
FAX: 632-9683

RELATED FORMS:

RELATED DOCUMENTS:

ANSI/AIHA Z9.5-1992 *American National Standard for Laboratory Ventilation*
ACGIH *Industrial Ventilation: A Manual of Recommended*

Practice 22nd Edition
ANSI/ASHRAE 110-1995 *Method of Testing Performance of Laboratory Fume Hoods*
ANSI/NFPA 30 *Flammable and Combustible Liquids* 1993
ANSI/NFPA 45 *Fire Protection for Laboratories Using Chemicals* 1991
NSF 49 *National Sanitation Foundation Standard No. 49 for Class II Biohazard Cabinetry (Laminar Flow)*, 1992