Stanford University
Laboratory Ventilation Management Program Appendix 10.2.1
Laboratory Fume Hoods - Performance Criteria and Certification Protocol

I. Application

- Laboratory fume hoods are used to prevent harmful exposure to hazardous substances.
- This protocol is to be used by Stanford University in-house personnel (e.g., HVAC Shop) and contractors for annual testing and certification.
- This document does not apply to biosafety cabinets or other exhausted enclosures.

II. Regulations and Standards

8 CCR 5154.1 Ventilation Requirements for Laboratory-Type Hood Operations
8 CCR 5191 Occupational Exposure to Hazardous Chemicals in Laboratories
ASHRAE 110 Method of Testing Performance of Laboratory Fume Hoods 2016

III. Definitions

Laboratory-Type Hood: A device enclosed except for necessary exhaust purposes on three sides and top and bottom, designed to draw air inward by means of mechanical ventilation, operated with insertion of only the hands and arms of the user and used to contain hazardous substances.
Hazardous chemical: Any chemical which is classified as a health hazard or simple asphyxiant.
Health hazard: A chemical classified as posing one or more of the following hazardous effects: acute toxicity (any route of exposure), skin corrosion or irritation, serious eye damage or eye irritation, respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity (single or repeated exposure), or aspiration hazard.

IV. Use

Observation of the laboratory hood environment, maintenance, and work practices can provide an indication of proper exposure control performance. For example, if the sash(es) of the hood are left open during operation of the research activity, the hood is likely to reduce its functional effectiveness. Laboratory fume hood performance can also be compromised by the following factors:

- equipment blocking airflow to slots in baffle
- equipment placed within 6" from the plane of hood face
- hood sash or panels not replaced after equipment setup completed
- cross drafts – can be due to ventilation supply ducts or blowers/exhaust related to nearby equipment
- maladjustment of exhaust dampers
- worker leaning into the hood
- leaks in exhaust ducting
- turning off the hood fan during actual hood use

V. New Laboratory Fume Hoods or other Special Purpose Hoods

New Equipment – New Facilities and Additions to Existing Facilities

- The project's contractor is responsible for the initial certification and balancing of the system using this protocol.
- Project managers are responsible for informing the appropriate unit when new laboratory fume hoods are coming on line:

--For the main campus, contact: Stanford University's HVAC Shop at 723-3360.
--For the School of Medicine, contact: Engineering & Maintenance at 723-5555.

Unauthorized Equipment

- If new fume hoods are identified (or removed) during the annual laboratory fume hood survey, report to the following:

--For the main campus, contact: Stanford University's HVAC Shop at 723-3360.

--For the School of Medicine, contact: Engineering & Maintenance at 723-5555.

This is important so that these hoods can be included in subsequent surveys and to determine if this additional equipment has created an unbalance in the building's HVAC laboratory exhaust systems.

VI. Performance Criteria

To ensure proper laboratory fume hood exposure control performance, each of the following criteria must be observed:

A) Inspection of fume hood condition

Prior to beginning tests we expect the technician to inspect the following:

1) Ensure cabinet in good condition, all panels in place, no corrosion of panels/work surface, sash in place and moves.

2) If there is damage to the fume hood, excessive storage, or signs of poor decontamination practices, do not proceed with the tests and report to client.

B) Quantitative Assessment Criteria

Per 8 CCR 5154.2(c), laboratory fume hoods shall provide a minimum average effective face velocity of 100 feet per minute (fpm), with a minimum 70 fpm at any point.

C) Qualitative Assessment Criteria

Laboratory fume hoods shall maintain an inward flow of air at all openings, which shall be demonstrated using smoke tubes or other suitable qualitative methods.

D) Quantitative Air Flow Indicator Requirement

Per 8 CCR 5142(e)(3)(A), a quantitative airflow monitor shall be provided. It must be located so that it is visible from the front of the fume hood.

1) Follow manufacturer's procedures for calibration during installation. Follow manufacturer's schedule for periodic calibration and maintenance parameters thereafter.

2) Performance criteria for various airflow indicators are as follows:

- FPM Readout: Average readout is 100 fpm.
- Airflow Alarm System with Audio or Visual Alarms: Go into alarm mode if average face velocity drops to 80 fpm.
- Consult with EH&S on performance criteria for other acceptable devices

VII. Frequency of Certification

Laboratory fume hoods used to prevent harmful exposures are required to be certified:

- annually, at a minimum *(per 8 CCR 5143)*
- whenever a laboratory fume hood has been modified
- whenever the exhaust duct system connected to a hood has been modified.
- whenever use is resumed after hibernation (i.e., un-hibernation)

VII. Equipment/ Materials Required For Certification

- Thermal anemometer (calibrated as specified by manufacturer)
- Titanium tetrachloride, dry ice in water, or other means of visualizing airflow
- Tape measure
- Laboratory Fume Hood survey forms (or contractor equivalent)

VIII. Certification Procedure

To attain certification, a laboratory fume hood must pass both the quantitative and qualitative evaluation and have a functioning quantitative airflow indicator.

A) **Qualitative Evaluation – "Smoke Test"**

1) Position the sash at the marked working height, indicated by an arrow (typically 15"-18").
2) Generate "smoke" in direction perpendicular to exhaust flow from locations of containment.
3) Generate "smoke" around the perimeter of the designated face, a line 6" behind the plane of the face, and any other location within the fume hood where turbulent airflow is thought to exist (i.e., around any large obstructions).
4) Use the Qualitative Smoke Visualization Rating Chart to evaluate effectiveness of smoke capture and assign a rating.

APPENDIX B

QUALITATIVE SMOKE VISUALIZATION RATING CHART*

RATING	DESCRIPTION
FAIL	• Smoke was visually observed escaping from the hood
POOR (Low Pass)	• Reverse flow of smoke is evident within six inches of the plane of the sash when generated at least six inches behind the plane of the sash. • Lazy flow into hood along openings. • Slow capture and clearance- greater than two minutes for clearance. • Observed potential for escape.
FAIR (Pass)	• Some reverse flow in hood not within six inches of opening. • Smoke is captured and clears readily from interior of hood- less than two minutes. • No visible escape.
GOOD (High Pass)	• Good capture and relatively quick clearance- approximately one minute or less. • No reverse flow regions. • No lazy flow. • No visible escape.

*Based on criteria developed by ECT, April 2009

5) Record all collected data on Laboratory Fume Hood Survey Form, or equivalent.

B) Quantitative Evaluation - Face Velocity Measurement

1) Position the sash at the marked working height, indicated by an arrow (typically 15"-18").
2) Set a simple grid pattern of no more than 1 sqft. in area.
3) Locate thermal anemometer mounted on a stand at center of every segment and measure/ record velocity. Take 20 velocity readings at 1 reading per second for each point. Average the 20 readings for each point.
4) Calculate average face velocity and identify minimum value.
5) If average face velocity is greater than or equal to 100 fpm, with a minimum of 70 fpm at any point, the unit has PASSED the quantitative evaluation.

- NOTE: Fume hoods with an average inflow velocity >150 fpm should be noted and the client notified. Client may request re-test after adjustment of air flows.

6) Record all collected data on Laboratory Fume Hood Survey Form, or equivalent.

C) Air Flow Indicator

1) Record the type and condition of airflow indicator on the Laboratory Fume Hood Survey Form.
2) For a pressure gauge, mark the pressure that corresponds to the passing face velocity from the quantitative evaluation.
3) For a digital indicator, confirm that it functions by restricting airflow.
4) If the air velocity indicator is not functioning, contact Fac/Ops Zone manager to issue work order to evaluate if it is out of calibration, broken, etc. and to repair it.

D) For units that PASS both the Quantitative and Qualitative Evaluations and has a *functioning* Air Flow Indicator:

1) Document that unit has passed performance inspection on the Survey Form and affix a certification sticker. The unit is certified for use to prevent harmful exposures to hazardous substances.
2) Mark sash position at the height at which the hood performance was certified.

E) For units that FAIL, immediately:

1) Inform users, FacOps Zone Manager or Engineering & Maintenance, and building manager that the unit has FAILED performance inspection and CANNOT be used for containment of hazardous materials until the unit has been certified.
2) Document that the unit has failed performance inspection on the Survey Form.
3) Affix signage to hood stating that it CANNOT be used for preventing harmful exposures to hazardous chemicals.
4) If fume hood appears to have failed certification due to improper hood use/ setup (i.e., due to equipment blocking baffles), indicate as such on the Survey Form and communicate to the Laboratory Manager for correction prior to any retesting.
5) If fume hood appears to have failed certification due to mechanical deficiencies, immediately request Fac/Ops Zone manager or Engineering & Maintenance to initiate repairs to reduce hood downtime.
6) Repeat performance evaluation after necessary corrections have been made.

F) Data Management

1) Provide the laboratory fume hood certification form to the client.
2) As feasible, provide a database or spreadsheet of all fume hoods tested, including the location (building and room), type of unit (e.g., chemical fume hood), date of test, and due date of re-test.

Stanford University Laboratory Fume Hood Survey

Date:	
Technician/Company:	
Survey Equipment:	
Thermal anemometer Model #	
Unit #	
Last Date of Calibration	
Fume Hood Information	
Building, Room #	
Fume Hood Local ID	
Make/Model of Fume Hood	
Program ID # (assigned by Stanford)	
Fan System #	
Comments (e.g., hood clear or cluttered, sash at appropriate height)	

Smoke Test:

Smoke generated around face of perimeter contained?

GOOD (high pass) FAIR (pass) POOR (low pass) FAIL

Velocity Measurements:

Average Velocity (fpm): (or attach digital printout)	Minimum Velocity (fpm)	Accept (Y / N)	Comments:

Air Flow Indicator:

Type of Indicator (check box)		Describe Status	Comments
FPM Readout		FPM:	
Audio Alarm		Alarm sounds: yes or no	
Visual Alarm		Green mode or red mode (circle)	
Other:			

Field Data: