FUME HOOD MANUAL

University of Windsor

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Introduction

A fume hood is an enclosed working chamber fitted with an exhaust ventilation system. It is one component of an exposure control system that is designed to contain, dilute and disperse gases, mists, vapours, and particulate matter to the external environment. It is also an integral part of the building air handling system. The fume hood is the primary engineering control device in most laboratories for protecting workers and students from exposure to hazardous chemicals. It is therefore imperative that it function properly at all times during its operation.

A fume hood structure is basically a cabinet, with an open side (or sides) for access to the interior of the hood. A transparent, movable sash, allows the user to restrict or enlarge the fume hood opening. The hood is connected, via ductwork, to an exhaust fan, usually located on the roof of the building in which the hood is located. The exhaust fan draws air from the room in which the hood is in through the hood opening and out through the ductwork.

This manual is intended to provide University of Windsor workers and students a greater understanding of fume hood selection, design, installation, operation and maintenance to ensure a consistent approach to the operation, testing and maintenance of fume hoods in laboratories at the University of Windsor.

This manual applies to all work that requires servicing and repairing of a fume hood, entering or removing duct work, entering the fan housing, changing filters, shutting off fans or any other maintenance that requires entering the inside of the exhaust system.

Special precautions are usually not required when servicing equipment that is outside of the fume hood cabinet and/or outside of the potentially contaminated air stream. For example, belts and pulleys may be serviced, vibration isolators may be adjusted and lamps may be replaced on many chemical fume hoods without entering the interior of the hood or exhaust duct.

Disclaimer

This manual addresses fume hood safety operational and maintenance issues. It must be reviewed by the Fume Hood User to ensure that their operations conform to the recommended procedures, as well as any federal, provincial or local laws and/or regulations.

Fume Hood Locations and Identification

The campus buildings that house fume hoods are:

1. Alan Wildeman Centre for Creative Arts
2. Biology
3. Centre for Automotive and Research Education (CARE)
4. Ed Lumley Centre of Engineering Innovation (CEI)
5. Education
6. Essex- Centre of Research Excellence (CORe)
7. Essex Hall
8. Great Lakes Institute for Environmental Research (GLIER)
9. Human Kinetics
10. Memorial Hall

Purpose of a Fume Hood

The primary purpose of a fume hood is to protect the user from exposure to potentially harmful chemical contaminates. The fume hood is a safety device that is designed to capture, contain and evacuate fumes, vapours and light matter. Successful hood performance depends on the velocity of air moving through the hood. The fume hood protects the user by pulling air into and through the hood opening and this inward airflow prevents vapours and gasses from entering the breathing zone of the Fume Hood User. Airflow is affected by cross drafts, entrance shapes, thermal loading and objects placed in the hood. The hood sash is meant to protect the user from exposure to harmful vapours, and to minimize the effects of explosions, fires, spills and splashes that may occur within the hood. Air from the fume hood is exhausted by fans and discharged into the outside atmosphere.

A fume hood that has been properly designed, manufactured, installed, and operated will deliver a safe working environment to laboratory personnel.

Purchasing a New Fume Hood

Selection Guide

This selection guide was developed in accordance with the Canadian Standards Association (C.S.A) Standard Z316.5 (Fume Hoods and Associated Exhaust Systems).

An assessment by Facility Services and the users should be made of the anticipated processes before a fume hood is selected to ensure that users are adequately protected and the fume hood may be expected to perform reliably. These may include but are not limited to the following: chemical resistance and reactivity; chemical toxicity; radioactive contamination; thermal stress; adsorption and absorption of hazardous substances; explosions; fire; services required (water, gas, and vacuum); mechanical stress, (vibration); and workplace environment.

Manufactures Information

The fume hood shall meet the minimum design criterial outlined in CSA Z316.5-04 and meet or exceed performance standards specified by ANSI/ASHRAE 110-1995. The following information should be obtained from the manufacturer prior to purchase.

1. Type of fume hood and exhaust system.
2. Identification of all materials of construction.
3. Dimensioned drawings of the fume hood.
4. Results of the evaluation in a test facility.
5. Operating and maintenance instruction for all the equipment used.
6. Any specific limitations on use.

Fume Hood Style & Considerations

1. All fume hoods shall be “High Performance” type, designed to meet the ASHRAE 110 test.
2. “Make up air” (auxiliary air) type fume hoods will not be used under any circumstances.
3. By-pass and restricted bypass style fume hoods are allowed but carefully selected with respect to constant or variable air volume applications.
   a. Constant air volume (CAV) fume hoods with bypass are recommended. These hoods shall have bypass grilles/openings of adequate size to maintain an acceptable face velocity over the entire range of sash openings.
   b. Variable air volume (VAV) systems are acceptable if properly designed. With variable air volume application, a restricted bypass should be selected to reduce the exhaust airflow as sash closes.
4. Perchloric Acid hoods and exhaust fans must be specifically designed for that use and never be tied to a manifold system.
5. Radioisotope hoods and exhaust fans must be specifically designed for that use.
6. All fume hoods shall have an audible and visual alarm to indicate to the user when the air flow deviates from the set point. Only authorized personnel shall be able to adjust the alarm set point, and the alarm shall remain functional in the event of loss of main electrical power.

When ready with your selection, fill in the Fume Hood Selection Form (Appendix 3 CCC-2010-12) and submit to the Chemical Control Centre. The Chemical Control Centre and Facility Services will review and assist in the ordering and purchasing process and will ensure the new fume hood is added to the University of Windsor Fume Hood inventory records.

Installation

Fume hoods shall be installed according to the manufacturer’s instructions. The following information shall be recorded and kept on file by Facility Services when the fume hood exhaust system is installed:

1. “As built” drawings showing the complete installation
2. Identification of the materials of construction
3. Operating and maintenance instructions
4. Make, Model, Serial Number and Associated Exhaust Fan Location

Commissioning

After the installation, the Chemical Control Centre, Facility Services and the Contractor shall be notified to commission the fume hood. Commissioning shall include, but not be limited to, determinations of the following:

1. Electrical safety
2. Adequate lighting
3. Noise level (less than 55 dBA)
4. Functioning of components and services
5. Field performance test results as specified in Clause 9.4 CSA Z316.5-04.

Documentation of these requirements shall be included in a commissioning report and submitted to the Chemical Control Centre. All fume hoods on campus will be listed on a University of Windsor Fume Hood Inventory database maintained by the Chemical Control Centre.

Fume Hood Responsibilities

In order for the manual to be effective, all workers and students who work with or supervise those working with fume hoods or perform fume hood maintenance shall understand and follow these responsibilities and guidelines.

Supervisor

A supervisor is a person who has charge of a workplace or authority over a worker. Examples of a supervisor may include but are not limited to the Dean, Department Head, Professor, Manager, Team Leader, and Senior Staff Member. The supervisor is responsible to ensure all lab personnel are instructed and trained on the proper operations of the fume hood and have taken the Fume Hood Training, and records of this training shall be kept. In addition the supervisor shall:

- Perform routine inspections of the fume hood.
- Ensure fume hoods are not being used improperly. Example: alarms silenced, cluttered, used for storage.
- Inform lab personnel if the fume hood is not working and instruct personnel to discontinue use of the fume hood and label fume hood with notification.
- Take appropriate assessment and corrective measures where fume hood performance is uncertain. This may include lockout of the fume hood to render it safe.
- Arrange for repair or air flow adjustments through the work order process with Facility Services by contacting dispatch at extension 2850 or repair@uwindsor.ca
- When work must be done inside of the fume hood, the supervisor shall ensure the sash is shut, hazardous materials are closed, secured and if necessary removed from the fume hood, and free from active experiments prior to and for the duration of the repair.

Fume Hood Users

A user is a person who performs work in a fume hood or supplies service to a fume hood.
The fume hood user shall:

- Not use the fume hood until instruction and training has been provided.
- Follow proper procedures when using the fume hood.
- Report questionable operation of a fume hood to the Supervisor.
- If a fume hood requires service, or if you wish to install, move, or upgrade a fume hood contact Facility Services dispatch at ext. 2850 or repair@uwindsor.ca. When requesting service, please be sure to reference the number of your fume hood.

Each fume hood user is expected to promote safety in the workplace and practice safe work procedures. Fume Hood Users should be able to answer the following questions before using a fume hood:

1. Has the fume hood been tested within the last year?
Check the card on the front panel of each fume hood is up to date.

2. Is the fume hood face velocity in the acceptable range (80 -120 fpm)?
Check the airflow alarm for the alarm light or buzzer noise. Check to see that the audible alarm has not been disabled.
If a visual display is not installed on the alarm, check for airflow with a paper strip hung from the bottom of the hood sash. Do not rely on noise from the fume hood to indicate proper operation (blower motor noise may persist even if a fan belt breaks).

3. Is work in the fume hood being conducted six inches back from the sash?
Setting work back six inches from the plane of the sash reduces influence of drafts from people, doors, air supply diffusers, etc.,

4. Is housekeeping in and around the Fume Hood acceptable?
Materials (supplies, equipment, etc.) in the fume hood typically reduce hood efficiency. Therefore, it is prudent to remove all materials not required for the task at hand.

5. Does the sash slide easily?
The fume hood safety-glass sash protects the user in case of fire or explosion as well as from fumes during routine operations. A sash that is difficult to move will not likely be set at optimal working heights. Notify your Supervisor if not functioning properly.

6. Is the sash at the proper height?
The fume hood sash should be kept at or below the "keep sash below this level" sticker. If the hood does not have this sticker, please call Health &Safety. Sash openings of over 18 inches may cause undesirable drafts in the fume hood.

7. What do I do if a fire occurs in my hood?
Be certain you know where your fire extinguishing equipment is located and that it is appropriate for the materials being used. Dial 911 if you are not confident that you can safely extinguish a fire.

8. Is the fume hood baffle properly set?
Some fume hoods have multiple baffle settings. Under most conditions, your fume hood will be most effective set in the "average" or "heavier than air" positions. The "lighter than air" setting should be used only for hot operations or when fumes are known to be less dense than air.

Facility Services

Facility Services is involved in the acquisition, installation, commissioning and maintenance of fume hoods on campus. Facility Service personnel shall:

- Ensure all fume hoods ordered through projects meet the regulatory requirements outlined in Z316.5-04 and this manual.
- Ensure installation of fume hood is done in compliance with the manufactures instructions.
- Ensure a commissioning report is conducted and provided to the University in accordance with the regulations and this manual.
- Notify and forward all commissioning, decommissioning reports to the Chemical Control Centre to be reflected in the University of Windsor fume hood inventory system.

As maintenance staff performs maintenance on fume hoods and filters, Facility Services shall:

- Upon receiving a work order request, Facility Services will conduct a fume hood system evaluation and communicate with the Supervisor an appropriate time line for evaluation and repair.
- Facility Services shall send out a Service of Interruption Notice to all parties prior to the date of work.
- Perform all required repairs to ensure the fume hood is performing in the acceptable range and all components are operational to ensure the fume hood provide a safe and reliable service.
- Contact the appropriate personnel to complete repairs as required.
- Notify applicable department, Supervisor and the Chemical Control Centre of completed repair.
- Perform annual inspections as outlined in CSA Z316.5-04 and Appendix 1 of this Manual.

Chemical Control Centre

The Chemical Control Centre is a resource for staff, students and faculty on the safe use of hazardous materials on campus. The Chemical Control Centre shall:

- Provide fume hood training to all required users and maintain a list of all users who have received training.
- Assist in the selection, purchasing, registration and decommissioning of fume hoods on campus.
- Maintain the University of Windsor fume hood inventory and database.
- Place height indicators and nameplates on fume hoods that are missing these indicators.
- Perform or arrange for face velocity measurements to be conducted on all fume hoods annually and place pass (green) or fail (red) inspections stickers on fume hoods.
- Place “Do Not Use” stickers on fume hoods that do not meet the face velocity range of 80-120fpm and notify the Supervisor and department head with the results.
- Perform face velocity measurements on fume hoods after maintenance is performed, removes “Do Not Use” stickers if required.

Types of Fume Hoods

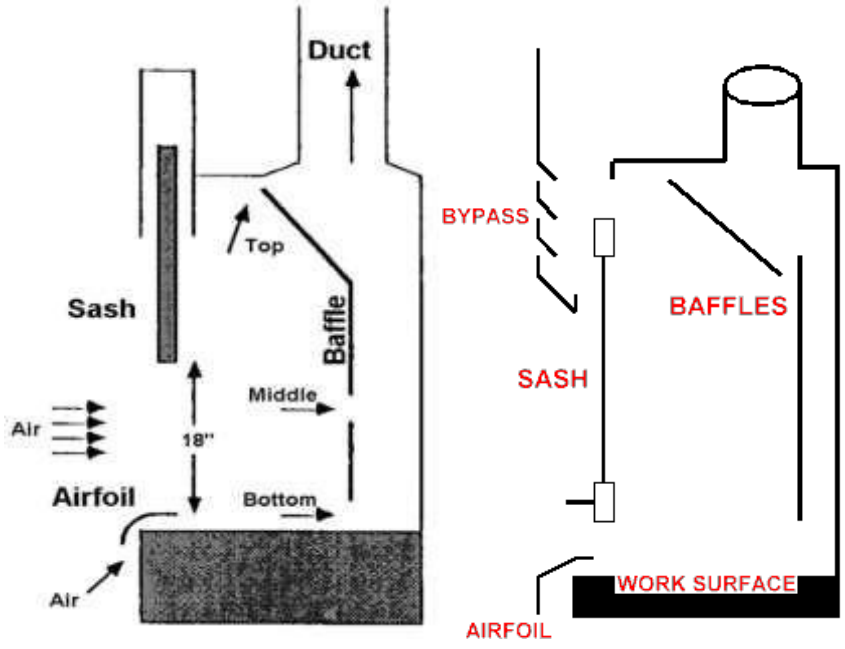
The following is a summary of some fume hoods that are installed at the University of Windsor:

1. Vertical Sash - A hood with a single vertical rising sash.
2. Horizontal Sash – A hood with two or more horizontal sliding sashes.
3. Combination Sash – A hood with a vertical rising sash as well as two or more moveable horizontal sashes.
4. Constant Air Volume (CAV) - Exhausts the same amount of air at all times, regardless of sash height.
5. Variable Air Volume (VAV) - Also called a Constant Velocity Hood. Varies the amount of air exhausted, based on sash height, to maintain a constant face velocity

Components of a Fume Hood

The following is a summary of the major components of a fume hood:

- Exhaust Duct – exhausts fumes and vapours.
- Baffles – maintains a uniform airflow across the face of the hood.
- Airfoil – prevents turbulent eddies at the face.
- Sash – see through barrier.
- Bypass Grill – helps maintain constant face velocity when the hood is closed.



FUME HOOD PERFORMANCE AND CONDITION CRITERIA

This section describes the operating performance criteria (primarily sash height and airflow face velocity) and physical condition criteria that has been established for fume hoods. In addition, several other factors may affect the operating performance of a fume hoods such as the location of the hood in the lab, make-up air, weather conditions outside, etc.

Sash Height and Face Velocity

All laboratory fume hoods on campus have been labeled with an arrow sticker indicating the maximum safe sash height for the hood. The sash should not be raised above this height because it may compromise the safety of lab personnel.

University of Windsor Fume hood policy dictates that:

- The fume hood face velocity must be between 80 and 120 feet per minute (fpm) with sash at 18".
- Fume hoods with face velocities less than 80 fpm and greater than 120 fpm (measured using an 18" sash height) must be serviced and must not be used until servicing has been completed.
- The Chemical Control Centre will confirm that the fume hood is acceptable after repairs are completed.

It is important to remember that face velocity is not the only factor contributing to hood performance. Work practices and make-up air also affect performance.

Fume hood face velocity will be measured by University of Windsor Chemical Control (CCC) personnel annually. If it is suspected that a fume hood is not operating properly, immediately notify your Supervisor.

When the annual face velocity measurement is complete, the certification sticker (located on the face of every fume hood) must be updated.

Note - Face velocity may be lower than 80 fpm or higher than 120 fpm if designed by manufacture to perform outside of this range. These fume hoods will be clearly identified on the fumehood by a notice from the CCC.

Higher face velocities do not offer more protection. They can result in decreased protection due to turbulence within the fume hood causing the release of contaminants from the hood to the worker.

Laboratory Supply Air

Make-up or supply air has a significant effect on a Fume Hood performance. Different types of supply systems have different requirements for supplying air to the lab without detracting from the performance of the laboratory hood. Some recommendations for supply air systems include the following:

- Ceiling diffusers should not be located immediately in front of the hood face. Deflecting supply air from the quadrant of the diffuser blowing at the hood face should result in better hood performance.
- Wall grilles or registers are not recommended by ACGIH (American Conference of Governmental Industrial Hygienists) for new facilities. However, in existing facilities, the wall grilles should have double deflection louvers set for maximum deflection.

Laboratory Services to Fume Hoods

Electrical

Duplex receptacles are provided. They are typically 120 volt, 20 amp, GFI, receptacles, mounted in the side post. Electrical service to each fume hood should be on a dedicated electrical circuit and CSA approved. The receptacle should be flush-mounted in a weatherproof box in the side post of the fume hood.

Plumbing Services

Isolating valves should be located within the end panels, controlled by handles projecting through the side-posts of the fume hood. These or any other controls installed on the side posts should be located to avoid any interference with the smooth entry of air into the fume hood. Acid neutralization tanks shall be installed on all fume hood sink drains as applicable.

Fixtures

Fixtures / valves for water, air, gas or nitrogen, exposed within the hood are to have a chemical resistant metallic bronze finish, and portions exposed on the exterior of the fume hood are to be chrome-plated. De-ionized and Reverse Osmosis water faucets should be polyvinyl corrosion-resistant finish with polyoxymethylene lining, and stainless steel valves. Faucets must be aligned with the cup sink to prevent overspray and wetting of interior hood surfaces. Colour coding and identification of service fixtures shall be according to the standard of the laboratory facility.

Cup Sinks

Cup sinks shall be raised 6 mm above the recessed work surface to prevent spills from entering the plumbing system, drains lines shall be 38 mm with integral debris catch.

Access to Services

Cut-outs for plumbing and electrical services and fitments are provided with the fume hood and all unused openings in exterior panels for service connections shall be complete with cap plugs of the same material as exterior panels.

Service connections shall be accessible from the outside of the fume hood, using removable panels. Isolating valves must be provided on the building side of the services. Where two or more hoods are installed side by side, interior service panels may be used. They shall be of the same material as the interior panels, have beveled edges and molded PVC gasket, and shall be secured by non-corrosive fasteners set flush with the face of the panel.

Integration with Room HVAC and Exhaust Systems

Some of the fume hood exhaust systems are integrated with the heating, ventilation and air conditioning (HVAC) system of the laboratory and some are not.

Fume Hood Operating Modes – Air Systems

Caution must be exercised at every individual laboratory to ensure that the HVAC sequence of operations correctly addresses the various possible fume hood operating modes.

Fume Hoods with Dedicated Exhaust Fan

1. Exhaust fan operation: Manual control (on/off switch) should be flush-mounted on the exterior surface of the fume hood and the Switch is labelled.
2. Fume hood exhaust fan shall not be turned off unless the hood is not in operation.
3. The local flow audible and visual alarms will indicate the air velocity is outside the acceptable range.
4. Fume hoods should be used only if **ALL** safety controls are satisfied.

Manifold Fume Hood Exhaust System

This is similar to the **Fume Hoods with Dedicated Exhaust Fan** except that no local control of exhaust fans. Instead, central system exhaust fans and Phoenix valves control the fume hoods.

Chemical Fume Hood Testing Procedure

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.

Face velocity testing will be carried out by the CCC annually and also by request of the Department Head/Research Supervisor. Every three years the face velocity measurement will be carried out by an external contractor.

Testing will include the following:

- Average face velocity of the fume hood when the sash is 45 cm opened (18 inches).
- Determination of sash height at which the average face velocity is 100 fpm, unless otherwise specified; Face velocity readings shall not vary by more than 20%. A minimum of six readings shall be used determine average face velocity.
- Smoke test to determine air flow patterns and leakage – to be carried out by an external contractor every three years or as required.

Detailed procedure for average face velocity testing is specified in the Chemical Fume Hood Testing Procedure (CCC-2010-14), see Appendix 2.

Inspection and Labeling
The CCC is responsible for inspecting and labeling all fume hoods on campus. The CCC will place identification cards and the labels to mark the recommended height of sash opening.

Maintenance
The fume hood maintenance procedure is designed to routinely verify the proper operation of fume hoods for all users. Proper maintenance and repairs will ensure the protection of users and staff against exposure to harmful vapours.

When conducting maintenance work on fume hoods, all work must be carried out according to current regulations. The work on fume hoods refers to all preventative or corrective maintenance work on all exhaust systems during which a person could be exposed.

This procedure applies to all personnel who perform maintenance and may require entering or removing duct work, changing filters, shutting off fans or any other maintenance that requires entering the inside of the exhaust system.

Fume Hood Maintenance
Fume hood service is provided by designated personnel and Facility Services. If you suspect your hood is not performing adequately, notify the supervisor.

Fume hood maintenance can involve daily, periodic, and/or annual inspections and details are specified in CSA Z316.5-04. When performing fume hood maintenance, proper pre-maintenance procedures shall be taken. When coordinating a shutdown of the system, all Supervisors affected by the shutdown must receive notification prior to the beginning of maintenance.

Please refer to Appendix 1 for Scheduled maintenance of Fume Hoods to be completed.
The supervisor shall remove any active experiments and make sure that all containers of hazardous materials are sealed shut before the fume hood receives maintenance.

Within the exhaust system, it shall be verified that the hazardous materials have been secured and that the area surrounding the system is cleared.

Note: It is not necessary to shut down the exhaust system when replacing lamps, cleaning behind the fume hood baffles, or replacing the airflow sensors.
For each hood type there are specific guidelines on proper maintenance and personal protective equipment (PPE).
Maintenance Staff shall not handle laboratory equipment. It must be assumed that the internal duct surface, fume hood lining and all internal exhaust components are potentially contaminated with chemical residue. Ask the Supervisor if any unique hazardous materials such as perchloric acid or radioactivity were ever used in the hood. If so, contact the Chemical Control Centre.
The following personal protective equipment (PPE) shall be worn when conducting maintenance on a Fume Hood:

- Half face air purifying mask shall be worn.
- Nitrile gloves, splash proof goggles, and coveralls shall be worn.
- Individual workers must maintain their PPE according to manufacture specifications and training provided.
- Additional PPE may be needed depending on the hazardous materials associated with the fume hood.

All maintenance personnel working on fume hoods shall wash their hands with soap and water (even if gloves were worn) at the completion of their work. In general, good personal hygiene such as washing your hands after working in any lab is highly recommended.

After maintenance work is completed, PPE shall be disposed of in accordance with Health & Safety requirements.

If potential contamination is identified, Maintenance staff must speak with their Supervisor.

Prior to any maintenance work being completed on an active fume hood:

1. The Supervisor of the user group must be contacted by Facility Services and informed that maintenance will be performed on their fume hood through a Service of Interruption Notice.
2. The user group must stop all use of the fume hood, ensure the fume hood is free from all active experiments, ensure all containers are capped and in proper storage containers and remove equipment as required.
3. If work is required on the interior of the hood, ask the laboratory personnel to move any chemicals and equipment in the hood and ensure all spills have been cleaned up/decontaminated.

Radioactive Material Hoods

If a radioactive material hood is being repaired, the tradesperson should verify with the lab personnel that a survey of the hood has been performed and no radioactive contamination is present. Do NOT work in areas or on equipment that is posted with Radioactive Material signs or labels.

Perchloric Acid Fume Hoods

Perchloric acid is highly corrosive and oxidative and can react with organic materials to form explosives. The use of a perchloric acid fume hood may be required when conducting frequent procedures, using large quantities, heating perchloric acid or using anhydrous perchloric acid. A risk assessment should be performed with the supervisor prior to working with percholoric 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.

Exhaust Fans

Facility Services shall;

1. Verify if fan is a dedicated fan or serves multiple fume hoods.
2. Confirm if fan is operational.
3. Inspect fan mountings, flexible connectors, pulleys and impeller and adjust/replace as necessary.
4. Check fan, motor, drive and bearings for correct running and repair /adjust as necessary
5. Inspect fan discharge flue for stability/slippage and repair/adjust as necessary.

Ductwork

Facility Services shall;

1. Inspect all ductwork for cracks and repair as necessary.
2. Inspect ductwork for additional attachments of tubing or miscellaneous ductwork that may have been added.
3. Check fire dampers for correct operation
4. Check volume control dampers for correct setting.
5. Check supply air inlets and measure velocity/volume on all grilles/diffusers and compare inlet/extract volumes for correct operation.

Room

Supervisors shall examine the surroundings of the fume hood with respect to furniture or large equipment installed after the original installation or previous check which do not comply with the requirements. Rectify as necessary.

Fume Hood Velocity Alarms

To provide additional protection to laboratory personnel, all fume hoods have been supplied with air velocity monitors.

These velocity alarms provide continuous monitoring of the air flow through the fume hood complete with a visual and audible alarm in the event of abnormal air flow conditions. Monitors provide adjustable alarm set points and a test button to confirm satisfactory operation.

Scheduled Shutdown Procedure – ALL Hoods

Facility Services will issue a Notice of Service Interruptions for all scheduled fume hood shutdowns. In preparation for the shutdown supervisors shall ensure all fume hoods in laboratories are cleared of active experiments, open chemicals, reagents or waste containers. All chemicals, reagents and waste that cannot be removed must be sealed and/or capped. Store chemicals and reagents in their appropriate storage containers and areas. A fume hood is not a storage area. Waste containers can be brought down to the Chemical Control Centre for disposal.

Supervisors post an "Attention – Do Not Use This Fume Hood" notice on the fume hood to be shut down. It is important that this notice be posted in the lower, center area of the sash so it is easily visible to lab occupants. Refer to Appendix 4 for the Do Not Use This Fume Hood Templates to be placed on the Fume Hood.

Where practical the sash of the fume hood must also be locked out (see lock out/tag out procedure) so lab occupants will not be able to inadvertently use the hood. Please be sure to check with lab occupants before locking out a fume hood so any research materials or experiments can be removed.

Upon completion of work on exhaust components, contact CCC to verify and document face velocity results, The CCC will remove the "Do Not Use This Fume Hood" notice. For work that does not affect the face velocity the supervisor can remove the notice.
Note: The new verification date may not affect the annual inspection date.

Unscheduled Shut Down

Facility Services personnel will post the emergency shutdown Service of Interruption Notice. Once notified, the Supervisor shall ensure the all affected fume hoods are locked out (if applicable) before an unscheduled shut down occurs.

Lock Out / Tag Out Procedures

Lockout is the use of a lock or locks to render machinery or equipment inoperable or to isolate an energy source. The purpose of a fume hood lockout is to prevent the accidental or inadvertent operation of the fume hood while it is not functioning properly. Lock out will ensure fume hood users and/or maintenance workers are not exposed to potential hazards associated with the fume hood and equipment. Maintenance is any work performed to keep machinery or equipment in a safe operating condition.

Implementing lockout

Lock out of the fume hood is required anytime the operation of the fume hood is in question and the function may result in a risk to the user and/or maintenance staff. Lockout is required for mechanical service and maintenance operations if the procedures to be performed could involve worker and/or student exposure to hazardous materials, energized electrical parts, to machinery that could unexpectedly start up, or to a stored energy source on the equipment or machinery. There may be times when full lock out is not required, this will be determined in consultation with the supervisor, health & safety, facility services and/or service provider.

Personal locks
Every Supervisor that is required to lock out machinery or equipment needs a lock and keeps the key to that lock. This lock ensures personal lockout protection. Each department, Health & Safety and Facility Services have their own locks to lock out the fume hoods.

Lockout
Once a Supervisor has determined that lockout of a fume hood is required, follow the procedures below. Every individual who is responsible to lock out a fume hood must know these steps.

1. Identify the fume hood that needs to be locked out.
2. Shut down all operations within the fume hood (Fume hood users may be required to assist in this step). Supervisors shall ensure all Fume hoods in laboratories are cleared of active experiments, open chemicals, reagents or waste containers. All chemicals, reagents and waste that cannot be removed must be sealed and/or capped.
3. Store chemicals and reagents in appropriate storage containers and ensure that the act of shutting off equipment does not cause a hazard to other workers.
4. Apply a personal lock to the fume hood, and ensure that all parts and attachments are secured against inadvertent movement.
5. Test the lockout to make sure it's effective and to verify that the Fume hood has been effectively locked out.
6. A tag shall be placed on the lock to identify the following information:
    - Area responsible for lock out
    - Date of Lock Out
    - Reason for Lock Out
    - Contact Information – Name, Phone, E-mail

Remove Locks.

1. A personal lock must only be removed by the individual who installed it, or if this is not possible, the matter must be referred to the supervisor or department in charge, who may take responsibility for its removal.
2. Removal by a Supervisor or manager in charge must only take place after making every reasonable effort to contact the worker who installed the lock, and ensure that the machinery or equipment can be operated safely.
3. A worker must be notified at the start of his or her next shift if the worker's personal lock(s) has been removed.

The procedures outlined in this manual will be followed when completing the repairs.

Fume Hood User Safe Work Practices

The health and safety of laboratory personnel and building occupants must be the primary goal of laboratory management.

Properly functioning fume hoods help achieve this goal with respect to the hazards of chemical vapours and other harmful airborne substances. It is important to remember that a fume hood is not a storage area. Keeping equipment and chemicals unnecessarily in the hood may cause airflow blockage.

An Operational Checklist Sign is recommended to be posted in areas where fume hoods are used, to remind the users of the minimum guidelines for operating the fume hoods. In addition, there should be a warning notice for actions that should NOT be undertaken.

The following is a summary of the minimum safe work practices:

Note – all fume hoods users must take Fume Hood Training prior to operating any fume hood.

- Train and educate users on fume hood use and specific hazards and work methods that help reduce contaminant exposure.
- Have a general awareness of the operation of your fume hood and be aware of any differences in visual or audible cues that may imply a change in function.
- Substitute toxic chemicals with less hazardous materials whenever possible.
- Keep fume hood exhaust fans on at all times.
- Perform all work six inches inside the fume hood.
- Never place your head inside the fume hood.
- Keep the fume hood sash closed as much as possible at all times to ensure the optimum face velocity and to minimize energy usage.
- Keep lab doors and windows closed to ensure negative room pressure to the corridor and proper air flow into the fume hood.
- Do not store chemicals in the fume hood.
- Keep the slots of the baffle free of obstruction.
- Do not use the fume hood exhaust as a waste disposal mechanism (e.g., for evaporation of chemicals).
- Avoid rapid movements in front of the fume hood including opening and closing the fume hood sash rapidly and swift arm and body movements in front of or inside the hood. These actions may increase turbulence and reduce the effectiveness of fume hood containment.
- Do not override or disable mechanical stops on the sash

Fume hood exhaust fans may shut down due to unexpected failure or for periodic fan maintenance. Scheduled exhaust fan outages will be coordinated and communicated by Maintenance. When exhaust fans shut down unexpectedly or when face velocities are low, all fume hood operations must be shut down, experiments terminated and all chemical

containers capped.

Fume Hood Use

- Always walk by fume hoods slowly at least three feet behind the operator at the fume hood. Air currents produced by a rapidly walking person can draw vapours and gasses out of the fume hood and expose the operator.
- Never walk by fume hoods rapidly or too closely behind the user at the fume hood.
- When removing objects and arms from fume hood, always move slowly in a direction parallel with airflow. Airflow will help to clean fumes and gasses off of arms and objects when arms are parallel with airflow direction.
- When removing objects and arm from fume hood, never use a scooping or side-to-side motion.
- Movement across the fume hood will defeat the inward airflow and may cause fumes and vapours to be drawn out.
- Keep doors and windows closed. Open windows and laboratory doors that are propped open cause disruptive air currents that can compromise fume hood performance and place operators at risk. Laboratory heating, cooling and ventilation systems are designed to operate with laboratory doors and windows closed.

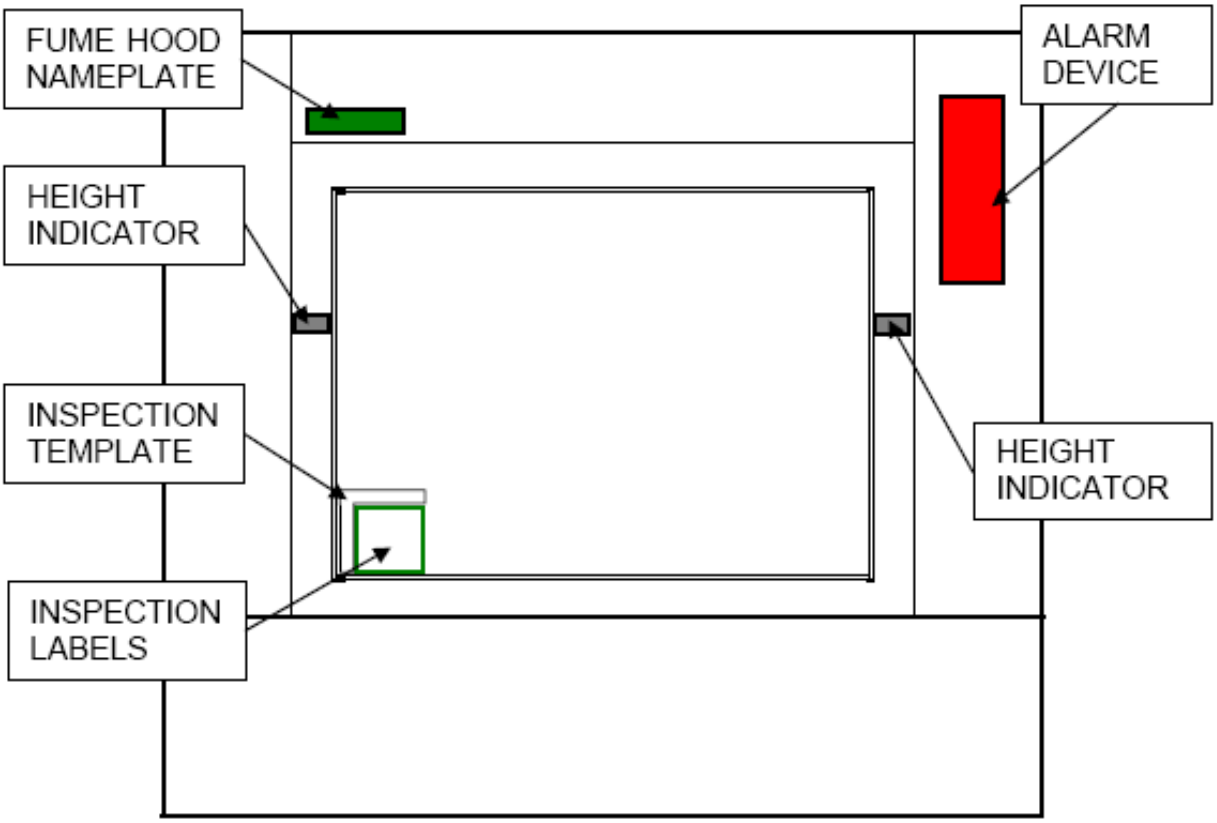
Flow Alarms (if installed)

- Verify the operation of the fume hood alarm daily.
  If the alarm fails to function after 30 seconds, close the hood sash and contact the Supervisor. Never operate the fume hood when the alarm is not functional.
- When alarm sounds, lower the sash and step away from the hood. If the alarm does not reset, evacuate the area and contact supervisor. There may be a malfunction in the exhaust system.
- Do not defeat the alarm function in any way.
- Do not tamper with the alarm settings or calibration.

Visual Management Standards

The Chemical Control Centre shall;

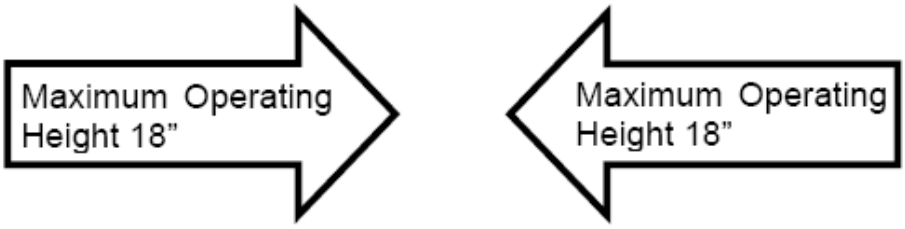
- Provide a Template Label for the location of the Inspection Sticker. This will provide all users an anchor point for where to locate the Inspection Sticker on each Fume Hood.
- Provide two (2) height indicators at the 18” height above the Fume Hood Bench.
- Provide a Nameplate with the name of the Fume Hood.
- Provide a Green (for pass) or a Red (for fail) Inspection Sticker with the following information:
  1. Inspection Date
  2. Measured Average Face Velocity
  3. Next Inspection Required By
  4. Associated Exhaust Fan
  5. Inspection Performed by



Fume Hood Identification Nameplate:

EH 371-1-01

Height Indicators:



Fume Hood Inspection Program

Fume Hood Number: _____

University of Windsor
Chemical Control Centre

1. Inspection Date: _____ (mm/dd/yyyy)

2. Average Face Velocity: _____ fpm

3. Next Inspection Required by: _____ (mm/dd/yyyy)

4. Associated Exhaust Fan

Name: _____

Location: _____

5. Inspection Performed by: _____ (initials)

_____ (Verification Authority)

Typical Fume Hood Inspection Sticker at each Fume Hood

Typical Air Flow Monitoring Station at each Fume Hood

Experiment Setup

- During setup and teardown only, the sash may be raised beyond the established working position.
- During setup time, there must be no hazardous vapours or gasses present in the fume hood since the fume hood will provide **NO PROTECTION.**
- Wait at least two minutes after all hazard generating activity has ceased before opening the sash above working position.
- During setup and teardown of experiments, the fume hood alarm will most likely sound due to insufficient airflow. During this time only, it is acceptable to mute the alarm by pressing the "Test" or "Enter" button. Alarms vary by manufacturer; contact the Supervisor if in doubt.

Sash Use

There are two types of sliding sashes on the front of fume hoods in common use:

- The Vertical Sash is the most common and moves vertically only.
- The Combination Sash consists of horizontally sliding panels in a vertically rising frame.

General Guidelines for Users

1. Always fully close the sash when the fume hood is unattended.
    - Open sash on unattended fume hoods may expose others users to potential hazards.
    - Active experiments may go awry – closed sash will help contain hazardous materials even if the fume hood is unattended.

<u>Acceptable Sash Use</u>

1. Sash is set at the maximum working height of 18".
2. Safe working height may vary from fume hood to fume hood. Check the fume hood for labels indicating the safe working height.
3. Operator's face is protected by safety glass.

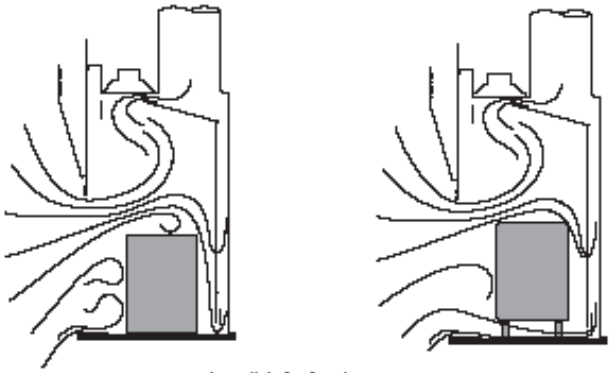
<u>Not Acceptable Sash Use</u>

1. Never raise the sash fully during active work.
2. Never insert you head or face inside the sash opening. Keep nose at least 3" outside plane of sash.
3. A wide open sash may result in unacceptably low face velocities and vapours may escape from the hood into the laboratory.
    - Insertion of the face inside the sash will result in exposure to fumes and vapours from experiments.

Apparatus Location

- Always locate apparatus at least 6 inches behind the sash plane. If this is not done, vapours and gasses released near the hood face may not be captured and contained.

- Always support large object on blocks. Airspace beneath these objects reduces airflow disruption and vapour buildup in front of the object. Ensure adequate air flow within the fume hood; consult with supervisor if in doubt.



Provide 2" lift for large equipment

Fume Hood Lighting

- Always turn the light on when using the hood.
- In the event that lamps need to be replaced, contact the Supervisor immediately since poor lighting can cause accidents.

Materials in Fume Hood

- Hood must be kept clean and uncluttered. Only small quantities of materials shall be stored in the hood.
- Large objects in the fume hood needlessly disrupt proper airflow and reduce the protection provided.
- With poor and unsafe housekeeping, severity of a fire increases since greater quantity and variety of materials become involved.

Heat in Fume Hood

- Avoid the generation of large amounts of heat in the hood.
- High heat loads within low volume or variable volume type fume hoods can overcome the negative pressure that the fume hood requires to provide containment.
- Low flow fume hoods are not suitable for applications that produce high heat loads.

Baffles

- Keep opening around the baffles in the rear and top of the fume hood clear of obstructions such as laboratory wipes.
- Do not adjust the baffles in any way. Only qualified personal should adjust baffle or duct dampers.
- Airflow may be affected, and workers could be exposed if baffles are improperly adjusted.

Electrical Safety

- Never tamper with cords or use ungrounded electrical items.
- Electrical **SHOCK** may result.
- Never use electrical items when flammable gasses or vapours are present in the hood. **FIRE** or **EXPLOSION** may result

Decommissioning

Chemical fume hoods will not be re-located or decommissioned without prior notification being given to the CCC and Facility Services.
Decommissioning shall be done with accordance of CSA Standard Z316.5-04(14) and the fume hood must be rendered unusable and safe by following these guidelines:

1. Remove all services (power, water, vacuum, gas, nitrogen, etc.) - cap lines if possible.
2. Turn off exhaust fan (typically via disconnect or fan shut off switch).
3. Use lockout system to prevent sash from opening during decommissioning.
4. Cover sash opening with plywood and screw in place.

Once the fume hood has been removed from service, the CCC must be notified to remove the fume hood from the active inventory and the data base updated.

Definitions

Fume Hood

In the context of this guideline, “fume hood” means “a boxlike structure enclosing a source of potential air contamination, with one open or partially open side, into which air is moved for the purpose of containing and exhausting air contaminants, generally used for bench-scale operations but not necessarily involving the use of a bench or table.”—*ANSI/ASHRAE 110*

Alarms, sensors, controls, and gauges

All fume hoods have a local Flow velocity alarm complete with sensors, controls, and gauges. This flow velocity features are included to provide lab personnel with a constant reading of fume hood performance. If the face velocity falls below an acceptable range the hood sensors will trigger an alarm to notify lab personnel. Low velocity alarms activate when the sash has been raised to a height at which the hood can no longer exhaust a sufficient amount of air, the building air exhaust system is not working properly, or there has been a power outage. When a low velocity alarm is activated, no hazardous chemical work should be performed until the exhaust volume is increased. Additionally, laboratory workers should not attempt to stop or disable hood alarms. Maintenance must be notified for adjustment of air handling system exhaust and fume hood maintenance.

Air foil (Sill)

The air foil or sill, located at the front of the hood beneath the sash, creates a smooth air flow, minimizing turbulence of the air entering the hood. The recessed work area is directly behind the sill. All work should be done at least six (6) inches into the recessed area.

Air jambs

The air jambs are vertical sills or side posts at the front of the hood. These are tapered to promote smooth air flow into the hood.

Baffles

Moveable partitions used to create slotted openings along the back of the Fume Hood body.

Biological Safety Cabinet

Is not a Fume Hood and it is an enclosed, ventilated laboratory workspace for safely working with materials contaminated with (or potentially contaminated with) pathogens requiring a defined biosafety level.

Constant Air Volume (CAV)

CAV system exhausts approximately the same air volume (cfm) regardless of the fume hood sash position. Therefore as the sash closes, the face velocity increases.

Containment

Is the fume hood’s ability to capture gases and vapours for effective exhaust.

Exhaust Volume

Is the volume of air that is exhausted from the fume hood. It is calculated by multiplying the face velocity (ft/min) by the face area (ft^2) and is expressed in cubic feet per minute (ft^3/min or cfm).

Face Velocity

The average air speed entering the open sash. It can be measured by various measuring devices or calculated by dividing the exhaust volume (cfm) by the face area (ft^2) and is expressed in feet per minute (ft/min or fpm).

Face velocity is a measurement of the average velocity at which air is drawn through the face of the fume hood. Face velocities too high or too low can be detrimental to the performance of the fume hood. The acceptable range of the average face velocity may vary between 80-100 feet per minute (fpm) depending on hood type and hazard. Currently, all fume hoods are certified for work with hazardous chemicals if the air velocity is between 80 and 120 fpm. At velocities greater than 120 fpm face velocity, studies have demonstrated that the

creation of turbulence causes contaminants to flow out of the hood and into the user's breathing zone.

Exhaust Volume = Face Velocity x Face Area

Face Area = Open Sash Width x Open Sash Height
Face Area is the fume hood's front access or sash opening. It is calculated by multiplying the open sash width (ft) and height (ft) and is expressed in square feet (ft^2).

Laminar Fume Hood
A carefully enclosed bench designed to prevent contamination of semiconductor wafers, biological samples, or any particle sensitive device.

Flammable and corrosive material storage cabinets
Flammable and corrosive cabinets typically comprise the bottom supporting structure of the fume hood. They can be vented or non-vented enclosures used primarily for storage of flammable or corrosive materials. If vented, the flammable storage cabinet is connected to the hood exhaust. The corrosive storage cabinet should be designed with a protective lining and secondary containment to inhibit chemical corrosion.

Plenum
A low-velocity chamber used to distribute static pressure (from the fan in the system) throughout its interior.

Radioisotopes Hood
A hood designed for safe and convenient handling of low-level radioactive matter.

Sash
Is the fume hood's moveable door which is usually made of laminated glass. Vertically raising, horizontal sliding, or combinations of both are the most common sash types.

Static Pressure
is pressure drop in an HVAC system resulting from duct bends and restrictions from various components such as a fume hood. It is expressed in inches of water gauge (in. WG).

Variable Air Volume (VAV)
is a fume hood with controls that adjust the volumetric exhaust airflow rate in response to sash position changes. This adjustment in exhaust airflow maintains a constant average face velocity.

Applicable Legislation and Standards

Occupational Health and Safety Act
R.S.O. 1990

Canadian Standards Association (CSA)
Z316.5-04 Fume Hoods and Associated Exhaust Systems

Canadian Biosafety Standards & Guidelines

Occupational Health and Safety Administration
Standard 29 (CFR) 1910.1450 Appendix A 4(a)(b)(e)(g)(f)

Scientific Equipment & Furniture Association (SEFA)
SEFA 1.2/1996

ANSI*/ASHRAE**
Standard 110-1995, Method of Testing Performance of Laboratory Fume Hoods

* American National Standards Institute
** American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.

Appendix 1- Fume Hood Maintenance

Daily User Maintenance

The efficiency of a fume hood is very dependent on its functional status and on how it is used.
Users must ensure proper operation of fume hoods by performing the following daily maintenance checks:

- Inspect the physical condition of the hood interior, sash and visible duct work
- Ensure the work surfaces, baffles and sash are clean
- Check sash for ease of operation
- Test air-flow monitoring device (alarm)
- Check mechanical services inside the hood (eg. water, steam, compressed air, gas, vacuum, etc.)
- Ensure the general illumination, indicator lights, and associated switches are in working order.

In case of fume hood malfunction, do the following:

- Discontinue use of fume hood
- Inform your supervisor to arrange for fume hood inspection and repair.

Scheduled Maintenance

Emergency and scheduled maintenance of fume hoods is the responsibility of University of Windsor Facility Services and all other inquiries regarding these matters should be directed to Facility Services Dispatch at ext. 2850 or repair@uwindsor.ca. Annual Face velocity testing is the responsibility of the Chemical Control Centre.

Monthly Maintenance

All ground-fault circuit interrupters shall be tested monthly by Facility Services

Six Month Maintenance

In accordance with CSA Standard Z316.5-04, every six months the following items shall be inspected and tested: the fan, motor, drive belts and shafts and bearing including machine guards by Facility Services.

Twelve Month Maintenance

Every twelve months, the maintenance schedule shall include the following (as applicable):

	Task	Responsibility
1	Inspect the sash mechanism for corrosion and damage;	Facility Services
2	Inspect the fans, motors, drives, and bearings for correct operation and wear;	Facility Services
3	Inspect the integrity of the liner	Facility Services
4	Operate the wash down system(if there is one) and observe the performance to ensure thorough washing;	Facility Services
5	Test the controls of the services to the fume hood for proper operation;(e.g. water, gas, air, vacuum)	Facility Services
6	Check the stability and condition of the discharge stack including guy wires	Facility Services
7	Check the laboratory make-up air balance and adjust as necessary	Facility Services
8	Inspect the interior of the ductwork through the inspection ports or other methods.	Facility Services
9	Check the operation of any balancing damper;	Facility Services
10	Inspection of the sink drains (if there is one) for corrosion; leakage and blockage;	Facility Services
11	Check acid neutralization tanks (if there is one) and replace material as required;	Facility Services
12	Repair defects and lubricate as necessary;	Facility Services
13	Measuring the hood face velocity;	Chemical Control Centre
14	Verification of the calibration of the airflow monitor;	CCC/Third Party
15	Testing the carbon filters (if any) for loading, contamination and leakage and replacing if necessary	Third party

Appendix 2 – CCC 2010-14 Chemical Fume Hood Procedure
1. Hood Face Velocity Test
Test Conditions

1. *The face velocity measurement test is to be conducted annually to check the performance of fume hoods.*
2. *Lab ventilating systems, both supply and exhaust, including fume hood exhaust shall be in full normal operation.*
3. *The door to the laboratory should be closed to maintain the negative pressure of the lab with respect to the corridor.*
4. *All fume hoods are tested with the sash opening of 45 cm (18-inches) and 15 cm (6-inch).*
5. *All other hoods in the same room are in the 45 cm sash opening position.*
6. *When adjustments are made to hood sashes, supply and exhaust air in the room will be allowed to stabilize before testing is done.*
7. *A calibrated air velocity meter is used to measure the hood face velocity in feet per minute (FPM) or meter per second (m/sec).*

Testing Procedure

1. *Position the sash so that the fume hood opening is 45 cm (18- inches).*
2. *Divide the fume hood opening into equal imaginary grids with sides measuring no more than 30 cm x 30 cm (12-inches) - total 6 grids.*
3. *Position the tip of the velocity meter probe in the Centre of each of six squares and measure the velocity of the air (each grid velocity should be the average of at least 10 measurements made over at least 10 seconds)*
4. *Record the measurements on the form "LABORATORY CHEMICAL FUME HOOD INSPECTION" (CCC-2010-13)*
5. *Continue taking reading until all grids are completed.*
6. *Average the readings to determine the average face velocity.*
7. *Position the sash at 15 cm (6 –inches) height.*
8. *Divide the fume hood opening into 3 equal grids.*
9. *Follow steps 3, 4, 5, 6 for measuring and recording data.*

All hoods should have a sticker designating the 45 cm sash height. Keep the sash at this level to ensure optimal face velocity.

2. Visual Capture (Dry Ice) Test
ANSI/ASHRAE 110-1995 provides a procedure to supplement face velocity with a visual test for capture called a dry ice test. We have used this procedure as the basis for our own dry ice protocol.
A visual capture test is the best way to assess how well your hood is performing. This test should be performed periodically (every few years).
All new hood installations must pass a smoke-dry ice test.

Always use eye protection and insulated gloves when conducting this test.

Needed for the test:
- *200 G of dry ice preferably in the form of pellets about 0.75 cm in diameter.*
- *Stainless steel bowl, capacity ~ 3 L filled with 1 L of hot water.*

Testing Procedure

1. *The sash should be positioned at 45 cm.*
2. *Fill the bowl with approximately 1 L of hot water. Add a 5 or 6 pellets of dry ice into the bowl. Place the bowl into the center of the hood, with the edge of the bowl 15 cm from the plane of the sash and wait a few seconds.*
3. *Observe the vapour dispersion for about 15 seconds. Containment is best observed from the side of the hood face. If no vapours break the plane of the sash then the test passes. If however, vapours consistently break the sash plane, then the hood fails the test.*
4. *The test can be repeated while challenging the hood by moving across the front, reaching into the hood and moving sash. These actions can simulate actual conditions of working in the hood and may give indication of what could contribute to leakage.*
5. *Dispose the water and left over dry ice into the sink.*

Tracer Gas Containment Test

The tracer gas (sulfur hexafluoride can be used) containment test releases a large volume of gas at prescribes location inside a hood. A mannequin is positioned in the front of the hood face with a monitoring device affixed in its breathing zone. The monitoring device tests the detected tracer gas outside the hood. Usually the mandated pass criteria are 100 ppb tracer gas at the breathing zone of the mannequin.

The tracer gas testing to determine direction of airflow pattern and leakage can be time consuming and expensive and is used mainly for newly installed hoods or in some other specific situations for rigorous evaluation of hood performance by the manufacturer.

Determining Whether to Pass a Hood

The following three conditions must be met in order for the hood to pass:

1. *The average face velocity with the sash opening of 18" must be a minimum 80 FPM*
2. *The average face velocity with the sash opening of 18" cannot be greater than 120 FPM*
3. *Smoke cannot come out of the hood.*

Appendix 3 – CCC201012 Fume Hood Selection Guideline

Installation Report

General Information			
Project Name			
Hood Location		**Date**	
Firm		**Prepared By:**	

Contact Information for Faculty & Staff Responsible for Hood Operation			
Name		**Title**	
Staff Contact		**Title**	
Department		**Account #**	
Campus Address			
Phone #		**Email**	

Hood Use Information[1]	
Application (describe expected use of hood):	
Apparatus (describe anticipated equipment use):	
Hood Usage	☐ 24/7 Continuous ☐Occasional/Intermittent ☐ Occupied/Unoccupied schedule
Utilities	☐ Vacuum ☐Natural Gas ☐Nitrogen ☐Air ☐Distilled Water ☐ Acid Neutralizing tank ☐Other: _____
Storage Cabinet	☐ Yes ☐ No *If yes, is vented storage required for toxic materials?* ☐ Yes ☐ No

[1] – Attach schematic drawings, designed, sketches, etc.

Hood Type (check all that apply)				
☐ Conventional ☐ Perchloric Acid ☐ Radio-isotope ☐ Acid Resistant ☐ Walk-In ☐ Other (specify): _____				
Hood Size	☐ 4 Foot	☐ 5 Foot	☐ 6 Foot	☐ 8 Foot
Sash Type	☐ Vertical Only	☐ Combination (vertical/horizontal)		

Return to:
Chemical Control Centre
Laboratory Safety, Assurance, and Compliance
F: 519.973.7013
E: ccc@uwindsor.ca

Approval (for CCC to complete)			
Serial#		**Model**	
Evaluation	☐ Approved ☐ Not Approved	**Signature**	
Tested By			
Certification	☐ Passed ☐ Failed	**Date**	

Appendix 4 – Do Not Use Sticker

Caution
Do Not Use

Fume Hood Has Failed Inspection

Air Velocity is_____
Date_____

Proper air flow at the face of the hood is: 80-120 FPM

University of Windsor

Exhaust Fan Not in Service
DO NOT USE
FUMEHOOD

Date: _____

For more information contact your Supervisor