Santa Clara University

Chemical & Biological Hoods, Spray Booths, and Local Exhaust Ventilation

Santa Clara University (SCU)
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Program Review Record

Revision 1		
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Program Approval

Signature on file in the EHS Office	*7/26/10*
Signature	**Date**
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Table of Contents

Laboratory & Biological Hood, Spray Booth, and Local Exhaust Ventilation Program

1. Purpose

The purpose of this program is to ensure that SCU is in compliance with Cal/OSHA and fire code requirements for providing proper design, flow rates, discharge points, and employee training for devices such as hoods and booths that provide local ventilation.

2. Applicability

This program covers the minimum requirements for the Cal/OSHA and Fire Code requirements related to the operation of chemical hoods, biological hoods and cabinets, spray booths, blast cabinets, and local exhaust ventilation systems located at the SCU campus.

It is not the purpose of this program to specify all the details contained in the Cal/OSHA or Fire Code regulations.

3. Definitions

NOTE: The most pertinent definitions for all users are contained in Attachment I. Review and use as necessary.

4. Roles and Responsibilities

The following are the SCU Roles and Responsibilities in regards to chemical and biological hoods, spray booths, and other ventilation installations**:**

Group	Responsibilities
Operations Supervisors	▪ Identifies and brings to EHS Director's attention all ventilation systems (new and altered) subject to this program document. ▪ Conducts required training for use of ventilation systems and ensure use rules are followed. ▪ Conduct maintenance and repair tasks, as required.
Faculty and Academic Staff	▪ Informs EHS Manager of intent to purchase or alter ventilation system at least 2 months in advance of doing so. ▪ Conducts required training for use of ventilation systems and ensures use rules are followed. ▪ Contacts EHS for minor maintenance and repair tasks, as required.
EHS Director	▪ Ensure that this procedure is kept up-to-date with regulatory requirements. ▪ Reviews the design of all hoods, booths, and ventilation systems prior to purchase, installation, alteration, and construction. ▪ Maintains master lists of all hoods, booths, and ventilation

	systems subject to this procedure. ▪ Determines the maintenance and flow rate requirements for each booth or ventilation system. ▪ Determines training requirements for each booth and ventilation system and communicates them to the responsible party. ▪ Ensures that maintenance, inspection, and testing occur at the required frequency for each system subject to this procedure. ▪ For systems not meeting required standards, works with Utilities to ensure that systems are repaired or upgraded appropriately. ▪ Reviews the implementation of this program on an annual basis.

5. Requirements

List of installations subject to this requirement

The EHS Director maintains a master list of all hoods, booths, and exhaust ventilation systems subject to this procedure.

General Maintenance, Testing & Training Requirements

Attachments 2, 3, and 4 define the general maintenance, testing, and training requirements for the laboratory hoods, biological hoods, and spray booths, respectively.

The EHS Director is responsible for ensuring the timely maintenance and testing of the installations, either through internal resources or through procurement of external service providers.

Design & Acceptance Requirements

Any Facilities or faculty member purchasing or altering a hood, spray booth, blast apparatus, or designing a local exhaust ventilation system for service at SCU must contact the EHS Director to have the design reviewed and approved prior to purchase, modification, and/or construction. Prior to acquisition and installation, the following information will be compiled for each installation, to the extent that it is not summarized in other documents:

- Design criteria, including flow rates, exhaust location, and other regulation-specific requirements;[1,2] and
- Maintenance and testing requirements, as they deviate from the General Requirements listed in Attachments 2, 3 and 4.

This information will be filed in the EHS files.

The EHS Director will also determine whether an air permit is required for a particular system. If such a permit is required, the EHS Director will arrange for the permitting and will work with the system owner to ensure that all permit conditions are understood and will be met.

[1] Note that any hood where flammable liquids or gases are used or combustible liquids are heated above boiling points must be reviewed to ensure that they provide sufficient airflow to prevent ignitable concentrations. Concentrations in the duct must not exceed 20% of the lower explosive limits.
[2] Regulations to be considered include BAAQMD requirements, Cal/OSHA requirements, and the CA Fire and Mechanical code requirements

At the time of installation, the EHS Director will work with the system owner and other Facilities personnel to arrange for initial acceptance testing, initial personnel training, and to ensure that the system maintenance requirements are entered into the appropriate tracking system. The EHS Director will update Attachments 2, 3, and 4 as appropriate.

If a Facilities or faculty member alters a hood, spray booth, blast apparatus, or a local ventilation system in any way, the EHS Director must be contacted to determine the following:

- If the altered system will meet regulatory requirements; and
- If the altered system needs retesting or requires alterations in the previously determined maintenance program.

No alterations are to proceed until this review is complete.

6. Training

All of these installations have initial and periodic (usually annual) training requirements. For laboratory and biological hoods, the training will be given as part of the chemical hygiene training or biological safety training.

For all other ventilation systems, the "owner" of each installation is responsible for ensuring that the required training is being provided and documented. The EHS Director will work with the person responsible for each system to define the training requirements for each system.

7. Reporting

The EHS Director will annually review the hood, booth, and ventilation program for compliance and refer any issues to the Operations VP. If the program is found to be non-compliant, the Operations VP will take appropriate actions, including root cause analysis, to ensure that the issues are corrected going forward.

8. Document Retention

The program records are retained as indicated below:

Document	Location	Retention Period	Responsible Party
List of Laboratory Hoods, Biological Hoods, Spray Booths and other systems subject to this program	EHS files	Until superseded	EHS Director
Maintenance Requirements for Laboratory Hoods	EHS files	Until superseded	EHS Director
Maintenance Requirements for Biological Hoods	EHS files	Until superseded	EHS Director
Maintenance Requirements for Spray Booths	EHS files	Until superseded	EHS Director
Maintenance Records	Utility files	5 years	Utility Manager
Test Records	EHS files	5 years	EHS Director
Installation-specific Installation and Requirements (including training requirements)	EHS files	For life of the system	EHS Director

9. Key References and Resources

The document(s) listed below may be obtained from the EHS Office either in paper form or on the EHS Website.

- 8 CCR 5143, 8 CCR 5150 – 5154.2 (Ventilation Requirements for various types of hoods, booths, etc.)
- 8 CCR 5445 et seq. (Spray Booths and Dip Tanks)
- CFC 1503, 1504 (Fire Code for Spray Operations)
- CMC Chapter 510 (Mechanical Code for Hazardous Exhaust)

Attachment 1 - Definitions

Biological safety cabinet - A ventilated cabinet which serves as a primary containment device for operations involving biohazard agents or biohazardous materials.

Blast-cleaning enclosures - These include rotary blast cleaning tables, blast cleaning barrels and drums, abrasive blasting cabinets, blast cleaning rooms, abrasive separators, and similar enclosures.

Hood - A shaped inlet designed to capture contaminated air and conduct it into the exhaust duct system.

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. These devices are also known as laboratory fume hoods.

Local Exhaust Ventilation - A ventilation system that captures and removes air contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan and possibly an air cleaning device.

Spray booth or Room - A power-ventilated structure provided to enclose or accommodate a spraying operation, to confine and limit the escape of spray, vapor and residue, and to safely conduct or direct them to an exhaust system.

Attachment 2 – Maintenance & Testing of Laboratory Hood Systems

Laboratory Hoods will be maintained and tested annually for the following:

- The ventilation rate shall be tested by means of a pitot traverse of the exhaust duct or equivalent measurements
- The hoods must show an average face velocity of at least 100 feet per minute with a minimum of 70 fpm at any point, except where more stringent special requirements are prescribed due to specific chemical usage. The minimum velocity requirement excludes those measurements made within 1 inch of the perimeter of the work opening.

  The face velocity should be obtainable with the movable sashes fully opened. Where the required velocity can only be obtained by partly closing the sash, the sash and/or jamb shall be marked to show the maximum opening at which the hood face velocity will meet the flow requirements. Any hood failing to meet these requirements is considered deficient in airflow and must be posted with placards, plainly visible, which prohibit use of hazardous substances within the hood.

  Note: if flammable gases or liquids are used in a hood, or when combustible liquids are heated above their flashpoints, the hood must be designed, constructed, and installed so that hood openings at all sash positions provide sufficient airflow to prevent ignitable concentrations. The EHS Manager will determine the required velocity for each hood in such usage and document it in the hood maintenance records.
- Each hood must have a quantitative airflow monitor in place and working that continuously indicates whether air is flowing into the exhaust system during operation. The quantitative airflow monitor shall measure either the exact rate of inward airflow or the relative amount of inward airflow.
- For each hood, a set of qualitative airflow measurements that indicate the ability of the hood to maintain an inward airflow at all openings of the hood are completed using smoke tubes or other suitable qualitative methods.
- To meet Bay Area Air Quality Management District requirements, at the time of testing, the tester will verify that all hoods are posted with a notice to remind employees to avoid open container procedures using volatile chemicals where feasible and to not leave any bottles of chemicals open when not in use.

Attachment 3 – Maintenance & Testing of Biological Hood & Cabinet Systems

Biological Hood and Cabinet Systems will be maintained and tested annually for the following:

- Note: All test or maintenance activities requiring access to potentially contaminated interior spaces of the hood/cabinet shall be performed after appropriate decontamination. EHS will verify that the principal investigator has completed decontamination prior to any service work and marked the hood/cabinet as decontaminated.
- As part of the maintenance and testing process, the tester will verify that a warning placard has been placed on the front of the cabinet requiring decontamination prior to opening any service panel or other interior access.
- Class I and II A hoods/cabinets must have a minimum inward average face velocity of 75 linear feet per minute at the work opening.
- Class II B1, B2, and B3 hoods/cabinets must have a minimum inward average face velocity of at least 100 linear feet per minute at the work opening.
- Class III hoods/cabinets must have sufficient air flow to maintain a constant purging of the work area of hazardous vapors, gases or particulate generated within the cabinet and to dilute flammable dusts, gases, or vapors to below 20% of the lower explosive limit (LEL) at a minimum negative pressure inside the cabinet of 0.5 inches of water gauge.
- For Class I hoods/cabinets, the following tests shall be performed:
    - The ventilation rate shall be tested at the work opening of the cabinet with a calibrated anemometer.
    - A quantitative aerosol challenge test must be performed on each high-efficiency particulate air filter. The test must be capable of detecting penetrations exceeding 0.005% of particles 0.3 micrometers or larger while the cabinet is in normal operation. Any measurement exceeding 0.03% penetration shall establish a failure of the test.
    - The ability of the hood to maintain an inward flow shall be demonstrated using smoke tubes or other suitable qualitative methods.
- For Class II hoods/cabinets, the following tests shall be performed:
    - For type A and B3 cabinets the average intake face velocity at the normal operating work access opening shall be determined by measuring the exhaust air velocity, calculating the cabinet's exhaust air volume, and dividing this volume by the open area of the work access opening. Average face velocity is calculated by the following equation: (average exhaust velocity X open area of HEPA filter or exhaust port) / (area of normal work access opening) = average face velocity.

        - Exception: Cabinets in which the exhaust filter is not accessible can be measured directly at the work access opening using a calibrated total capture air flow hood to measure the air volume entering the cabinet, and dividing this measurement by the area of the work access opening to determine the average face velocity.
    - For type B1 cabinets the average intake velocity shall be determined by directly measuring the inflow velocity at the normal operating work access opening with the cabinet recirculating blower turned off. A calibrated total captured airflow hood may be used for type B1 cabinets as in the point above.
    - For type B2 cabinets the average face velocity shall be calculated based on total exhaust air volume (velocity measurement at exhaust port), supply airflow volume, and work access area. Average face velocity is calculated by the following equation: [(average exhaust velocity X area of exhaust port) - (average supply downflow velocity X open area of supply HEPA filter)] / (area of normal work access opening) = average face velocity.
        - Exception: Average intake velocity can also be measured directly at the work access opening using a calibrated total capture air flow hood to measure the air volume entering the cabinet, and dividing this measurement by the area of the work access opening to determine the average face velocity.
    - A quantitative aerosol challenge test shall be performed on each high-efficiency particulate air filter. The test must be capable of detecting penetrations exceeding 0.005% of particles 0.3 micrometers or larger while the cabinet is in normal operation. Any measurement exceeding 0.03% penetration shall establish a failure of the test.
    - The ability of the hood to maintain an inward flow will be demonstrated using smoke tubes or other suitable qualitative methods.
- For Class III hoods/cabinets, the following tests shall be performed:
    - The airflow through the Class III biological safety cabinet shall be determined by measuring the exhaust velocity at the exhaust port. Total air volume is calculated by the following equation: (exhaust velocity) X (area of exhaust port) = total air volume. The air change rate for a class III biological safety cabinet shall be a minimum of 1 air change in 3 minutes or airflow required to maintain flammable gases/vapors below 20% of the LEL whichever is greater. The measurement of the negative pressure inside the cabinet shall be made with a calibrated gauge. The accuracy of the gauge shall be +5% at the required 0.5 inches of water gauge.
    - A quantitative aerosol challenge test shall be performed on exhaust HEPA filters. The test must be capable of detecting penetrations exceeding 0.005% of particles, 0.3 micrometer or larger while the cabinet is in normal operation. Any measurement exceeding 0.03% penetration shall establish a failure of the test.
- The tester will verify that a flow indication system is in place. Where biological safety cabinets are attached to external duct systems with a blower and the cabinet system also contains a blower, or where the cabinet uses an external blower, an

audible and visual alarm system must be in place to alert the user indicating the loss of exhaust flow in the external duct. Biological safety cabinets which are served with a canopy or thimble connected exhaust system must have a ribbon streamer or like device attached to the edge of the canopy or thimble to indicate the direction of flow and are exempt from the requirement for flow alarms.

Attachment 4 – Maintenance & Testing of Spray Booth Systems

Spray Booth Systems will be maintained and tested annually for the following:

- The velocity of air into all openings of a spray booth shall be verified not to be less than that specified in 8 CCR 5153 Table V-6. The ventilation rate of the mechanical ventilation system used to prevent harmful exposure shall be tested after initial installation, alterations, or maintenance, and at least annually, by means of a pitot traverse of the exhaust duct or equivalent measurements.
- A physical inspection to verify that the booth meets the requirements of 8 CCR 5445 et seq., CFC 1503/1504, and CMC 510 shall be conducted annually. That testing shall include testing of all required interlock and safety systems.