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1.0 Introduction

The Standard Operating Procedure for Fume Hoods was developed by the Department of Environmental Health and Safety (EH&S) in conjunction with Physical Plant Services, in accordance with the University Policy Statement on Health and Safety and to ensure compliance with the applicable legislation governing the installation, maintenance and use of Fume Hoods.

Applicable Legislation:

- CSA-Z316.5-15 Fume Hoods and Associated Exhaust Systems
- ANSI/AIHA (American National Standards Institute/American Industrial Hygiene Association), Z9.5-2003 Laboratory Ventilation
- ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers), 110-1995 Method of Testing Performance of Laboratory Fume Hoods
- 2012 ASHRAE Handbook – HVAC Systems and Equipment
- Occupational Health and Safety Act, R.S.O. 1990
- Canada Occupational Health and Safety Regulations, SOR/86-304
- Canadian Environmental Protection Act, S.C. 1999, c. 33
- Nuclear Safety and Control Act, S.C. 1007, c. 9
- National Building Code of Canada, 2010
- National Fire Code of Canada, 2010
- NFPA (National Fire Protection Association), 45 (2015) Standard on Fire Protection for Laboratories Using Chemicals
- NSF/ANSI 49 (2014) Biosafety Cabinetry: Design, Construction, Performance, and Field Certification
- SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) HVAC Duct Construction Standards – Metal and Flexible, 3rd edition (2005)
- Ontario Fire Code Part 4 (Reg. 388127)
- Scientific Equipment & Furniture Association (SEFA) SEFA 1.2/1996

2.0 Scope and Definitions

A chemical fume hood consists of an enclosed working chamber with an exhaust ventilation system attached. The workspace of the fume hood is ventilated by an induced flow of air through the face opening. The air flow is intended to capture and contain gases, vapours or aerosols generated within the enclosure. These airborne contaminants are then exhausted from the cabinet. Laboratory fume hoods are used as a primary means of protection to the employee from inhalation of and exposure to odorous and/or hazardous chemicals.

Biological Containment cabinets and Laminar Flow cabinets are not chemical fume hoods and therefore not in the scope of this document.

2.1 Definitions

Airfoil: a deflector shaped to promote uniform airflow into a fume hood.

Biological safety cabinet: a cabinet for containing potentially infectious aerosols generated by microbiological procedures. A biological safety cabinet is not a fume hood.

Chemically resistant: the ability of a solid material to resist damage by chemical reactivity or solvent action.

Cross drafts: all air currents external to the fume hood that can impact the performance of the hood.

Damper: an adjustable device for controlling airflow.

Perchloric acid fume hood: a fume hood where construction materials have been selected to prevent a reaction with perchloric acid.

Radioisotope fume hood: a fume hood constructed to contain spills, be easy to decontaminate and strong enough to bear the weight of any necessary radiation shielding material.

Recirculating fume hood: a fume hood that is not ducted outside, but instead air is passed though chemical-specific filters and the 'clean air' is returned to the laboratory. **(The Department of Environmental Health and Safety will not approve applications for use of recirculating fume hoods.)**

Face opening: the part of the fume hood through which work is performed.

Face velocity: the velocity of air moving through the face opening, usually expressed as feet per minute. In a laboratory setting the recommended face velocity is 100fpm +/- 20 fpm.

Sash: term used to describe the movable glass panel that covers the face area of a fume hood.

Baffles: Movable panels located on the sides and/or back wall of the fume hood that create slots in which air is exhausted. The pattern of air moving into and through the hood is determined by the setting of the baffles.

Bypass: Compensating opening in a fume hood that functions to limit the maximum face velocity as the sash is raised or lowered.

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3.0 Responsibilities

This section outlines the responsibilities within the university for implementation of this SOP.

3.1 Physical Plant Services

Physical Plant Services have the following responsibilities under this SOP:

- Ensure that a maintenance personnel who work with or perform maintenance on fume hoods shall be trained prior to use or servicing.
- Comply with CSA Standards when installing chemical fume hoods.
- Perform preventative maintenance on fume hoods, fans, and ductwork on a scheduled basis (at least bi-annually).
- Inspect and perform maintenance on sashes, lights, service fixtures and interior.
- Perform repairs or maintenance identified by scheduled inspections or by fume hood users.
- Notify the Department of Environmental Health and Safety when maintenance or modifications to fume hoods have occurred.

3.2 The Department of Environmental Health and Safety

Responsibilities of the Department of Environmental Health and Safety include the following:

- Ensure that the fume hoods are evaluated at least annually.
- Maintain documentation of relevant legislation.
- Establish criteria of acceptable performance.
- Perform field tests for verification of face velocity and test the operation of the air flow alarm.
- Perform field tests for verification of proper airflow and patterns.
- Implement and maintain a sticker program for testing verification.
- Report any variations from “acceptable performance” to Laboratory Supervisor/Principal Investigators, Departmental Safety Officer and Physical Plant Services.
- Certify sash height for safe working conditions based upon face velocity testing results and post appropriate signage.
- Maintain documentation of testing result records.
- Review this Standard Operating Procedure (SOP) periodically and amend as necessary.

3.3 Directors, Department Heads and Managers

Each has the following responsibilities under this SOP:

- Ensure that pertinent Supervisors, employees, and students are notified of their responsibilities

when working with fume hoods.
- Ensure that all employees and students have received instructions in the proper operation of fume hoods.
- Ensure that procedures, equipment and materials appropriate for the fume hoods under his/her authority are provided to protect the health and safety of all employees and students.
- Ensure that all employees and students are given adequate supervision and instructions on the hazards of chemical usage and fume hood operation.
- Ensure that the components of this SOP and the applicable legislation are implemented in all facilities under his/her authority.

3.4 Departmental Safety Officer

Departmental Safety Officers shall:

- Ensure that supervisors/principal investigators and all fume hood users are aware of their responsibilities under this document.
- Receive report from EH&S regarding fume hood testing results specific to department.
- Establish department-specific policies as necessary.

3.5 Laboratory Supervisors/Principal Investigators

Supervisors must be knowledgeable about hazards and standard operating procedures associated with working with the fume hoods under his/her authority, the education and training requirements, as well as the other requirements of this program. He/she has the following responsibilities:

- Ensure that Fume Hood Users receive safety training regarding best laboratory work practices and fume hood user guidelines prior to commencing work with fume hoods.
- Ensure that all fume hood users follow best laboratory practices when operating fume hoods.
- Ensure that no work or experiments are carried out in a malfunctioning fume hood.
- Receive report from EH&S regarding results of fume hood testing specific to respective laboratory.
- Coordinate modifications, maintenance, repair and new equipment needs with Physical Plant Services and/or the Department of Environmental Health and Safety.

3.6 Fume Hood Users

The responsibilities of fume hood users include the following:

- Rigorously follow best laboratory work practices.
- Use hoods only according to recommended guidelines for safe use.
- Notify Laboratory Supervisor/Principal Investigator immediately in the event of malfunction.

4.0 User Guidelines

4.1 General Use Chemical Fume Hoods

It is highly recommended that all operations that involve the following WHMIS hazard classes be performed in a functioning fume hood.

- Class B; Flammable and Combustible Materials
- Class C; Oxidizing Materials
- Class D1 (a & b); Materials with Immediate and Serious Toxic Effects
- Class D2 (a); Materials with Other Toxic Effects
- Class E; Corrosive Materials
- Class F; Dangerously Reactive Materials

Do not use any chemical without being aware of its physical characteristics and toxicity.

When using a fume hood, it must be remembered that the hood does not provide absolute containment or absolute protection from the materials in the hood. However, an appropriately designed hood in an appropriately designed laboratory will provide adequate protection if the following practices are observed:

Do not conduct work in a malfunctioning fume hood. Ensure that the fume hood is on before commencing any work. (Note – Fume hoods should be kept running at all times).

Safe operating practices:

1. Substitute toxic chemicals with less hazardous materials whenever possible.
2. Familiarize yourself with the MSDS for the chemical(s) you're about to use.
3. Operate the hood at the proper sash height as indicated by the EH&S sticker located on the front of the hood. The only time the sash may be above that height is during set up or tear down of experiments. In some cases the fume hood doubles as a general room exhaust, and in those instances the sash should be left open at all times. Physical Plant Services can provide that information to the lab operators.
4. Reduce foot traffic in front of hoods and minimize nearby disturbances such as the opening and closing of doors. Windows should never be open in a lab.
5. Do not position fans so that the airflow is directed across the face of the hood. This can interfere with the airflow and containment of hazardous chemicals.
6. Do not block the airfoil. The airfoil provides airflow across the work surface in the fume hood. If you use absorbent paper in the hood, keep it clear of the airfoil.

7. Do not block the sash windows from closing by feeding wires or hoses through. Cords should go into the fume hood from under the airfoil to allow the sash to be fully closed.
8. No adjustments should be made to the interior or exterior of the fume hood such as adjusting the baffles or removing side panels. Doing so will interfere with airflow and containment.
9. Place bulky equipment towards the rear of the hood and raise it about 2 inches off of the work surface with blocks or bricks. Do not place against the wall of the hood as it will block airflow to the rear.
10. Use extreme caution with ignition sources inside of a fume hood. Electrical plugs or other sources shall not be placed inside the hood when flammable liquids or gases are present.
11. Work as far inside the hood as possible, chemicals should be at least 6 inches from the front edge with the sash face between you and the task at hand.
12. Keep your working area and sash face clean and clear. To encourage use of the sash as added protection against splashes, sprays, etc. keep sash face clean. If sash must be blocked with paper or foil for certain experiments, please take it down after the experiment has been completed.
13. Never put your head inside a fume hood while operations are in progress and potential contaminants are being generated.
14. Do not use the hood as a storage cabinet for chemicals or equipment. Materials in fume hoods should be kept to a minimum and placed in a manner that will not interfere with airflow.
15. Place any heat-generating equipment in the rear of the hood. Heating devices in the hood produce convection currents that can disrupt airflow.
16. Do not use a hood for any function it was not designed for (e.g. for evaporation of chemicals). Refer to the Hazardous Wastes Disposal Procedures for instructions on waste disposal.
17. Wear protective equipment. Fume hoods do not prevent accidents or chemical splashes.
18. Clean up/decontaminate the fume hood after any spills and after every use.
19. It is recommended that chemicals and amounts used should be recorded in a log book, dedicated to one fume hood, in order that appropriate monitoring protocols may be used.

4.2 Radioisotope Fume Hoods

Fume hoods used for radioisotope work will be appropriately labeled and located in radioisotope laboratories only.

Refer to **Radiation Safety Policy and Procedures** for general rules for working with radioisotopes.

4.3 Perchloric Acid Fume Hoods

Perchloric acid is highly corrosive and oxidative and can react with organic materials to form explosive perchlorate salts and esters. The use of a perchloric acid fume hood will be required when conducting frequent procedures, using large quantities, heating perchloric acid or using anhydrous perchloric acid.

(Note: Acid digestions using acids other than perchloric should be performed in fume hoods designed to withstand the corrosive and damaging effects of repeated manipulations using acid. Consult with Physical Plant Services or the Department of Environmental Health and Safety for further information.)

4.4 Recirculating (Ductless) Fume Hoods

It is the policy of the Department of Environmental Health and Safety not to allow recirculating fume hoods to be used on campus for several reasons:

- They have limited use because of the wide variety of chemicals used at Queen's University;
- The use of inappropriate chemicals or compounds or other misuses of the recirculating fume hood could resulting contaminated air being recirculated into the laboratory; and
- It is difficult to determine whether the filters are functioning adequately or when they need to be changed. Therefore, the potential for recirculating toxic materials into the laboratory is significant.

5.0 Maintenance and Testing

Emergency and Scheduled Maintenance of Fume Hoods is the responsibility of Physical Plant Services and all other inquiries regarding these matters should be directed to that department. Face Velocity and Air Flow testing is the responsibility of the Department of Environmental Health and Safety.

A written safety plan for maintenance activities shall be developed and reviewed annually by Physical Plant Services which includes but is not limited to the follow:

- Specifications on the required personal protection equipment, including respiratory and protective clothing to be used by personnel while working on fume hood system components;
- The removal of all hazardous materials from the fume hood before commencing work;
- Provisions for the lockout of the fan motor;
- Physical barrier(s) to prevent use of the fume hood during the maintenance procedure;
- Fall protection of workers accessing and maintaining fume hoods which meet the requirements of the authority having jurisdiction;
- Power to the fume hood shall be shut off when maintenance is being performed. If the power cannot be shut off, safety procedures shall be in place to protect workers from injury; and
- Maintenance shall be performed only by personnel trained to conduct such activities. Only authorized personnel shall work on motors, drive systems, and other electrical components.

5.1 Scheduled Maintenance

Daily maintenance shall be performed by fume hood users which includes the verification of the following:

- Clean work-surface, baffles, and sash;

- Labeling and operation of services such as water, natural gas, and compressed air;
- Operation of general illumination, indicator lights, and associated switches;
- Sink drains are functional;
- Sash is easy to raise and lower; and
- Air flow alarm is operational.

All ground-fault circuit interrupters shall be tested monthly by the users or lab supervisors.

In accordance with CSA Standard Z316.5-15, every six months Physical Plant Services shall inspect and test the following:

- The fan;
- Motor;
- Drive belt and shafts; and
- Bearing and machine guarding.

Every twelve months, the maintenance schedule shall include the following (as applicable):
● Inspect the sash mechanism for corrosion and damage (including sash and cables);
● Inspect the fans, motors, drives, and bearings for correct operation and wear;
● Operate the wash down system and observe the performance to ensure thorough washing;
● Test the controls of the services to the fume hood for proper operation (eg: water, gas, air, vacuum etc);
● Inspect the integrity of the fume hood liner;
● Inspect the sink drain for corrosion, leakage and blockage;
● Check the stability and condition of the discharge stack (including guy wires);
● Inspect the condition of the exhaust ducting, particularly the integrity of the joints;
● Inspect the interior of the ductwork through inspection ports, or by other methods, particularly at bends where substances can accumulate and cause corrosion, perforation and horizontal runs;
● Measure face velocity and compare to fume hood specifications and correct if needed;
● Verify calibration of the airflow alarm;
● Check the laboratory make-up air balance and temperature and adjust as necessary;
● Check the operation of any balancing damper;
● Repair defects and lubricate as necessary;

5.2 Face Velocity and Containment Testing

Fume hoods must be tested for minimum control functions and face velocity as follows:
● After new installation;
● After any repair or modifications are made to the fume hood or exhaust system;
● At least once per year.

Air velocity and air flow testing will be carried out by the Department of Environmental Health and Safety according to the above schedule and also by request of the Department Head/Principal Investigator or Physical Plant Services.

Testing will include the following:
- A physical inspections to check the condition of the liner, sash, baffles, alarm, placement of equipment and free space within the fume hood
- Average face velocity of the fume hood when the sash is fully opened;
- Determination of sash height at which the average face velocity is 100 fpm, unless otherwise specified;
- Average cross drafts in front of the fume hood;
- Determination of the variable air volume response times;
- Small and large smoke test to determine air flow patterns and leakage.

5.3 Certification and Labeling

The Department of Environmental Health and Safety will implement a labeling and certification program. Each fume hood on campus will be provided with a label that carries the following information:
- Fume hood identification number;
- Sash opening height requirements to maintain 100 fpm face velocity;
- Date that the fume hood was inspected and by whom.

6.0 Installation of Fume Hoods

The installation of any fume hood on campus requires the approval of Physical Plant Services and the Department of Environmental Health and Safety.

Physical Plant Services will be responsible for assessing the installation with respect to the existing exhaust systems and coordinating the design of the installation to meet all applicable legislation. Physical Plant Services will also be responsible for amending existing Ministry of Environment Certificate Approval or applying for Certificates of Approval for new installations.

The Department of Environmental Health and Safety is responsible for receiving and approving the proposed design of the installation before construction work begins.

6.1 Fume Hood Selection

Only Constant Air Volume and Variable Air Volume fume hoods shall be installed. Auxiliary and Recirculating fume hoods shall not be used.

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Before a fume hood is selected, a risk assessment of the anticipated use of the fume hood should be undertaken. Failure to do so may result in the selection, purchase and use of substandard or inappropriate equipment. This could therefore increase the risk of injury to the fume hood user.

6.2 Fume Hood Location

The efficiency of a fume hood is directly related to its location in the laboratory. Traffic can cause air turbulence, which can then cause contaminants to be drawn outside the hood. Therefore, fume hoods should be located in areas with as minimal traffic as possible.

The fume hood should be located away from major air patterns (air inlets and other sources of air turbulence).

Seated work stations should not be located directly opposite fume hood openings.

More specific recommendations for fume hood locations can be found in CSA Standard Z316.5-15(Figure 1, page 49).

6.3 Fume Hood Exhaust Systems

Radioisotope and perchloric acid fume hoods must be exhausted separately from each other and from general-use chemical fume hoods.

Duct materials should be compatible with vapors to be exhausted. Stainless steel can be used with most solvents and potentially flammable vapors. The use of perchloric acid and corrosive vapors require the installation of acid resistant, non-reactive, impervious materials.

The ductwork shall:
- be designed in a manner that will provide optimum air flows in the working chamber of the fume hood;
- avoid horizontal runs in order to minimize the collection or build up of corrosive materials;
- provide circular cross-sections to reduce the number of corners and crevices where corrosion can occur.

Fume hood exhaust ducts shall not contain fire dampers.

The exhaust system shall meet legislative requirements and have a valid Ministry of Environment Certificate of Approval to discharge air.

6.4 Fume hood – Make up (Supply) Air

Supply air should be balanced with hood exhaust in the laboratory such that supply air should be slightly less than exhaust air to allow for the laboratory to be under negative pressure at all times.

Supply air should be at a suitable temperature to be acceptable by laboratory users.

7.0 Training

A training program shall be established by departments for personnel who use and maintain fume hoods. The training programs shall:

- Ensure the safety of users and maintenance personnel is not compromised; and
- Reinforce appropriate use and limitations of the fume hood, for the safety of the user, the facility, and the environment.

The training program should cover the topics listed in Table 8 of CSA Z316.5-15 Fume Hoods and Associated Exhaust Systems.

Personnel who work with or perform maintenance on fume hoods shall be trained prior to use or servicing.

Records documenting completion of training shall be maintained by departments and made available to the Department of Environmental Health and Safety upon request.

Revision History:

July 2005 – Initial Release
December 2015 – Updated to reflect changes in the new CSA Z316.5-15

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Appendix A
Application For Fume Hood Procurement / Installation

Contact Person:	Phone Number:

Location Information:

Building:	Room/Location:
Anticipated Installation Date:	Campus Department:

Fume Hood Information:

Type of Fume hood (including make and model): Will this hood replace an existing fume hood? Yes No Has the area been engineered to support the hood? Yes No If yes, by whom (ex. PPS engineer): _____; When _____ Has a list of chemicals to be used in this fume hood been submitted to EH&S Yes No Area Manager Approval: _____	
Additional Details: (Attach schematic drawings, designs, sketches etc.)	
(EH&S to complete) Approved For Purchase: Not Approved For Purchase	_____ Environmental Health and Safety Date
Installed equipment: Passed Certification Failed Certification Tested By: Date:	(EH&S to complete) Approved For Use: Not Approved For Use: Signed: Date: