# CHAPTER 4 VENTILATION

## 4.1 INTRODUCTION

All Laboratory operations must be ventilated to the degree required to assure a safe, healthful, and comfortable environment. This chapter deals with controlling exposures to hazardous substances with the use of ventilation.

## 4.2 SCOPE

This chapter pertains to all ventilation systems in all Laboratory facilities and operations.

## 4.3 DEFINITIONS

4.3.1 **Air cleaner** - Any mechanical, chemical, electrical, inertial, or filtering device that removes a significant portion of the contaminants present in the air passing through the device. Air cleaners include air washers, filters, precipitators, and charcoal filters.

4.3.2 **Air Contaminant** - Any particle, mist, gas, or vapor that is not normally present in the air or that is not normally present in a quantity sufficient to interfere with comfort, health, or welfare of persons.

4.3.3 **Capture Velocity** - The air velocity at any point in front of a hood or at the hood opening necessary to overcome opposing air currents and to capture the contaminated air at that point by causing it to flow into the hood.

4.3.4 **Face Velocity** - The average air velocity into the exhaust system measured at the opening into the hood or booth.

4.3.5 **General (Dilution) Ventilation** - System of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is *not* the recommended type of ventilation to control contaminants that are toxic.

4.3.6 **High Efficiency Particulate Air (HEPA) Filter** - A disposable, extended medium, dry type filter with a particle removal efficiency of no less than 99.97 percent for all particles 0.3µ (microns) or larger in size.

## 4.4 RESPONSIBILITIES

4.4.1 Department and Division Heads are responsible for ensuring implementation of this section.

4.4.2 Line Supervisors are responsible for:

A. Identifying, with the assistance of the Industrial Hygienist (IH), those areas where ventilation may be needed.

B. Providing the proper ventilation system.

C. Maintaining the degree of ventilation required.

D. Enforcing the use of ventilation where required.

E. Providing preventive and necessary maintenance for ventilation systems.

4.4.3 The Industrial Hygienist (IH) is responsible for:

A. Investigating, identifying, and evaluating hazards where ventilation may be necessary.

B. Specifying the minimum ventilation flow rate required to eliminate a health hazard.

C. Assisting the Maintenance and Operations Division and the line supervisor in the design and installation of the ventilation system.

D. Reviewing and approving design specifications for proposed and existing ventilation systems.

E Performing inspections and tests of the air flow and use of ventilation systems at a frequency based upon the hazard potential that the system is controlling, to ensure that each system is working and being used properly. Frequency of tests shall be semi-annual for high hazard operations, such as tritium control systems, and annually for low hazard operations, such as dust control ventilation systems.

F. Labeling each ventilation system indicating inspection date, date the system is due for it's next inspection, average flow rate, and IH approval.

4.4.4 The Maintenance and Operations Division is responsible for:

A. Designing, installing, and maintaining ventilation systems, incorporating the criteria developed by the IH and the line supervisor.

B. Conducting periodic preventive maintenance on all ventilation systems.

4.4.5 All other employees are responsible for:

A. Ascertaining that the ventilation system has been inspected and approved by the IH for the intended use by checking the inspection label.

B. Reporting malfunctioning ventilation systems to their supervisors.

C. Properly using the ventilation systems for their intended use.

## 4.5 REQUIREMENTS

All laboratory ventilation systems shall meet or exceed the requirements and regulations of the Occupational, Safety, and Health Administration (OSHA), the U.S. Department of Energy (DOE), the National Fire Codes, the American National Standards Institute, and the U.S. Environmental Protection Agency. Ventilation systems should also meet or exceed the recommendations of the American Conference of Governmental Industrial Hygienists (ACGIH).

## 4.6 PRACTICES AND PROCEDURES

4.6.1 General Practices

A. Air contaminants shall be controlled primarily by utilizing equipment and facilities that prevent the release of contaminants. This includes the use of closed containers and systems, if practical. Where toxicity or other hazard characteristics are involved, the least hazardous material or process should be utilized.

B. Local exhaust ventilation shall be utilized wherever practical to capture and control airborne contaminants at the point of generation. General or "dilution" ventilation is not effective for controlling the release of contaminants to the air.

C. An approved laboratory hood or other approved local exhaust system shall be used in all laboratory operations that may result in the release of undesirable or hazardous gases, vapors, mists, or airborne particles. However, exhaust hoods are not to be used for the disposal of large quantities of toxic gases, vapors, or liquids by evaporation.

D. Extremely hazardous materials and processes, highly toxic materials, virulent pathogens, and volatile carcinogens in relatively large quantities and open containers must be handled in closed systems such as glove boxes or controlled atmosphere enclosures. The type of atmosphere and enclosure will be dependent on the needs of the system. Regardless of the type of atmosphere, adequate atmosphere make-up or cleaning shall be provided to prevent internal buildup of atmospheric contaminants. Such systems shall incorporate High Efficiency Particulate Air (HEPA) filtration or other air cleaning devices as necessary on any intake, exhaust, or vent lines to prevent the escape of contaminants.

E. Respirators and other personal protective equipment are unacceptable alternatives to adequate ventilation for long-term use, except in special cases where ventilation control cannot provide sufficient protection, or where respirators are needed for backup protection. Approved temporary exhaust systems or other engineering controls are to be utilized in preference to using respirators when more permanent equipment or facilities are unavailable or not feasible.

F. Ventilation systems in buildings shall be engineered and balanced in such a way that general airflow is from offices and corridors to laboratories (from clean areas to contaminated areas). Adequate makeup air shall be provided to maintain desired airflow patterns, to guarantee proper operation of hoods and exhaust systems, to prevent unnecessary leakage through walls and windows, and to prevent tight building syndromes. Air shall not be recirculated from exhaust systems handling potentially hazardous materials, nor from areas having a potential for releasing hazardous or undesirable air contaminants, except as specifically approved by the IH.

4.6.2 Local Exhaust Systems

A. Local exhaust systems, in general, shall be designed and built to provide control commensurate with the anticipated hazard utilizing the criteria and specifications set forth in the latest edition of Industrial Ventilation: A Manual of Recommended Practice (see References). Corrosion-resistant, non-reactive materials of sufficient strength shall be used in fabrication to fulfill the intended purpose of the system.

B. Weather caps that deflect the exhaust downward should be used only on systems utilized for the removal of heat.

C. Noise shall be considered and systems shall be designed and maintained so that noise levels are controlled to below the maximum safe levels (see Chapter 8, Noise Control and Hearing Conservation) and do not constitute an annoyance to personnel.

4.6.3 Laboratory Hoods

A. Laboratory hoods shall be built, installed, and operated in accordance with guidelines approved or provided by the IH.

B. Face velocities shall be commensurate with the anticipated hazard. Hoods shall have face velocities of 100 ± 20 linear feet per minute (fpm) full open, except in special circumstances approved by the IH. Processes that generate fast moving particles (such as grinding) shall have higher velocities to capture the contaminant.

C. Glove boxes are necessary for significant quantities of extremely toxic materials such as beryllium compounds in powder form. Hoods generally are not adequate for this type of usage.

D. Large bulky objects and hood clutter are detrimental to hood performance. Excessive equipment or bulky objects in the hood are the most common causes of poor performance. To minimize the undesirable effects of these items:

1. Place bulky objects, which must be in the hood, on blocks to allow air to flow beneath the object. This decreases air flow turbulence and improves the performance of the hood.

2. Do not use the hood for storage, even if the hood is no longer used.

3. Avoid blocking the rear baffle exhaust slot.

4. Keep the hood clean. Clean up spills immediately. Periodically, clean the debris off of the baffles. Do not allow wipe tissues or other materials to be drawn into the exhaust slots.

E. Work far inside the hood. The forward six inches are most subject to drafts and turbulence. A line marking this distance should be drawn on the floor of the hood indicating the safe work zone. (This may be marked by tape strip or permanent marking pen.)

1. Pouring and transferring of toxic materials is most safely done at arm's length, well inside the hood.

2. Avoid placing your head into the hood. This obviously defeats the purpose of the hood.

3. Maintain the sliding glass sash at the lowest practical level. This improves hood performance. The sash may be used as a protective shield.

F. Hoods are not designed to contain explosions. However, most hoods can withstand some process excursions and almost any fire long enough for it to be extinguished.

G. A hood suspected of not performing properly should be promptly brought to the attention of the IH and the Maintenance and Operations Division.

H. Questions regarding the safety of a particular use of a material or process in a hood warrant specific evaluation by the IH.

4.6.4 Confined and/or Oxygen Deficient Spaces and Ventilation - (see Chapter 5, Confined Spaces, for ventilation requirements)

## 4.7 REFERENCES

American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practice, Cincinnati, OH, 21st edition or later.

Occupational Safety and Health Administration, "General Industry Standards," 29 CFR 1910.94 and 29 CFR 1910.1450.

American National Standards Institute

A. ANSI Z9.1, "Practices for Ventilation and Operation of Open-Surfaced Tanks," latest edition.

B. ANSI Z9.2, "Fundamentals Governing the Design and Operation of Local Exhaust Systems," latest edition.

C. ANSI Z9.4 "Ventilation and Safe Practices of Abrasive Blasting Operations," latest edition.