1.0 Purpose and Requirements

The OSHA Laboratory Standard 1910.1450 requires that "fume hoods … function properly and that specific measures are taken to ensure proper and adequate performance of such equipment". The proper functioning and maintenance of fume hoods is the responsibility of a variety of service groups including Environmental Health and Safety (EHS), Maintenance Management, Facilities and Campus Services (FCS), Building Coordinators, and laboratory personnel.

This SOP describes the processes for commissioning and annual inspection of laboratory fume hoods and is based on testing and specifications found in the ANSI/AIHA Z9.5 and ANSI/ASHRAE 110.

2.0 Scope

This SOP applies to all ducted chemical fume hoods on the Cornell Ithaca Campus and the outlying College of Agriculture and Life Sciences facilities; but excluding the Federal Nutrition Lab. It incorporates the health and safety responsibilities of the EHS department and the energy conservation efforts of the University.

3.0 Responsibilities

3.1 Laboratory Ventilation Specialist

- Establish procedures for fume hood commissioning and annual inspections based on testing and specifications found in ANSI/AIHA Z9.5 and ANSI/ASHRAE110.
- Commission, or arrange commissioning, of new, renovated or relocated fume hood installations.
- Provide fume hood commission information to FCS for input into the University's database system (Maximo).
- Oversee the annual inspection of fume hoods by the FCS Controls Shop.
- Facilitate or conduct annual inspection in facilities not covered by Maintenance Management.
- Provide training on fume hood inspection and commissioning to EHS staff/students, FCS Controls Shop, or their designees.
- Monitor test data and reports.
- Respond to problems; provides advice and guidance on new installations.
- Consult with FS Energy Management regarding laboratory ventilation.
- Track fume hood repair tickets (service requests) to ensure timely repairs are made.

- Follow up on fume hoods identified by the FCS Controls Shop as “Too Full to Test”.
- Perform quality control testing on a sub-set of hoods tested by the FCS Controls Shop.

3.2 EHS Staff/Student

- Inspect fume hoods under the supervision of the Laboratory Ventilation Specialist.

3.3 FCS Central Zone Controls, Trades Superintendent, Zone Managers

- Provide FCS Controls Shop Technician(s) for annual inspection and related.
- Activities, such as inspection after repairs of fume hoods, covered by maintenance management.
- Oversee work done by FCS Controls Shop Technicians.

3.4 FCS Controls Technician

- Schedule and conduct annual inspection of fume hoods covered by maintenance management or those contracted with the University on university properties.
- Schedule and conduct annual inspection of fume hoods not covered by maintenance management when requested by the user on a fee-for-service basis.
- Inspect fume hoods that have out-of-date annual inspection tags within 2 weeks of notification.
- Adjust controls during inspection if it is necessary and can be easily accomplished.
- Assign repair tickets (service requests) to hoods that fail inspection.
- Report hoods that are “Too Full to Test” to the Laboratory Ventilation Specialist.
- Enter test results into MAXIMO database.
- Retest fume hoods that have been repaired.

3.5 FCS Central Zone Project Associate

- Provide Laboratory Ventilation Specialist with access to test results, including building reports and full testing reports.
- Send out building reports to building coordinator.
- Enter new fume hood commissioning data into Maximo.
- Enter annual test results for fume hoods not covered by maintenance Management that have been tested by EHS.

3.6 Project Manager

- Purchase and install hoods per FCS design standard.
- Schedule commissioning with the Laboratory Ventilation Specialist.

- Provide controls person (e.g. contractor, Control Shop Technician) to put fume hoods into unoccupied mode during commissioning of VAV and 2-position bypass hoods.

3.7 Maintenance Management, Director of Facilities

- Provide financial support to the controls shop for conducting annual inspection and follow-up testing of repairs for fume hoods covered under Maintenance Management.

3.8 Building Coordinator

- Receive reports of annual fume hood testing.
- Make service requests for fume hood repairs identified outside of annual testing cycle or by EHS.
- Arrange non-ticket maintenance items (e.g. new light bulb needed)

4.0 Procedure Instruction

4.1 Training

FCS Controls Technicians, and EHS staff/students who perform fume hood testing must receive introductory and periodic training about the laboratory ventilation program. See Toolbox Talks associated with this program.

4.2 Safety

4.2.1 Cryogen Safety

Dry ice is a cryogenic solid. Always use protective gloves and eye protection when handling dry ice. It is extremely cold and can burn the skin on contact. It also generates CO_2 gas as it warms and in an enclosed space can produce an oxygen deficient environment. Persons working with dry ice must read the SDS and be aware of the hazards before handling it.

4.2.2 Chemical Contamination

If there are concerns about the chemicals/equipment or contamination in a hood, do not do testing and contact the Laboratory Ventilation Specialist with the hood ID and contact information for that laboratory.

4.2.3 Guidance Documents and Forms

Guidance for Cornell staff who maintenance work on hoods is given in these documents:

1. ToolBox Safety Talk *Safety Precautions for Fume Hood Repair*

2. ToolBox Safety Talk *Fume Hood Decommissioning*

3. Fume Hood Repair Notice

4. Fume Hood Commissioning Request Form

5. Fume Hood Decontamination Request Form

6. Fume Hood Commissioning/Inventory Form

7. Maximo Job Plan

These can be found at: https://sp.ehs.cornell.edu/lab-research-safety/chemical-safety/lab-ventilation/Pages/default.aspx

4.2.4 Special Precautions

Special precautions are needed when testing radiation hoods.

Hoods where radioactive material is used are identified with labels or signs stating RADIOACTIVE MATERIAL on the sash or in the hood. Special procedures need to be followed when testing a “Rad” hood.

The laboratory should be notified in advance so they can plan for the hood testing or schedule an appropriate time. Laboratories need to perform a contamination survey of the entire hood prior to testing and clean surfaces that the survey identifies as being contaminated.

Upon arriving at the laboratory, the tester should verify with the Principle Investigator, lab manager, or hood users that a survey was done and the hood is free of contamination. If this cannot be verified, reschedule testing for another time when the laboratory can have the hood prepared. Contact EHS Radiation Safety with questions or problems.

4.2.5 Iodination Hoods

Hoods that are used for radioactive iodination are always constant volume, never VAV. The Radiation Section of EHS checks these hoods for radiation contamination twice a year but these procedures are not equivalent to routine annual hood testing. There are (6/17/2019) currently 3 iodination hoods at Cornell:

Rm 412 Morrison

Rm S1 091 Schurman

Rm C2 221 Vet Medical Center

5.0 Commissioning and Inspection

Commissioning of new hoods is conducted by EHS and is arranged by Project Managers when required. To request commissioning, Project Managers are to fill out a Request for Commissioning Form located on the EHS Laboratory Ventilation Management webpage. For this procedure, Project Managers need to provide a controls person to put the ventilation system into unoccupied mode during commissioning of VAV and 2-position bypass fume hoods. Fume hood inspections are done annually and upon renovation. In facilities maintained by Maintenance Management, the schedule for testing of fume hoods is coordinated by assignment of Job Plans via the Maximo database system. For facilities not under the Maintenance Management program, but who have contracted with the Controls Shop to perform annual testing, the scheduling of fume hood inspections is accomplished in the same manner except there must be a standing service request associated with the job to allow for payment. Hood inspectors should notify building coordinators at least 2 business days before testing.

5.1 Commissioning

Commissioning of lab ventilation systems ensures proper installation and operation. Face velocity tests are accompanied by visual containment tests. The following procedures are based on the ANSI/ASHRAE 110 Method of Testing Performance of Laboratory Fume Hoods and the ANSI/AIHA Z9.5 Standard for Laboratory Ventilation. The check list that EHS uses for commissioning is given in **Appendix 5,** “Fume Hood Inspection/Commissioning Form”.

5.1.1 Face Velocity Measurement

This is the measurement of the velocity of the air flow at the fume hood sash opening, expressed in feet per minute (fpm). The procedure for face velocity measurement is described in **Appendix 2**. A Shortridge electronic micromanometer with VelGrid attachment is used to conduct the test. The criteria for pass/fail are described in **Appendix 1**, “Hood Testing Criteria”. Hoods that have an unoccupied mode (typically VAV and 2-position bypass) are tested in unoccupied mode at 18” for face velocity and capture during commissioning. It is also verified that the occupancy sensor controls are over ridden when the sash is raised over 18” in height.

The project manager must provide a controls technician to put fume hoods into unoccupied mode during commissioning of VAV and 2-position bypass hoods.

5.1.2 Airflow Visualization Test

ANSI/ASHRAE 110 provides a procedure to supplement face velocity testing with a visual test for containment and airflow patterns. Smoke or water vapor can be used and containment determined visually and rated subjectively.

Observe the airflow at the face and inside of the hood. The patterns across the bench can be described as:

- If the smoke moves forward toward the front of the hood, the air flow is described as “reverse flow.”
- If the smoke remains on the work surface without smoothly flowing to the back baffle, the air flow is described as “lazy.”
- If the smoke moves outside the plane of the sash, the observation of such is described as “escape.”

5.1.2.1 Dry Ice Visualization Test

Water vapor is produced when dry ice sublimes in water.

Dry ice can be obtained in the following laboratory containing buildings on main campus: 1) Weill Hall basement 2) Biotech 2ND floor 3) ST Olin basement, and 4) VRT receiving.

For testing, the dry ice needs to be in small pellets or chunks.

Fill a 2-liter stainless steel bowl about 3/4 full with hot water. Put dry ice (about ½ cup) into the bowl so that vapors are rolling out of the bowl. Place the bowl on the fume hood bench at various locations, around equipment, to observe directional flow of the water vapor. See airflow patterns in 5.1.2 of this procedure.

If there is any dry ice left in the bowl after testing, either let it dissolve or pour the left-over ice into the side of a sink. Do not to leave the dry ice in the drain since it could freeze the trap and burst the pipe.

5.1.3 Room Pressurization

Laboratories should be under negative pressure relative to hallways and offices.

Total Room Exhaust Ventilation > Total Supply Ventilation

This can be verified either with the Shortridge Meter or visually. In order to balance the energy conservation efforts of the University and the safety of laboratory workers there is no numerical value recommended to accomplish this pressure differential.

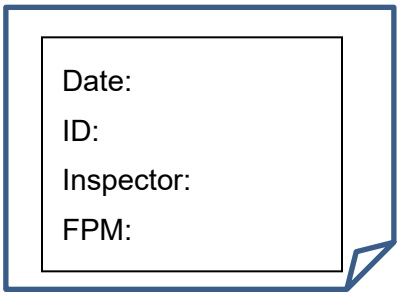
The water vapor for the dry ice test should visually draw into the lab. On campus, there are buildings connected to adjacent buildings. If, during a dry ice test of the room, there is the occasional drawing out of water vapor into the hallway, the Laboratory Ventilation Specialist must be notified. Re-commissioning of the labs or entire building may need to be done.

5.1.4 Visual Inspection

When a fume hood is not actively being used, the sash of a fume hood should be closed. This conserves energy in a Variable Air Volume system (VAV) and maintains safety by providing a smaller opening area. Initial sash height is recorded so that both EHS and FCS Energy Management can evaluate how consistently laboratory staff are adhering to these recommendations.

A visual inspection of the hood is done to ensure its integrity and working order. Cracked glass, sashes that don't operate properly (stuck or creep down); poor visibility and lights not working are examples of things that would be noted as needing repair.

5.1.5 Postings



5.2 Commissioning at 80 FPM

Standard fume hoods designed to have increased capture capabilities and better fluid dynamics may be candidates for commissioning at a lower face velocity. These have specific pass/fail criteria at the commissioning and annual inspection. See table in **Appendix 1**.

Candidates for commissioning and subsequent inspection must meet all of the following criteria or be returned to a face velocity of 100 fpm (occupied) and 65 fpm (unoccupied):

- Consistent and stable face velocity readings across the area being measured with the Velgrid. This is to be tested with items blocking airflow inside the cabinet.
- Visual capture of water vapor as described above with the sash at a height of 18 inches.
- Commissioning and inspection with the room in unoccupied mode. The face velocity must maintain containment at 65 fpm with the sash open and at 18".
- If proper hood usage is not maintained, the face velocity must be returned to 100 fpm.

Hoods that are potential candidates for this lower face velocity are to be commissioned by the Laboratory Ventilation Specialist with the assistance of a Controls Technician.

5.3 Annual Performance Inspection

The steps for routine inspection are the same for commissioning, with the exception of testing in unoccupied mode. See Headings 5.1.1 through 5.1.5 and 5.4 for these steps, and **Appendix 1** for performance acceptance criteria.

5.4 Hood Housekeeping Score

This scale is based on best practices for safe and sustainable fume hood use. Trends in these scores will be used to design laboratory worker training and education efforts.

Hood Housekeeping Score (HHS)		Reason for concern
1	Hood hibernated	None
2	Hood on, used for a single chemical process or well, organized multiple purposes	None
3	Hood on, but empty or being used for storage	Sustainability
4	Hood on, crowded or used for competing multiple chemical uses	Safety
5	Hood on and contamination evident	Safety
6	Hood decommissioned	None

5.5 Fume Hood Hibernation

ANSI/AIHA Z9.5: fume hoods must “maintain a minimum exhaust volume to ensure that contaminants are properly diluted and exhausted”. This exhaust requirement can increase the volume of ventilation for the laboratory room. By temporarily turning off the hood, and only using the general exhaust, significant energy reductions can be realized.

For those labs not using or storing hazardous chemicals, which must be kept inside the hood or a vented corrosive cabinet underneath; the fume hood may be a candidate for temporary shutdown.

The purpose of hibernating a fume hood is to save on energy costs. Identifying hoods that may be candidates is done via the Hood Housekeeping Score (HHS) during the annual performance inspection, through lab inspection or ventilation assessment, or by the request of the lab occupants.

To request a fume hood be “hibernated” go to the FCS website and submit a “Request for Repairs & Maintenance” ticket. This process is repeated to “un-hibernate” a fume hood.

6.0 Hood Repair or Decommissioning

When a hood or associated hood equipment (e.g. exhaust fan, ducts, sash) are shut down, laboratory personnel may be unaware that the hood is out-of-service. A sign affixed to the front of the sash, or other form of communication, must be used to notify users.

Hoods that have had exhaust system repair or controls adjustment should be recertified before repair signage is removed.

7.0 Reporting and Quality Control

All data is transferred to the Maximo database system.

Reports are generated that show the hood testing schedule and results. These are used to identify areas of concern and for quality control.

Tracking the performance of the Lab Ventilation Management Program is intended to maintain the quality of service provided to the stakeholders as well as manage the proper functioning of the mechanical systems. Information gathered helps staff to identify coaching and training needs.

Information gathered includes:

- Fume hood usage based on the HHS
- Chemical storage and segregation
- Awareness of safety value of lab ventilation
- Communication by lab occupants of possible chemical exposures
- Fume hood face velocity within ANSI/AIHA Z9.5 parameters
- Effective Operations & Maintenance

8.0 Definitions

AIHA: American Industrial Hygiene Association

ANSI: American National Standards Institute

ASHRAE: American Society of Heating, Refrigerating, and Air- Conditioning Engineers

SEFA: Scientific Equipment & Furniture Association

9.0 References

ANSI/AIHA Z9.5 Laboratory Ventilation

ANSI/AIHA Z10 Occupational Health and Safety Management Systems

ANSI/ASHRAE 110 Method of Testing Performance of Laboratory Fume Hoods

SEFA Guide to Selection and Management of Exposure Control Devices in Laboratories

SEFA 1 Recommended Practices for Laboratory Fume Hoods

Appendix 1: Fume Hood Pass/Fail Criteria					
		Face Velocity	Sash Height	Commission	Routine Testing
Vertical Sash Position, Occupied Mode	Constant Volume, 2-Position	100 fpm	18" ht	100 fpm +/- 10 & pass capture	90 ≤ 100 ≤ 120 and pass capture
	Variable Air Volume	100 fpm	18" ht	100 fpm +/- 10 & pass capture	90 ≤ 100 ≤ 120 and pass capture
	Variable Air Volume	80 fpm	18" ht	75-85 fpm and pass capture	75-85 fpm and pass capture
Horizontal Sash Position, Occupied Mode				90-110 fpm & pass capture	90 ≤ 100 ≤ 120 and pass capture
Combination Sash		Must Meet Both Vertical and Horizontal Acceptance Criteria			
All, Unoccupied Mode			18" ht	65 fpm +/-5 & pass capture	≥ 65 fpm & pass capture
Typical Room Pressure				Negative to Hallway	Negative to Hallway

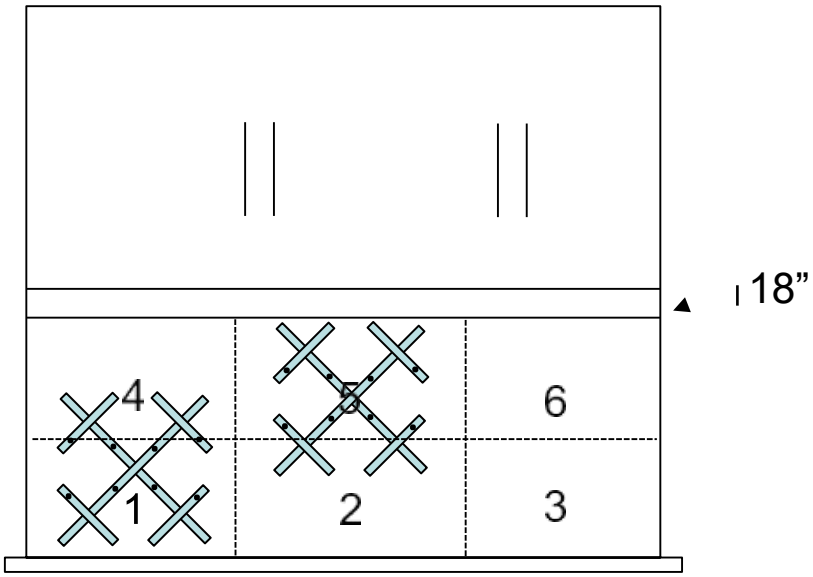
Appendix 2: Face Velocity Measurement

Testing with the Shortridge meter is in a grid pattern divided into even sections. Readings should be taken with the VelGrid flush against the top or bottom of the face opening. Align the VelGrid along the plane of the sash. Hold the probe as still as possible. Do not stand directly in front of the area being tested, as this will affect the air flow.

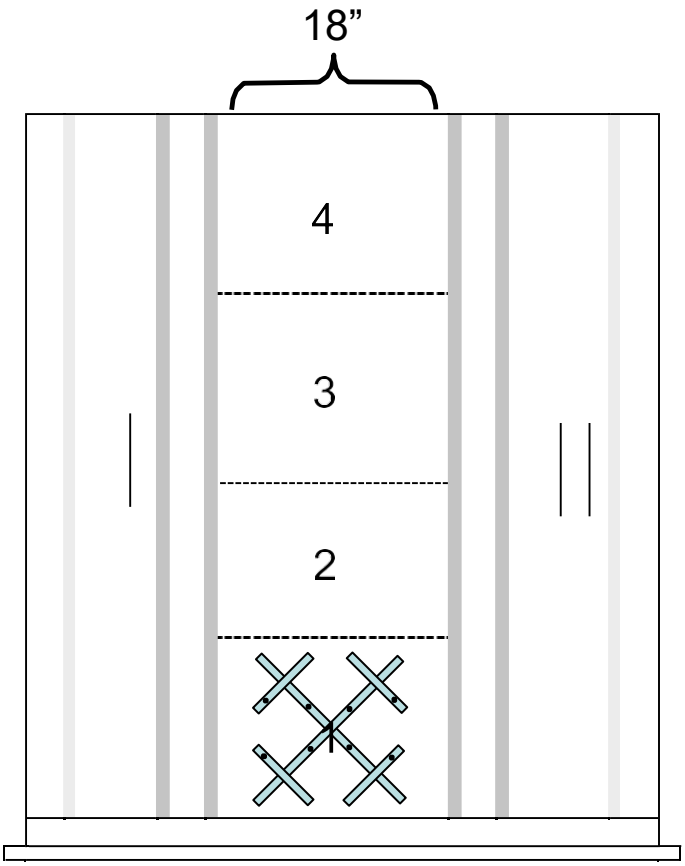
Follow directions for meter operation in the owner's manual and the Maximo Job Plan #2261. Readings are recorded in the Maximo database. For commissioning, readings are recorded on the Fume Hood Commissioning form. This information is sent to a Maximo Administrator for addition into the campus inventory.

VAV fume hood controls should be observed for responsiveness. Move the sash down from 18" stopping at different sash heights. If there is a digital control box, the face velocity should be seen to go up for a few seconds. Then it should settle at about 100 fpm.

<u>18 inches, vertical sash</u> – 4 to 8 readings depending on the hood width



18 inches horizontal sash – 4 or more readings depending on the height of the hood



Test these hoods with an 18” horizontal opening. Try to make the opening toward the middle. Take a representative sample with the VelGrid staying at 3” inches from the left or right sides. Visual smoke testing should be conducted in the middle, 6” from the plane of the sash.

Note: Units with combination sashes must satisfy both horizontal and vertical test criteria.

Appendix 3: Special "Hoods"

A. Radiation Hoods

 See Section 4.2.4

B. Double sash hoods

These hoods are like two hoods side by side but with no inside wall so that the sash height from one affects the face velocity of the other. These should be tested (face velocity and visual) while both sashes are at 18".

C. Auxiliary Air hoods

Auxiliary air hoods, in addition to pulling air, also have a blower that injects air into the hood. The dynamics are not easily tested so take the usual face velocity readings and **always perform a dry ice or smoke test.**

All Auxiliary fume hoods on the Cornell campus have had the auxiliary airflow disabled.

D. Fixed height sash/No sash

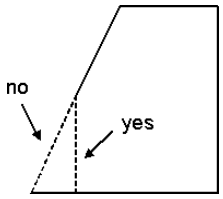
Fixed position sash- Test (face velocity and dry ice) the hood at that height and use standard/bypass criteria.

No sash- Test the face velocity along the imaginary grid of the open area and do the dry ice test in the working area.

Hoods with fixed position sashes or no sashes should have an "**Eye Protection is Required**" sticker placed on them.

E. Slanting sash

If the sash is slanting, test the face velocity on the **vertical plane** not the slanting plane. Dry ice testing should be conducted in the middle, 6" in from the vertical plane.



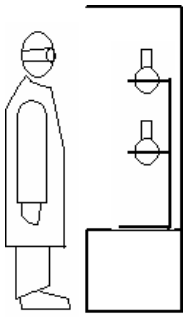
F. Ductless hoods

Ductless hoods as their name implies do not duct air to the outside but recirculate it to the room. They are equipped with chemical adsorbing filters such as charcoal to remove chemical vapors. Filters must be changed according to the manufacturer's recommendation. These hoods should have the filter change date posted prominently.

EHS does not routinely test ductless hoods.

G. Vertical Sash Walk-in hoods

Walk-in hoods are large hoods and the openings can be 6 feet high. They are used with a large apparatus that requires assembly such as distillation equipment. These hoods should **always be tested with visual capture (dry ice)** in the following way: Open the sash all the way. Prepare the dry ice and place it on the primary working surface and then slowly lower the sash until dry ice is captured. Place a **red arrow label** at this point and test the face velocity at this point as well.



Note that this is the only case where we use a **red arrow label**.

H. Wet Process Hoods

Clean hoods are designed to keep the work clean by running the majority of the air through a HEPA filter from above and only a portion through the face, resulting in low face velocities. They also may have sinks in them. Some models perform as a fume hood. See the owner's manual. These are also tested using dry ice capture visualization. For questions regarding testing these hoods, contact the Laboratory Ventilation Specialist or the facility coordinator.