UNIVERSITY of KANSAS – LAWRENCE CAMPUS
DEPARTMENT of ENVIRONMENT, HEALTH & SAFETY

# Standards/Specifications for High Performance Laboratory Fume Hoods

## PART 1 - GENERAL

The purchase and installation of any laboratory ventilation devices (fume hoods, ventilated workstations, snorkels, biosafety cabinets, etc.) at the University of Kansas – Lawrence campus requires the review and approval of the KU Department of Environment, Health & Safety.

This document sets forth the standards & specifications for high performance fume hoods, which is the desired type of fume hood for all such installations on campus, in order to achieve safety first, then energy savings/sustainability. Any deviations or exceptions must be reviewed and approved by the KU-EHS Dept.

### 1.01 SUMMARY

A. Section Includes:
1. Bench-top High-Performance Laboratory Fume Hoods.
2. Service fixtures (i.e. water, gas, etc.) and electrical service fittings in fume hoods.
3. Piping and wiring within service fittings, light fixtures, switches, and other electrical devices.
4. Fume hood base support.
5. Work Surfaces within fume hoods.
6. Laboratory sinks and cup sinks in fume hoods.
7. Filler panels and ceiling enclosures for fume hoods.

B. Related Sections:
1. Division 22 – Plumbing: Furnishing and installation of plumbing utilities and final connections to fume hoods.
2. Division 23 – HVAC: Furnishing and installation of exhaust duct work and equipment, and final connection of hoods.
3. Division 26 – Electrical: Furnishing and installation of electrical utilities and final connections to hoods.

## 1.02 SCOPE AND CLASSIFICATION

A. This specification covers the requirements for the purchase and installation of bench/cabinet mounted high performance laboratory fume hoods for remote exhaust blower systems (CAV or VAV). It is written to cover the airflow design, by-pass design and service fixture configurations that are available on these hoods.

B. Bench-mounted laboratory fume hoods in 4, 5, 6 and 8-foot widths, internal depth of 27.2" and external depth of 37.7" are required.

C. This specification sets the intent for quality, performance and appearance.

## 1.03 REFERENCES

A. The laboratory hoods must conform to the following regulations and standards.
1. SEFA 1, Scientific Equipment and Furniture Association , Recommended Practices for Laboratory Fume Hoods
2. SEFA 8, Recommended Practices for Laboratory Grade Metal Casework, 8.0 Cabinet Surface Finish Tests
3. NFPA 45, National Fire Protection Association, Fire Protection for Laboratories Using Chemicals
4. ASTM E84-09C, ANSI 2.5, NFPA 255, UL 723, UBC 8-1 (42-1), Standard Test method for Surface Burning Characteristics of Building Materials
5. ASHRAE 110, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Method of Testing Performance of Laboratory Fume Hoods
6. ANSI/AIHA Z9.5, American Industrial Hygiene Association, Laboratory Ventilation
7. OSHA, Federal Register 29 CFR Part 1910, Occupational Safety & Health Administration, U.S. Department of Labor, Occupational exposures to hazardous chemicals in laboratories.

B. The laboratory fume hoods must carry the ETL listed mark for the following.
1. UL 61010-1 (formerly 3101-1), Underwriters Laboratories Inc., Electrical Equipment for Laboratory Use
2. CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
3. UL 1805, Underwriters Laboratories Inc., Standard for Laboratory Hoods and Cabinets

C. 230 volt model fume hoods must carry the CE conformity marking as required by the Council of European Communities.

## 1.04 PERFORMANCE REQUIREMENTS

A. General Design Requirements (See Part 2 for details)

1. Fume hoods shall function as ventilated, enclosed workspaces, designed to capture, contain and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.
2. Fume hood shall be factory designed to function as a by-pass fume hood or as a variable air volume fume hood without modification.
3. Structure and Materials of construction
    a. Hoods are of double-wall construction
    b. Epoxy-coated, cold rolled steel exterior
    c. Galvanized steel support members
    d. Sheet molded composite board internal liner
4. Baffles
    a. Perforated primary baffle designed to pull air in horizontal streams to minimize the air roll pattern associated with traditional fume hoods.
    b. Baffle slot pattern designed to optimize face velocity profile.
    c. A secondary baffle is located behind the primary perforated baffle to counteract upward air streams that produce roll.
    d. Moving or adjustable baffles are not acceptable
5. Sash
    a. Maximum opening is 28” sash may not extend above exterior sheet metal of hood.
    b. Unobstructed viewing height is 37.5".
    c. Hood incorporates a perforated sash handle to bleed air into the hood chamber directing fume concentrations away from the user's breathing zone.
6. Airfoil:
    a. Hoods are provided with an air foil across the bottom of the sash area to allow airflow into the hood regardless of user's position.
7. Hoods are provided with an upper dilution air supply for by-pass air to bathe the sash interior and upper interior and to provide 5-10% of the hood's air volume requirements.
8. Besides the exhaust blower, no additional blowers are required for specified containment.
9. Access for maintenance is from both the front, interior, and exterior sides of the hood.
10. Services:
    a. Hood manufacturer shall furnish and deliver all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings.
    b. Plumbing fittings mounted on the fume hood superstructures shall be pre-plumbed per section 2.03.
    c. Final plumbing and electrical connections are the responsibility of those contractors fulfilling requirements of applicable Divisions.
    d. All electrical services are pre-wired to a single point internal junction box at the top right of the hood.
11. Hoods without service fixtures pass through a 38" opening without disassembly.

B. Containment (as manufactured)
1. The purpose of this section is to set a standard of performance for the bidder's laboratory fume hood before award of contract, and may not necessarily represent the operating conditions of the hoods after installation. Before or after award of contract, owners may require representative witness to said testing at their option, with failure to meet passing criteria as grounds for rejection of the bidder. Test data shall be provided at no cost to the owner.
2. Evaluation of manufacturer's standard product shall take place in manufacturer's test facility meeting the following criteria.
   a. Lab to be located at manufacturer's place of business for the testing of bench-mounted laboratory hoods in accordance with ASHRAE Standard 110.
   b. Room shall accommodate hoods up to 16' wide, while maintaining sufficient area so that a minimum of 15 feet of clear space is available in front of and 5' on both sides of hoods for viewing tests.
   c. The facility's ventilation system shall have adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.
   d. One hundred percent non-recirculated air to be both carbon and HEPA filtered to ensure removal of contaminants that could interfere with containment testing before entering the lab.
   e. Make-up air to the test room shall be ceiling-supplied through any combination of multiple diffusers to either minimize adverse airflow, or increase it depending on test objectives.
   f. Exhaust volumes shall be computer controlled and measured via AMCA calibrated orifices and flow station at each exhaust trunk.
   g. Room pressurization must be digitally monitored, and variable depending on test objectives.
   h. All equipment must be properly calibrated.
   i. Qualified personnel familiar with the laboratory and its operation shall be available to perform the test.
   j. Include the following instrumentation and test equipment:
      1) Properly calibrated hot wire thermal anemometer capable of measuring air velocities from 10 to 600 ft/minute; correlate with computer data acquisition format to provide simultaneous readings at all points.
      2) Theatrical smoke generator or other source of high volume smoke.
      3) Smoke tubes or other source of localized smoke.
      4) Leak meter with traceable calibration, calibrated just before test, to indicated concentration of sulfur hexafluoride.
      5) Tracer gas: Sulfur hexafluoride supplied from a cylinder with two stage regulator.
      6) Adjustable mannequin, 5' 0' to 5'8" in height, with reasonable human proportions, clothed in a smock
      7) Inclined manometer with graduations no greater than 0.2 inch of water.
      8) Ejector system: Tracer gas ejector built to specific ASHRAE-110 requirements.
      9) Critical orifice: Sized to provide tracer gas at four or eight liters per minute at an upstream pressure sufficient to maintain release rate.
      10) Data acquisition software to include HoodPro™ and LabMeasurePro™ from Exposure Control Technologies, Inc.

3. Hood shall be tested to ASHRAE 110 modified test method as detailed below.
4. Some fume hoods may use face velocity controls, motorized baffles, integral auxiliary make up, or supply fans. Because all of these devices are subject to failure, containment testing shall show both operational containment and product containment with these systems off.
5. Fume hood sashes shall be placed in their full open position, at least 28” from the work surface, unless noted otherwise.
6. Ambient Temperature: 68 to 74 degrees F
7. **Average Face Velocity:** Face velocity average shall be 40 and 50fpm, as noted below in subsection 8.d, parts 1 and 2 respectively, plus or minus 5%.
    a. An imaginary grid is formed comprised of equal 12” by 12” squares, or smaller, across the face opening of the laboratory hood. Airflow velocity readings are taken at the intersections of these grids with calibrated hot wire anemometer over a twenty second period of time. Probes shall communicate readings to a computer data acquisition package, which will provide an average of each reading over the one-minute period and also an overall average upon completion of data acquisition. Face velocity shall be determined by averaging readings at the hood face.
    b. Average face velocity must be achieved without exceeding the CFM noted in part C.
8. **Tracer Gas Detection:** Hood shall achieve a rating of 4.0AM0.00 maximum average and 4.0AM0.01 maximum spike (unless specifically otherwise noted), wherein:
    a. 4.0 = tracer gas release in liters/minute, AM = as manufactured, 0.01 = tracer gas in parts per million (PPM)
    b. With the ejector body 6" from the rear of the sash plane, the test shall be conducted for each ejector position noted.
        1) Left position with ejector 12" from the left interior wall.
        2) Center position with ejector equidistant from the sidewalls.
        3) Right position with ejector 12" from the right interior wall.
    c. Install mannequin positioned in front of the hood, centered on the ejector.
    d. Detector probes shall be placed 3” in front of the sash plane. The test shall be conducted for each detector probe position and corresponding face velocity.
        1) Detector probe in the region of the **nose and mouth of the mannequin**. Test with average face velocity of **40 fpm**.
        2) With the mannequin height reduced 4”, place detector probe in the **chest of the mannequin**, and even with the height of the ejector. Test with average face velocity of **50 fpm**.
    e. Open tracer gas valve, and collect readings with a computer data acquisition package, which is capable of monitoring and visually recording a minimum of one reading per second for a minimal five minute time period for each position.
    f. The single control rating of the fume hood shall be the results of the test position yielding the highest average levels of tracer gas in any of the six mannequin/ejector configurations.
    g. With the ejector and mannequin in the center position, detector probe in the region of the **nose and mouth of the mannequin**, average face velocity of **40 fpm**, tracer gas released, and concentration recorded, open and close the sash in a smooth motion. Test to be repeated three times, with peak values of 0.01 PPM or less.
    h. With the mannequin removed, the periphery of the hood is traversed by the probe at 1” in front of the hood opening at a rate of 3 inches per second. The hood shall have a maximum perimeter reading of 0.01 PPM or less.

9. Flow Visualization:
   a. Test the operation of the lower air bypass airflow opening and hood periphery by introducing light smoke under the air foil, and around the perimeter of the sash opening. If any smoke that enters the hood reverses directions and escapes from any of these locations, the hood fails this portion of the test and receives no rating.
   b. Introduce smoke along both walls and the hood floor in a line parallel to the hood face and 6 inches (152 mm) back into the hood. Define air movement toward the face of the hood as reverse airflow and define lack of movement as dead air space. All smoke should be carried to the back of the hood and out.
   c. Introduce a large volume of smoke at the work surface in the center of the hood, and 6" inside the plane of the sash. The smoke shall not get entrained in an interior vortex, and shall clear in a single pass.
10. All data on the above, including instrumentation and equipment, and test conditions shall be provided on a report, including the average face velocities, and a separate graph-type performance curve on all tracer gas tests for all required fume hood widths. Performance test data for a 6' representative hood shall be conducted by an independent testing agency and by a specific individual certified to perform such tests by the National Environmental Balancing Bureau (NEBB).

C. Efficiencies
1. The fume hood shall maintain constant volumetric rate (+/- 5 CFM) and static pressure losses (+/- 0.01" H2O) across all sash positions. Without any modifications, the hood shall also maintain a sufficiently restricted by-pass for use with a variable air volume (VAV) system.
2. The fume hood shall demonstrate a minimization of the volumetric rate of air (CFM) requirement at any given face velocity. Required CFM to achieve desired face velocity shall not exceed that which is noted in the chart below.
3. The fume hood shall demonstrate a minimization of static pressure loss (inches of H2O) at any given CFM. Static pressure loss at desired face velocity, and corresponding CFM, shall not exceed that which is noted in the chart below.

| Face Velocity (fpm) Sash at 28" open | Airflow Volumetric Rate (CFM) @ Static Pressure (inches of water) | | | |
|---|---|---|---|---|
| | 4' Hood | 5' Hood | 6' Hood | 8' Hood |
| 100 | 705, 0.26" | 930, 0.32" | 1150, 0.41" | 1600, 0.29" |
| 80 | 565, 0.17" | 745, 0.20" | 920, 0.25" | 1280, 0.19" |
| 60 | 425, 0.09" | 560, 0.12" | 690, 0.15" | 960, 0.10" |
| 50* | 350, 0.06" | 465, 0.08" | 575, 0.10" | 800, 0.07" |
| 40* | 280, 0.04" | 370, 0.05" | 460, 0.07" | 640, 0.05" |
| Face Velocity (fpm) Sash at 18" open | Airflow Volumetric Rate (CFM) @ Static Pressure (inches of water) | | | |
| | 4' Hood | 5' Hood | 6' Hood | 8' Hood |
| 100 | 440, 0.10" | 580, 0.12" | 720, 0.16" | 1000, 0.11" |
| 80 | 350, 0.06" | 465, 0.08" | 575, 0.10" | 800, 0.07" |
| 60 | 265, 0.04" | 350, 0.05" | 430, 0.06" | 600, 0.04" |

*There is not a written standard that would suggest a design face velocity below 60 fpm. This data is for informational purposes only.

D. Noise Criterion: The hood shall have a Noise Criterion (NC) rating of less than 50; measured 36" in front of the hood with full open sash, at 100 fpm face velocity. NC is a factor of sound pressure level (dB) and frequency.

E. Illumination: Shall be a minimum average of 80 foot-candles inside the work area. Work area is defined as the area inside the lined portion of the fume hood, from the face of baffle to sash plane, from interior left to interior right, and from the work surface to a height of 28 inches.

F. Materials of Construction: Interior and Exterior materials of construction and finishes shall meet the requirements in Part 2 of this specification.

## 1.05 QUALITY ASSURANCE

A. Fume hoods shall be designed, including comprehensive engineering analysis, by a qualified, licensed Professional Engineer.

B. Manufacturer's Qualifications
1. ISO 9001 Certified manufacturing plant and processes.
2. Ten installations of equal or larger size and requirements. Provide contact at each.
3. Only hood manufacturers who have had fume hoods as a principal product for 75 years are considered.

C. Fume hoods shall be **Made in America**
1. 95% or more of raw material and component suppliers shall be United States based.
2. Stainless and cold rolled steel used in manufacturing shall be sourced from United States steel mills.
3. Final product must be fabricated and assembled within the United States of America.
4. Owner reserves the right to evaluate Made in America claims for compliance with the Bureau of Consumer Protection.

D. Supply all equipment in accordance with this specification. Offering a product differing in materials, construction, or performance from this specification requires written approval by KU-EHS Dept. obtained seven days or more before the proposal deadline.

E. The owner/architect reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.

F. Manufacturer's warranty against defects in material or workmanship on its fume hoods will be for 1 year from date of installation or 2 years from date of purchase, whichever is sooner, and includes replacement of parts (except lamps) and labor. Owner warranty requirement is 5 years from date of installation. This is obtained by purchasing the hoods through the KU Contract with Fisher Scientific.

## 1.06 SUBMITTALS

A. Action Submittals
1. Laboratory hood specification sheets and product manuals shall be submitted by the hood manufacturer upon request, and include safe and proper operation and maintenance information.
2. Shop Drawings: Include plans, elevations, sections, and details.
   a. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
   b. Indicate locations and types of service fittings together with associated service supply connection required.
   c. Indicate duct connections, electrical connections, and locations of access panels.
   d. Include rough-in information for mechanical, plumbing, and electrical connections.
   e. Provide face opening, volumetric rates, and static pressure drop data.
3. Submit a document detailing the information supplied on the Hood Safety Practices Label to verify compliance to specifications.

B. Informational Submittals
1. Product Test Reports: Showing compliance with specified performance requirements, including NEBB representative test report as defined previously.
2. Independent validation:
   a. Written verification that the laboratory fume hoods carry the ETL listed mark for the following.
      1) UL 61010-1 (formerly 3101-1), Underwriters Laboratories Inc., Electrical Equipment for Laboratory Use
      2) CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
      3) UL 1805, Underwriters Laboratories Inc., Standard for Laboratory Hoods and Cabinets
   b. Written verification that 230 volt model fume hoods carry the CE conformity marking as required by the Council of European Communities.
   c. Written verification from an outside testing agency confirming coating compliance to SEFA 8-2010, Recommended Practices for Laboratory Grade Metal Casework, 8.0 Cabinet Surface Finish Tests
3. Documentation of ISO 9001 Certified manufacturing plant and processes.
4. List of five installations (of equal or larger size and requirements) is available upon request. Provide contact at each.
5. Declaration of Made in America, Owner reserves the right to evaluate Made in America claims for compliance with the Bureau of Consumer Protection.

C. Material Submittals
   1. Samples for Verification: of the hood exterior wall material, interior liner and baffle material, epoxy work surface material, and color selection chips are available from the hood manufacturer upon request.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

B. Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility rough-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The only high performance bench top hood approved for purchase and installation on the KU Lawrence campus by the KU Department of Environment, Health & Safety is:
B. Acceptable Manufacturer: **Labconco Corporation**, 8811 Prospect Avenue, Kansas City, Missouri 64132
C. Basis-of-Design Product: **Labconco Protector XStream**
**D. Hood acquisition is to be made through the KU Contract with Fisher Scientific**

## 2.02 MATERIALS

A. Hood Interior Liner and Baffle
1. Liner material must comply with UL 1805, and be listed within NRTL test report as proof of compliance.
2. General Material Properties
   a. Nonflammable, corrosion and chemical-resistant
   b. Sheet molded homogenous polyester panels
   c. Minimum thickness is 3/16"
   d. Smooth, white finish
3. Mechanical Properties
   a. Tensile Strength: 7,500 PSI (51.7 Mpa)
   b. Tensile Modulus: 1.7 x 10^6 PSI (11,700 Mpa)
   c. Flexural Strength: 21,000 PSI (145 Mpa)
   d. Flexural Strength at 130 degrees C: 12,900 PSI (89 Mpa)
   e. Compressive Strength: 32,500 PSI (224 Mpa)
   f. IZOD Impact Strength (Notched): 8.4 Ft Lb/in (4.5 J/cm)
4. Flame and Smoke Characteristics
   a. Flame retardant, self-extinguishing, with a flame spread rating of 25 or less in accordance with ASTM-E84
   b. Oxygen Index: 35%
   c. Smoke Density: 115
5. Physical Properties
   a. Water Absorption: 0.4%
   b. Specific Gravity: 4.81
   c. Coefficient of Thermal Expansion: 2 In/in/ degree C x 10^-5
   d. Thermal Conductivity: 1.9 BTU/Hr/Ft^2/In/degree F
6. Chemical Resistance
   a. Splash and Spill Resistance:
      1) Suspend sample panel in a vertical plane
      2) Apply five drops of each reagent listed with an eyedropper
      3) Apply liquid reagents at top of panel and allow to flow down full panel height
   b. Fume Resistance:
      1) Place 25 milliliters of reagent into 100 milliliters beakers and position panel over beaker tops in the proper sequence. Ensure beaker pouring lip permits air to enter the interior atmosphere.
      2) After 24 hours remove panel, flush with water, clean with detergent, rinse, wipe dry and evaluate

c. Evaluation ratings: Change in surface finish and function shall be described by the following numerical ratings
   1) No Effect: No change in color or gloss
   2) Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material
   3) Good: Clearly discernible change in color or gloss, but no significant impairment of function or life
   4) Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period
   5) Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration

d. Required minimum results for each reagent (Reagent: Fume Resistance Rating, Splash and Spill Resistance Rating)

| | | |
|---|---|---|
| 1) | Hydrochloric Acid (37%): | 2,1 |
| 2) | Sulfuric Acid (33%): | 2,1 |
| 3) | Sulfuric Acid (77%): | 1,1 |
| 4) | Sulfuric Acid (96%): | 1,2 |
| 5) | Formic Acid (90%): | 2,1 |
| 6) | Nitric Acid (20%): | 2,2 |
| 7) | Nitric Acid (30%): | 1,2 |
| 8) | Nitric Acid (70%): | 3,2 |
| 9) | Hydrofluoric Acid (48%): | 2,2 |
| 10) | Phosphoric Acid (85%): | 1,1 |
| 11) | Chromic Acid (60%): | 1,4 |
| 12) | Acetic Acid (98%): | 1,1 |
| 13) | Ammonium Hydroxide (20%): | 1,1 |
| 14) | Sodium Hydroxide (10%): | 1,1 |
| 15) | Sodium Hydroxide (20%): | 1,3 |
| 16) | Sodium Hydroxide (40%): | 1,3 |
| 17) | Sodium Hydroxide Flake: | 1,- |
| 18) | Sodium Sulfide: | 1,1 |
| 19) | Zinc Chloride: | 2,1 |
| 20) | Tincture of Iodine: | 3,3 |
| 21) | Silver Nitrate: | 2,1 |
| 22) | Methyl Alcohol: | 1,1 |
| 23) | Ethyl Alcohol: | 1,1 |
| 24) | Butyl Alcohol: | 1,1 |
| 25) | Benzene: | 1,1 |
| 26) | Xylene: | 1,1 |
| 27) | Toluene: | 1,1 |
| 28) | Gasoline: | 1,1 |
| 29) | Dichloro Acetic Acid: | 2,2 |
| 30) | Dimethyl Formanide: | 2,2 |
| 31) | Ethyl Acetate: | 1,1 |
| 32) | Amyl Acetate: | 1,1 |
| 33) | Acetone: | 1,1 |
| 34) | Chloroform: | 1,1 |
| 35) | Carbon Tetrachloride: | 1,1 |
| 36) | Phenol: | 2,2 |

| | | |
|---|---|---|
| 37) | Cresol: | 1,1 |
| 38) | Formaldehyde: | 1,1 |
| 39) | Trichloroethylene: | 1,1 |
| 40) | Ethyl Ether: | 1,1 |
| 41) | Furfural: | 1,3 |
| 42) | Methylene Chloride: | 1,1 |
| 43) | Mono Chloro Benzene: | 1,1 |
| 44) | Dioxane: | 1,1 |
| 45) | Methyl Ethyl Ketone: | 1,1 |
| 46) | Acid Dichromate: | 1,2 |
| 47) | Hydrogen Peroxide: | 1,1 |
| 48) | Napthalene: | 1,1 |

B. Sheet Steel
1. Side panels and access panels 20-gauge (or heavier) sheet steel.
2. Hood corner posts are 18-gauge sheet steel.
3. Ceiling enclosure panels are 18 gauge sheet steel.
4. Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M.

C. Chemical Resistant Finish
1. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling.
2. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Third party validation required.
3. Powder-coat process required. Paint processes that release Volatile Organic Compounds (VOC) are not acceptable
4. Color for Fume Hood Finish:
   a. Glacier White
   b. As approved by the owner from Manufacturer's full range

D. Safety Glass
1. Tempered
   a. Clarity and temper test to be as specified in latest edition of Glass Tempering Association, *Engineering Standards Manual*, Section 8.1.
   b. Surface and interior visible quality to be as specified per ASTM C 1036, *Standard Specification for Flat Glass*, Table 4, Quality level Q3.

## 2.03 CONSTRUCTION

A. Superstructure:
1. Self-supporting, rigid structural assembly, to support inner wall consisting of fume hood liner and outer wall of sheet metal exterior.
2. Fabricated from galvanized steel.
3. Space shall accommodate fume hood wiring and plumbing components for service fixtures.
4. Access to fixture valves concealed in wall provided by exterior removable access panels, gasket access panels on the inside liner walls, or through removable access panels on the front posts.

B. Exterior
   1. Fabricate from steel sheet with component parts screwed together.
   2. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
   3. Interchangeable side panels shall lift off without the use of tools to allow access to plumbing lines, service fittings, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.
   4. Corner posts
      a. Pre-punched and plugged to accommodate up to 4 service fixtures per side
      b. All services are accessible from the front of the hood.
      c. Aerodynamic shape
      d. Accommodate two electrical duplexes per side.
      e. Right hand corner post includes electrical switches and pre-cut for Airflow monitor installation.
      f. Un-used penetrations shall be plugged.
   5. Top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
   6. Panel above header shall be removable without the use of tools to allow access to mechanical connection, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.

C. Dimensions
   1. Overall exterior dimensions are as follows:
      a. 4 foot nominal width: 48” w x 59” h x 37.7” d
      b. 5 foot nominal width: 60” w x 59” h x 37.7” d
      c. 6 foot nominal width: 72” w x 59” h x 37.7” d
      d. 8 foot nominal width: 96” w x 59” h x 37.7” d
   2. Overall interior dimensions are as follows:
      a. 4 foot nominal width: 38.1” w x 48” h x 27.2” d
      b. 5 foot nominal width: 50.1” w x 48” h x 27.2” d
      c. 6 foot nominal width: 62.1” w x 48” h x 27.2” d
      d. 8 foot nominal width: 86.1” w x 48” h x 27.2” d

D. Hood Liner
   1. Adhere interior liner components to superstructure.
   2. Stainless steel fasteners shall be used on the interior ceiling for structural integrity.
   3. Fasteners exposed to chemical environment are not acceptable.
   4. Punch fume hood lining side panels to receive four service fittings, for use with remote controls, per side. Provide removable plug buttons for holes not used for indicated fittings.
   5. Each side wall shall include an oval interior access panel to provide access to the side wall of the fume hood for plumbing service access. Access panel material shall be that of the liner, and gasketed to form a vapor proof seal.

E. Hood Baffle
1. Baffle system shall be designed to optimize the face velocity profile, and to capture a wide range of gaseous densities without adjustment or moving components.
2. Include a two-baffle system.
   a. Primary baffle: Shall provide a continuous horizontal slot at the work surface. Baffle panels shall have multiple horizontal slots, with a chamfered entry. Slot pattern shall be proven to optimize face velocity profile, and direct air in a non-turbulent/laminar flow stream from the hood face into the baffle in a single pass.
   b. Secondary baffle: located between the primary baffle and the back wall of the hood, neutralizes any upward air streams and reduce air stream roll.
3. The baffle system shall be constructed with the same material as the fume hood liner.
4. The baffles shall be removable for cleaning. The primary baffles shall be two pieces to allow removal without the use of tools.
5. Exposed components to be non-metallic. Metal components exposed to chemical environment are not acceptable.
6. Moving parts or adjustment of any kind is not acceptable.

F. Exhaust Connection
1. 316 stainless steel with Chemical-Resistant Finish
2. 12.81" ID to accommodate any 12” nominal duct without the need for a transition adapter. 4, 5, and 6-foot hoods have one exhaust connection, and 8-foot hoods have two exhaust connections. Additional components required to accommodate 12” nominal mechanical system are not acceptable.
3. Ducting shall go inside the duct collar to ensure condensate travels into the hood and evaporates. Duct collars that allow duct connection over the collar are not acceptable.

G. Airfoil

1. Cold Rolled Steel with Chemical-Resistant Finish or 316 stainless steel.
2. Airfoil shall have an aerodynamic radius to sweep the air into the hood with minimal turbulence. Airfoil directs airflow across work top to remove heavier-than-air gases.
3. Must have 5 rows of perforations to allow the air to bypass underneath and through the foil and sweep across the work surface to prevent any back flow of fumes escaping from the front of the hood opening. This airflow continues even if blocked by the presence of the operator.
4. Foil must extend back under the sash to prevent closure of the lower by-pass opening when the sash is in the fully closed position, directly on top of the airfoil.

H. Sash Assembly
1. Glass: Fully tempered safety glass with unobstructed, side-to-side view of fume hood interior and service fixture connections.
2. Dimensions: The full sash opening height is 28", the total unobstructed viewing height is 37.5" measured from the work surface.
3. Sash Tracks: Steel with Chemical Resistant Finish. Shall include bump stops for opening and closing.
4. Sash Handle: extruded aluminum with Chemical Resistant Finish. Sash handle includes a perforated air passage directly atop the handle to bleed air into the hood chamber and direct chemical fumes away from the user's breathing zone. The handle is ergonomic in design and is easy to grasp when operating

5. Sash guides: Corrosion resistant extruded poly-vinyl chloride.

6. Sash System

   a. Sash system is to be determined by Owner

   b. Will either be:

      1) Labconco Vertical Sash cable & pulley system

      2) Labconco Intelli-Sense Automatic Sash Position System

I. Electrical Components

1. Lighting
   a. Provide UL Listed, high-efficiency, quick-start, LED lighting systems, including bulbs.
      1) 4 Foot Hoods - 2 each, 3-foot 11 watt LED lamps
      2) 5 Foot Hoods - 2 each, 4-foot 17 watt LED lamps
      3) 6 Foot Hoods - 2 each, 4-foot 17 watt LED lamps
      4) 8 Foot Hoods - 4 each, 3-foot 11 watt LED lamps
   b. Vapor-Proof: all electrical components shall be outside of the contaminated air space. Lighting shall be located behind a laminated safety glass shield, sealed to the top of the hood liner.
   c. The LED light assemblies shall be serviceable from outside the fume hood cavity, without the use of tools.
   d. Light switch to be included on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).
2. Blower Switch
   a. Hoods shall be provided without a blower switch, as they will share a single mechanical system with other hoods for VAV systems, or for CAV installations will be required to stay on 24/7.
3. Electrical Receptacles
   a. The hoods shall accommodate up to four (two per corner post) electrical receptacles as indicted in schedule or drawings. Options to include:
      1) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex
      2) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex, with Ground Fault Circuit Interruption (GFCI)
      3) 230volt, 60 Hz, three-wire polarized and grounded electrical duplex
   b. Receptacles shall be individually wired to field wiring box, and each rated at 20 Amperes.
   c. Cover plates shall be acid resistant thermoplastic.

4. Wiring
   a. Every electrical component shall be individually wired to a single point internal field wiring box (including individual duplexes/receptacles).
   b. Field wiring box to be 7” x 4” x 2.5”, grounded, and have (12) 7/8” diameter knock out penetrations.
   c. Final wiring and circuit dedication is to be by others.
5. Fume hood to have third party validation of compliance to UL 1805 and UL 61010-1 by a Nationally Recognized Testing Laboratory (NRTL)

J. Upper Dilution Air Supply
1. Located behind and above the sash to introduce between 5 and 10% of the required hood air volume, and maintain sufficient exhaust air volume through hood to adequately dilute hazardous fumes regardless of sash position.
2. This device bathes the sash interior above the work area to eliminate chemical fumes along the sash plane near the operator's critical breathing zone.
3. Shall act as a by-pass opening controlled by sash position. If on a constant volume mechanical system, the hood shall not have a change in static pressure or exhaust volume across all sash positions.
4. Shall offer a significant restriction to the by-pass opening to allow the use of a VAV mechanical system without modification to the by-pass opening.

K. KU Hood Safety Practices Label:
Corrosion resistant plate attached to the left corner post of the fume hood with the following Hood Safety Practices:
1. For use with substances that produce hazardous levels of airborne chemicals: gas, fumes, vapors, dust
2. Do not put your head in the hood.
3. Minimize drafts and sudden movements in front of the hood.
4. Work a minimum of six inches inside the hood.
5. Elevate equipment above the work surface.
6. Keep sill and baffle unobstructed.
7. Do not use the hood for storage.
8. Adjust the sash to smallest opening possible when in use.
9. Close sash when unattended.
10. Do not remove any of the hood components.
11. Do not place flammable solvents near heat, flame or sparks.
12. Do not evaporate large amounts of flammable liquids.
13. Wipe up spills immediately.
14. Routinely validate airflow.
15. If the ventilation system malfunctions, or airflow alarm indicates unsafe condition, close sash and discontinue hood operation immediately-call for help.
16. Do not use with Biohazards and Perchloric Acid

L. Fume Hood Accessories
1. Service Fixtures: Color-coded hose nozzle outlets and valves mounted inside the fume hood and controlled from the exterior with color-coded index handles
   a. The hoods are equipped without service fixtures or will be provided with a total of up to 8 service fixtures as indicated in schedule.
   b. Hose connectors located inside the fume hood cavity are chemically-resistant, glass-filled polypropylene with 6 serrations.
   c. Service lines shall be factory installed from valve to outlet
      1) Copper tubing unless otherwise noted
      2) Brass service lines for gas
      3) Stainless steel service lines for Deionized Water
      4) Connections shall be made with quick-connect compression fittings on the inlet and outlet of the valve body, soldered and brazed connections not easily disassembled are not acceptable.
      5) Services pre-piped to the top of the hood
   d. Valves
      1) Extruded brass valve and rotating seat, TFE-coated silicone bronze stem and TFE packing.
      2) Fixture handles are plastic and color coded as well as labeled for the designated type of service.
      3) Fixtures are rated at maximum pressure of 200 psi.
      4) Coefficient of flow for the valve, Cv=0.43.
      5) Valves are front loaded, located on the fume hood corner post for remote use, and include:
         a) Hot and cold tap water (flow rate 3.5 GPM or 13.25 LPM at 67 psi at full open
         b) Natural gas (theoretical flow rate of 71CFM at 100 psi, provides 1095 BTU/Sec at a density of .667 Lbs/CU. FT.)
         c) Air (theoretical flow rate of 59 CFM at 100psi)
         d) Vacuum (theoretical flow rate of 6 CFM at 10 psi)
         e) Nitrogen
         f) Argon
         g) Steam
         h) Oxygen (include oxygen compatible lubricant)
         i) Deionized/Distilled water (Nickel plated and stainless steel components)
2. Tissue Screen: Provide epoxy-coated, stainless-steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.

3. Rear Finish Panel: Shall be the same materials and coating as the hood exterior.

4. Ceiling Enclosure Panels:
   a. If required by owner, provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.
   b. Exposed fasteners are not acceptable.
   c. Height adjustment to be within the following ranges as specified in the schedule.
      1) 11.0 - 14.0”
      2) 14.0 – 18.6”
      3) 18.6 – 24.4”
      4) Fixed height of :

5. Distillation Grid: If requested by owner, include stainless steel rods, connectors, and factory drilled liner.

6. Fire Suppression System:

   a. Fire suppression systems are not to be obtained or installed within a hood without prior review/approval by KU-EHS Dept.

   b. If required/directed by owner, an ABC dry powder fire suppression system, with 165 degree Fahrenheit fusible link, shall be factory supplied and prepped, and field installed through the ceiling of the fume hood.

7. Face Velocity Monitor/Alarm

   a. Shall not be included on Explosion Proof hoods

   b. For CAV Installations - Labconco Guardian Digital Airflow Monitor
      1) Provide audible and visual alarm in the event of an unsafe face velocity.
      2) Alarm must sit flush with the fume hood corner post.
      3) Based on a thermally compensated thermistor in the alarm module, and air passing through a separate airstream into the hood interior.
      4) Velocity shall be displayed digitally on the user facing LCD in fpm or m/s.
      5) LED lights display red for alarm, yellow for caution, and green for normal operation.
      6) Must include external alarm and night setback functions.
      7) Alarm mute shall be accessible from the front of the monitor; visual alarm must remain activated until alarm condition is corrected.
      8) UL Listed electrical components
      9) Calibration shall be through a menu driven step by step procedure.
      10) Calibration is the responsibility of the owner, following a complete balancing of the mechanical system, and concurrently with As-Installed testing.

c. For VAV Installations - VAV Prepared

1) Fume hoods shall come factory prepared with the proper cutouts and brackets to field mount specified VAV controller and sash position sensor as directed by owner. Current KU-Lawrence Campus standard is Phoenix VAV FHM 631 series fume hood airflow monitor.

d. Sash Stop at 18" above dished working surface.

8. Cupsinks

Normal owner preference is to not have cupsinks at hoods. All cupsinks must be reviewed and approved by KU-EHS Dept. If owner request cupsinks, shall be as follows:

a. 3 x 6" dimension, polypropylene construction
b. Provide with strainers and tailpieces, NPS 1-1/2 (DN 40)
c. To sit flush with dished area of work surface
d. Cupsink(s) to be located **[Select all that apply or as detailed in the schedule/drawings]**
   1) Left rear
   2) Left side
   3) Right rear
   4) Right side

M. Hood Work Surface

a. Current KU-EHS approved work surface for use with the Protector XStream is the "Labconco SpillStopper Work Surface". Consult with Labconco rep or EHS to determine appropriate catalog numbers. No other hood work surface shall be installed without prior review and approval by KU-EHS Dept.

b. 1.25" thick, molded from solid modified epoxy resin, with smooth, non-specular, black finish.

c. One inch radius front edge for optimal fume hood performance.

d. 3/8" dished area to match the fume hood interior work space and form a water tight pan for spill containment.

e. Include a 2.5" diameter hole on each side for service pass-through and piping. Hole to be covered by hood superstructure upon installation.

f. Include two 1.5" diameter penetrations to accommodate base cabinet venting. Holes to be located outside of dished area and under the fume hood baffles. Include plugs.

g. Physical Properties:
   1. Flexural Strength: Not less than 10,000 psi (70 MPa).
   2. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
   3. Hardness (Rockwell M): Not less than 100.
   4. Water Absorption (24 Hours): Not more than 0.02 percent.
   5. Heat Distortion Point: Not less than 260 deg F (127 deg C).
   6. Flame-Spread Index: 25 or less per ASTM E 84.

N. Supporting Base Cabinets

1. Normal owner preference is to have Labconco base cabinets underneath Labconco fume hoods. All base cabinets must be reviewed and approved by KU-EHS Dept.

2. Base cabinets shall be in depths of 22", widths, quantities, and types called out in the equipment schedule and/or drawings**,** and meet the requirements of this specification.

3. Construction requirements for all hood base cabinets
   a. Exterior construction is 18 gauge (or heavier) cold rolled sheet steel with Chemical Resistant Finish.
   b. Hinges are 10 gauge (or heavier) plate with self-clinching pilot pin. Knuckle, bullet, or piano type hinges are not accepted.
   c. The rear panel will feature a 12" x 8" removable plumbing access panel.
   d. Units 24" wide or less have only one door.
   e. Each cabinet includes four leveling feet.
   f. Capable of supporting up to 800 pounds.
   g. A 14" filler panel is required to increases the cabinet depth to 36".

4. Standard Storage
   a. Overall exterior dimensions:
      1) 48" 48" w x 22" d x 35.5"-36.75"
      2) 36" 36" w x 22" d x 35.5"-36.75"
      3) 30" 30" w x 22" d x 35.5"-36.75"
      4) 24" 24" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
      5) 18" 18" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
      6) 12" 12" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
   b. Flush pull handles are ABS, low gloss black.

5. Acid Storage
   a. Overall exterior dimensions:
      1) 48" 48" w x 22" d x 35.5"-36.75"
      2) 36" 36" w x 22" d x 35.5"-36.75"
      3) 30" 30" w x 22" d x 35.5"-36.75"
      4) 24" 24" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
      5) 18" 18" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
   b. Completely lined with a polyethylene corrosion resistant liner. The liner is 3/16" thick, with a vacuum formed PVC liner pan at the bottom to contain spills. Each door has a 3/16" sheet polyethylene liner.
   c. The cabinet is labeled: "ACID".
   d. Flush pull handles are ABS, low gloss black.
   e. Each cabinet is vented into the fume hood with a 1-1/2" vent pipe. It should provide a positive airflow directly into the fume hood exhaust system.
   f. Supply an epoxy coated steel shelf with PVC liner pan if indicated in the schedule.
   g. Acid cabinets with louvers are not acceptable

6. Solvent Storage
   a. Overall exterior dimensions:
      1) 48" 48" w x 22" d x 35.5"-36.75"
      2) 36" 36" w x 22" d x 35.5"-36.75"
      3) 30" 30" w x 22" d x 35.5"-36.75"
      4) 24" 24" w x 22" d x 35.5"-36.75" h or 31.5"-32.75" for ADA cabinet
   b. Solvent storage cabinets are specifically designed for the storage of flammable and combustible liquids.
   c. Solvent Storage Cabinet must be compliant with NFPA 30 “Flammability and Combustible Liquids Code.”
   d. Cabinets 30" wide and greater shall be tested and approved by Factory Mutual to meet Factory Mutual Approval Standard 6050.
   e. The bottoms, top, sides, and doors are fabricated of 18 gauge steel and are all double panel construction with a 1-1/2" air space between panels.
   f. All joints are welded or screwed to provide a rigid enclosure. A 2" deep liquid tight pan that covers the entire bottom of the cabinet is furnished to contain liquid leaks and spills.
   g. A full-depth, 18 gauge steel, adjustable shelf is also provided. Shelves are sealed leak tight.
   h. Two diametrically opposed flame arrestor vents with spark screens are provided in the back of the cabinet, as well as a grounding screw.
   i. The cabinet has an interior finish same as the exterior.
   j. The cabinet is labeled: "FLAMMABLE - KEEP FIRE AWAY".
   k. The right hand door shall have a three point latching device.
   l. Door handles include a key lock. Solvent storage handles are locking lever handles with bright chrome finish.
   m. If noted on the schedule, self-closing/self-latching models shall be provided with a fusible-link feature to ensure the doors will close if the temperature outside the cabinet exceeds 165 degrees Fahrenheit. The doors are synchronized so that both doors will fully close.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine areas, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
B. Coordinate with other trades for the proper and correct installation of plumbing and electrical rough-in and for rough opening dimensions required for the installation of the hood.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. KU Requirement: Installer shall have verifiable record of Labconco fume hood installations, or a certificate of installation training by Labconco factory representative. Contact Labconco, Cale Beiermann, 800-821-5525, for arrangements.
B. General: Install fume hoods according to shop drawings and manufacturer's written instructions.
C. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework.
D. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
**E. Neighboring splash blocks shall not be attached directly to the hood.**
F. Install according to standards required by authority having jurisdiction.
G. Sequence installations to ensure utility connections are achieved in an orderly and expeditious manner.
H. Touch up minor damaged surfaces caused by installation. Replace damaged components as directed by Architect.
I. Complete hood installation, connections and initiate hood operation according to standards required by authority having jurisdiction (KU Department of Environment, Health & Safety and the KU Department of Facilities Planning & Development).

1. Initial high performance hood exhaust flow is to be designed for and based on achieving 80 - 100 fpm at a 60% sash opening (approx 18” open). Hoods may not be designed/set at lower face velocities without KU-EHS review, approval and direction.

2. KU-EHS’s primary focus/requirement is to establish hood exhaust that ensures safety & proper containment. KU-EHS’s secondary goal is to achieve energy savings where possible so hood exhaust flows (after proper assessment by KU-EHS) may be lowered to allow less face velocity where conditions and activities allow. For Labconco XStreams with VAV connections, we desire to attempt to achieve at least 80 fpm where possible.

3. Each fume hood being attached to a CAV system shall have a manual damper installed by exhaust system contractor and/or hood installer. Manual damper shall be located in an appropriate, readily accessible location in the exhaust ductwork within close proximity to the fume hood it serves. Contact KU-EHS for approval of locations.

4. Each fume hood being attached to a VAV system shall be connected in accordance with hood manufacturer's requirements, exhaust control valve manufacturer's requirements and per the Engineer's design. Required face velocities will be determined/provided by KU-EHS Department.

## 3.03 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
C. Clean adjacent construction and surfaces that may have been soiled in the course of installation of work in this section.
D. Provide all necessary protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.
E. Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.

## 3.04 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.

## 3.05 DEMONSTRATION

A. Trained Labconco representative shall provide systems demonstration and demonstrate all equipment operations and functions on an as needed basis, as determined by KU-EHS Dept. representative with responsibility for supporting the individual project.

## 3.06 FINAL SETUP, INSPECTION & APPROVAL

A. Final inspection and approval for each fume hood installation shall be made by staff from the KU-EHS Dept.

B. Project Contractor or KU Project Manager shall notify KU-EHS Dept. (785-864-4089) when they are ready for hood system testing and final inspection.

C. Acceptable fume hood exhaust flow shall be based on achieving 80-100 fpm at a 50-60% sash opening (approx. 18" open) as measured by KU-EHS Dept. staff only.

D. Hoods may only be set at lower exhaust flows/face velocities (<100 fpm) as approved and directed by KU-EHS Dept. Goal is to achieve 80 fpm where possible, but face velocity needs to be what is required to achieve safety containment based on KU-EHS hazard & performance assessment.

E. Airflow velocity alarm monitors

1. For CAV systems will be final calibrated and set be KU-EHS Dept. staff.

2. For VAV systems, will be final calibrated and set be KU-EHS Dept. staff in conjunction with VAV controller contractor.

F. Fume hood installation problems or incomplete installation items shall be documented by KU-EHS Dept. and provided in writing to KU Project Manager.

G. Acceptable "as installed" fume hood performance will be determined by KU-EHS Dept. utilizing procedures outlined in Section 3.07. Installation Contractor/Hood manufacturer may be required to provide "installed performance" hood testing per Section 3.07at the direction of KU-EHS Dept.

H. Final approval for acceptance of any/all fume hoods will be provided in writing from KU-EHS Dept. to KU Project Manager.

## 3.07 AS INSTALLED PERFORMANCE TESTING CRITERIA

A. ASHRAE 110 Qualitative Testing

1. KU-EHS Dept. will use ASHRAE 110 Qualitative Testing protocol to assess fume hood "as installed" performance. This includes:

   a. Visual assessment of airflow and exhaust capacity utilizing appropriate test substance per ASHRAE protocol

   b. Face velocity testing utilizing a hot-wire anemometer per ASHRAE protocol.

B. ASHRAE 110-95 Quantitative Testing

1. KU-EHS Dept. and/or owner directed 3rd party may be utilized to perform ASHRAE 110-Quantitative Testing to assess fume hood "as installed" performance. This includes:

   a. Visual assessment of airflow and exhaust capacity utilizing appropriate test substance per ASHRAE protocol

   b. Face velocity testing utilizing a hot-wire anemometer per ASHRAE protocol.

   c. Containment testing via tracer gas assessment per ASHRAE protocol

C. Failure to pass ASHRAE requirements and performance objectives as determined/set by KU-EHS Dept. will require contractor and hood manufacturer to correct situation to achieve satisfactory safety results.