

APPENDIX P - FUME HOODS: GENERAL PURPOSE, RADIOISOTOPE AND PERCHLORIC ACID HOODS

1. Provide fume hoods that safely capture hazardous, flammable, corrosive or toxic chemicals, and that allow for changes in laboratory function and fume hood use.

2. Governing Regulations

2.1. See Appendix L - Laboratories Where Hazardous Chemicals Are Present for a list of governing regulations and reference standards.

2.2. University of Minnesota Standards and Procedures for Construction must be reviewed for specific specifications on material and equipment. These are general standards for typical research uses. In special circumstances, different standards may apply.

3. General Features

3.1. PROHIBITED: Installing heated drying base cabinets under fume hoods.

3.2. Fume hoods in research laboratories must comply with ANSI/AIHA Z9.5 Class A performance standards. Capture efficiency as installed and used must be at least 4 AUO.1 per ANSI/ASHRAE.

3.3. Locate fume hoods in distal corners of a laboratory and away from high traffic areas to avoid high turbulence and blocking an exit if there is an emergency.

3.4. Provide 2 lineal feet of storage space for each lineal foot of fume hood width. Refer to Division 12, Section 12345 - Laboratory Casework. Ventilate half of this space. Provide sufficient storage space to protect new and waste chemicals. Without adequate storage space, containers of waste chemicals are often boxed and stacked on the floor where they might be broken and cause injury.

4. Laboratory Ventilation Systems

4.1. Laboratory ventilation systems shall be addressed with the Department of Environmental Health and Safety (DEHS), Facilities Management and the code officials during the program phase of the design process.

4.2. Ensure that the laboratory is under negative pressure and has at least four air changes per hour. Labs where hazardous chemicals are used in closed systems or in a fume hood shall have between six and 12 air changes per hour. Where open

use of hazardous chemicals is planned, 10 or more air changes per hour shall be necessary.

4.3. Noise from the laboratory ventilation system shall not exceed NC 45 throughout the laboratory.

5. Supply Air Requirements

5.1. PROHIBITED: Auxiliary air supply hoods.

5.2. PROHIBITED: Cross drafts in rooms.

5.3. To ventilate efficiently and minimize turbulence, diffuse supply air from behind the operator. Consider technology that diffuses air in a radial manner with high volume and low velocity, or pattern-control technology.

6. Exhaust System Requirements

6.1. PROHIBITED: Modulating or controlling fume hood exhaust volumes to balance air requirements for air conditioning or heating.

6.2. PROHIBITED: Fire or smoke dampers in any chemical fume exhaust duct.

6.3. Systems shall be installed in accordance with the requirements of NFPA 91, Standard for the Installation of Blower and Exhaust Systems.

6.4. High duct velocity results in high noise levels, excessive leakage and high power consumption. Therefore, air velocity on the suction of the fan shall be a minimum of 1,000 feet per minute (fpm) and shall not exceed 2,000 fpm under any circumstances. A velocity of 1,200 fpm is recommended.

6.5. The average fume hood face velocity shall be 100 +/- 10 fpm with the vertical-sliding sash at 18 inches above the work surface. Also, on hoods wider than 4 feet, the safety shield must be in place. Readings shall be measured in the center of several square grids measured in the plane of the face opening. In addition, individual face velocities shall not exceed 20 percent of the open-face velocity average.

6.6. Fume hoods shall run continuously to minimize potential hazards when the fume hoods are off. Only the maintenance staff shall control the on/off switches.

6.7. General-purpose fume hood ductwork shall be 304 stainless steel. The fan and housing shall be corrosion resistant. Special purpose hoods may be constructed of other materials only after thorough review with DEHS and the user.

6.8. Ductwork shall be round to ensure uniform airflow.

6.9. Laboratory units shall have a one-hour, fire-resistance rating. Sheet metal ductwork usually provides one-hour fire separation. Where more than one-hour, fire-rated separation is required or if the use of combustible ductwork materials is proposed, a ductwork enclosure may be needed to meet the required fire rating.

6.10. General-purpose fume hoods shall be ducted individually. However, up to four hoods in the same room may be connected to a common exhaust duct leading from that room to an exhaust fan. If more than one hood is connected to an exhaust duct, a balanced, drop without a damper must be engineered or blast gate dampers must be provided. Fume hoods provided with filter enclosures always shall be individually ducted.

6.11. Fume hood exhaust systems shall function independently of the general building HVAC system.

6.12. Provide an independent exhaust system for associated equipment in the same room such as flammable liquid storage cabinets, biological safety cabinets and atomic absorption units. In exceptional circumstances, associated equipment may be exhausted into the fume hood ductwork. On hoods with filter enclosures, associated equipment shall be connected between the hood and the filter enclosure.

7. Exhaust Filter Enclosures

7.1. PROHIBITED: Proprietary or custom-sized filters and pre-filters.

7.2. Exhaust filters are not normally required or even recommended. However, if a filter is necessary, comply with the following provisions:

7.2.1. The filter enclosure must be airtight and constructed of stainless steel.

7.2.2. When a filter enclosure is required, it shall be easily accessible from the outside of the hood. The filter enclosure shall provide bag-in/bag-out of filters, so the maintenance staff is not exposed to collected material.

7.2.3. Provide an indicator on hoods with a filter enclosure that is clearly visible and indicates when the pressure drops across the filter.

7.2.4. Use a standard-size pre-filter and charcoal and/or HEPA filter on the filter enclosure.

7.2.5. To allow for filter loading, the initial, average face velocity of the fume hood shall be 120 fpm with the sash at 18 inches and a clean filter.

8. Fans and Discharge

8.1. PROHIBITED: Square to round fabric connectors.

8.2. PROHIBITED: Radial-blade, paddle-wheel type centrifugal fans.

8.3. Use forward or backward curved industrial duty fans for fume hood systems. Select fans that have a chemical resistant coating and meet selected noise criteria.

8.4. Discharge ducts and fan housing shall be airtight when fans are installed in an equipment room. Fan shafts shall be sealed with a stuffing box shaft seal or equivalent device. Alternatively, install a fan with wheel back plate fins that pull air into the fan from the shaft opening. Seamless welded ductwork shall be installed on the discharge side of the fan. Transition fittings between the fan housing and discharge ductwork shall be factory fabricated with round connections. Flexible connectors shall have flanged ends and shall be factory fabricated.

8.5. Provide rain protection that does not increase discharge air pressure or deflect air downward.

8.6. Stack-design and discharge velocity shall distribute contaminants outside the eddy current envelope of the building. On structures with roof areas at more than one level, discharge ducts within 30 feet of a higher level shall terminate at a point at least 10 feet above the elevation of the higher level.

8.7. Consider clustering discharge ductwork or inducing outside air to help dilute discharge and increase the mass of the air column. Doing so raises the height of the column stack.

8.8. Maintain the maximum distance from fresh air intakes on the building and on adjacent buildings. Maintain at least 100 feet between fume hood exhausts and fresh air intakes.

8.9. Ventilate the equipment room where fume hood exhaust fans are located.

9. Fume Hood Construction

9.1. Non-combustible, corrosion-resistant construction is required.

9.2. Use an airfoil design to minimize air turbulence entering the hood.

9.3. Provide a vertical sliding safety glass sash that is balanced and counter-weighted so it can be raised or lowered with one hand from any point along the bottom.

9.4. The vertical sliding safety glass sash shall have a positive steel mechanical latch 18 inches above the work surface. The latch prevents the operator from opening the sash above 18 inches without intervention. The operator shall be able to handle the latch with one hand and close it from any position.

9.5. Provide an 11-inch wide to 12-inch wide horizontal sliding safety-glass shield on hoods that are 4 feet and longer. The shield shall be suspended on bearings or slide in an easily cleaned channel. It must be supported so pressure is not displaced and the user cannot remove it.

9.6. A removable safety shield is permitted on hoods that are 4 feet or shorter. When a removable shield is provided, do not consider the area of the shield when calculating the exhaust volume of the fume hood.

9.7. Provide an air by-pass so that the face velocity of the hood does not exceed 200 fpm as the sash is lowered.

9.8. Locate electrical outlets on the exterior of the fume hood.

9.9. Locate utility controls for gas, water and vacuum on the exterior of the hood with utility outlets mounted on the interior sidewall. Label and color-code controls.

9.10. Provide a liquid-tight work surface built to contain at least 3/8-inches of liquid.

9.11. Mount cup sinks on a raised lip to partly contain a spill before the liquid flows into the sink. The cup sinks shall be 1/16 of an inch lower than the surrounding raised margins of the work surface.

9.12. Provide an electronic airflow indicator with an audible alarm in a conspicuous location so that the user can see the status of the airflow. Set the low airflow alarm at 80 fpm.

9.13. Interior lighting shall be vapor-sealed and covered with a safety glass lens. Bulbs shall be changeable from the exterior of the hood. Illumination levels at the working surface shall be at least 80 foot-candles.

10. Additional Requirements: Radioisotope Fume Hoods

10.1. Contact DEHS for construction requirements pertinent to the user's license.

10.2. The interior lining and baffles of the fume hood shall be smooth, polished, type 304 stainless steel. The need for seamless welded construction depends upon NRC license requirements. Usually, seamless welded construction is not required.

10.3. The work surface shall be capable of supporting up to 200 pounds per square foot of shielding material.

10.4. Work surface corners shall be smooth, seamless stainless steel with 1/2-inch radius.

10.5. An exhaust filter enclosure with a pre-filter and a HEPA and/or charcoal filter usually is not required for radioisotope hoods. If required, however, the enclosure must meet the specifications detailed in item 7. Exhaust Filter Enclosures of this appendix.

11. Additional Requirements: Perchloric Acid Fume Hoods

11.1. PROHIBITED: Connecting perchloric acid hood ductwork to other exhaust equipment.

11.2. Hoods and exhaust ductwork shall be constructed of acid-resistant, non-reactive, impervious materials. All duct work seams and joints shall be welded and watertight.

11.3. Ductwork shall be installed in the shortest and straightest path to the outside. Provide positive drainage back to the hood.

11.4. A water spray system shall be provided to wash down the entire exhaust system from the hood interior behind the baffle, through the fan, and up to the roofline. The hood work surface shall be watertight with a minimum depression of 1/2 inch at the front and sides. An integral trough shall be provided at the rear of the hood to collect wash down water and direct it to a drain. The baffle shall be removable for cleaning. Provide a hose bib within 40 feet of the discharge stack to allow for manual wash down.

11.5. Provide controls so that the user can easily wash down the system. Also provide an automatic wash down cycle. The duration of the automatic cycle depends on the configuration of the ductwork. Because wash down of a contaminated hood requires up to 24 hours of continuous washing, provide manual override of the automatic cycle.

11.6. Provide an easily readable placard on the face of the hood that states: "Wash down often. Perchloric acid (HClO₄) can violently decompose on contact with organic compounds such as acetic acid, alcohols, ketones, aldehydes, ethers, dialkyl sulfoxides, paper, wood, grease and oils. Perchlorate compounds formed by reaction with heavy metals, alkali metals, ammonium or some organic materials can be shock sensitive explosives."

11.7. Provide an easily readable placard on the exhaust fan in the penthouse and on the discharge stack above the roof that states: “Perchloric acid exhaust system - EXPLOSION HAZARD - verify system has been decontaminated before performing any maintenance work.”

End of Appendix P - Fume Hoods: General Purpose, Radioisotope and Perchloric Acid Hoods

University of Minnesota Facilities Management

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