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INTRODUCTION

This document provides standardization for the design, construction, maintenance, and use of laboratory ventilation systems in order to maintain acceptable air quality in the laboratory buildings and surrounding common areas. This standard also outlines or references standard criteria for stack heights, exhaust exit velocities, and design considerations that shall be considered and implemented at the University of Tampa.

This document is intended to become part of the Facilities Department design standards when establishing requirements for laboratory exhaust ventilation systems. These requirements do not preclude adherence to good engineering practice or local Building Code standards. The Facilities Department will consider these requirements for inclusion in contract specifications for all future contracts submitted to the University of Tampa. The University will only accept bids on future contracts which meet these specifications.

ALL LABORATORY EXHAUST VENTILATION SYSTEMS DESIGNED, CONSTRUCTED, MAINTAINED, AND USED AT THE UNIVERSITY OF TAMPA SHALL COMPLY WITH THE SPECIFICATIONS AND STANDARDS SET FORTH IN THIS DOCUMENT AND IN THE PUBLICATIONS REFERENCED IN APPENDIX A

BACKGROUND

This standard describes aspects of fume hood system design and operation that are critical to protecting the health and safety of faculty, staff, students, and visitors with an overall goal of achieving acceptable concentrations of air contaminants. Properly designed ventilation systems function to capture contaminants from the work area and disperse them to the outside environment. Exhaust stacks function to release contaminants from the inside of a building in order to minimize contaminant reentrainment. The critical design aspects of fume hood systems that are discussed in this document are:

- the quality of the fume hood enclosure;
- the quality and quantity of supply air provided to the fume hood,
- face velocity of the fume hood,
- exhaust stack height; and
- exit velocity of air being exhausted from the stack.

In addition, effluent dispersal is contingent upon factors such as exhaust stack / air intake separation, stack height, stack height plus momentum, topography of the building and surrounding environment, and wind dynamics.

Although system performance depends heavily on the above design elements it must be noted that the fume hood performance in a room is affected by room layout and supply air distribution. System performance depends on the fan and duct layout as well as fan type and discharge conditions. These issues are dealt with in more detail in the mechanical design standards developed by the Facilities Department and as concurrent with ANSI/AIHA Z9.5-2003 Laboratory Ventilation and ANSI/ASHRAE 62-1999 Ventilation for Acceptable Indoor Air Quality standards.

FUME HOOD DESIGN AND CONSTRUCTION

Laboratory fume hoods and associated exhaust ducts should be constructed of non-combustible, nonporous material that will resist corrosion. They should be equipped with vertical or horizontal sashes that can be closed; an air foil built into the fume hood at the bottom and the sides of the sash opening, and baffles to attain a uniform face velocity under different conditions of hood use. Additionally, recognized good design and construction features are listed in the latest editions of ACGIH Industrial Ventilation: A Manual of Recommended Practice, ANSI/AIHA Z9.5 2003, ANSI/AIHA Z9.2-2001 Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems, and the most current codes, guidelines and standards of any other applicable regulations. Laboratory Fume Hoods shall be either Standard By-Pass, Constant Volume or Variable Air Volume -VAV NOTE:

VARIABLE AIR VOLUME FUME HOODS

Variable-air volume [VAV] fume hoods shall be installed unless accepted design practice dictates otherwise. A VAV fume hood is one that is fitted with a face velocity control which varies the amount of air exhausted from the fume hood in response to the sash opening to maintain a constant face velocity. These hoods produce an acceptable face velocity over a relatively large sash opening and also provide significant energy savings by reducing the flow rate from the hood when it is closed. VAV fume hoods shall not be permitted for radioisotope or perchloric acid activities.

RECIRCULATING HOODS

Recirculating or ductless fume hoods are not permitted for the removal of chemical contaminants.

SPECIAL LABORATORY FUME HOODS

ACGIH's Industrial Ventilation, A Manual of Recommended Practice and ANSI/AIHA Z9.5 2003 provide standards for non-traditional laboratory fume hoods. These hoods include perchloric acid fume hoods, walk-in fume hoods, biological safety cabinets, and glove boxes. Biological safety cabinets (BSC) and/or glove boxes require separate design and installation criteria which shall be in conformance with the requirements outlined in National Sanitation Foundation NSF International Standard #49 (most current version), Class II (Laminar Flow) Biohazard Cabinetry and "Biosafety in Microbiological and Biomedical Laboratories" (U.S. Department of Health and Human Services, publication no. CDC 93-8395).

SUPPLY AIR

The proper volume, distribution, and quality of supply air shall be provided to laboratories containing fume hoods. ANSI/AIHA Z9.5 2003 and ANSI/ASHRAE 62 provide the basic guidelines for these minimum standards. Make up air (replacement air) should be equal to at least 95% of the volume exhausted from the laboratory. This air shall not be recirculated from other laboratory areas. Although laboratory supply air seldom requires air cleaning, ASHRAE provides technical information for the reduction of contamination from atmospheric dust and dirt, if necessary.

Air supply systems for rooms containing chemical fume hoods shall not create room air drafts at the face of any hood greater than one half (and preferably one third) the face velocity of the hood. For most laboratory hoods, this means 50 fpm or less terminal velocity at 6 feet above the floor. ACGIH's "Industrial Ventilation - A Manual of Recommended Practice" provides design criteria to help achieve these standards.

AUXILLARY SUPPLIED AIR HOODS

Auxiliary Air Hoods are not permitted for installation on new laboratory construction or major renovation projects. Auxiliary air hoods may be considered for laboratory renovation projects on a case-by-case basis for general purpose and special use activities only. Where approved for use, auxiliary air hoods shall introduce make-up air in a uniformly distributed fashion at the top of the fume hood opening and in an amount no greater than seventy (70) percent of total exhaust volume. These types of hoods must be designed and installed carefully to control contamination control elements both inside and outside of the hood face. Performance criteria for testing auxiliary supplied air hoods shall additionally include confirmation of >90% capture velocity with the full open hood face when room air is ± 20 °F different from outside air.

EXHAUST STACK DISCHARGE AND EXIT VELOCITIES

Exhaust stacks shall be designed and built to prevent recirculation of contaminated air from the fume hood exhaust system into the fresh air supply of the facility or adjacent facilities. The effluent exhaust shall not be designed to reenter the building envelope. The stack shall also provide significant effluent dispersal so that effluent downwash does not occur at ground level. They shall be designed and built with the latest applicable ASHRAE standard. ASHRAE's 2005 Fundamentals Handbook presents alternative methods for specification and evaluation of stack heights from laboratory hood exhaust fans.

Effluent discharge shall at a minimum:

1. Be directed to the atmosphere (unless treated for recirculation).
2. Conform to federal, state, and local air emission regulations.
3. Be released so that reentry of effluent from the discharging building or a surrounding building is reduced to allowable concentrations inside of the building. Allowable concentrations shall be determined using information on the nature of the contaminants to be released, recommended industrial hygiene practice, and applicable safety codes.

Exhaust discharge from stacks shall at a minimum:

1. Be in a vertical up-draft direction at a minimum of 10 ft above adjacent roof lines and located with respect to surrounding air inlets as to avoid contaminant reentry.
2. Have a minimum exit velocity of 3000 fpm.

NEW HOOD PURCHASE SPECIFICATIONS AND EVALUATIONS

Fume hoods should be tested before a hood leaves the manufacturer using the ANSI/ASHRAE 110 standard, "Method of Testing Performance of Laboratory Fume Hoods". Documentation of test results shall be provided to the EH&S Board with delivery of the new fume hood.

PERFORMANCE TESTING OF FUME HOOD EXHAUST SYSTEMS AND BIOLOGICAL SAFETY CABINETS

All new and renovated fume hoods will be tested after installation and before use. In addition tests will be conducted annually or whenever a significant change is made to the operating characteristics of the hood. Tests to be performed include face velocity measurements, flow visualization qualitative tests and possibly additional containment tests as warranted

When a fume hood fails to meet acceptable performance requirements the hood will be declared out of service. Fume hood systems that do not meet these requirements must not be used. The responsibility for fume hood system evaluations lies within the Facilities Department.

The operational integrity of a new biological safety cabinets (BSC) must be validated by certification before it is put into service or after a cabinet has been repaired or relocated. In addition, it will be the responsibility of the Facilities Department to have each BSC tested and certified annually. Certification will be performed by an accredited Biohazard Cabinet Field Certifier using National Sanitation Foundation (NSF) Standard Number 49 for Class II Biological Safety Cabinets.

TESTING CRITERIA

FACE VELOCITY

Face velocity measurements determine the average velocity of air moving perpendicular to the hood face. The measurement is usually expressed in feet per minute (fpm). Face velocities will often provide information concerning the fume hood's ability to properly control contaminants. The average face velocity of the hood shall produce sufficient capture velocity to contain air contaminants during as used conditions.

Each variable air volume hood shall maintain an average face velocity of 90-110 fpm at the maximum allowed hood opening. Each constant volume hood shall maintain an average face velocity of 90-110 fpm in the half open position. A written request for an exception to this requirement must be submitted to University of Tampa Environmental Health & Safety [EH&S] Board and will be granted only after the EH&S Board’s thorough evaluation.

Face velocity measurements are to be made with a recently calibrated and NIST traceable instrumentation (i.e. mechanical or electrical thermal anemometer). Measurements should be made of 1 square foot areas across the face of the hood and no single face velocity measurement should be more than plus or minus 20% of the average. For further information, refer to ANSI/ASHRAE 111-1988, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

FLOW VISUALIZATION QUALITATIVE TESTS

Flow visualization qualitatively tests a hood's ability to contain vapors. This test consists of a small local challenge (use of a smoke tube or dry ice) and a gross challenge (use of a smoke candle or smoke generator) to the hood. Smoke released in the hood is visually monitored to determine if hood or associated duct work leaks during operation.

Containment must be verified for all hoods using a minim of one of the described visual methods (i.e. smoke tube or dry ice). Poor results would dictate that advanced testing protocols using tracer gas containment test methods, including the ANSI/ASHRAE 110 “Method of Testing and Performance of Laboratory Fume Hoods” may be employed in certain instances where hood performance is questionable during operation.

FACE VELOCITY MONITORING

All fume hoods shall include some means of monitoring face velocity with a visual and audio alarm. After the laboratory air handling system has been balanced, the "low-limit" of the air velocity and/or static pressure sensors shall be adjusted and set to activate the alarm whenever the face velocity of any fume hood falls 10% or more from its baseline average face velocity with the sash at 18”.

PROCEDURES FOR TESTING FUME HOOD SYSTEMS

1. General room ventilating systems, both supply and exhaust, including fume hood exhaust, must meet Facilities Planning Design Specifications and shall be in full normal operation. Airflow systems in the laboratory shall be properly tested and balanced prior to this test. This includes calibration of airflow controls, calibration of automatic temperature controls, balance of supply air, etc. Laboratories must be under negative pressure relative to corridor unless special design conditions prevail.
2. Hoods are tested in fully open position, half-open position, and 25% open position.
3. All other hoods in the same room are in half-open position.
4. All other hoods on the same floor exhaust system are in half-open position.
5. The hood being tested should be empty.
6. The doors to the laboratory will be closed.
7. When adjustments are made to hood sashes, supply and exhaust air in the room will be allowed to stabilize before testing is done.
8. Hood monitor is calibrated and not in alarm.

Determination of Average Face Velocity for Variable Air Volume (VAV) Hoods

1. The open face of the hood shall be divided into imaginary rectangles of equal area approximately 1 square foot and velocity shall be measured in each rectangle.
2. Instruments used shall be calibrated prior to and after using an NIST traceable standard.
3. Average the readings to determine average face velocity.
4. Note reading of each face velocity measurement.
5. Average face velocity must be between 90-110 fpm at maximum allowed hood opening. Maximum opening is the point above which the face velocity deteriorates below 90 fpm.
6. Readings must be within + 20% of the average face velocity.
7. Face velocities will also be measured at the one half and one quarter open positions. The average face velocities at these openings should be + 10% of the average at the fully open position.

Determination of Average Face Velocity for Constant Air Volume Hoods

1. The open face of the hood shall be divided into imaginary rectangles of equal area approximately 1 square foot and velocity shall be measured in each rectangle.
2. Note reading of each face velocity measurement.
3. Average face velocity must be 90-110 fpm at the one-half open position.
4. Readings must be within + 20% of the average face velocity.

Smoke Testing To Determine Direction of Airflow and Air Turbulence and Contaminant Reentry

1. Using a smoke tube or dry ice, allow smoke or vapor to reach within 6 inches of the face of the hood around the outside edge of the opening. Determine direction of smoke/vapor flow. If visible fumes flow out of the front of the hood, make necessary adjustments.
2. Place smoke tube or dry ice in the hood and visually observe if there is leakage of smoke from the ductwork or if smoke is being drawn back into building or surrounding buildings.

Acceptance Criteria Hood Testing

- General room ventilating systems, both supply and exhaust, including fume hood exhaust shall be in full normal operation and properly tested and balanced.
- Hood must have an acceptable average face velocity and must pass the visual qualitative testing procedure.
- No leakage of exhaust from ductwork and no reentry of hood exhaust into buildings.
- Airflow monitoring indicator must be functioning

- Refer to Appendix C Local Exhaust Ventilation Systems Testing, Balancing, and Operational Check List

Actions for Hood Testing Failure

- Inform users, EH&S Board, and Facilities Department that unit has failed
- Document failure on Check list Form
- Affix signage to hood stating that it is "Out of Service"
- Repeat performance evaluation after corrective actions have been made

USE OF LABORATORY HOODS AND BIOLOGICAL SAFETY CABINETS

All personnel using fume hoods and biological safety cabinet boxes will follow the policies and procedures outlined in University of Tampa Laboratory Chemical Hygiene and Safety Manual. ANSI/AIHA Z9.5 2003 and ACGIH's Industrial Ventilation Manual provide additional work practices to minimize emissions and employee exposure when working with fume hoods.

Laboratory fume hood performance can be compromised by the following factors:

- Articles blocking airflow to baffle slots
- Articles blocking plane of hood face
- Cross drafts
- Improper adjustment of exhaust dampers
- Leaks in exhaust ducting

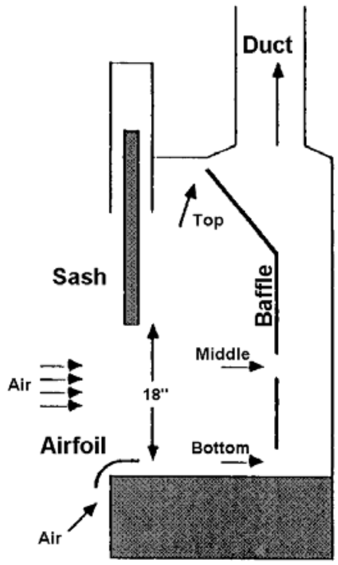

Figure showing common baffle locations

CDC/NIH's publications Biosafety in Microbiological and Biomedical Laboratories and Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets provide additional information on the use of biological safety cabinets. Horizontal and vertical laminar flow clean benches are not biological safety cabinets. These clean benches provide a very clean environment for the manipulation of non-hazardous materials and can be used for activities such as the dust-free assembly of sterile equipment or electronic devices. Since the operator sits in the downstream exhaust from the clean bench, this equipment must never be used for the handling of toxic, radioactive, infectious, or sensitizing materials.

OVERSIGHT

ENVIRONMENTAL HEALTH AND SAFETY BOARD

- Maintains a list of competent personnel or contractors to certify fume hoods
- Inspects the entire fume hood operating systems including the fume hood, associated duct work, exhaust blowers, and stacks
- Places a sticker on fume hoods with average face velocity if the hood operating systems "PASS"
- Places a "DO NOT USE" sign on the hood sash if the hood operating system does "NOT PASS"
- Puts in a work order on behalf of the department head to Facilities Department for repair
- Notifies the Department Head, Environmental Health and Safety Coordinator, and Facilities Department of any hoods which are placed "OUT OF SERVICE"

FACILITIES PLANNING

- Make all necessary repairs/modifications, in a timely manner, to the fume hood operating system, and any associated equipment which affects the fume hood operating system in order to make the entire system safe to use.
- Notify Environmental Health and Safety (EH&S) after all repairs/modifications are completed. EH&S will then retest the system.
- Notify EH&S on a monthly basis in writing as to the status of repair/replacement of fume hoods based on work orders/work requests submitted.

DEPARTMENT HEAD

- Ensure that any fume hoods which are placed "OUT OF SERVICE" will not be used until notified by EH&S that the hood can be used.
- Ensure that repairs/modifications are completed in a timely manner to any fume hoods which have been placed "OUT OF SERVICE".
- Notify EH&S and Facilities Planning of any fume hoods which are not operating properly.

PERSONNEL USING FUME HOODS

- Follow all safety and health procedures specified in the Laboratory Chemical Hygiene and Safety Manual and by the faculty supervisor in the laboratory.
- Attend all required health and safety training sessions.
- Do not use fume hoods which are "OUT OF SERVICE".
- Report fume hoods which are not operating properly, accidents, unhealthy, and unsafe conditions to the faculty supervisor.
- Notify faculty supervisor of any pre-existing health conditions that could lead to serious health situations when using a fume hood.
- Do not put your head in the hood when contaminants are being generated.
- Hoods should not be routinely used as a waste disposal mechanism for volatile materials. If a flammable storage cabinet is not available, the hood may be used to store volatile waste waiting to be picked up by EH&S. The volatile waste must be in proper containers, closed and have proper labeling.
- Place any heat generating equipment in the rear of the hood to minimize the effect of convection currents on the airflow in the hood.
- Keep the slots in the hood baffle free of obstruction by apparatus or containers.
- Place large apparatus to the rear of the hood and raise it off the surface with two to three inch blocks to allow airflow under the object and into the lower rear baffle.
- Minimize foot traffic past the face of the hood.
- Keep laboratory doors and windows closed.

- Do not position fans or air conditioners in a manner that will direct airflow across the face of the hood and interfere with containment.
- Do not block air supply vents or exhausts in the room.
- Do not remove the hood sash or panels except when necessary for apparatus setup. Replace sash or panels before operating.
- Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. No permanent electrical receptacles are permitted in the hood unless approved by the manufacturer.

DECONTAMINATION AND REMOVAL OF FUME HOOD SYSTEMS OR BIOLOGICAL SAFETY CABINETS

When a fume hood is scheduled for removal, the hood, fan, and associated ductwork must be tested for the presence of radioactive materials and hazardous chemicals [i.e. perchlorate salts, asbestos, oxidizers, sulfides, cyanides, lead, and mercury]. EH&S will determine the need for testing and decontamination of the hood and ductwork. If decontamination is necessary, fume hood(s) must be decontaminated before removal. Biological safety cabinets must be decontaminated before removal or when relocated.

CONTRACTORS WORKING WITH FUME HOODS AND ASSOCIATED FANS AND DUCTWORK

Before beginning work, all contractors and subcontractors, involved with a renovation project involving fume hoods and associated fans and ductwork must provide EH&S job objectives and dates of activity for oversight. EH&S will make recommendations for training and personal protective equipment for all contracted employees working near University chemicals during the course of project.

Appendix A - PUBLICATIONS

ACGIH. "Industrial Ventilation- A Manual of Recommended Practice." American Conference of Governmental Industrial Hygienists, Ed. 25, 2005 (or most recent addition).

ANSI/AIHA. Z9.2 2001 "American National Standard for Fundamental Design and Operation of Local Exhaust Ventilation Systems. 2001. (or the most recent edition).

ANSI/AIHA. Z9.5 2003 "American National Standard for Laboratory Ventilation." American Industrial Hygiene Association. 2003. (or the most recent edition).

ANSI/ASHRAE 62-1999 and Addenda [2001-2004], "Ventilation for Acceptable Indoor Air Quality", (or the most recent edition).

ANSI/ASHRAE 110-1995, "Method of Testing Performance of Laboratory Fume Hoods", 1995 (or the most recent edition).

ANSI/ASHRAE 111-1988, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems, (or the most recent edition).

ASHRAE. "2004 ASHRAE Handbook- HVAC Systems and Equipment" American Society of Heating and Air-Conditioning Engineers, Inc. 2004. (or the most recent edition).

ASHRAE. "2005 Handbook- Fundamentals ". American Society of Heating and Air-Conditioning Engineers, Inc. 2005 (or the most recent edition).

ASHRAE's Laboratory Design Guide, American Society of Heating and Air-Conditioning Engineers, Inc. 2002 (or the most recent edition).

Biosafety in Microbiological and Biomedical Laboratories. U. S. Department of Health and Human Services. U. S. Government Printing Office. Washington, D. C. 1993 (or most recent).

CRC, The CRC Handbook of Laboratory Safety, Fifth Edition, 2000.

EPA STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES 40 CFR 60, Appendix A, most recent addition.

NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals, 2004 Edition.

OSHA 29 CFR 1910.94 OSHA Occupational Health and Environmental Control - Ventilation

OSHA 29 CFR 1910.1450 OSHA Occupational Exposure to Hazardous Chemicals in Laboratories

OSHA 29 CFR 1910 Subpart Z OSHA Toxic and Hazardous Substances

Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets. U. S. Department of Health and Human Services. U. S. Government Printing Office. Washington, D. C. 1995 (or most recent).

Appendix B -- DEFINITIONS

ACGIH: American Conference of Governmental Industrial Hygienists

AIHA: American Industrial Hygiene Association

ANSI: American National Standards Institute

ASHRAE: American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc.

Building envelope: the three-dimensional space surrounding a building containing the building's makeup air.

Downwash: pollutants discharged from an exhaust stack that travels towards the ground due to insufficient discharge velocities, poor wind dispersion, and physical obstructions.

Exhaust Air: the air that is removed from an enclosed space and discharged into atmosphere (ANSI/AIHA Z9.5, 2003).

Face Velocity: average velocity of air moving perpendicular to the hood face, usually expressed in feet per minute (fpm) or meter per second (m/s) (ANSI/ASHRAE 110, 1995)

Glove Box: a boxlike structure provided with tight-closing doors or air locks, armholes with impervious gloves sealed to the box at the armholes, and exhaust ventilation to keep the interior of the box at negative pressure relative to the surroundings (ANSI/AIHA Z9.5, 2003).

Hood Face: the plane of minimum area at the front portion of a laboratory fume hood through which air enters when the sash(es) is (are) fully opened, usually in the same plane as the sash(es) when sash(es) is (are) present (ANSI/ASHRAE 110, 1995)

Internal Condensation: fumes and vapors that condense into liquids inside of the exhaust stack.

Laboratory Fume Hood: 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 laboratory operation but not necessarily involving the use of a bench or a table (ANSI/ASHRAE 110, 1995) lpm: liters per minute (ANSI/ASHRAE 110, 1995)

Makeup Air: outside air drawn into a ventilation system to replace exhaust air (ANSI/AIHA Z9.5, 2003). Makeup air MUST always be provided when any exhaust system is designed and installed.

perchloric acid hood: a fume hood constructed with water wash so it is safe for use with perchloric acid or other reagents that might form flammable or explosive compounds with organic materials of construction (ANSI/AIHA Z9.5, 1992).

Recirculation: air withdrawn from a space, passed through a ventilation system, and delivered again to an occupied space (ANSI/AIHA Z9.5, 2003).

Reentry: The flow of contaminated air that has been exhausted from a space back into the space through air intakes or openings in the walls of the space (ANSI/AIHA Z9.5, 1992).

Replacement Air: see makeup air

Return Air: air being returned from a space to the ventilation fan that supplies air to a space (ANSI/AIHA Z9.5, 2003).

Special Purpose Hood: an exhaust hood, not otherwise classified, for a special purpose such as- but not limited to - capturing gases from equipment such as atomic absorption, gas chromatographs, liquid pouring or mixing stations, and heat sources (ANSI/AIHA Z9.5, 2003).

Variable Air Volume Fume Hood: a fume hood designed so the exhaust volume is varied in proportion to the opening of the hood face by changing the speed of the exhaust blower or by operating a damper in the exhaust hood (ANSI/AIHA Z9.5, 2003).

Velocity: speed and direction of motion (ANSI/AIHA Z9.5, 2003).

Walk-in hood: a fume hood designed to be floor mounted with sash and/or doors for closing the open face (ANSI/AIHA Z9.5, 2003).

Appendix C – LOCAL EXHAUST VENTILATION SYSTEMS TESTING, BALANCING, AND OPERATIONAL CHECK LIST

Item No.	Local Exhaust Ventilation Systems Testing, Balancing, and Operational Check List	Date Completed
1.	General room ventilation requirements for laboratory and adjoining spaces shall have proof of testing & balancing report that conforms to applicable standards referenced in this policy.	
2.	Fume hood manufacturer documentation shall be provided to the owner certifying that a quality assurance program is in place to verify that the unit successfully completed the ASHRAE 110-R performance test (with a minimum rating of 4.0 AM 0.05). The quality assurance program and test shall indicate that hood performance is adequate for the intended use.	
3.	Each newly installed fume hood system shall be tested and balanced to provide the airflow rates (negative and positive pressures) and volumes specified. Final adjustments, where necessary, shall be made to enhance system performance before occupancy and also shall be tested and balanced six months after date of occupancy. A copy of the test report shall be provided as part of the final project documentation.	
4.	Built-in fume hood sash stops shall be tested for operational effectiveness and to verify that the alarm console will properly activate if the sash stops are compromised.	
5.	Overall fume hood system operational and maintenance instructions shall be provided to the owner.	
6.	Any deficiencies noted during laboratory fume hood testing and balancing shall be corrected before occupancy.	
7.	Fume hood fans, blowers and drive mechanisms shall be located on the exterior (rooftop) of the building and shall be designed and located so they are readily accessible for visual	

Item No.	Local Exhaust Ventilation Systems Testing, Balancing, and Operational Check List	Date Completed
	inspection and maintenance. Exhaust discharge velocities shall be maintained in the range of 3500-4000 fpm and shall be located in a manner to prevent re-entrainment of contaminants back into building.	
8.	Upon installation in the laboratory, a fume hood safety test, including face velocity measurements and visual performance testing, shall be completed. Certification of successful fume hood safety tests shall be submitted prior to acceptance of commissioned hood. A. Each fume hood shall be designed and installed to operate at an average face velocity of 100 fpm [between 90-110 fpm] with the vertical sash set at the designated sash height above the work surface. B. . All hoods should have a sticker designating the maximum safe sash height. Keep the sash at the appropriate level to ensure optimal face velocity. C. Positive pressure ventilation shall **not** be introduced into any fume hood behind the plane of the hood sash. D. The motor(s) and fan(s) for each fume hood system shall be designed to accommodate a minimum of ten (10) % extra capacity to compensate for normal system loss. Fan motors shall not operate at design capacity exceeding 90% of motor nameplate horsepower.	
9.	Due to the complex flow dynamics of Auxiliary Supplied Air Hood systems, the hood should be additionally tested after installation to capture >90% of the auxiliary jet airflow when the auxiliary air is ± 20° F different than the ambient air at the full open hood face position.	

Item No.	Local Exhaust Ventilation Systems Testing, Balancing, and Operational Check List	Date Completed
	In addition: The supply plenum is located externally and above the top of the hood face (and outside of the hood), The supply jet is distributed in a manner that does not affect contaminants inside hood, and The auxiliary air does not disrupt containment or increase potential for escape. The 90% capture efficiency should be tested by introducing a tracer gas at a known rate inside the hood and simultaneously sampling the hood exhaust. Also, Flow volume and sampling should be in accordance with EPA methods 1, 2 and 17 as outlined in 40 CFR 60, Appendix A or other acceptable testing methods approve by the EH&S Board. The pass criteria are achieved when each of the three test criteria is achieved.	
10.	Each fume hood shall have peel and stick-type labels indicating safe operating conditions are met and the date of performance testing.	