SECTION 15877

FUME HOODS

1. General

1.1. Summary – These specifications provide a performance specification for a chemical laboratory Fume Hood (herein referred to as FH). The intent of the specification is to provide a working FH which:

1.1.1. Provides containment of chemical fumes for the safety of personnel working within laboratory areas, including lab workers, maintenance staff, visitors and others whether or not they are trained in lab safety.

1.1.2. Design Requirements – The system shall be designed, manufactured, tested and installed in compliance with the current versions or issuance of:

1.1.2.1. OSHA 29 CFR Part 1910
1.1.2.2. ASHRAE 62 & 110
1.1.2.3. AIHA Z9.5
1.1.2.4. NFPA 45
1.1.2.5. Americans with Disabilities Act
1.1.2.6. Factory Mutual (FM)

1.1.3. Provides visual and audible alarm notification when containment is compromised or lost.

1.1.4. Addresses the issue of shorter height, seated or disabled lab workers by requiring safety performance testing for various height workers.

1.1.5. Provides energy savings with proven containment to OSHA limits via ASHRAE test procedures with lowest face velocities possible.

1.1.6. Provides integral linear air balancing valve and cfm monitor for initial and routine setup and balance.

1.2. Submittals – Submittals shall include documentation of:

1.2.1. Testing Documentation Certifying Hoods meet the "Factory As Manufactured (AM) Quality Control Testing of Fume Hoods" section of this specification.

1.2.2. Shop drawings showing plans, elevations, details, all dimensions, all materials and gages, and method of construction.

1.2.3. Control Components Specifications and Sequence of Operations.

1.2.4. Performance characteristics for each of the criteria specified herein. Submittal shall include a copy of these specifications with each section marked with either a "C" for comply or "D" for deviation. A written explanation shall be provided for each deviation for the system to be considered for acceptance. Any deviation may result in the system being determined "Not Acceptable".

1.2.5. Warranty Statement.

1.3. Approved Manufacturers – This specification is intended as a performance specification. Manufacturers which provide equipment meeting the performance specified herein shall be acceptable with the provisions that:

1.3.1. Manufacturer shall not take exception to any of the factory or field testing provisions herein.

1.3.2. Manufacturer has been making FH Equipment & Controls for a minimum of 5 years.

1.3.3. There are not projects where the submitted manufacturer's equipment has performed unacceptably as known by the engineer or owner.

1.3.4. Naming of a manufacturer or model number herein or on the drawings shall not relieve manufacturer of meeting all performance criteria herein.

2. Product

2.1. Schedule –FH shall be as shown on the drawings or listed below.

2.1.1. Services Codes: Codes for services in the table above are:

C_2H_2	Acetylene
A	Air
A_R	Argon
$C0_2$	Carbon Dioxide
C	Cold Water
D	De-ionized Water
He	Helium
H	Hydrogen
E	515R-2 Receptacle
G	Natural Gas
N	Nitrogen
NO_2	Nitrous Oxide
O	Oxygen
S	Steam
V	Vacuum

2.1.2. Liner Codes: Codes for liner types in the table above are:

P	Phenolic Resin
S304	Stainless Steel 304
S316	Stainless Steel 316

2.2. Construction: FH shall be constructed as follows subject to exceptions noted in the schedule or on the project drawings:

2.2.1. Standard bench-type fume FH superstructure shall be designed for installation on the work surface.

2.2.2. Walk-in type FH superstructure shall be floor mounted.

2.2.3. Superstructure: The inner wall lining to be 1/4" thick chemically resistant white phenolic resin. The exterior shall be finished in reagent resistant catalytically activated polyurethane, color selected from manufacture's standard color chart by architect/engineer/owner.

2.2.4. Baffle: Epoxy coated baffle with slots at top, center and bottom.

2.2.5. Countertops: Counter tops to be epoxy resin, thickness and color per drawings or schedule, with 3/8" dished design to avoid spillage.

2.2.6. FH front to include posts, tracks, sash with weight, pulleys, cable, foil, pre-piped plumbing fixtures and pre-wired electrical fixtures. FH front with sash and pre-wired electrical components, including the light box, are to be removable from hood body as a complete assembled one piece unit without disconnecting cable components or electrical components. This is to facilitate rigging into place.

2.2.7. Sash: Sash shall be stainless steel construction with combination style with both vertical and horizontal moving glass panels. Vertical movement to allow hood loading and horizontal movement to provide a safety body shield when needed. No more than a 1/8" air gap above sash in any vertical position or a sash pocket may be provided. Horizontal sliding sashes are on two tracks. Horizontal sash shall be ¼" laminated safety plate glass with finger pulls on each panel. Each panel must ride on rollers supported from top rail only. Sash frame shall be welded at intersections, and reinforced to support added weight. All glass panels to have plastic edge guard on all vertical surfaces. Maximum horizontal sliding sash opening height to be 27±1". An additional 7±" high, clear glass panel integrated as part of FH lintel shall maintain a clear vision height of 34±1" above countertop.

2.2.8. The walk-in type fume hood shall have double hung combination horizontal/vertical sashes each with a vertical height of 34±1".

2.2.9. Sash Height Limiting Hardware: The FH maximum vertical sash height opening of 27±1" will be measured from leading edge of bypass, turning vane airfoil to the bottom of sash handle. The 27±1" maximum vertical opening cannot be defeated. Provide a key lock preventing vertical sash movement above height specified herein or as shown on the schedule. Each FH to have integral sash height limiting hardware mounted on the exterior of the hood, which prevents unintentionally raising the vertical sash above a set point. Sash stop shall be at 19" unless noted elsewhere on the hood schedule or drawings. Note the hood exhaust air volume is not specified to maintain containment if sash is raised above sash limiting hardware. Operational procedures should allow bypassing the sash limit only when necessary for apparatus loading and setup.

2.2.10. Air Entry Transitions: The following requirements are to prevent reverse eddy airflow. Area surrounding sash opening to be rounded to create an aerodynamic configuration. Side posts to incorporate an airfoil design.

2.2.11. Electrical Access: All electrical components shall be accessible from the front of hood. Pre-wiring of all electrical components to junction box must be removable with hood front section without disconnecting components. Front panel must be removable for access to all wiring at junction box and re-lamping of (2) tube fluorescent fixtures.

2.2.12. Counterweight system shall include , stainless steel cables and sash guides, steel pulleys with cable retaining device. Counterweight system shall be balanced to provide smooth operation of the sash at any point along the full width of the bottom pull and prevent sash creep at any position.

2.2.13. Interior Access: Provide removable flush access panels on the inside and on the outside which will provide direct access to valves and all other items requiring maintenance shall be provided.

2.2.14. Duct Collar: 4" high parabolic connection, 8" O.D. for 4 ft., 10" O.D. for 5 ft. & 6 ft., and 2 - 8" O.D. for 7 & 8 ft. hoods.

2.2.15. Rear Panel: A Finished rear panel is required if rear of hood is exposed to view. Panel shall match material and color of the hood's main exterior skin.

2.3. Laboratory FH services, fixtures and accessories:

2.3.1. All switches, outlets, fixture handles, alarm monitors shall be on the front posts of the superstructure at a height that is ADA accessible when the FH is mounted at an ADA height.

2.3.2. References FH hood details and schedules on drawings for service rough-in locations, fixture quantities and fixture mounting locations.

2.3.3. Factory pre-piping shall extend beyond the top of the FH to a single connection point for each different service and shall be capped until final connection is made.

2.3.4. Water Service: 3/8 inch, type L copper water tube, H (drawn temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22 lead free (<. 2%) solder, ASTM B32 flux, ASTM B813 copper phosphorous brazing alloy, AWS A5.8 B cup.

2.3.5. Cold water piping, fittings and valve bodies shall be factory insulated with ½" thick closed cell elastomeric insulation. Slip insulation over piping where possible. Seal joints and seams with full bed of adhesive on both surfaces. Taped joints and seams are not acceptable.

2.3.6. Compressed Air and Vacuum Services: 3/8 inch, type L copper water tube, cleaned, washed and capped, H drawn temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22 lead free (<. 2%) solder, ASTM B32 flux, ASTM B813 copper phosphorous brazing alloy, AWS A5.8 B cup.

2.3.7. Natural Gas and Steam Services: ASTM A 53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A 197/ANSI B16.3 class 150 black malleable iron threaded fittings using thread lubricant or Teflon tape.

2.3.8. Plumbing Fixtures: Cup sinks modified epoxy resin, polyethylene or polyolefin oval cup sinks, nominal 3 inch x 6 inch, 1-1/2 inch IPS outlet, color: black.

2.3.9. Provide sidewall panel mounted cup sink for walk-in type fume hood.

2.3.10. Single service cold water fixtures: forged brass valve bodies, 80 psi working pressure, renewable type neoprene valve disc and a replaceable stainless steel seat. Valve body shall be remote mounted inside superstructure wall.

2.3.11. Fixture outlets shall be brass, stem type with 90 degree tip, panel mounted in side wall liner of fume hood above cup sink. Fixture outlet shall have removable serrated tips, acid and solvent resistant epoxy finish. Fixture outlet shall have a color-coded mounting washer. Fixture control handle mounted in exterior superstructure post shall be chrome four arm handle with plastic color-coded center index button that matches color of serrated tip mounting washer.

2.3.12. Water fixtures shall be factory pre-piped with a laboratory vacuum breaker mounted on exterior, top front corner of fume hood superstructure post.

2.3.13. Vacuum, Natural Gas, Compressed Air Fixtures: forged brass valve bodies, 125 psi working pressure, needle valve construction with renewable type stainless steel floating cone and replaceable stainless steel seat. Valve body shall be remote mounted inside superstructure wall.

2.3.14. Fixture outlets shall be brass, stem type, and panel mounted in sidewall liner of fume hood above cup sink. Fixture outlet shall have 30-degree angle removable serrated tips, acid and solvent resistant epoxy finish. Fixture outlet shall have a color-coded mounting washer. Fixture control handle mounted in exterior superstructure post shall be chrome four arm handle with plastic color-coded center index button that matches color of serrated tip mounting washer.

2.3.15. Steam Fixtures: forged brass valve bodies, 20 psi working pressure, renewable type Teflon valve disc and replaceable stainless steel seat. Valve body shall be remote mounted inside superstructure wall. Fixture outlets shall be brass, stem type, panel mounted in side wall liner of fume hood above cup sink. Fixture outlet shall have 30-degree angle removable serrated tips, acid and solvent resistant epoxy finish. Fixture outlet shall have a color-coded mounting washer. Fixture control handle mounted in exterior superstructure post shall be chrome four arm handle with plastic-color coded center index button that matches color of serrated tip mounting washer.

2.4. Electrical Services: The following specifications are for factory pre-wired 120 VAC electrical services within the laboratory fume hood. All materials and installation methods shall meet the requirements of the National Electric Code.

2.4.1. Wiring: minimum #12 copper, type THHN/THWN insulation. Wire color-coding shall be black for current carrying conductors, white for neutral conductors and green for ground conductors.

2.4.2. Conduit: Unless noted or required otherwise, ½ inch, flexible PVC conduit. Secure conduit to superstructure framework with conduit clamps. Conduit to light fixture to have pigtail for ease of lamp maintenance.

2.4.3. Junction Boxes: 4 inch square by 2-1/8 inch deep, code gauge galvanized steel, screw covers.

2.4.4. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for splices and taps.

2.4.5. Electrical Fixtures: All electrical devices shall be UL listed.

2.4.6. Fume hood light fixtures shall have two lamps, fluorescent type with electronic ballast. Average illumination of work surface shall be 80 foot-candles minimum. Fixture shall be mounted in roof liner and sealed behind a laminated safety glass panel to isolate light fixture from fume hood interior.

2.4.7. Light fixture switch shall be toggle type mounted in front post of superstructure. Switch plate shall be stainless steel with a brushed finish.

2.4.8. Duplex, 20 amp, 120 VAC, GFCI, grounding type, hospital grade receptacles shall be provided as called for on drawings. Receptacle shall be mounted on front superstructure post. Reference detail on drawings.

2.4.9. Fume light fixture, switch and receptacle shall be pre-wired by fume hood manufacturer to a junction box for a single point power connection by the electrical contractor.

2.4.10. Explosion Proof Electrical Fixtures: All electrical wiring, conduit and devices installed in FHs, in rated areas per schedule shall meet NEC class 1, division 1 explosion proof requirements.

2.5. Controls: FH shall be provided with factory installed and tested controls, from one manufacturer for single source responsibility, as follows.

2.5.1. Alarm Module: Alarm to include tri-color LED indicator lights, minimum ¼" square to allow distant recognition, green (normal airflow), yellow (caution), red-flashing (low flow), audible alarm with silence switch with red indicator LED light to indicate audible silenced status. When an alarm condition clears, audible alarm shall automatically return to enabled status. Set points shall not be affected by power outages. The Hood alarm module shall be factory mounted in the post of the FH.

2.5.2. CFM Monitor: Velocity probe shall be factory installed in FH collar to measure FH exhaust volume with an accuracy of + 2%. 1/4" pressure taps and tubing for connection to velocity probe shall be

provided. CFM monitor shall be mounted on the FH post for use with portable measuring instrument.

2.5.3. Linear Balancing Valve: Linear trim balancing damper (REV-S), constructed of material to match ductwork, shall be provided properly sized per hood take-off, with quadrant locking handle. Balancing valve shall exhibit linear relationship between position and flow throughout its range of travel. Valve pressure drop shall not exceed 0.25" at mid position with rated airflow.

2.6. FH pressure drop: The maximum hood pressure drop from inlet to discharge collar shall not exceed 0.25" H_2O based upon the airflows listed in the Air Pattern/Volume section of this specification.

2.7. ADA Compliance: FH shall be designed to be ergonomically correct when used as a standard height bench hood or set at a lower 32" height for A.D.A. compliance.

2.8. Explosion Proof Controls: Where hood is noted in a rated area, control components shall be provided in a panel for field installation remote from the rated area. Any components required at the hood must be intrinsically safe.

2.9. Factory As Manufactured (AM) Quality Control Testing of Fume Safety Cabinets.

2.9.1. General: Positive assurance of hood performance is the most critical aspect of this specification for personnel safety for those who will be in proximity to the working hood. As such the factory and field testing section of this specification is specifically noted as critical. Evaluation of manufacturer's standard product shall take place in manufacturer's own test facility, with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer at no cost to the owner. The testing procedure and reporting shall be strictly adhered to.

2.9.2. Submit test report consisting of the following test parameters and equipment for each hood width and configuration specified.

2.9.2.1. FH shall at no time exceed a spill above 0.05 PPM at both 4.0 liter/min. and 8.0 liter/min. tracer gas release rates, per

OSHA/AIHA/ASHRAE/ANSI American Conformance requirements, 4.0 AM 0.05, 8.0 AM 0.05. Tests shall be static and dynamic using a modified version of ANSI / ASHRAE - 110-1995 method of testing performance of laboratory FHs. The object is to test for both tall (5-'9" or taller) and short ADA (4'-11") worker. Shorter workers are expected to be seated. (The 8-liter/min. release rate is to simulate boiling activity within the hood.)

2.9.2.2. Test Facility: Facility shall be sufficient size to provide similar conditions FH will experience in normal operating conditions. Provide make-up air and general exhaust system controls so that space pressure may be fluctuated between +0.015"WC to -0.15" WC. Introduce an adjustable cross draft of 50 FPM during all testing per OSHA / ANSI requirements. Adjustment of exhaust blower shall permit varying face velocity from 100 FPM down to 40 FPM at test FH's maximum vertical face opening.

2.9.2.3. Witnesses: During testing up to three witnesses as determined by owner/architect/engineer shall be allowed present in test room to simulate as used activity conditions and for observation.

2.9.2.4. The minimum cfm at which the test FH may be operated shall be an exhaust volume of 50 cfm/foot of FH width, for a 24-inch deep hood (or 25 cfm per ft^2 of FH work surface for deeper FHs) except where a written hazard characterization indicates otherwise. For this cfm calculate the fpm. This is the lowest fpm at which the test FH can be operated as long as it passes all the tests as outlined below and is equal to or higher than the fpm established below.

2.9.2.5. Test FH shall be challenged at full 27±1" vertical sash face opening (per ANSI/ASHRAE 110-1995), both statically (AM) (as manufactured) and dynamically [SME (sash movement effect) and SPE (space pressure effect)] over a range of fpm. This is to establish the lowest fpm at which the test FH passes all the tests. To this fpm add 30% (safety factor) to establish the lowest fpm at which the test FH may be operated at full vertical sash face opening. Test FH shall be challenged at its maximum horizontal face opening both statically (AM) and dynamically (SME and SPE) at different fpm in order to establish the lowest fpm at which the test FH passes all the

tests. To this fpm add 30% (safety factor) to establish the lowest fpm at which the test FH may be operated at full vertical sash face opening.

2.9.2.6. Probe Height During Tests: To simulate varied personnel height test shall be done at the ASHRAE standard gas pick-up height measured from the work surface of 26" and at 18" from the work surface for both vertical and horizontal tests. Testing and confirmation of containment performance at both heights is critical to ensure safe operating conditions for tall, shorter and seated lab workers.

2.9.3. Testing Equipment

2.9.3.1. Recently calibrated (within six months) hot wire thermal anemometer probe equal to Alnor Compuflow 8525. Calibration by certified facility or by ISA Certified Level III CCIT Technologist. Readings to be taken per OSHA / ANSI recommendation of 12 or more equal areas.

2.9.3.2. During testing FH exhaust airflow volume to be continuously monitored and recorded using a NIST traceable velocity pressure-measuring device.

2.9.3.3. Multiple Point Equal Area Averaging Airflow Probe: Number of multiple points and number of probes determined by Reynolds number calculations as detailed in latest Chemical Engineering Handbook (Pitot tube). Calculation required for 10:1 turndown for each specific airflow condition. Required straight run upstream and downstream for each application shall be provided and confirmed. Probe multiple sensor positions to be based of the 7th power law for airflow profiling as determined by ASHRAE, ANSI, ISO, and ACGIH. Detail drawing indicating probe-sensing positions is required for each application.

2.9.3.4. Accuracy, +2% testing confirmation by independent AMCA DS610-7/92 run test.

2.9.3.5. Each Flow element shall have its individual flow coefficients supplied at the time of testing.

2.9.3.6. Airflow volume signal to be displayed on a 3 1/2 digital LCD.

2.9.3.7. Tracer gas: Sulfur hexa-fluoride (SF6) supplied from a cylinder.

2.9.3.8. Ejector system: Tracer gas ejector shall be the same as outlined in ANSI / ASHRAE 110-1995 standard. Submit proof of ejector system calibration.

2.9.3.9. Critical orifice: Sized to provide tracer gas at four liters per minute at an upstream pressure of 30 PSIG and another sized to provide tracer gas at eight liters per minute at an upstream pressure of 30 PSIG. Orifice sizes shall be verified and recorded.

2.9.3.10. Detection Instruments: Foxboro Miran IA or equal. Calibration of analyzer must be witnessed at time of testing. Analyzer shall be calibrated to 0 to 0.15-PPM full-scale range versus analyzer real time 0-1 VDC output. Calibration must be witnessed before testing, and be performed by ISA Certified Level III CCIT Technologist. Analyzer shall have a sample rate representative of human breathing at 15 liters./min sampling. Analyzers with sampling below 10 liters/min or above 20 liters/min are not acceptable.

2.9.3.11. Recorder with an accuracy better than plus or minus .05% of full scale, and be indicating recording at real time.

2.9.3.12. Three-dimensional mannequin, clothed in a smock, overall height adjustable to allow testing as specified herein for taller, shorter and seated workers.

2.9.3.13. Theatrical smoke machine, or equal titanium tetrachloride glass modules. Caution: Titanium tetrachloride is hazardous and skin contact or inhalation must be avoided.

2.9.4. Factory Preliminary Test Procedure:

2.9.4.1. Provide sketch of room indicating room layout, location of significant equipment, including test and other hoods. Provide sketch of air supply system indicating type of supply fixtures.

2.9.4.2. Reverse airflows and dead space test:

2.9.4.2.1. Swab smoke along both walls and floor of hood in a line 6” behind and parallel to the hood face, and along the

top of the face opening. Swab an 8" diameter circle on the back of the hood. All smoke should be carried to the back of the hood and exhausted. Test the operation of the bottom air bypass airfoil by running smoke under the airfoil.

2.9.4.2.2. If visible fumes flow out of the front of the hood, the hood fails the test and receives no rating.

2.9.4.3. Face velocity measurements: Face velocity shall be determined by averaging minimum of 12 readings at the hood face. Take readings at center of grid made up of sections of equal area across the top, center and bottom of the full sash opening. Each reading to be recorded after a minimum 10-second duration at each point.

2.9.4.4. Test Procedure:

2.9.4.4.1. Check sash operation by moving sash through its' full travel. Verify that sash operation is smooth and easy, and that vertical rising sash shall hold at any height without creeping up or down. Position sash in full open position.

2.9.4.4.2. Monitor exhaust cfm at various vertical and horizontal sash positions to completely closed. Cfm must not vary more than 3% in any position. Hoods exceeding this fail the test and receive no rating.

2.9.4.4.3. Hood Static pressure shall be measured per ANSI / ASHRAE 41.3-1989 standard of pressure measurement, in the center of exit plane at the top plane of collar(s). Static pressure loss shall not exceed values given under design requirements.

2.9.4.4.4. To ensure safe performance when the hood is used, i.e. non-empty state, as required by OSHA, **all tests** shall be conducted with the FH loaded with 12"L x 9" W x 8" D (or similar) boxes blocking 66% of the vertical sash area opening. Boxes shall be within one inch of the airfoil and one inch to the back of the gas injector. All boxes shall be flush to the work surface.

2.9.4.4.5. Install ejector in test positions per ANSI / ASHRAE 110-1995 guideline. For a typical bench-type hood, three positions are required: left, center, and right as seen looking into the hood. In the left position the ejector centerline is 12" from the left inside wall of the hood; center position is equal distance from the inside sidewalls; and the right position is 12" from the right inside wall. The ejector body is 6" in from the hood face in all positions. Location of ejector may require modification for hoods of unusual dimensions.

2.9.4.4.6. Install mannequin positioned in front of the hood, centered on the ejector.

2.9.4.4.7. Fix detector probe in the region of the nose and mouth of the mannequin. Take care that the method of attachment of the probe does not interfere with the flow patterns around the mannequin. Locate nose of mannequin 9" in front of the ejector (3" in front of sash).

2.9.4.4.8. All FHs must pass a three position static tracer gas test in a manufacturer's laboratory under ideal conditions. At no time can a peak spill exceed 0.05 PPM with tracer gas release rates of 4 and 8-liters/min. Hoods exceeding this level fail the test.

2.9.4.4.9. ANSI / ASHRAE 110-1995 incorporates a sash movement effect (SME) procedure which shall be utilized to simulate actual hood usage conditions. After testing FH statically in the three positions and the results recorded, the mannequin shall be placed in the most vulnerable center position and the following test proceedings followed:

2.9.4.4.9.1. The mannequin shall be located at the appropriate center test position with the sash at 27±1" full vertical opening. The block valve shall be opened releasing SF6 gas (perform at both 4 and 8-liters/min. rates) and the sash closed. After two minutes, a background level with the sash closed shall be determined. If tracer gas is detected with the sash closed, the test shall be terminated until the source of leakage is determined and eliminated.

The sash shall be fully opened in a smooth motion at a velocity between 1.0 ft/s (0.3 m/s) and 1.5 ft/s (.05 m/s) while tracer gas is released and the tracer gas concentration is recorded. The peak levels shall be noted. After the system has stabilized for a maximum of one minute after opening the sash, the sash shall be closed at a rate between 1.0 ft/s (0.3 m/s) and 1.5 ft/s (0.5 m/s) while continuing to record the tracer gas concentration. The cycle shall be repeated three times at each gas release rate.

2.9.4.4.9.2. The sash movement effect (SME) is the maximum peak tracer gas concentration determined in above test. The sash movement performance rating of the hood shall be recorded as SME-AM yyy, where yyy equals sash movement effect, ppm. Hoods exceeding SME-AM 0.05 fail the test.

2.9.4.4.10. FHs performance is effected by fluctuations in space pressure. The following test procedure shall be followed.

2.9.4.4.10.1. The mannequin shall be located at the appropriate center test position with the sash at a full 27±1" vertical opening. The block valve shall be opened releasing SF6 gas (perform at both 4 and 8-liters/min. rates. The test chamber room shall be set for negative 0.05" WC pressure with test room door closed. The test chamber door shall be abruptly opened in less than one second, pause for 15 seconds and then abruptly shut in less than one second while the tracer gas is released and the tracer gas concentration is recorded. The peak levels shall be noted. This sequence is to be repeated three times, with a maximum of one minute between tests.

2.9.4.4.10.2. The "Space Pressure Effect" (SPE) is the maximum peak tracer gas concentration determined in above test. The space pressure performance rating of the hood shall be recorded as SPE-AM yyy, where yyy equals space pressure, ppm. Hoods exceeding SME-AM 0.05 peak fail the test.

2.9.4.5. All data on the above test conditions including instrumentation and equipment, test conditions, preliminary test data information shall be provided via written report, including a printout of the average face velocities, and a separate graph recorded performance data from analyzer results of all above tests. Hoods not meeting the listed requirements shall be determined “Not Acceptable”.

2.9.4.6. Field As Installed Testing.

2.9.4.6.1. The test procedure as outlined in “Factory As Manufactured (AM) Quality Control Testing of Fume Safety Cabinets” above shall be conducted in the field after the FH installation and airflow balancing.

2.9.4.6.2. A Minimum of 10% random sample of installed FHs shall undergo field tracer gas testing. The “as installed” test will be at 8.0 AI 0.1.

2.9.4.6.3. An "As Used" tracer gas testing shall follow the owner's chemical hygiene plan (CHP) and be contracted by the owner after as installed acceptance testing.

3. Execution

3.1. Installation: FHs shall be installed as indicated on the project drawings.

3.2. Factory Test Report: Factory (AM) test report shall be provided to the owner and engineer prior to hood shipment for verification of performance.

3.3. Field Test: Upon installation, setup and balance, field-testing shall be performed. A report of performance in each area shall be provided to the owner and engineer prior to final acceptance on the project.

3.4. As installed field performance verification: Spillage limit for field tests with hoods loaded shall be 8.0 AI 0.1 ppm which is double the 0.05 limit for testing in manufacturer’s facility. Any hood not meeting specifications in the As Installed (AI) testing shall be brought into conformance or replaced. Raising airflow above airflows specified on drawings to pass performance testing is not acceptable.

3.5. Startup & Training: The system shall be installed and balanced in compliance with manufacturer’s recommended practice and in

compliance with applicable codes. Prior to energizing the system, it shall be inspected by authorized manufacturer personnel. After startup, balancing and system commissioning the owner and designated personnel shall be trained in proper operation of the system.

END OF SECTION