LABORATORY FUME HOOD/CANOPY USE AND MAINTENANCE PROGRAM

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Laboratory Fume Hood Use and Maintenance Program

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1. INTRODUCTION AND SCOPE

A fume hood is an enclosed working chamber fitted with an exhaust ventilation system. It is one component of an exposure control system which is designed to contain, dilute and disperse gases, vapors and aerosols to the external environment. It is also an integral part of the building air handling system. The fume hood is the primary control device in most laboratories for protecting employees and students from exposure to hazardous chemicals. Canopy hoods are primary devices used for hot work, welding area and general work areas; also, the efficiency of operation for both types of ventilation systems is essential in maintaining good air quality in laboratories and general work environments. It is therefore imperative that it function properly at all times during its operation.

1.1 OBJECTIVE

It is the objective of this program to ensure that laboratory fume hoods and canopies are appropriately selected, installed, used and maintained such that the health of laboratory and general work area personnel are safeguarded in accordance with the University Health and Safety Policy, NFPA 45-Fire Protection for Laboratories Using Chemicals, OSHA-29 CFR Part 1910-Occupational Exposures to Hazardous Chemicals in Laboratories, standards set by ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.) and ANSI Z49.1-1967.

1.2 SCOPE

This program applies to By-pass and Variable Air Volume Chemical Fume Hoods which are the most commonly used fume hoods. Specialty fume hoods such as Re-circulating, Walk-in, Explosion Proof, Laminar and Perchloric Acid fume hoods to include biosafety cabinets require special design considerations that are dealt with on a case-by-case basis through either the WVU Department of Environmental Health and Safety or the Biohazard Safety Committee. Laboratories that have specialty fume hoods and canopy hoods will still follow all user guidelines and basic procedures specified in this program. This program is also intended to provide a standard for usage and maintenance of the laboratory exposure control systems.

1.3 TYPES OF FUME HOODS

Canopy hoods: A suspended ventilation device used only to exhaust heat, water vapor, odors, and other nonhazardous materials.

Fume exhaust duct connections: commonly called snorkels, elephant trunks or flex ducts, are designed to be somewhat mobile allowing the user to place it over a small area needing ventilation. However for optimal efficiency, these connections must be placed within six (6) inches of an experiment, process, or equipment. These funnel-shaped exhausts aid in the removal of contaminated or irritating air from a point source to the outside.

Perchloric acid hoods: have wash-down capabilities to prevent the buildup of explosive perchlorate salts within the exhaust systems.

Conventional fume hoods: vent a constant amount of air over a 24-hour period. The volume of air passed is controlled by the sash; the higher it is opened, the higher the volume of air and the lower the face velocity.

Another type of conventional hood uses a bypass to keep air volume and face velocity constant, regardless of sash height.

Reduced flow fume hoods: like conventional fume hoods, also vent a constant volume of air. However, they vent air at volumes up to 50% lower than conventional fume hoods. This increases the safety of the user, and also reduces energy consumption.

Variable air volume hoods: use a feedback system of controls to constantly adjust the volume of air being adjusted based on sash height. The end result is a constant face velocity across the front of the hood. There are several benefits to this type of hood, including decreased turbulence, increased user safety, and significantly decreased energy use.

Ductless fume hoods: are used only in situations with minimal danger. These types of fume hoods filter laboratory air then recycle it.

Laminar flow cabinet: A ventilated, partially enclosed cabinet primarily intended to provide filtered airflow over the work surface by use of laminar airflow methods.

Biological safety cabinets: A ventilated cabinet for personnel, product, and environmental protection having an open front with inward airflow for personnel protection, downward HEPA-filtered laminar airflow for product protection, and HEPA-filtered exhausted air for environmental protection.

1.4 DEFINITIONS

Dilute: To make weaker; to reduce the strength, force, or efficiency of by admixture.

Disperse: To cause (particles) to separate uniformly throughout a solid, liquid, or gas.

CHO: Chemical Hygiene Officer

EHS: Environmental Health and Safety

Exposure: The act of exposing.

Face: The front or access opening of a laboratory fume hood.

Face Velocity: Speed of air moving into a fume hood entrance expressed in feet per minute (fpm).

Fume Hood: A four-sided enclosure with a movable sash or sashes designed to capture, contain, and exhaust fumes.

Malfunction: Failure to function properly.

Perchlorate: A salt or ester of perchloric acid.

PI: Principal Investigator

PPE: Personal Protective Equipment

Radioactive: Of or exhibiting radioactivity.

Sash: The movable panel(s) in a fume hood entrance.

Turbulence: Irregular motion of the atmosphere, as that indicated by gust and lulls in the wind.

Velocity: A speed of airflow expressed in feet per minute (fpm).

2. ROLES/RESPONSIBILITIES

This section outlines individual responsibilities for implementation of the fume hood use and maintenance program.

Individual or Office	Roles/Responsibilities
DEANS AND DIRECTORS	• To ensure that pertinent supervisors, Chemical Hygiene Officers, Principal Investigators, and fume hood users are notified of their responsibilities as defined in this program.
Colleges and Departments	• To test all laminar hoods and biological cabinets annually for proper flow rates.
LABORATORY SUPERVISORS/PRINCIPAL INVESTIGATORS	• To ensure that all fume hood users perform the necessary "Maintenance Checks" (guidelines are located in Section 3 of this program) on a routine basis. • To ensure that no work or experiments are conducted in a malfunctioning fume hood. • To ensure that fume hoods and canopies meet requirements for ventilation for all experiments and/or work being performed. • Provide a copy of this program so that all fume hood users follow prudent work practices when operating fume hoods (prudent work practices are located in Section 3 of this program). • DO NOT alter any mechanical devices to hood that could change the flow. For example, any instruments that exhaust large amounts of air could change the positive and negative air flow of the hood. If these types of equipment are required for your research, contact your Chemical Hygiene Officer (CHO) and together arrangements can be made to accommodate you. • DO NOT modify or attach other devices to duct work.
FUME HOOD/CANOPY USERS	• To regularly inspect the physical condition of the hood interior and the mechanical services inside the hood and to report deficiencies and malfunctions to the appropriate authority. • To routinely test the air flow monitoring device (if present). To assure functional status, press the test button on the flow monitor that is affixed to the front of the fume hood. • To rigorously follow user guidelines located in Section 3. • DO NOT modify or attach other devices to duct work. • DO NOT alter any mechanical devices to hood that could change the flow. For example, any instruments that exhaust large amounts of air could change the

	positive and negative air flow of the hood. If these types of equipment are required for your research, contact your CHO and together arrangements can be made to accommodate you.
WVU FACILITIES MANAGEMENT (Engineering, Central Shops, and Zones)	• To routinely inspect and adequately maintain all exhaust systems (ducting, exhaust fans and exhaust stacks). • To respond when notified of a system malfunction. • To provide appropriate service for malfunctioning fume hood cabinets (working chambers) ---e.g. repair malfunctioning sashes, etc. • To validate (test and re-calibrate) all fume hood (air flow) monitoring devices on a regular basis.
OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY	• To test all chemical fume hoods/canopies/trunks annually for proper flow rates. • Maintain documentation on chemical fume hoods located on all WVU main campuses and divisional campuses. • To review and update this program on a regular basis. • To audit the implementation of this program. • To ensure that new installations conform to specifications listed in the FM Design and Construction Standard. • To be present for testing and balancing of newly installed equipment. • Work with Facilities Management and outside contractors to maintain ventilation systems.

3. USER GUIDELINES

The efficiency of a fume hood or a canopy hood is dependent on its functional status and on how it is used. Users must ensure proper operation of the hood before each use by performing the following "Maintenance Checks":

- Inspect the physical condition of the hood interior, sash and visible duct work;
- Check the fume hood sash for ease of operation;
- Test air-flow monitoring device (if present), the monitoring device is located on the front of the fume hood, press the test button;
- Check mechanical services inside the hood and under the canopy (e.g. water, steam, compressed air, gas, vacuum, etc.);
- In case of fume hood or canopy malfunction, do the following:
    1. Discontinue use of the hood;
    2. Inform your supervisor or Chemical Hygiene Officer;
    3. Notify Facilities Management (304) 293-HELP. Be sure to include an in-depth description of malfunction;
    4. Once the hood has been repaired please contact EHS for retesting at 304-293-3792.
    5. If hood or canopy is not repaired in a timely manner contact EHS at 304-293-3792.

When using a fume hood, one must remember that the hood does not provide absolute containment or absolute protection from the materials in the hood. However, a properly designed hood used properly can provide adequate protection if the following practices are observed:

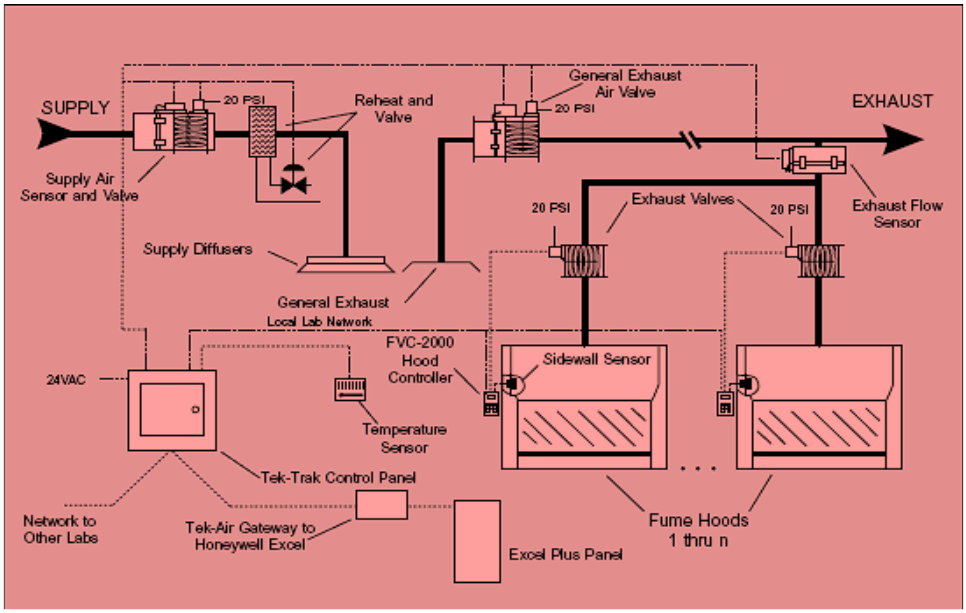
Prudent Work Practices

• All work involving hazardous or odorous chemicals should be performed in a fume hood.
• All equipment and materials should be placed at least 6 inches back from the face of the hood; these items should not obstruct the movement of air into the hood.
• One should not place one's head into the hood when contaminants are present.
• The sash should be used to minimize the size of the working aperture and to act as a safety screen; one should use an appropriate barricade if there is a chance of an explosion. The proper working height of the sash is 18 inches. Hoods are marked with a label signifying the 18 inches mark.
• The hood should not be used as a storage area or overloaded with unnecessary equipment and materials. The presence of these materials can seriously affect the air flow in the hood. Storage underneath the fume hood or in approved safety storage cabinets is preferred. All chemical product and waste containers should have caps on tightly.
• The hood should not be used for long-term storage of hazardous chemical wastes. To have wastes removed visit the Environmental Health and Safety website at http://ehs.wvu.edu/home click on Chemical Waste. Follow the directions that are posted online when filling out the disposal form.
• Electrical receptacles or other initiation sources should not be placed inside the hood if flammable liquids or gases may be present. If you are unsure if your experiment contains flammable liquids or gases please review the SDS (Safety Data Sheet) for the individual chemicals. Electrical connections should be made outside the hood and no permanent electrical receptacles should be permitted in the hood.
• Foot traffic past the face of the hood should be minimized. Air flow caused by such traffic can cause turbulence and disrupt the air flow in the hood which can cause gases and vapors to be drawn out of the hood into the room. Cross drafts from windows and doors in close proximity to fume hoods will also affect the stability of the air flow within the fume hood.
• Keep the interior of the hood clean and tidy, to protect yourself and others.
• **Do not conduct work in a malfunctioning fume hood**, if the alarm is triggered contact your CHO and/or PI. A work-request must be submitted to Facilities Management. Please do not mute alarm and continue working.
• Wear safety glasses/goggles or face shield, gloves, aprons and any other PPE required for materials being used. Information for PPE can be found in the SDS for the products.

4. SYSTEM DESIGN SPECIFICATIONS

The fume hood is one component of a larger system engineered to control exposure; its performance therefore cannot be judged in isolation from the rest of the system. The total system consists of:

1. Working chamber
2. Exhaust system
3. System indicators



Basic Fume Hood system design

The figure above shows the most common components of a fume hood system, not all systems on WVU campuses contain all components shown above. This diagram is being used as a reference only, you're system design may vary. Follow the design standards posted at http://facilitiesmanagement.wvu.edu/design-construction/design-guidelines-and-construction-standards for more in-depth fume hood guidelines.

5. SYSTEM MAINTENANCE

For many employees not directly engaged in research or teaching, laboratories are an unfamiliar environment. Support staff and maintenance employees whose job responsibilities require them to work in these areas must communicate with laboratory occupants before beginning work to avoid creating a situation that may be hazardous to one or both parties. Advanced planning of projects and effective communication will help to ensure that everyone involved understands all the potential implications of the work. If a work request has been submitted or EHS has placed a hood failure sign on the hood, it is imperative that the hood not be used for several reasons.

One classic example is chemical fume hood and canopy system maintenance. If the user attempts to work in the hood/canopy while maintenance is being performed, the individual working on the system may be exposed to contaminants being exhausted through the ventilation system or to mechanical or electrical hazards. Similarly, personnel may be exposed if an exhaust fan is shut down without warning during an experiment. Following the procedures given below will help to ensure that all necessary precautions are taken and that maintenance is completed without undue risk.

5.1 SCOPE AND APPLICATION

This procedure applies to any maintenance, repair or renovation activities that may impact laboratory operations or create a potentially hazardous work environment. Examples of specific circumstances are listed below. These activities include, but are not limited to:

• Maintenance on both fume hood and canopy exhaust systems requiring fan shut down or work involving fan, ductwork, or fume hood interior surfaces is a Lockout/Tagout procedure;
• Changing of filters;
• Servicing plumbing and traps which may be contaminated with chemical residues;
• Maintenance of exhaust systems which have been used for perchlorates, radioactive materials, etc.
• Working in chemical storage areas;

NOTE: Materials being used or stored in the hood may be extremely hazardous. Wear proper PPE when conducting any services on fume hoods and fume hood exhaust systems. If you are unsure please contact Lab PI or CHO of the facility, and review all applicable SDS's.

5.2 BASIC PROCEDURES FOR MAINTENANCE

System Maintenance Procedures

Submit Fume Hood Shutdown Notification forms to the Building Supervisor, CHO (Chemical Hygiene Officer) and PI (Principal Investigator) prior to shut down. Also place a copy of the notification on the entry doors to the building.

Consult the Lab Occupants

Consult the laboratory personnel responsible for the area where the work will be done before beginning. These personnel can supply the most information about the hazards likely to be found in the work area. This will not only get you most of your information but also inform lab occupants about the work and how it might impact their work area. Often, the Chemical Hygiene Officer (CHO) can help contact the right people.

Consult EHS

If consultation with the user concludes that exposure to hazardous materials may occur, contact Environmental Health and Safety as far in advance of the planned work as possible. EHS will survey the work area and/or provide specific recommendations or precautions relating to the work. When in doubt, consult EHS.

Notify the Occupants

Notify the occupants of all affected areas immediately before beginning work. Post warning signs on equipment, such as sinks or hoods, which may be affected. Be sure to remove the signs when the work is finished, so there is never any doubt that an "Out of Service" sign truly means that the equipment cannot be used. This is a Lockout/Tagout procedure. Information about the Lockout/Tagout is located at http://ehs.wvu.edu/workplace-safety/control-of-hazardous-energy-lockout-tagout

If health or safety problems arise in the course of the work, suspend work and contact your supervisor and EHS.

5.3 MAINTENANCE OF DUCTWORK/FUME HOODS/CANOPY HOODS

West Virginia University shall apply reasonable measures to reduce the risk of chemical exposures during maintenance of laboratory ventilation systems. This procedure recognizes that the safety of the employee during maintenance of laboratory ventilation systems depends on the coordinated efforts of Facilities Management staff, department chairpersons, faculty and staff, and Environmental Health and Safety. These

procedures pertain to all maintenance of laboratory ventilation systems including the fume hoods, ductwork, and components therein. Safe work practices shall be used during **all maintenance procedures** to avoid possible exposures to hazardous materials. At a minimum, all personnel performing maintenance on laboratory ventilation systems shall be made aware of the potential for exposure to hazardous substances during maintenance activities. A consultation with the laboratory supervisor and/or the Chemical Hygiene Officer shall precede any work. Some operations could require Lockout/Tagout procedures for energy sources.

Exclusions

Special precautionary procedures are required for the following:

- "Hot Work" - work involving torch cutting, welding or any related work.
- Maintenance of Perchloric Acid Hoods or any laboratory hoods suspected of using perchloric acid.
- Maintenance of radioactive hoods or biological safety cabinets.

5.4 MAINTENANCE INSIDE DUCTWORK/FUME HOODS/CANOPY HOODS

After consulting with the hood user and/or the Chemical Hygiene Officer, appropriate work procedures and personal protective equipment (PPE) can be utilized.

If no specific hazard is identified by the laboratory supervisor and/or the Chemical Hygiene Officer, the following minimum work procedures and PPE shall be employed:

- Ensure all areas have been washed down and are free of chemical hazards before work begins. If areas have not been cleaned prior to maintenance notify laboratory supervisor.
- Acid resistant gloves.
- Splash proof goggles.

If specific hazards or potential hazards have been identified, or if entry into the ventilation system is required, the following minimum work procedures and PPE should be employed:

- Wet work practices - All areas shall be wetted and washed down before work begins.
- Acid resistant gloves.
- Splash proof goggles.
- Disposable hood and clothing.
- Half mask respirator with appropriate cartridge. (Should respirators be necessary, compliance with OSHA's Respiratory Protection Standard 29 CFR 1920.134 and WVU's Medical Monitoring Policy will be required. Contact Environmental Health and Safety if assistance if respirator selection is required.)

6. REFERENCES

6.1 REGULATION

- OSHA-29 CRF 1910.1450 (Occupational Exposures to Hazardous Chemicals in Laboratories)
- NFPA 45 (Fire Protection for Laboratories Using Chemicals)

6.2 STANDARDS

- ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.)
- ANSI/AIHA Z9.5-1992 (American National Standards Institute/American Industrial Hygiene Association)
- ANSI Z49.1-1967 Safety in Welding and Cutting

6.3 WVU SAFETY PROGRAMS and POLICIES

- Respiratory Protection Program http://ehs.wvu.edu/health/respiratory-protection
- Confined Space Program http://ehs.wvu.edu/r/download/192903
- Medical Monitoring Program http://ehs.wvu.edu/health/medical-monitoring
- Hot Work Program http://ehs.wvu.edu/workplace-safety/hot-work
- Lock Out Tag Out http://ehs.wvu.edu/workplace-safety/control-of-hazardous-energy-lockout-tagout
- HAZCOM http://ehs.wvu.edu/

6.4 OTHER HELPFUL REFERENCES

- Laboratory Fume Hood Testing Procedure
- Prudent Practices in the Laboratory (National Research Council of the National Academies)
- N.I.H. (National Institutes of Health): National Institutes of Health Fume Hood Containment Testing
- NIOSH (National Institute for Occupational Safety and Health): Knutson, G. Fume Hood 2000, Laboratory Hood Testing and Evaluation.
- ACGIH (American Conference of Governmental Industrial Hygienists): Industrial Ventilation A Manual of Recommended Practice

6.5 WEBSITES

Standard Operating Procedures (SOP) for Facilities Management:
http://branch.intranet.wvu.edu/facilities_services/plant/standard_operating_procedures.html#maintenance

Facilities Management Procedures:
http://branch.intranet.wvu.edu/facilities_services/plant/policies_procedure.html

Design Guidelines and Constructions Standards:
http://facilitiesmanagement.wvu.edu/design-construction/design-guidelines-and-construction-standards

Environmental Health & Safety:
http://ehs.wvu.edu/home

7. PROGRAM REVIEW

8. NATURE OF PROGRAM CHANGE

Environmental Health and Safety reviews this program on an annual basis. Canopy hoods were not fully addressed within the program and the EHS website has also been updated, hyperlinks were no longer valid as a result changes have been made.