SECTION 15860 - FUME HOODS AND LOCAL EXHAUST SYSTEMS

This standard describes fundamental good practices relating to the design, selection, installation, commissioning, and testing of local exhaust systems used to control employee exposures to airborne contaminants. Deviations from this standard require approval from Environmental Health and Safety’s Occupational Safety Unit.

The requirements shall be considered minimum criteria and are a compilation of good practices outlined in the latest edition of the American National Standards/AIHA Z9.2 (Fundamentals Governing the Design and Operation of Local Exhaust Systems), the American National Standards Z9.5 (Laboratory Ventilation), ANSI/ASHRAE 110 (Methods of Testing Performance of Laboratory Fume Hoods), and ASHRAE Handbook (Fundamentals). This design standard is based on the above references and written to comply with the NIH guidelines for acceptable practice.

Research laboratories consume large amounts of energy to maintain safe working conditions. Energy consumption has become the focal point for various energy sustainability issues and conservation programs, such as Labs21. The University desires to use energy efficient fume hoods as a goal toward energy sustainability. New technologies, such as low flow fume hoods (high-performance fume hoods) and variable air volume (VAV) fume hoods provide a significant potential for energy conservation while maintaining the necessary safety measures for the users. Studies have found that a fume hood’s face velocity is not a sole indicator of degree of safety. Rather, errant eddy currents and vortexes induced around the hood reduce containment effectiveness.

Local exhaust captures and removes contaminants before dilution in the work place. Local exhaust is different than general room ventilation or exhaust in that it removes contaminants at or near the point source.

Depending upon the hazards present in a lab, a number of local exhaust systems may be required or used to control exposures. They include, but are not limited to:

1. Fume hoods
2. Ductless fume hood systems (for limited use only, see Section 2.0)
3. Canopy hoods
4. Slot exhausts
5. Gloves boxes
6. Ventilated gas cabinets
7. Emergency exhaust systems
8. Elephant trunk exhausts (Snorkels)

The requirements for each of the above exhaust systems, other than ducted or non-ducted biological safety cabinets, are listed below. See SECTION 15870 - BIOSAFETY CABINET STANDARDS for requirements for bio cabinets.

This standard shall apply to any laboratory project, ranging from entire buildings to single room renovations, and for those projects that involve moving or other change to an existing fume hood within a lab. New fume hood purchases shall be the low-flow, high-efficiency type or variable air volume hoods as described below in Section 1.1 of this document. Fume hoods located within a new lab or renovation project must be replaced or upgraded to meet the requirements of this standard. Existing fume hoods can be converted to a low flow configuration by use of a retro-kit. Existing fume hoods containing asbestos materials require abatement prior to an upgrade or relocation. Facilities and EH&S’s Occupational Safety Unit (OSU) must approve the relocation of existing fume hoods.

Fire dampers are prohibited from being added to local exhaust systems. Existing dampers must be removed upon renovation. Exceptions or variations will be in accordance with all applicable mechanical codes.

FUME HOOD EXHAUSTS AND PRESSURE GRADIENTS

A. Fume hood exhaust systems, particularly ganged systems, must be provided with adequate valves, alarms, and other devices to ensure that fume hood face velocities and other design criteria are met at all times. All fume hoods must be equipped with airflow sensors, either in the hood itself or in its associated ductwork, and local out-of-spec air flow audiovisual alarms to notify the fume hood users immediately if the system has a problem.
B. Auxiliary hoods shall not be used. Auxiliary hoods are defined as bypass hoods with the addition of directly ducted auxiliary air to provide unconditioned or partially conditioned outside makeup air. Originally designed to save heating and cooling energy costs, auxiliary hoods increase the mechanical and operational costs due to the additional ductwork, fans, and air tempering facilities. Unless the volume (and therefore velocity) of auxiliary air is carefully adjusted, the air curtain created will affect the hood operation and may pull vapors out of the hood interior.

C. Air from laboratory local exhaust systems (i.e., fume hoods, elephant trunks, etc.) must never be recirculated.

D. Fume hoods and Biosafety Cabinets must not be joined into a single ganged exhaust system. When this condition exists, the precautions taken to prevent backflow of contaminated air and to ensure containment of hazardous biologicals must be submitted to the Occupational Safety Unit for approval.

E. Fume hood exhaust systems must be designed so that there are no positive pressure duct runs within normally occupied areas.

F. The location of exhausts must take into account the height of adjacent buildings and/or wings. Ideally, fume hood exhausts should be located as far as possible (at least 50 feet) from fresh air intakes, downwind from fresh air intakes under prevailing conditions and above the highest structure in the area. The design of new exhaust discharges as well as fresh air intakes should be accompanied by written reports documenting considerations such as wind direction, existing exhaust sources, and proximity to parapet walls or other structures, such as penthouses, that will interrupt air flow patterns. At a minimum, exhaust stacks must be at least 10 feet above the roof level, and have exit velocities of at least 3000 fpm to protect personnel required to work on roofs. Stacks of 15 feet and higher are highly desirable.

G. Exhaust stacks shall not be located where the materials emitted can be re-entrained into the building through other means (e.g. near doors, open windows, etc.).

H. Under no conditions are any devices, which direct air downward towards the roof or impede exhaust velocity (such as goose necks, mushroom caps, or conical rain caps) be installed in any exhaust stack.

I. Roof exhausts must be clearly labeled as to their source.

1.1 FUME HOOD TYPES

A. Classical fume hood types include constant volume, two-position, and variable volume fume hoods. Constant volume, high velocity, two-position hoods are not energy efficient and are not to be installed in University laboratories. The University Design Standard for fume hoods for new construction or renovations shall consist of the following options:

1. Low-flow, or high-efficiency, fume hoods must be installed to operate with a minimum face velocity of 80 feet per minute and minimize potential errant eddy currents and vortexes during use. These hoods can be operated with a constant or variable air volume supply.

2. Variable volume (VAV) fume hoods maintain a constant (minimum) face velocity of 100 feet per minute regardless of sash position. The system continuously measures the amount of air exhausted to maintain a constant face velocity. VAV system increases the ability of the hood to protect the worker from the possibility of exposure to chemical fumes compared to “standard” fume hoods.

3. Both of the above hoods can be operated with occupancy sensors (see Sections 1.3.B.1 and 2) that provide for lower fume hood flows during periods of non-occupancy.

B. Ductless (i.e., filter) fume hoods are not appropriate in most cases and not allowed for hazard control (see Section 2.0). OSU will consider their use on a case-by-case basis for the control of nuisance dusts, odors, small volumes of low-hazard chemicals. Guidelines and information regarding selection, installation and appropriate work practices must be followed as defined in Ductless Fume Hood Policy.

C. Perchloric Acid is a very strong oxidizer which, in contact with organic materials, can form an explosive reaction product. A specially designed fume hood and duct system must be utilized where perchloric acid fumes might be released.
Perchloric acid fume hoods shall comply with the criteria described in this standard and with the following additional requirements at a minimum:

1. Fume hoods designed for and used with perchloric acid shall be identified by a prominent and permanent label indicating suitability for use with perchloric acid procedures.
2. All exposed parts of the fume hood interior shall be suitable for use with perchloric acid.
3. The work surface shall be watertight and furnished with a raised lip to contain spills and “wash down” water.
4. The fume hood shall be provided with a water spray (wash down) system for rinsing the duct work from point of discharge to the fume hood collar and also the area behind the baffle.
5. The duct work shall be self-draining.
6. Service fitting controls for internal outlets and for the wash down systems shall be external to the fume hood, clearly identified, and within easy reach.
7. The baffle shall be removable to allow periodic inspection for damage/corrosion.
8. The fume hood, duct work and exposed fan parts shall be constructed of nonporous, inorganic, acid-resistant, non-reactive material, and shall be impervious to perchloric acid.
9. Total hood exhaust system shall be dedicated for use with only perchloric acid.

Contact the Occupational Safety Unit for additional information on these systems.

1.2 GENERAL CONSIDERATIONS - FUME HOODS

All fume hoods must be installed per manufacturer’s specifications, and:

A. All new fume hoods for installation must have successfully passed the as-built manufacturer criteria, as listed in the newest addition of ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods.
B. Fume hoods or other local exhaust ventilation used for containing or removing radioactive substances must be approved by the Radiation Safety Unit prior to use.
C. All fume hoods are to have sash stops. Acceptable sash stops shall include both vertical and/or horizontal stops. In the event a manufacturer does not have a sash stop, the project contractor shall install an appropriate stop at approximately 2/3 open (approximately 18”).
D. The velocities for walk-in fume hoods, hoods with combination sashes and other local exhaust systems shall be evaluated and approved by the Occupational Safety Unit prior to installation.
E. Provisions should be made for occupancy sensors to allow for ventilation set-backs to conserve energy during periods when the lab is not occupied, wherever appropriate and safe to do so. Such a system shall be evaluated and approved by the Occupational Safety Unit prior to implementation.
F. Fume hoods should be located so that persons exiting the room do not have to pass in front of the hood and shall be at least 10’ from any functioning doorway where there will be routine traffic. Variations must be approved by Occupational Safety.
G. A minimum space of 8” must be allowed between the hood and a wall surface to minimize the disruption of airflow into the hood.
H. Fume hoods must not be installed face to face or opposite a biological safety cabinet unless the distance between them is 10 feet or more. Variations must be approved by Occupational Safety.
I. Whenever possible, fume hoods should be installed in the end of the room opposite the exit door, where a fire or unexpected chemical release will not block the path of egress.
J. Windows in labs with fume hoods must be fixed closed.
K. Supply air diffusers or any other source of air currents must be located at least 10' from fume hoods. Exceptions to this are possible if:
   1. The project engineer and architect specify the use of specialized diffusers which will direct air away from the fume hood, or
   2. The project engineer can demonstrate that air currents from the source will have a velocity at the hood no greater than 30% of the hood’s face velocity.

L. Any control devices installed in ductwork associated with fume hoods must fail in an open position to assure continuous draft.

M. When a fume hood system is moved from one location to another, then all current design standards must be applied.

N. Emergency eye washes should be installed within 10 seconds (55 feet unobstructed) of a fume hood.

1.3 GENERAL CHEMICAL AND RADIOISOTOPE FUME HOOD CRITERIA

A. The Occupational Safety Unit reserves the right to have “as installed” testing performed, in accordance with the newest ASHRAE 110, Methods of Testing Performance of Laboratory Fume Hoods Standard. Such testing performed must meet the standards listed prior to use by University personnel.

B. Any new or updated fume hood installations for either chemical or radioactive materials use shall be designed and tested to meet the following criteria:
   1. The face velocity for low-flow, low-exhaust volume, or high-efficiency fume hood, shall have a minimum of 80 feet per minute with the sash 2/3 open. Occupancy set-backs shall reduce the face velocities of the hood to 55 feet per minute (roughly 1/3 reduction) when the lab is not occupied.
   2. Variable volume fume hoods shall be designed and installed with a face velocity set point of 100 fpm. These hoods shall also be designed to maintain a minimum flow of air, when the sash is closed, to maintain the hood with a negative pressure with respect to the room. Non-occupied set-backs shall reduce the face velocities of the hoods to no less than 60 feet per minute (roughly 1/3 reduction).
   3. Ductless fume hoods shall be set to provide a minimum face velocity of 70 feet per minute with the sash 2/3 open.
   4. Occupancy sensors shall be installed to recognize presence or absence of occupants, and tied into the exhaust controls to regulate the face velocity for high-performance and VAV fume hoods.
   5. Any fume hood exhaust system will not deviate from established set points by more than 10%.
   6. The room where the fume hood is located must be maintained with a negative pressure to hallways and adjoining uncontaminated spaces to prevent the spread of contaminants. No fume hood control system shall be installed which cannot maintain a negative pressure at all fume hood sash heights. Room pressurization should be monitored and alarmed in critical areas as determined by the Design Team and/or at Design Reviews.
   7. Fume hoods must be equipped with a local alarm system at the fume hood giving the user feedback as to the operational status of the fume hood. This alarm should have both audio and visual components with an audio silence switch. If the fume hood will be used with highly toxic compounds or for other reasons the hood status is critical, the alarm should be a static tap or other flow sensing device and not a fan failure only device. Facilities shall determine the manufacturer and make for such alarm systems. The project manager must hold a review with the Occupational Safety Unit and the researcher to determine the appropriate alarm and termination point (i.e. Security).

1.4 SERVICING OR DISMANTLING A FUME HOOD

Before a fume hood is serviced or dismantled, lab personnel must:
   1. Remove all equipment in the hood which may impeded or impair access;
   2. Remove all chemicals or radioactive materials in the hood which may pose a hazard;
   3. Decontaminate the interior of the hood;
   4. If the fume hood needs to be turned off, request it of Facilities and place a warning sign on the hood;
   5. Lab personnel need to notify the Occupational Safety Unit (x5-3241) to verify the above steps were taken.
1.5 USED FUME HOODS

The Occupational Safety Unit’s approval must be granted before a fume hood can be acquired from a previous owner. The following minimum requirements must be documented and provided to Occupational Safety:

1. A documented history of chemical use and the decontamination procedure used;
2. A documented history of biological use and the decontamination procedure used;
3. A documented history of radioactive use and the decontamination procedure used;
4. The hood’s intended use at the University; and,
5. The materials and construction of the hood.

2.0 DUCTLESS FUME HOODS

Ductless (i.e., filter) fume hoods are not appropriate for hazard control. The Occupational Safety Unit will consider their use on a case-by-case basis for the control of nuisance dusts and odors or low hazard chemicals only. Green Fume Hood Technologies’ Ductless Fume Hoods, using the Green Fume Hood Technology (GFHT) with proprietary Neutrodine Filtration have been approved for limited use. Any variation from this must be approved by the Occupational Safety Unit in advance of purchase, acquiring or installation. Occupational Safety will maintain a list of other approved ductless hoods as they become approved. The project manager must provide the information as outlined in EH&S Ductless Fume Hood Policy to Occupational Safety for consideration in the use/installation of any ductless hood.

As stated previously (paragraph 1.1.B), guidelines and information regarding selection, installation and appropriate work practices must be followed as defined in Ductless Fume Hood Policy.

3.0 CANOPY HOODS

Canopy hoods are to be installed above equipment that releases odorous or toxic materials. Such equipment includes, but is not limited to, large autoclaves and atomic absorption instruments. Sufficient exhaust must be provided to maintain the flow of contaminated air into the exhaust unit. Canopy hoods must be installed in such a manner as to prevent contaminants from passing through the operator’s breathing zone.

4.0 SLOT EXHAUSTS (BACKDRAFT EXHAUSTS)

Slot exhaust systems assist in the directional flow of contaminated air away from the employee and into the exhaust. Often, the placement of these exhausts utilizes the lab countertop or special sink. Examples of these units include, but are not limited to, photographic tables, microscopy staining, and perfusion sinks.

5.0 GLOVE BOXES

Glove boxes are often used to permit the handling of highly hazardous chemicals in a moisture and oxygen-free atmosphere. Treated compressed nitrogen is often the carrier gas used in these systems. Glove boxes are recommended when multiple high hazard chemicals (carcinogens, those capable of causing severe reproductive or teratogenic effects) are used in a single location. Although these units are usually equipped with special filters on the exhaust, the Occupational Safety Unit may require that the exhaust for the carrier gas flow into a local exhaust system, such as a fume hood.

6.0 VENTILATED GAS CABINETS

Ventilated gas cabinets must be installed for the use and storage of non-cryogenic gases having a hazard rating of 3 or 4, based on NFPA 704. The exhaust for these systems must meet the manufacturer’s specifications for the cabinets. An example of the use of a ventilated gas cabinet would be the use of hydrogen cylinders. The Occupational Safety Unit must be consulted for any deviations from this requirement.
7.0 EMERGENCY EXHAUST SYSTEMS FOR CRYOGENIC LIQUIDS

Some locations utilize cryogenic gases that, should a catastrophic release occur, personnel may be subject to severe or fatal injuries. Building code regulations prohibit the storage of the pressurized tanks in exit corridors. When used in either regularly occupied or unoccupied laboratory locations, these systems shall have a local alarm system unless The Occupational Safety Unit determines the alarm should be connected to Security. Consult with Occupational Safety for guidance in determining specialized exhaust or alarm systems. Exceptions to these systems would include fire suppression systems installed and operated as specified by NFPA.

8.0 ELEPHANT TRUNK EXHAUSTS (SNORKELS)

Elephant trunk systems provide personnel with flexibility when performing certain activities. By having the appropriate intake manifold, contaminants such as waste anesthetic gases, are easily captured and exhausted from the room. Such systems must be designed by a New York State registered engineer.

9.0 LABELING OF EQUIPMENT

- The local exhaust systems shall be clearly labeled so that University personnel can associate all components of the system relative to each other. For example, fume hood labeling is to include the motor number (exhaust fan) and location if these components are not within sight of the hood and the duct. A unique nomenclature should be associated with equipment related to the fume hood system, which would be distinctly different from the common HVAC system equipment.

10.0 Commissioning of the fume hoods shall consist of the following:
1. The project contract shall ensure air balancing of any room containing a fume hood to verify the installed equipment meets the planned installation.
2. The fume hood’s velocity shall be within 10% of that listed in Section 1.3 B.
3. Fume hoods shall be permanently labeled with the type of hood (i.e. low-flow, high-efficiency, etc.) and the expected face velocity (i.e. 80 fpm, 100 fpm, etc.). This information shall be forwarded to Occupational Safety for entry into its database.
4. Forward the air balance report to Occupational Safety. Upon receiving the report, Occupational Safety will verify the fume hood face velocity meets that listed in Section 1.3.B. Occupational Safety will notify the project manager of its findings.

END OF SECTION 15860