

Chapter 8 Laboratory Ventilating Systems and Hood Requirements

8.1* General.

8.1.1 This chapter shall apply to laboratory exhaust systems, including chemical fume hoods, special local exhaust devices, and other systems for exhausting air from laboratory work areas in which flammable gases, vapors, or particulate matter are released.

8.1.2 This chapter shall apply to laboratory air supply systems and shall provide requirements for identification, inspection, and maintenance of laboratory ventilation systems and hoods.

8.2 Basic Requirements.

8.2.1* Laboratory ventilation systems shall be designed to ensure that fire hazards and risks are minimized.

8.2.2* Laboratory units and laboratory hoods in which chemicals are present shall be continuously ventilated under normal operating conditions.

8.2.3* Chemical fume hoods shall not be relied upon to provide explosion (blast) protection unless specifically designed to do so. (*See also C.5.4 and C.5.5 for further information on explosion-resistant hoods and shields.*)

8.2.4 Chemical fume hoods using perchloric acid shall be in accordance with Section 8.11.

8.3 Supply Systems.

8.3.1 Laboratory ventilation systems shall be designed to ensure that chemicals originating from the laboratory shall not be recirculated.

8.3.2 The release of chemicals into the laboratory shall be controlled by enclosure(s) or captured to prevent any flammable and/or combustible concentrations of vapors from reaching any source of ignition.

8.3.3* The location and configuration of fresh air intakes shall be chosen so as to avoid drawing in chemicals or products of combustion coming either from the laboratory building itself or from other structures and devices.

8.3.4 The air pressure in the laboratory work areas shall be negative with respect to corridors and non-laboratory areas of the laboratory unit except in the following instances:

- (1) Where operations such as those requiring clean rooms preclude a negative pressure relative to surrounding areas, alternate means shall be provided to prevent escape of the atmosphere in the laboratory work area or unit to the surrounding spaces.
- (2) The desired static pressure level with respect to corridors and non-laboratory areas shall

be permitted to undergo momentary variations as the ventilation system components respond to door openings, changes in chemical fume hood sash positions, and other activities that can for a short term affect the static pressure level and its negative relationship.

- (3) Laboratory work areas located within a designated hazardous electrically classified area with a positive air pressure system as described in NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, Chapter 7, Pressurized Control Rooms.

8.3.5* The location of air supply diffusion devices shall be chosen so as to avoid air currents that would adversely affect the performance of chemical fume hoods, exhaust systems, and fire detection or extinguishing systems. (*See Sections 6.2, 6.5, and 8.9.1.*)

8.4 Exhaust Air Discharge.

8.4.1* Air exhausted from chemical fume hoods and other special local exhaust systems shall not be recirculated. (*See also 8.3.1.*)

8.4.2* Energy Conservation Devices.

8.4.2.1 If energy conservation devices are used, they shall be designed in accordance with 8.3.1 through 8.3.3.

8.4.2.2 Devices that could result in recirculation of exhaust air or exhausted contaminants shall not be used unless designed in accordance with Section 4:10.1, "Nonlaboratory Air," and Section 4:10.2, "General Room Exhaust," of ANSI/AIHA Z9.5, *Laboratory Ventilation*.

8.4.3 Air exhausted from laboratory work areas shall not pass unducted through other areas.

8.4.4* Air from laboratory units and laboratory work areas in which chemicals are present shall be continuously discharged through duct systems maintained at a negative pressure relative to the pressure of normally occupied areas of the building.

8.4.5 Positive pressure portions of the lab hood exhaust systems (e.g., fans, coils, flexible connections, and ductwork) located within the laboratory building shall be sealed airtight or located in a continuously mechanically ventilated room.

8.4.6 Chemical fume hood face velocities and exhaust volumes shall be sufficient to contain contaminants generated within the hood and exhaust them outside of the laboratory building.

8.4.7* The hood shall provide containment of the possible hazards and protection for personnel at all times when chemicals are present in the hood.

8.4.8 Special local exhaust systems, such as snorkels or "elephant trunks," shall have sufficient capture velocities to entrain the chemical being released.

8.4.9* Canopy hoods shall not be used in lieu of chemical fume hoods.

8.4.10 Only Class II, Type B2 biological safety cabinets listed by National Sanitation

Foundation as meeting NSF/ANSI 49, *Class II (Laminar Flow) Biosafety Cabinetry*, shall be permitted to be used in lieu of chemical fume hoods, as determined by a qualified person.

8.4.11 Laminar flow cabinets shall not be used in lieu of chemical fume hoods.

8.4.12* Air exhausted from chemical fume hoods and special exhaust systems shall be discharged above the roof at a location, height, and velocity sufficient to prevent re-entry of chemicals and to prevent exposures to personnel.

8.5 Duct Construction for Hoods and Local Exhaust Systems.

8.5.1* Ducts from chemical fume hoods and from local exhaust systems shall be constructed entirely of noncombustible materials except in the following cases:

- (1) Flexible ducts of combustible construction shall be permitted to be used for special local exhaust systems within a laboratory work area. (*See 8.5.2.*)
- (2) Combustible ducts shall be permitted to be used if enclosed in a shaft of noncombustible or limited-combustible construction where they pass through non-laboratory areas or through laboratory units other than the one they serve. (*See 8.5.2.*)
- (3) Combustible ducts shall be permitted to be used if all areas through which they pass are protected with an approved automatic fire extinguishing system, as described in Chapter 6. (*See 8.5.2.*)

8.5.2 Combustible ducts or duct linings shall have a flame spread index of 25 or less when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*. Test specimens shall be of the minimum thickness used in the construction of the duct or duct lining.

8.5.3 Linings and coatings containing such fill as fiberglass, mineral wool, foam, or other similar material that could accumulate chemical deposits shall not be permitted within laboratory exhaust systems.

8.5.4 Duct systems for perchloric acid hoods shall be constructed in accordance with Section 8.11.

8.5.5 Ducts shall be of adequate strength and rigidity to meet the conditions of service and installation requirements and shall be protected against mechanical damage.

8.5.6 Materials used for vibration isolation connectors shall comply with 8.5.2.

8.5.7 Flexible connectors containing pockets in which conveyed material can collect shall not be used in any concealed space or where strong oxidizing chemicals are used (e.g., perchloric acid).

8.5.8 Controls and dampers, where required for balancing or control of the exhaust system, shall be of a type that, in event of failure, will fail open to ensure continuous draft. (*See 8.10.3*)

through 8.10.5.)

8.5.9 Hand holes, where installed for damper, sprinkler, or fusible link inspection or resetting and for residue clean-out purposes, shall be equipped with tight-fitting covers provided with substantial fasteners.

8.5.10 Manifolding of Chemical Fume Hood and Ducts.

8.5.10.1 Exhaust ducts from each laboratory unit shall be separately ducted to a point outside the building, to a mechanical room, or to a shaft. (*See 5.1.5 and 8.10.3.*)

8.5.10.2 Connection to a common chemical fume hood exhaust duct system shall be permitted to occur within a building only in any of the following locations:

- (1) Mechanical room protected in accordance with Table 5.1.1
- (2) Shaft protected in accordance with the chapter for protection of vertical openings of NFPA 101, *Life Safety Code*
- (3) A point outside the building

8.5.10.3 Exhaust ducts from chemical fume hoods and other exhaust systems within the same laboratory unit shall be permitted to be combined within that laboratory unit. (*See 8.4.1.*)

8.6 Duct Velocities.

Duct velocities of laboratory exhaust systems shall be high enough to minimize the deposition of liquids or condensable solids in the exhaust systems during normal operations in the chemical fume hood.

8.7 Exhausters (Fans), Controls, Velocities, and Discharge.

8.7.1 Fans shall be selected to meet requirements for fire, explosion, and corrosion.

8.7.2 Fans conveying both corrosive and flammable or combustible materials shall be permitted to be lined with or constructed of corrosion-resistant materials having a flame spread index of 25 or less when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

8.7.3 Fans shall be located and arranged so as to afford ready access for repairs, cleaning, inspection, and maintenance.

8.7.4* Where flammable gases or vapors or combustible dusts are passed through the fans, the rotating element shall be of nonferrous or spark-resistant construction. Alternatively, the casing shall be constructed of or lined with such material.

8.7.4.1 Where there is the possibility of solid material passing through the fan that would produce a spark, both the rotating element and the casing shall be constructed of such material.

8.7.4.2 Nonferrous or spark-resistant materials shall have a flame spread index of 25 or less

when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

8.7.5 Motors and their controls shall be located outside the location where flammable or combustible vapors or combustible dusts are generated or conveyed, unless specifically approved for that location and use.

8.7.6* Fans shall be marked with an arrow or other means to indicate direction of rotation and with the location of chemical fume hoods and exhaust systems served.

8.8 Chemical Fume Hood Construction.

(See also 8.2.2 and Section 8.11.)

8.8.1 Chemical Fume Hood Interiors.

8.8.1.1* Materials of construction used for the interiors of new chemical fume hoods or for the modification of the interiors of existing chemical fume hoods shall have a flame spread index of 25 or less when tested according to NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, unless the interior of the hood is provided with automatic fire protection in accordance with 8.10.2.

8.8.1.2* Baffles shall be constructed so that they are unable to be adjusted to materially restrict the volume of air exhausted through the chemical fume hood.

8.8.1.3* Chemical fume hoods shall be provided with a means of preventing overflow of a spill of 2 L (0.5 gal) of liquid.

8.8.2* Chemical Fume Hood Sash Glazing. The sash, if provided, shall be glazed with material that will provide protection to the operator against the hazards associated with the use of the hood. *(See also Annex C.)*

8.8.3* Chemical Fume Hood Sash Closure.

8.8.3.1 Chemical fume hood sashes shall be kept closed whenever possible.

8.8.3.2 When a fume hood is unattended, its sash shall remain fully closed.

8.8.4* Electrical Devices.

8.8.4.1 In installations where services and controls are within the hood, additional electrical disconnects shall be located within 15 m (50 ft) of the hood and shall be accessible and clearly marked.

8.8.4.2 If electrical receptacles are located external to the hood, no additional electrical disconnect shall be required. *(See 5.6.1.)*

8.8.5 Other Hood Services.

8.8.5.1 For new installations or modifications of existing installations, controls for chemical fume hood services (gas, air, water, etc.) shall be located external to the hood and within easy
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reach.

8.8.5.2 In existing installations where service controls are within the hood, additional shutoffs shall be located within 15 m (50 ft) of the hood and shall be accessible and clearly marked.

8.8.6 Auxiliary Air. For auxiliary air hoods, auxiliary air shall be introduced exterior to the hood face in such a manner that the airflow does not compromise the protection provided by the hood and so that an imbalance of auxiliary air to exhaust air will not pressurize the hood interior.

8.8.7 Measuring Device for Hood Airflow.

8.8.7.1 A measuring device for hood airflow shall be provided on each chemical fume hood.

8.8.7.2 The measuring device for hood airflow shall be a permanently installed device and shall provide constant indication to the hood user of adequate or inadequate hood airflow.

8.9 Chemical Fume Hood Location.

8.9.1* Chemical fume hoods shall be located in areas of minimum air turbulence.

8.9.2 Chemical fume hoods shall not be located adjacent to a single means of access to an exit or to high-traffic areas.

8.9.3* Work stations not directly related to the chemical fume hood activity shall not be located directly in front of chemical fume hood openings.

8.10 Chemical Fume Hood Fire Protection.

8.10.1 Automatic fire protection systems shall not be required in chemical fume hoods or exhaust systems except in the following cases:

- (1) Existing hoods having interiors with a flame spread index greater than 25 in which flammable liquids are handled.
- (2) If a hazard assessment shows that an automatic extinguishing system is required for the chemical fume hood, then the applicable automatic fire protection system standard shall be followed.

8.10.2 Automatic fire protection systems, where provided, shall comply with the following standards, as applicable:

- (1) NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*
- (2) NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*
- (3) NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*
- (4) NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*
- (5) NFPA 13, *Standard for the Installation of Sprinkler Systems*

- (6) NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*
- (7) NFPA 17, *Standard for Dry Chemical Extinguishing Systems*
- (8) NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*
- (9) NFPA 69, *Standard on Explosion Prevention Systems*
- (10)* NFPA 750, *Standard on Water Mist Fire Protection Systems*
- (11) NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*

8.10.2.1 The fire extinguishing system shall be suitable to extinguish fires within the chemical fume hood under the anticipated conditions of use.

8.10.3 The design and installation of ducts from chemical fume hoods shall be in accordance with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, except that specific requirements in NFPA 45 shall take precedence.

8.10.3.1* Automatic fire dampers shall not be used in chemical fume hood exhaust systems.

8.10.4 Fire detection and alarm systems shall not be interlocked to automatically shut down chemical fume hood exhaust fans.

8.10.5 Proper door operation for egress shall be maintained when the supply system shuts down and the lab exhaust system operates, creating a pressure differential.

8.10.6 Chemical fume hoods equipped with control systems that vary the hood exhaust airflow as the sash opening varies and/or in conjunction with whether the laboratory room is in use (occupied/unoccupied) shall be equipped with a user accessible means to attain maximum exhaust hood airflow regardless of sash position when necessary or desirable to ensure containment and removal of a potential hazard within the hood.

8.10.7* Chemical fume hoods shall be installed in a manner that prevents fire or smoke from a fire in the chemical fume hood from spreading into the voids above the ceiling.

8.11 Perchloric Acid Hoods.

8.11.1* Perchloric acid heated above ambient temperatures shall only be used in a chemical fume hood specifically designed for its use and identified as follows:

FOR PERCHLORIC ACID OPERATIONS

Exception:

Hoods not specifically designed for use with perchloric acid shall be permitted to be used where the vapors are trapped and scrubbed before they are released into the hood. (See also 12.1.2.5.)

8.11.2 Perchloric acid hoods and exhaust ductwork shall be constructed of materials that are

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acid resistant, nonreactive, and impervious to perchloric acid.

8.11.3 The exhaust fan shall be acid resistant and spark resistant.

8.11.4 The exhaust fan motor shall not be located within the ductwork.

8.11.5 Drive belts shall be conductive and shall not be located within the ductwork.

8.11.6 Ductwork for perchloric acid hoods and exhaust systems shall take the shortest and straightest path to the outside of the building and shall not be manifolded with other exhaust systems.

8.11.6.1 Horizontal runs shall be as short as possible, with no sharp turns or bends.

8.11.6.2 The ductwork shall provide a positive drainage slope back into the hood.

8.11.6.3 Ductwork shall consist of sealed sections.

8.11.6.4 Flexible connectors shall not be used.

8.11.7 Sealants, gaskets, and lubricants used with perchloric acid hoods, ductwork, and exhaust systems shall be acid resistant and nonreactive with perchloric acid.

8.11.8* A water spray system shall be provided for washing down the hood interior behind the baffle and the entire exhaust system.

8.11.8.1 The hood work surface shall be watertight with a minimum depression of 13 mm (½ in.) at the front and sides.

8.11.8.2 An integral trough shall be provided at the rear of the hood to collect wash-down water.

8.11.9 The hood baffle shall be removable for inspection and cleaning.

8.11.10* If a chemical fume hood or exhaust system was used for perchloric acid heated above ambient temperature, tests shall be conducted for explosive perchlorates before any inspection, cleaning, maintenance, or any other work is done on any part of the exhaust system or hood interior.

8.11.11 Prior to using a perchloric acid hood for any purpose, the hood shall be water-washed and shall be tested according to 8.11.9 to ensure residual perchlorates are not present.

8.12 Identification of Chemical Fume Hood Systems.

8.12.1* Special-use chemical fume hoods and special-use local exhaust systems shall be identified to indicate their intended use.

8.12.2 A sign shall be affixed to each hood containing the following information from the last inspection, or a properly maintained log of all hoods providing the following information shall be maintained:

- (1) Inspection interval
- (2) Last inspection date
- (3) Average face velocity
- (4) Location of fan that serves hood
- (5) Inspector's name

8.13 Inspection, Testing, and Maintenance.

8.13.1* When installed or modified and at least annually thereafter, chemical fume hoods, chemical fume hood exhaust systems, and laboratory special exhaust systems shall be inspected and tested as applicable, as follows:

- (1) Visual inspection of the physical condition of the hood interior, sash, and ductwork (*see 7.5.3*)
- (2) Measuring device for hood airflow
- (3) Low airflow and loss-of-airflow alarms at each alarm location
- (4) Face velocity
- (5) Verification of inward airflow over the entire hood face
- (6) Changes in work area conditions that might affect hood performance

8.13.2 Deficiencies in hood performance shall be corrected or one of the following shall apply:

- (1) The activity within the hood shall be restricted to the capability of the hood.
- (2) The hood shall not be used.

8.13.3 Chemical fume hood face velocity profile or hood exhaust air quantity shall be checked after any adjustment to the ventilation system balance.

8.13.4 Detectors and Alarms.

8.13.4.1 Air system flow detectors, if installed, shall be inspected and tested annually.

8.13.4.2 Where potentially corrosive or obstructive conditions exist, the inspection and test frequency shall be increased.

8.13.5 Fans and Motors.

8.13.5.1* Air supply and exhaust fans, motors, and components shall be inspected at least annually.

8.13.5.2 Where airflow detectors are not provided or airflow-rate tests are not made, fan belts shall be inspected quarterly; double sheaves and belts shall be permitted to be inspected semiannually.

8.13.5.3 Frayed or broken belts shall be replaced promptly.

8.13.6 Fixed fire extinguishing systems protecting filters shall be inspected quarterly for accumulation of deposits on nozzles and cleaned as necessary.