UCI Environmental Health & Safety

Fume Hood Program

Responsible Administrator: Industrial Hygiene
Revised: November 2023

Summary:

1. Program Description

The Fume Hood Program provides a system for complying with the requirements of the applicable regulatory standards. The program defines the procedures for:

- Testing the face velocity/inward flow;
- Indicating the proper working sash height;
- Evaluating the various components of a fume hood;
- Reporting deficiencies and repair requests;
- Newly installed fume hood, as part of new construction or renovation;
- UC Irvine fume hood user training in
    - General hood purpose
    - Airflow characteristics
    - Potential for turbulent airflow and escape of hazardous substances from the hood
    - Safe use of the hood and its features
    - Performance testing
    - Quantitative airflow monitor or alarm system
    - Energy Conservation
- Fume hoods affected by the Cal OSHA Variance, OSHSB File No. 11-V-030

2. Scope

When laboratory fume hoods are used to prevent harmful exposure to hazardous substances, such hoods shall conform to all applicable provisions the Cal-OSHA Title

8, Section 5154.1 and other applicable provisions in the UC Irvine Fume Hood Testing Program. Biological Safety Cabinets are not covered by this program.

3. 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 control exposure to hazardous substances.

4. Responsibilities

UC Irvine/EHS:

UC Irvine, through the administration of the EHS office, shall be responsible for the establishment, implementation, and maintenance of a written fume hood program. The EHS office shall:

- facilitate and coordinate testing of fume hoods;
- report deficiencies found during the EHS-facilitated survey and produce repair requests;
- develop and provide training for the fume hood users;
- review fume hood commissioning reports.

The program shall be updated as necessary to reflect changes in workplace conditions that affect fume hood use.

Manager/Supervisor:

The UC Irvine department manager/supervisor/PI/administrator shall be responsible for ensuring the proper use of the fume hood, following the Chemical Hygiene Plan, observing laboratory safe practices, and implementing worksite-specific procedures. These measures are intended to minimize, reduce, or eliminate UC Irvine personnel exposures and may include administrative controls, or the use of personal protective equipment. EHS shall work collaboratively with the affected UC Irvine department to develop worksite-specific procedures. The affected department shall be responsible for

implementing and maintaining the worksite-specific procedures.

Employee/Fume Hood User: UC Irvine personnel shall be responsible for:

- using the fume hood correctly;
- following the Chemical Hygiene Plan, laboratory safe practices, and worksite-specific procedures;
- reporting any fume hood in need of repair found during daily use.

5. Program Components

Fume Hood Testing Protocol:

Fume hood testing shall be performed annually. The face velocity shall be measured with the sash placed at the designated, proper working height (typically no higher than 18 inches or less as indicated by a sash stop and/or an affixed sticker that indicates the proper working height) using a calibrated, NIST traceable hot wire anemometer. Smoke visualization test shall also be performed to evaluate containment capability and turbulence. The Qualitative Smoke Visualization Rating Chart is in Appendix B. The fume hood shall be tested as is.

The “pass criteria” shall comply with 8 CCR 5154.1 (c)(1), and other applicable standards, as appropriate.

The following information should also be collected and reported:

- fume hood make and model
- operational status of the fume hood interior light
- presence of the sash stop
- operational status and condition of the sash and association components (glass, cables, etc.)
- presence and operational condition of the airflow alarm/monitor
- smoke test result
- Principal Investigator and laboratory contact number

All tested fume hoods shall bear a “fume hood decal” (Appendix A) that contains the following information:

- Proper working height
- Result of the qualitative smoke visualization test
- Face velocity (the text “FAIL” shall be written in this field if the tested fume hood does not meet the “pass criteria”)
- Inspector
- Date of inspection
- Re-inspection date

Reporting Deficiencies and Repair Requests:

Fume hoods that do not meet the “pass criteria” are marked “FAIL”. Repairs to fume hoods associated with the Phoenix System are addressed by the contractor retained by UCI; all others addressed through issuance of a work order to Facilities Management. The fume hood shall not be used until deficiencies are corrected. In addition, the fume hood shall be tagged out to prevent use until the face velocity is adjusted to meet the “pass criteria”. A sample of the tag is in Appendix E.

Newly Installed Fume Hood (New Construction or Renovation)- changes that may affect fume hood performance:

Commissioning testing is required for all newly installed fume hoods, as part of new construction or renovation, or when changes are made to the laboratory, its building, and/or the mechanical systems, or to the fume hood itself that may impact the fume hood’s performance. The testing shall include elements specified in the Fume Hood Testing Protocol of this program, as well as tracer gas test pursuant to 8 CCR 5154.1 (c)(2)(B).

Cal OSHA granted variance for use of “low flow, high efficiency” fume hoods at UCI. The variance document, OSHSB File No. 11-V-030, is in Appendix D of this program. All fume hoods affected by the variance are subject to and shall follow the document’s compliance elements.

6. Reporting Requirements

Fume hood testing is performed annually by the consultant retained by EHS to perform such tests. Testing requests can also be made by contacting the UC Irvine EHS Office.

Fume hood repair requests are made by contacting the Facilities Management Service Desk.

Variance Hoods Reporting Requirements details are in Appendix D1:

If a fume hood monitor alarms (audible or visual), discontinue use, completely close the hood sash, and notify all lab occupant(s) of the condition.

Document and investigate the cause of alarm including the perceived trigger/circumstance(s). Use the EH&S provided form posted on the side of the chemical fume hood.

7. Competency Assessment and Training Requirements

Fume Hood User Training:

All fume hood users shall receive training in the following elements:

- General hood purpose

    - Primary engineering control method for potential exposures
    - Containment method for unanticipated fires/explosions/splashes
    - Fume hood components
- Airflow characteristics
    - Once-through system
    - Capture efficiency and optimum velocity
- Potential for turbulent airflow and escape of hazardous substances from the hood
    - Impact of high face velocity/low face velocity
    - Impact of blocking baffles
- Safe use of the hood and its features
    - Types of fume hoods
    - Work practices/correct use
        - "Do not operate fume hoods marked 'FAIL' until repaired"
- Performance testing
    - EHS procedures (survey, tags, yellow decal, repair requests)
    - Other performance tests
- Quantitative airflow monitor or alarm system
    - Location on the hood
    - Use as flow indicator
- Energy Conservation
    - Anecdotal statistical data
    - Keep sash closed when not in use

User competency is assessed during the instructor-led training. The training script is in Appendix F.

More information on the safe use of fume hoods is in the Fume Hood Safety Reference Guide (Appendix G).

8. Information and External References

Appendix A- Fume Hood Certification
Decal
Appendix B- Qualitative Smoke Visualization Rating Chart
Appendix C- Fume Hood Commissioning and Performance Testing
Appendix D- Cal OSHA Variance Addressing "Low Flow" Fume Hoods
Appendix D1- Variance Hoods Alarm Procedure
Appendix E- Tag Out "Do Not Use Fume Hood" Sample
Appendix F- Fume Hood Training Script
Appendix G- Fume Hood Safety Reference Guide

Title 8 California Code of Regulations Section 5154.1. "Ventilation Requirements for Laboratory-Type Hood Operations."

ANSI/ASHRAE 110-1995, Method of Testing Performance of Laboratory Fume Hoods
ANSI Z9.5- 2003 Laboratory Ventilation

Appendix A
Fume Hood Certification Decal

FH ID:
WORKING HEIGHT
Qualitative Smoke Test
Face Velocity (fpm)
Reported for Repair? Yes □
Inspector
Inspection Date
Re-Inspection Date
Close sash when not in use Revised 07.2020

Appendix B
Qualitative Smoke Visualization Rating Chart

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

Appendix C
Fume Hood Commissioning and Performance Testing

FUME HOOD COMMISSIONING AND PERFORMANCE TESTING

A fume hood commissioning and performance testing process are critical in ensuring the proper function of a laboratory ventilation system. When fume hoods are installed as part of new construction they will be certified by a Test and Balance (TaB) service as part of the building commissioning process. Fume hoods installed as part of a laboratory renovation project will also be certified by a TaB service.

The following excerpt from the University of California EH&S Laboratory Safety Design Guide and the UCI D&CS Construction Specifications provide important points to include in a commissioning process:

A written commissioning plan shall accompany design documents and be approved by the commissioning authority in advance of construction activities. The commissioning plan, along with the other project documents, shall be available to all potential suppliers and contractors prior to bid. The commissioning plan shall address the operation of the entire ventilation system where the hoods, laboratories, and associated exhaust and air supply ventilation systems are considered subsystems. The plan shall include, in addition to written procedures to verify or validate the proper operation of all system components:

- Laboratory Chemical Hood Specification and Performance Tests
- Preoccupancy Hood and Ventilation System Commissioning Tests
- Preoccupancy Laboratory Commissioning Tests

Preliminary and final commissioning documents shall be issued to the appropriate parties by the University representative. The documents shall include:

- Design Flow Specifications
- Laboratory and System Drawings for Final System Design
- Copy of Test and Balance Report
- Commissioning Test Data
- List of Ventilation System Deficiencies uncovered and the details of how (and if) they were satisfactorily resolved

Operational deficiencies and other problems uncovered by the commissioning process shall be communicated to the responsible party (i.e., installer, subcontractor, etc.) for prompt correction.

Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood.

Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.

The volumetric flow exhausted from a laboratory chemical hood shall be determined by measuring the flow in the exhaust duct, using industry-approved methods.

Fume Hood General Balancing Requirements:

Fume hoods shall be balanced with an inward flow, to a minimum of 100 feet per minute (fpm) face velocity across the opening, with a minimum of 70 fpm at any point.

Fume hoods equipped with automatic controls and occupancy sensors, shall be balanced for the controls system “unoccupied mode” (no employee working in the vicinity of the fume hood opening) to 60 fpm when all of the conditions of California Title 8 General Industrial Safety Order are met.

Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.

- For laboratory fume hoods installed in variable exhaust systems, measure, adjust, and record the hood exhaust airflow at maximum and at minimum airflow conditions.

- For laboratory fume hoods designed with integral makeup air, measure, adjust, and record the exhaust and makeup airflow.

- For laboratory fume hoods that are connected to centralized exhaust systems using automatic dampers, adjust the damper controller to obtain the indicated exhaust airflow.

After balancing is complete, do the following:

Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.

Measure and record the face velocity across the open sash face area. Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter of the opening.

1. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.

2. Calculate and report the average face velocity by averaging all velocity measurements.

3. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.

4. If the average face velocity is less than the indicated face velocity, retest the average face velocity and adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity.

Check each laboratory fume hood for the capture and containment of smoke by using a hand-held emitting device. Observe the capture and containment of smoke flow pattern across the open face and inside the hood. Make adjustments necessary to achieve the desired results.

With the room and laboratory fume hoods operating at indicated conditions, perform an "as installed" performance test of the laboratory fume hood according to ANSI/ASHRAE 110-1995 *Method of Testing Performance of Laboratory Fume Hoods*, modified. Test each laboratory fume hood in occupied mode, unoccupied mode, and at minimum flow mode and document the test results.

ANSI/ASHRAE 110-1995 Testing

Tests demonstrating proper operation and performance of the fume hood will be conducted after installation and prior to use of the hood according to ANSI/ASHRAE 110-1995 “Method of Testing Performance of Laboratory Fume Hoods” as required by CCR,Title 8, 5154.1. All tests shall be conducted at a design opening sash height of 18 inches.

ASHRAE 110-1995 testing would be performed using sulfur hexafluoride as the tracer gas or in accordance with UC variance file No. 09-V-141 granted on April 21, 2011 that allows the use of nitrous oxide at a tracer gas source rate of 5.5 lpm.

The ANSI/ASHRAE 110-1995 testing would be performed upon commissioning and when required by CCR,Title 8, 5154.1. Testing would also occur if a fume hood was not maintaining capture as indicated by face velocity and/or smoke visualization testing even after repair, or if there are any major changes to laboratory rooms or ventilation systems that could impact hood performance.

Each hood shall have a label indicating the date of the most current tracer gas test and the date the next test is due. The records of tracer gas tests and velocity verifications shall be maintained for 5 years.

Appendix D
Cal OSHA Variance Addressing “Low Flow” Fume Hoods

Appendix D1
Variance Hoods Alarm Procedure

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD
2520 Venture Oaks Way, Suite 350
Sacramento, California 95833
(916) 274-5721

In the Matter of an Application for a Permanent Variance by: University of California, Irvine, Applicant.	OSHSB FILE No. 11-V-030 DECISION

The Occupational Safety and Health Standards Board hereby adopts the attached PROPOSED DECISION by David Beales, Hearing Officer.

JOHN D. MACLEOD, Chairman

WILLIAM JACKSON, Member

JOHN KASTORFF, Member

HANK MCDERMOTT, Member

GUY PRESCOTT, Member

DAVID THOMAS, Member

WILLIE WASHINGTON, Member

OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Date of Adoption: March 15, 2012

THE FOREGOING VARIANCE DECISION WAS ADOPTED ON THE DATE INDICATED ABOVE. IF YOU ARE DISSATISFIED WITH THE DECISION, A PETITION FOR REHEARING MAY BE FILED BY ANY PARTY WITH THE STANDARDS BOARD WITHIN TWENTY (20) DAYS AFTER SERVICE OF THE DECISION. YOUR PETITION FOR REHEARING MUST FULLY COMPLY WITH THE REQUIREMENTS OF CALIFORNIA CODE OF REGULATIONS, TITLE 8, SECTIONS 427, 427.1 AND 427.2.

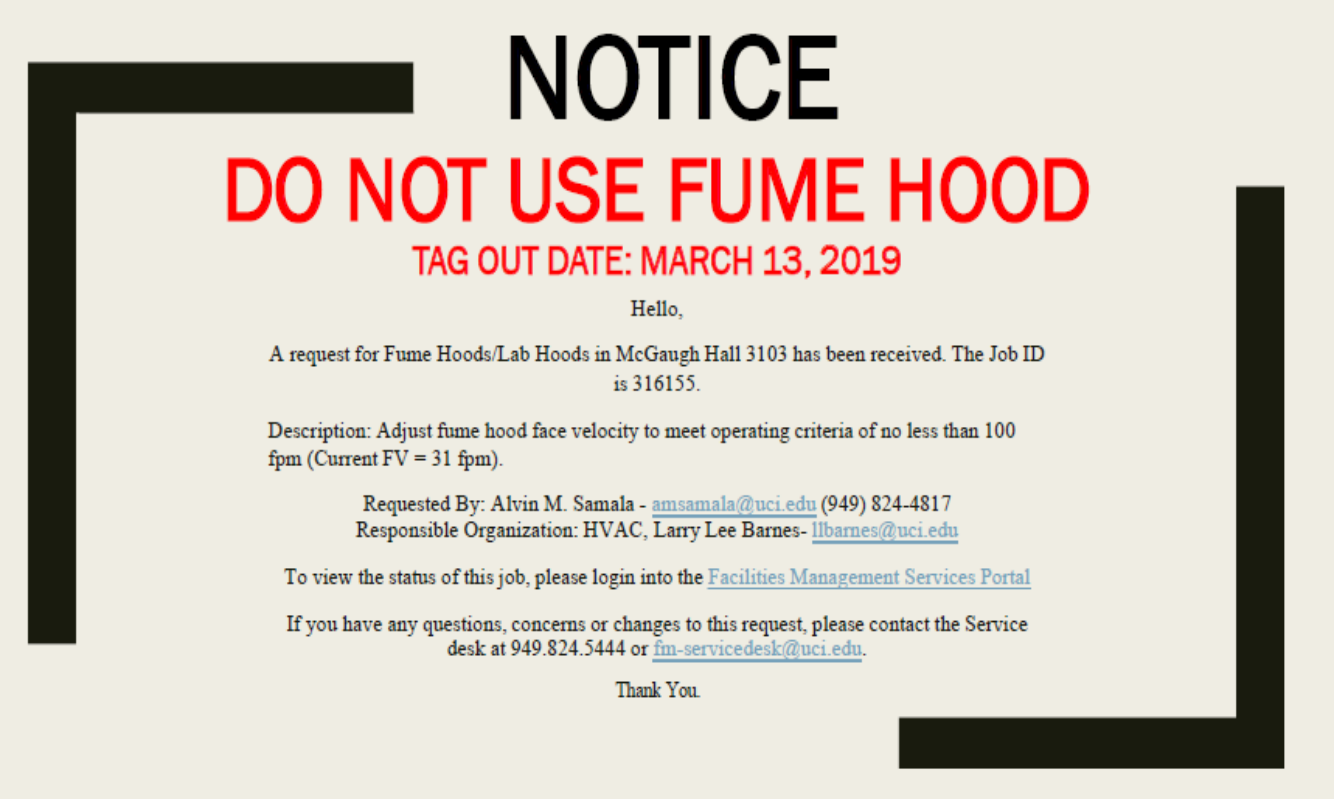
Note: A copy of this Decision must be posted for the Applicant's employees to read, or a copy thereof provided to the employees' Authorized Representative(s).

Appendix D1

Variance Fume Hoods Alarm and Test Failure Procedure

1. If a fume hood monitor alarms (audible or visual), discontinue use, completely close the hood sash, and notify all lab. occupant(s) of the condition.
2. Document and investigate the cause of alarm including the perceived trigger/circumstance(s). Use the EH&S provided form posted on the side of the chemical fume hood.
3. Initiate a tag out procedure for the subject hood by printing, completing, and placing the below (see Appendix E) image/document on the closed hood sash. Please also email safety@uci.edu and/or use the UCI **With U • For U** app (http://www.fa.uci.edu/mobile.php).
4. Additionally, contact FM @ x5444 and/or submit a repair/service request using the *Online Service Request* link found at http://www.fm.uci.edu/.
5. The fume hood will not be returned to service until the cause of the alarm is resolved.
6. Be advised, if a fume hood fails any regular and/or routine certifications and tests, such as, but not limited to, the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air Conditioning Association of Engineers (ASHRAE) Standard 110-1995 “Method of Testing Performance of Laboratory Fume Hoods”, it will also be removed from service. It will not be returned to service until after the cause of failure is determined and repaired.

Appendix E
Tag Out “Do Not Use Fume Hood” Sample


NOTICE
DO NOT USE FUME HOOD
TAG OUT DATE: MARCH 13, 2019
Hello,
A request for Fume Hoods/Lab Hoods in McGaugh Hall 3103 has been received. The Job ID is 316155.
Description: Adjust fume hood face velocity to meet operating criteria of no less than 100 fpm (Current FV = 31 fpm).
Requested By: Alvin M. Samala - amsamala@uci.edu (949) 824-4817
Responsible Organization: HVAC, Larry Lee Barnes- llbarnes@uci.edu
To view the status of this job, please login into the Facilities Management Services Portal
If you have any questions, concerns or changes to this request, please contact the Service desk at 949.824.5444 or fm-servicedesk@uci.edu.
Thank You.

Appendix F
Fume Hood Training Script

Fume Hood Training Script

1. ***Ask***: What is the general purpose of a Fume Hood?
   Answer: The FH is the primary engineering control method for protection against the inhalation of hazardous vapors and gases.

2. Fume Hood component exercise- Identify the following:
   a. Air Foil (*Purpose?- facilitates laminar airflow and minimizes turbulence*)
   b. Baffles (*Purpose?- allow uniform airflow along the back, optimize capture efficiency, eliminate dead spots*)
   c. Sash (*Purpose?- control airflow, provide additional shielding*)
   d. Work Surface
   e. Hood Body
   f. Face
      i. ***Ask***: What is the optimum face velocity operating range?
      Answer: no less than 100 feet per minute

3. Teach MOPS:

   M - Monitor. Check the airflow monitor. (*Kimwipes)
   O – Operational. Check the other fume hood components (sash, lights, baffles).
   P – Placement. Place the experiment 6 in. back from face. Do not block baffles.
   S – Sash Height. Adjust the sash height to the operating height or lower.

   3.a. Occupancy Sensor – Discuss function
   3.b. Fume Hood in Alarm – Discuss response action.

4. Practical Show and Tell (***OPTIONAL***)

   Choose a volunteer. Verbally convey the following instructions: “Pretend that you have an experiment that must be performed inside a fume hood. Walk us through the steps that you should follow when using a fume hood.”

   Observe the volunteer.

   Group critique.

5. Energy Conservation

   “Remember to close the sash when not in use. It costs approximately $3K a year to operate a fume hood due to the energy expended to move the vast volume of

air. Closing the sash helps minimize the volume and therefore affect the operating cost of the fume hood."

M O P S

Appendix G
Fume Hood Safety Reference Guide

Fume Hood Safety

REFERENCE GUIDE

Issued: July 2022

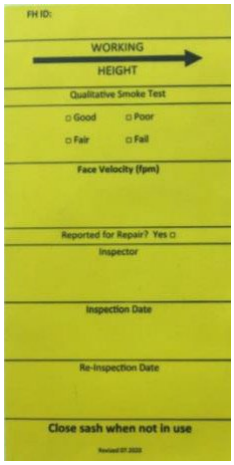
The general purpose of the laboratory fume hoods is to serve as the primary engineering control method for protection against the inhalation of hazardous vapors and gases. Operations and experiments that generate air contaminants above the exposure limit must be conducted inside a fume hood. When used correctly, a fume hood minimizes a user's potential for exposure to airborne contaminants and prevents the contaminants from reaching the user's breathing zone. A fume hood can also provide protection from unanticipated fires, explosions, and chemical splashes.

While the laboratory fume hood is a very effective engineering control, it does not provide absolute containment or protection. The laboratory fume hood and its associated features must be used correctly to enhance the protection and safety of the user. When using the fume hood, the acronym MOPS will help you remember the correct work practices and procedures:

M—Monitor. Check the airflow monitor before commencing to ensure that the fume hood is working correctly. Laboratory fume hoods come with monitors or devices whose function is to provide the user of the hood with important information concerning airflow & face velocity. Monitors will alarm and alert the user when there is a problem with the airflow or face velocity. For a typical fume hood, the optimum face velocity is no less than 100 feet per minute (fpm). In the case of low-flow, high-efficiency fume hoods, the acceptable face velocity is no less than 80 fpm. (NOTE: Document all alarm events for low-flow, high- efficiency fume hoods. Include the date and time of occurrence, as well as the cause of the alarm event.)

O-Operational. Check the other fume hood components (sash, lights, baffles) to make sure that these items are operational. Do not remove the fume hood sashes or panels except when it is necessary to set- up apparatus; they must be replaced before any operations begin. All chemical hoods should have spill protection lips along the front of the hood. If your hood has a cup sink, it should have a lip as well.

P-Placement. Place apparatus a minimum of six inches back from the face of the hood. Do not store excessive amounts of chemicals or apparatus in the hood since these items can greatly impair fume hood performance. Fume hoods are not meant for long-term chemical storage. Do not obstruct the slots of the baffles along the back of the hood. No more than 25% of the bottom slot should be blocked. All large equipment should be elevated 1-2 inches above the working surface of the hood to reduce the amount of baffle blockage and to maintain the hood's performance. If there is a chance



of explosion or eruption, use an appropriate barricade or shield. Do not place your head inside the hood when contaminants are being generated.

S-Sash Height. Adjust the sash height to the working height or lower. The working height is indicated by an arrow on the yellow/gold/green (see example to the right) certification decal affixed to the front side of the hood. When the sash is placed at the proper working height, it will also provide a barrier against unanticipated explosions, fires, spills, or splashes, and help conserve energy.

Additional PI or Supervisor Considerations

Airflow monitors directly measure the face velocity of the fume hood, making certain that fume hoods have adequate containment and ventilation. If the velocity drops below a set level, audible and visual alarms provide an indication of potentially unsafe conditions.

If a fume hood monitor continuously alarms (audible or visual), discontinue use, completely close the hood sash, and notify all lab occupant(s) of the condition. Do not tamper with or defeat the fume hood alarm. Tampering or defeating a safety device, such as a fume hood alarm, is illegal and is subject to the penalties imposed by local, state, and federal regulations. Examples of tampering include but are not limited to:

- covering the visible lights and emergency indicators.
- applying tape, toothpicks, or other methods that results in muting the alarm.
- disengaging the power supply to the alarm.
- any action that disables the functionality and purpose of the alarm.

Fume hood repair requests are made by contacting the Facilities Management Service Desk. Notify the School/Building Facility/Building Manager of such action.

- Submit an FMR https://service.fac.uci.edu/ or call the FM Service Desk 949-824-5444
- Depending on the repair action, the user may need to empty the fume hood of its contents, decontaminate the interior surfaces, and submit a Lab Equipment Clearance Form.

The fume hood shall not be used until deficiencies are corrected.

Contact **EH&S at (949) 824-6200 or safety@uci.edu** for general inquiries on fume hoods and fume hood use.