SECTION 11610 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Laboratory fume hoods.

B. Related Sections:
   1. Section 12345 - Steel Laboratory Casework: Base unit and working surface for fume hood/base unit assembly.
   2. Division 15: Furnishing and installation of plumbing utilities and final connections to fume hoods.
   3. Division 15: Furnishing and installation of exhaust duct work and equipment, and final connection of fume hoods.
   4. Division 16: Furnishing and installation of electrical utilities and final connections to fume hoods.

1.02 FUME HOOD GENERAL DESIGN REQUIREMENTS

A. All fume hoods are *Isolator* type with a top and bottom airfoil and aerodynamically shaped fascia posts to minimize turbulence. The design incorporates an automatic air bypass system so that the exhaust air volume is constant. Bypass is recessed behind plane of the sash and affords velocity tempering performance with face velocities not in excess of 3.8 times full-open face velocity.

B. Design fume hoods for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 20% of the average face velocity at any designated measuring point as defined in this section.

C. Average illumination of work area: minimum 80 foot-candles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 48 inches.

D. Fume hood shall be designed to minimize static pressure loss with stainless steel round duct collar configuration. Maximum average static pressure loss readings taken three diameters above the hood outlet from four points, 90 degrees apart, shall not exceed the following maximums:

   Face Velocity at sash full open - measured S.P.L. (W.G.)

75 F.P.M.	.30 inches
100 F.P.M.	.50 inches
125 F.P.M.	.80 inches
150 F.P.M.	1.16 inches

E. Fume hood shall maintain essentially constant exhaust volume at any baffle position for safety. Maximum variation in exhaust CFM, static pressure and average face velocity as a result of baffle adjustment shall not exceed 5% for any baffle position at the specified face velocity.

1.03 SUBMITTALS

A. Submit manufacturer's test data and installation instructions for each type of fume hood. Provide data indicating compliance with ANSI/ASHRAE Standard 110-1995.

B. Provide samples of the following:

1. 6" x 6" section of the interior fume hood liner material.
2. 12" x 12" section of countertops with dish formation.
3. Color samples of manufacturer's finish.
4. Hardware and accessories including sample sash handle and/or pulls, chains, axles, and sprockets.

Samples of the approved manufacturer will be kept at the job site or the office of the architect until completion of the project.

C. Provide submittal drawings for fume hoods showing plans, elevations, sections and service run spaces. Details shall include notation of all specified items.

1. Provide location and type of service fittings as related to the fume hood when required.

2. Provide rough-in drawings for mechanical and electrical services as related to the fume hood when required.

3. Provide face opening, air volume, and static pressure drop data.

1.04 QUALITY ASSURANCE

A. All laboratory fume hoods specified herein will be the product of one manufacturer and will be based on the specifications of the product line described in Part 2. All manufacturers other than those of the specified products will provide evidence of expertise in the manufacture of fume hoods and be willing to have their manufacturing facility scrutinized by the customer.

B. All manufacturers desiring approval for this project must maintain a fume hood test facility at their factory location. This facility must provide for variable exhaust and make-up air control. In addition, any facility that provides for fume hood make-up air by using floor-to-ceiling wall diffusers is unacceptable. All qualified test facilities must contain, as part of their permanent equipment, ANSI/ASHRAE 110-1995 testing hardware as specified in that standard. In addition, all data readings shall be computer-recorded and the raw data submitted in disc format.

C. The manufacturer shall provide certification that fume hoods shall meet the performance requirements described under Appendix A "Fume Hood Performance Testing Requirements."

D. The manufacturer shall warrant the sash counterweight system, excluding glass, against defects in materials and workmanship for the life of the fume hood. Any material or manufacturing defect in these components will be repaired without charge by the manufacturer.

E. The manufacturer shall, for a period of three years from date of shipment, warrant that furnished products shall be free from defects in material and workmanship. The manufacturer shall also warrant the products to be as represented and will repair or replace any part, under normal use, if examination discloses it to have been defective within the warranty period.

1.05 DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery of fume hoods with delivery of other laboratory casework components and with work of other trades.

B. Deliver, store, and handle laboratory fume hoods in a manner designed to prevent damage and disfigurement to the product.

C. Protect all surfaces from damage during transit.

1.06 PROJECT CONDITIONS

Do not deliver or install equipment until the following conditions have been met:

A. Windows and doors are installed and the building is secure and weather-tight.

B. Ceiling, overhead ductwork and lighting are installed.

C. All painting is completed and floor tile located below casework is installed.

PART 2 - PRODUCTS

2.01 MANUFACTURER

Design of laboratory fume hoods and casework is based on products manufactured by Jamestown Metal Products, Inc., 178 Blackstone Avenue, Jamestown, New York 14701. All fume hoods shall be the product of one manufacturer.

2.02 FUME HOOD MATERIALS

A. Steel: High quality, cold rolled, mild steel meeting requirements of ASTM A366; 12 and 18 gauge U.S. Standard.

B. Stainless steel: Type 304 or Type 316; 14, 16, 18 and 20 gauge U.S. Standard. Stainless steel shall be supplied with:

Standard: A #4 finish free of burrs, weld marks, or other imperfections.

Optional: A mirror-like ultra polished finish exposing maximum chromium and nickel content free of weld marks or other imperfections.

C. Galvanized steel: 18 gauge, G90 finish.

D. Sash Glass: 1/4" (6 mm) clear tempered glass.

E. Sash tracks: Corrosion-resistant polyvinyl chloride (PVC).

F. Fastenings:

1. Interior fastening devices: Nylon bolts, PVC fasteners, PVC-capped 410 stainless screws.

2. Exterior structural members attachments: 410 stainless screws.

3. Exterior panel member fastening devices: PVC-capped 410 stainless screws.

G. Interior Liners:

The liner consists of all interior surfaces, including sides, top, back and baffles. See also Appendix B.

Standard: Fiberglass reinforced polyester material (polyglass), 1/4" thick, white

Optional: Type 304 stainless steel, 16 gauge, with a #4 finish

Optional: Type 316 stainless steel, 16 gauge, with a #4 finish

Optional: Epoxy resin, 1/4" thick, black

Optional: PVC plastic sheet, 1/4" thick, white

Optional: Polypropylene plastic sheet, 1/4" thick, white

2.03 CONSTRUCTION - BENCH HOODS

A. Superstructure

Superstructure shall consist of 18 gauge galvanized steel side pans and back pans, maximum 4-3/4" thick, holding side and rear liner panels, and fastened together with pinions and screws so that the entire structure is secure and rigid. Any framing system not providing structural support is unacceptable.

Front and both sides of the superstructure are aligned and precision fit, eliminating the need for exterior gaskets.

B. Hood Roof

The hood roof shall be fabricated from 18 gauge galvanized steel with liner material identical to that used in the rest of the containment cavity mounted to the interior. Such construction affords additional containment for accidental fire.

C. Airfoil Construction

Bottom airfoil shall be constructed of 14 gauge 304 #4 finish stainless steel with a minimum clearance of 3/4" from the work surface to insure maximum operating efficiency and minimum eddy effects. Bottom airfoil shall also be equipped with power cord/tube pass-throughs 3" square near each side post. These pass-throughs shall allow sash handle to seal against airfoil without running cords and tubes under the airfoil, but by simply resting cords and tubes into the pass-through cavity. Painted steel parts in the fume hood airfoil are not acceptable.

Top airfoil shall be constructed of 18 gauge 304 #4 finish stainless steel.

D. Sash ***(Select One)***

* Provide a frameless vertical sash containing a 1/4" (6 mm) tempered glass panel and a full width anodized aluminum aerodynamic wedge-shaped sash handle connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

* Provide a combination sash with horizontal sliding panels no wider than 18". Sash elements are tempered glass panels set into an aluminum track housed within the stainless steel sash frame giving either horizontal or vertical movement options to the end user. A steel rear-hung, counterweight system is used to insure non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

* Provide a horizontal sliding sash consisting of a stainless steel top rail holding stainless steel framed glass panels and an aluminum bottom track. Sash elements are tempered glass panels set into an aluminum track housed within the stainless steel rail. Painted steel parts in the sash are not acceptable.

* Provide a framed vertical sash containing a 1/4" (6 mm) tempered glass panel set into a stainless steel frame connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

E. Baffles providing controlled air vectors into and through the fume hood shall be fabricated of the same material as the liner. Provide three fixed baffles and one bottom adjustable baffle.

F. Bypass system shall be Isolator Viewpass system consisting of a 1/4" (6 mm) smoked tempered glass panel allowing complete visual display of fume hood interior.

G. Duct collar(s) will be 10" or 12" round exhaust outlet collar(s) and be fabricated of 20 gauge Type 304 stainless steel. Coated steel collars are not acceptable.

H. All bench type fume hoods are designed to have an interior vertical clearance of not less than 47" in the front twelve inches of the hood depth. Internal dimensions may be affected by accessories or options.

I. Fume hood fascia posts shall be:

Standard: Painted, 18 gauge cold rolled steel.

Optional: Type 304 stainless steel.

J. Exterior end panels shall be:

Standard: Painted, 18 gauge cold rolled steel.

Optional: Type 304 stainless steel.

K. Interior Lighting

Standard: A hinged fluorescent light fixture configured for T-12 lamp tubes shall be provided and installed on the exterior of the fume hood roof. A tempered glass panel is provided and has a vapor-tight seal to isolate the fluorescent fixture from the hood interior. The largest possible double tube UL approved fixture is provided for each hood.

Optional: A hinged fluorescent light fixture configured for T-8 lamp tubes shall be provided and installed on the exterior of the fume hood roof. A tempered glass panel is provided and has a vapor-tight seal to isolate the fluorescent fixture from the hood interior. The largest possible double tube UL approved fixture is provided for each hood.

Optional: An incandescent, explosion-proof 150 watt light shall be provided.

Standard configurations for fluorescent light fixtures are: 36" hood (1-24" fixture); 48" hood (1-36" fixture); 60" hood (1-48" fixture); 72" hood (1-48" fixture); 96" hood (2-36" fixtures).

L. Fluorescent Tubes or Incandescent Bulbs

Standard: Lamp tubes or bulbs shall be provided by others.

Optional: Lamp tubes or bulbs shall be included with fixture.

M. Service Fittings and Fixtures When Required

1. All laboratory service fittings and fixtures shall be as manufactured by the Water Saver Fixture Company or an approved equal. Fixtures, including handles, shall be color coded to indicate the proper service. Color code requirements for indexing service fixtures shall be as follows:

Service	Index Color
Gas	Blue
Air	Orange
Vacuum	Yellow
Steam	Black
Cold Water	Green
Hot Water	Red
Deionized Water	White
Other Services	On Application

2. Finish of Service Fixtures ***(Select One)***

A. Laboratory service fixtures (except fittings inside the fume hood) shall have:

* A polished chrome finish with clear epoxy coating.

* A satin chrome finish with clear epoxy coating.

B. Fittings inside the fume hood shall have an epoxy finish color-coded to match the fixture service index color.

N. Electrical Services When Required ***(Select One)***

* Specified electrical outlets and switches are shipped loose for field installation by the electrical contractor. All electrical receptacles are 3-wire, 20 amp duplex, 120/277VAC or as specified. Light switch shall be 3-wire polarized grounded, 15 amp, 125VAC or as specified. Face plates are stainless steel.

* Wiring harnesses shall be furnished for each specified fascia post mounted electrical device and field-installed.

* Specified electrical services are prewired to a junction box located on the roof of the fume hood for field connection by the electrical contractor. All electrical receptacles are 3-wire, 20-amp duplex, 120/277VAC or as specified. Light switch shall be 3-wire polarized grounded, 15 amp, 125VAC or as specified. Face plates are stainless steel.

O. Fume Hood Work Surfaces ***(Select One)***

* All fume hood work surfaces are 1-1/4" thick molded epoxy resin tops made in the form of a watertight pan, not less than 1/4" deep to contain spillage. Work surfaces are non-glaring finish and black, gray, or light gray (lt.gray) in color.

* All work surfaces are fabricated of 16 gauge, Type 304 stainless steel formed down, making a 1-1/4" high face, and dished to form a watertight containment not less than 1/4" deep to contain any spills within the fume hood.

P. Instruction Plate

Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, use of sash and recommended safe operating procedures.

2.04 CONSTRUCTION - WALK IN HOODS

A. Superstructure

Superstructure shall consist of 18 gauge galvanized steel side pans and back pans, maximum 4-3/4" thick, holding side and rear liner panels, and fastened together with pinions and screws so that the entire structure is secure and rigid. Any framing system not providing structural support is unacceptable.

Front and both sides of the superstructure are aligned and precision fit, eliminating the need for exterior gaskets.

B. Hood Roof

The hood roof shall be fabricated from 18 gauge galvanized steel with liner material identical to that used in the rest of the containment cavity mounted to the interior. Such construction affords additional containment for accidental fire.

C. Airfoil Construction

Top airfoil shall be constructed of 18 gauge 304 #4 finish stainless steel.

D. Sash ***(Select One)***

* Provide two frameless vertical sashes, each containing a 1/4" (6 mm) tempered glass panel and a full width anodized aluminum aerodynamic wedge-shaped sash handle connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

* Provide two sashes; the upper being a combination sash with horizontal sliding panels no wider than 18" and the lower being a framed vertical sash. Sash elements in the combination sash are tempered glass panels set into an aluminum track housed within the stainless steel sash frame giving either horizontal or vertical movement options to the end user. Sash elements in the framed vertical sash are a 1/4" (6 mm) tempered glass panel set into a stainless steel frame connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

* Provide a horizontal sliding sash consisting of a stainless steel top rail holding stainless steel framed glass panels and an stainless steel bottom track. Sash elements are tempered glass panels set into an aluminum track housed within the stainless steel rail. Painted steel parts in the sash are not acceptable.

* Provide two framed vertical sashes, each containing a 1/4" (6 mm) tempered glass panel set into a stainless steel frame connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable.

E. Baffles providing controlled air vectors into and through the fume hood shall be fabricated of the same material as the liner. Provide four fixed baffles and two adjustable baffles.

F. Bypass system shall be Isolator Viewpass system consisting of a 1/4" (6 mm) smoked tempered glass panel allowing complete visual display of fume hood interior.

G. Duct collar(s) will be 10" or 12" round exhaust outlet collar(s) and be fabricated of 20 gauge Type 304 stainless steel. Coated steel collars are not acceptable.

H. All walk in type fume hoods are designed to have an interior vertical clearance of not less than 83" in the front twelve inches of the hood depth. Internal dimensions may be affected by accessories or options.

I. Fume hood fascia posts shall be:

Standard: Painted, 18 gauge cold rolled steel.

Optional: Type 304 stainless steel.

J. Exterior end panels shall be:

Standard: Painted, 18 gauge cold rolled steel.

Optional: Type 304 stainless steel.

K. Interior Lighting

Standard: A hinged fluorescent light fixture configured for T-12 lamp tubes shall be provided and installed on the exterior of the fume hood roof. A tempered glass panel is provided and has a vapor-tight seal to isolate the fluorescent fixture from the hood interior. The largest possible double tube UL approved fixture is provided for each hood.

Optional: A hinged fluorescent light fixture configured for T-8 lamp tubes shall be provided and installed on the exterior of the fume hood roof. A tempered glass panel is provided and has a vapor-tight seal to isolate the fluorescent fixture from the hood interior. The largest possible double tube UL approved fixture is provided for each hood.

Optional: An incandescent, explosion-proof 150 watt light shall be provided.

Standard configurations for fluorescent light fixtures are: 48" hood (1-36" fixture); 60" hood (1-48" fixture); 72" hood (1-48" fixture); 96" hood (2-36" fixtures).

L. Fluorescent Tubes or Incandescent Bulbs

Standard: Lamp tubes or bulbs shall be provided by others.

Optional: Lamp tubes or bulbs shall be included with fixture.

M. Service Fittings and Fixtures When Required

1. All laboratory service fittings and fixtures shall be as manufactured by the Water Saver Fixture Company or an approved equal. Fixtures, including handles, shall be color coded to indicate the proper service. Color code requirements for indexing service fixtures shall be as follows:

Service	Index Color
Gas	Blue
Air	Orange
Vacuum	Yellow
Steam	Black
Cold Water	Green
Hot Water	Red
Deionized Water	White
Other Services	On Application

2. Finish of Service Fixtures ***(Select One)***

A. Laboratory service fixtures (except fittings inside the fume hood) shall have:

* A polished chrome finish with clear epoxy coating.

* A satin chrome finish with clear epoxy coating.

B. Fittings inside the fume hood shall have an epoxy finish color-coded to match the fixture service index color.

N. Electrical Services When Required ***(Select One)***

* Specified electrical outlets and switches are shipped loose for field installation by the electrical contractor. All electrical receptacles are 3-wire, 20 amp duplex, 120/277VAC or as specified. Light switch shall be 3-wire polarized grounded, 15 amp, 125VAC or as specified. Face plates are stainless steel.

* Wiring harnesses shall be furnished for each specified fascia post mounted electrical device and field-installed.

* Specified electrical services are prewired to a junction box located on the roof of the fume hood for field connection by the electrical contractor. All electrical receptacles are 3-wire, 20-amp duplex, 120/277VAC or as specified. Light switch shall be 3-wire polarized grounded, 15 amp, 125VAC or as specified. Face plates are stainless steel.

O. Fume Hood Work Surfaces ***(Select One)***

* All fume hood work surfaces are 1-1/4" thick molded epoxy resin tops made in the form of a watertight pan, not less than 1/4" deep to contain spillage. Work surfaces are non-glaring finish and black, gray, or light gray (lt.gray) in color.

* All work surfaces are fabricated of 16 gauge, Type 304 stainless steel formed down, making a 1-1/4" high face, and dished to form a watertight containment not less than 1/4" deep to contain any spills within the fume hood.

P. Instruction Plate

Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, use of sash and recommended safe operating procedures.

2.05 OPTIONAL FEATURES

A. Velocity Alarm

Fume hoods shall be equipped with Alert-Tech fume hood velocity alarm to detect low hood face velocities. The units are surface-mounted on the hood's fascia panel. Any system whose control module, when mounted, is thicker than 1-1/2" is unacceptable.

The UL approved velocity alarm signals an unsafe operating condition when the fume hood face velocity falls below a preset amount. The alarm set-point calibration is performed by the user/owner once a proper face velocity has been set and measured. The alarm system consists of the following:

1. A red LED digital display that registers face velocities between 0 and 200 FPM plus a safety reference display that actuates in low velocity conditions.

2. An interconnected set of micro-switches that serve as a way of selecting the alarm set-point.

3. An audible alarm of at least 80 dB.

4. A flashing red warning light in synchronization with the audible alarm.

5. A silencer switch for the audible alarm that <u>will not</u> stop the red warning light.

6. A test mode that simultaneously tests L.E.D. function, sensor and alarm set-point.

7. The alarm system is furnished complete with velocity detector, 110V/12VDC power supply, detector mounting hardware, alarm, and optional case. The system operates at 110V, 60 Hz. power.

B. Vapor Alarm

Fume hoods shall be equipped with a Vapor-Track flammable vapor sensing device. Units are surface-mounted in the fume hood top or on the fascia posts. Any system that cannot be surface-mounted with 1-1/4" or less of projection from the fascia post is unacceptable.

The Vapor-Track signals an unsafe condition when flammable vapors are sensed inside the fume chamber above a level predetermined by the operator. The alarm system consists of the following:

1. An L.E.D. digital display that registers vapor concentration by an increasing value of 1 to 200 for higher concentrations.

2. An interconnected set of micro-switches that serves as a way of selecting any of the L.E.D. display lights as the alarm set-point.

3. A warbling audible alarm (1,500 Hz to 3,000 Hz) of at least 85 dB.

4. A flashing red warning light in synchronization with the audible alarm.

5. A spring-loaded test switch that simultaneously tests L.E.D. function and alarm set point.

6. A TGS813 temperature-compensated sensor module for mounting on the hood interior sidewall.

7. The Vapor Track unit is furnished complete with sensor, sensor mounted hardware, alarm, and optional case for surface mounting. The system is D.C. driven by a UL approved plug-in conversion transformer.

8. Alarm sensitivity shall be 50 PPM.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install fume hoods and equipment in accordance with manufacturer's instructions.

B. Install equipment plumb, square, and straight with no distortion and securely anchored as required.

C. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations.

3.02 OPTIONAL FIELD QUALITY CONTROL TESTING OF FUME HOODS *(Select One)*

* Have [all] [a representative number of one of each width of the] fume hoods static tested for three (3) minutes using ANSI/ASHRAE 110-1995. All hoods shall pass with an average rating of AI 0.05 or less.

* Have [all] [a representative number of one of each width of the] fume hoods tested using SEFA 1.2 - 1996. All units tested shall pass using the specified criteria.

3.03 ADJUSTING

A. Repair (or remove and replace) defective work, as directed by Owner's Representative upon completion of installation.

B. Adjust sash and other moving or operating parts to ensure smooth, near-silent and accurate sash operation with one hand and with uniform contact of rubber bumpers. Ensure counterweights operate without interference.

C. Adjust fixtures and accessories to function smoothly.

3.04 CLEANING

A. Clean equipment, touch up as required.

3.05 PROTECTION OF FINISHED WORK

A. Provide all reasonable protective measures to prevent exposure of equipment from exposure to other construction activity.

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

3.06 OPTIONAL USER TRAINING

Provide a factory-certified trainer for ___ workshop sessions over a ___ day period.

END OF SECTION 11610

APPENDIX A - FUME HOOD PERFORMANCE TESTING REQUIREMENTS

A. GENERAL

One (1) hood of the same design as specified herein will be successfully tested as detailed below. Production of the hoods specified herein will not commence until the "Performance Test" has been successfully performed by the manufacturer. In general, the below detailed "Performance Test" will consist of the ANSI/ASHRAE 110-1995 test procedure using a five-minute tracer gas challenge at a rate of four (4) liters per minute. The PPM concentration outside the hood of a tracer gas released inside the hood will be measured utilizing a MIRAN 203 Gas Analyzer, or equivalent.

B. TEST EQUIPMENT

1. Tracer gas orifice and ejector as specified in ANSI/ASHRAE 110-1995.

2. Tracer gas is sulfur hexafluoride supplied from a cylinder capable of maintaining 30 PSI pressure at the test flow rate for at least five minutes. The test flow rate is four (4) liters per minute.

3. Detector is a MIRAN 203 Infrared Spectrophotometer capable of indicating or recording concentrations of tracer gas in the range of 0.001 PPM, with an accuracy of $\pm$ 10% and a response time not to exceed ten (10) seconds to 90% indication of actual concentration.

4. "Dummy" will be a manikin such as used in clothing display. The height of the manikin will be 67 inches with a shoulder height of 55" to 57", and otherwise represent normal proportions of the human body. Hairless dummies or torsos are unacceptable.

5. The detector is calibrated with a known concentration of tracer gas within 24 hours preceding a test, using the methods furnished or specified by the detector manufacturer.

C. TEST CONDITIONS

Hood is tested with ceiling-supplied make-up air in a test area where face velocity, temperature, and room air flow can be monitored and documented.

D. HOOD CONDITION

1. The sash or sashes shall be located in the design position or positions.

2. If the hood has an auxiliary air supply, the supply shall be in operation.

E. QUANTITATIVE TEST PROCEDURE

1. Turn on detector, allow time to equilibrate.

2. Insert orifice in test diffuser to give (4) liter per minute release rate.

3. Install diffuser to a central test position. This position is equidistant from the inside side walls, six inches behind the sash plane.

4. Install manikin standing 3" from the plane of the sash.

5. Turn on tracer gas block valve. Position the detector probe between the nose and lip of the manikin.

6. Observe and record the detector readings automatically. Background readings are to be taken before each test and subtracted from the actual test readings.

   The tests are run for five (5) minutes. An average reading above 0.07 PPM constitutes unsatisfactory performance under the conditions that exist for that test.

7. During the sixth and seventh minute of testing, the sash is closed completely - then, at 420 seconds elapsed time, the sash is re-opened.

8. Between 450 and 510 seconds elapsed time, the hood perimeter is tested at a distance of 1" outside the plane of the sash.

9. During all these procedures, breathing zone gas concentration shall not exceed 0.05 PPM.

F. QUALITATIVE TEST PROCEDURE

Excerpt from SEFA 1.2 1996 (formerly SAMA Standard LF10-1981)

It is recommended that the user make provisions to have the following tests performed on all laboratory fume hoods. These tests should be performed by qualified personnel to verify proper operation of the fume hoods before they are put to use. The tests of the fume hoods should be performed after the installation is complete, the building ventilation system has been balanced and all connections made. Any unsafe conditions disclosed by these tests should be corrected before using the hood.

7.1 Test Conditions

Verify that building make-up air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at design conditions.

7.2 Test Procedures

7.2.1 Equipment List

(a) A properly calibrated hot-wire thermal anemometer.
(b) A supply of 2 -minute smoke candles.
(c) A bottle of titanium tetrachloride and supply of cotton swabs or other recognized device for producing smoke.

7.2.2 Room Conditions

Check room conditions in front of the fume hood using a thermal anemometer and a smoke source to verify that the velocity of cross drafts does not exceed 20 percent of the specified average fume hood face velocity. Any cross drafts that exceed these values shall be eliminated before proceeding with fume hood test.

Caution: Titanium Tetrachloride fumes are toxic and corrosive. Use sparingly; avoid inhalation and exposure to body, clothing and equipment that might be affected by corrosive fumes.

Note: It must be recognized that no fume hood can operate properly if excessive cross drafts are present.

7.2.3 Face Velocity

Determine specified average face velocity for fume hood being tested. Perform the following test to determine if fume hood velocities conform to specifications or to the designated fume hood class. With the sash(es) positioned, turn on the exhaust blower. The face velocity shall be determined by averaging the velocity readings taken at the open fume hood face. Note: If not in accordance with specified face velocity, refer to Appendix A (Troubleshooting Guide) of the complete SEFA document for aid in determining the cause of variation in air flow. If face velocity cannot be corrected to that specified, reclassify fume hood to conform to actual face velocity.

7.2.4 Sash Operation

Check operation by moving sash(es) through its (their) full travel. Sash operation shall be smooth and easy. Vertical rising sashes shall hold at any height without creeping up or down, unless designed otherwise.

7.2.5 Verification of Proper Air Flow and Patterns

7.2.5.1 Fume Hoods Without Auxiliary Air

(a) Turn fume hood exhaust blower on.
(b) With sash(es) in full open position, check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source.

Note: On fume hoods with horizontal sliding sash(es), check air flow with sash(es) at various full open positions. A complete traverse of the fume hood face should verify that air flow is into the fume hood over the entire face area. A reverse flow of smoke indicates unsafe fume hood operation.

(c) Move a lighted smoke candle throughout the fume hood work area, directing smoke across the work surface and against the side walls and baffle. Smoke should be contained within the fume hood and be rapidly exhausted. (Fume hoods with horizontal sliding sash(es) will show reverse flow and turbulence behind sash panel, but no outflow of smoke shall be evident.)

7.2.5.2 Fume Hoods With Auxiliary Air

(a) Turn exhaust blower on and determine face velocity in accordance with 7.2.3.

Note: Face velocity and exhaust volumes shall be determined with the auxiliary air blower off.

(b) Calculate exhaust volume from face velocity data.
(c) Turn on auxiliary air, verify that auxiliary air volume is as specified. Locate a straight section of the supply air duct and drill two holes of a size appropriate for the pitot tubes to be used, 90 degrees apart, on a plane through the duct, at the downstream end of the straight section. Measure the air velocity and calculate the air volume. Compare volumes determined with the specified volume of auxiliary air and with exhaust volume, to determine if proper ratio exists. Deviations of plus or minus five percent are acceptable. If deviations of more than five percent are noted, corrective measures should be taken. Seal holes in duct with duct tape or suitable sealant.

(d) With sash(es) in the open position, check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source. A complete traverse of the fume hood face should verify that air flow is into the fume hood over the entire face area. A reverse flow of air indicates unsafe fume hood operation.

(e) Move a lighted smoke candle throughout the fume hood work area, directing smoke across the work surface and against the side walls and baffle. Smoke should be contained within the fume hood and be rapidly exhausted. Fume hoods with horizontal sliding sash(es) will show reverse flow and turbulence behind sash panel, but no outflow of smoke shall be evident.

7.2.6 Evaluation of Low Air Flow Monitor

On fume hoods with low flow warning devices, verify that monitor functions properly and indicates unsafe conditions.

APPENDIX B - LINER SURFACE FINISH PERFORMANCE REQUIREMENTS

REAGENT	POLYGLASS	PVC	POLYPROPYLENE	EPOXY RESIN	304 SS	316 SS
HYDROCHLORIC ACID 35%	0	0	0	0	4	4
HYDROFLUORIC ACID	1	0	0	3	4	4
PHOSPHORIC ACID 80%	0	0	0	0	1	1
NITRIC ACID 35%	0	0	0	0	0	0
SULFURIC 70%	0	0	0	0	2	3
ACETIC ACID	1	0	0	0	1	1
SODIUM HYDROXIDE 20%	0	0	0	2	0	0
ACETONE	0	1	1	0	0	0
ETHANOL	0	0	0	0	0	0
METHANOL	0	0	0	0	0	0
MEK	0	1	1	0	0	0
GASOLINE	0	0	0	0	0	0
CARBON TETRACHLORIDE	0	0	1	0	0	0
FORMALIN 35%	0	1	0	0	0	0
XYLENE	1	1	1	0	0	0

0= NO EFFECT 1= EXCELLENT 2=GOOD 3=FAIR 4= FAILURE

No effect: No detectable change in working surface material.

Excellent: Slight detectable change in color or gloss, but no change to the function or life of the working surface material.

Good: A clearly discernable change in color or gloss, but no significant impairment of working surface function or life.

Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over a period of time.

Failure: Pitting, cratering or erosion of working surface material. Obvious and significant deterioration.

APPENDIX C - WORK SURFACE FINISH PERFORMANCE REQUIREMENTS

TEST RESULTS OF CHEMICAL RESISTANCE OF EPOXY RESIN WORKTOPS

Inorganic Acids - Corrosive	Black	Gray	Lt. Gray
Chromic Acid - 40% CrO_3	4	3	3
Hydrochloric Acid - 10% HCL	1	1	1
Hydrochloric Acid - Conc -37% HCL	1	1	1
Nitric Acid - 40% HNO_3	1	1	1
Nitric Acid - Conc - 70% NHO_3	1	1	1
Sulfuric Acid - 60% H_2SO_4	1	1	1
Sulfuric Acid - Conc - 96% H_2SO_4	5	5	5
Organic Acids - Corrosive	**Black**	**Gray**	**Lt. Gray**
Acetic Acid - 5% CH_3CO_2H	1	1	1
Acetic Acid - Glacial CH_3CO_2H	1	1	1
Citric Acid - 1% $C_6H_8O_7$	1	1	1
Oleic Acid - $C_{18}H_{34}O_2$	1	1	1
Phenol Solution - 5% C_6H_5OH	1	1	1
Alkaline Solutions - Corrosive	**Black**	**Gray**	**Lt. Gray**
Ammonium Hydroxide - 10% NH_4OH	1	1	1
Sodium Carbonate Sol - 20% NA_2CO_3	1	1	1
Sodium Hydroxide Sol - 60% NAOH	1	1	1
Sodium Hypochlorite Sol - 4% NAOCL	1	1	1
Organic Solvents	**Black**	**Gray**	**Lt. Gray**
Acetone CH_3COCH_3	2	2	2
Benzene C_6H_6	2	2	2
Carbon Tetrachloride CCL_4	2	2	1
Diethyl Ether $CH_3CH_2OCH_2CH_3$	1	1	2
Dimethyl Formamide $HCON(CH_3)_2$	1	1	1
Ethyl Acetate $CH_3CO_2C_2H_5$	1	2	2
Ethyl Alcohol - 95% CH_3CH_2OH	1	1	1
Ethylene Dichloride $C_1CH_2CH_2C_1$	1	1	1
Heptane $CH_3(CH_2)_5CH_3$	1	1	2
Isooctane C_8H_{18}	1	1	1
Kerosene	1	1	1
Methyl Alcohol CH_3OH	1	1	1
Toluene $C_6H_5CH_3$	1	1	1
Organic Compounds	**Black**	**Gray**	**Lt. Gray**
Aniline $C_6H_5NH_2$	1	1	1
Mineral Oil	1	1	1
Olive Oil	1	1	1
Soap Solution - 1%	1	1	1
Transformer Oil	1	1	1
Turpentine	1	1	1

1 - No Effect: No detectable change in the material surface.
2 - Excellent: Slight detectable change in color or gloss but no change in function or life of the surface.
3 - Good: A clearly discernable change in color or gloss but no significant impairment of surface life or function.
4 - Fair: Objectionable change in appearance due to discoloration or etch, possibly resulting in deterioration of function over an extended period of time.
5 - Failure: Pitting, cratering, or erosion of the surface. Obvious and significant deterioration.

Copies of independent laboratory's analytical report are available upon request.

APPENDIX D - PAINTED SURFACE FINISH PERFORMANCE REQUIREMENTS

TESTING METHOD FOR DETERMINING CHEMICAL RESISTANCE OF PAINTED FINISH

GENERAL

Forty-nine (49) sample panels measuring 4" x 6" were submitted for testing.. The received samples to be tested for chemical resistance as described herein.

TEST PROCEDURE

The received panel was placed on a flat surface, cleaned with soap and water and blotted dry. The panel was then conditioned for 48 hours at 73 3 F and 50 5% relative humidity. The panel was then tested for chemical resistance using forty-nine (49) different chemical reagents by one of the following methods:

Method A - Volatile chemicals were tested by placing a cotton ball saturated with reagent in the mouth of a 1 oz. bottle and inverting the bottle on the surface of the panel.

Method B - Non-volatile chemicals were tested by placing five (5) drops of the reagent on the surface of the panel and covering with a 25 mm watch glass.

For both of the above methods, the reagents were left on the panel for a period of 24 hours. The panel was then washed off with water, cleaned with detergent and naphtha, and rinsed with deionized water. The panel was then dried with a towel and evaluated after 24 hours at 73 3 F and 50 5% relative humidity using the following rating system.

No Effect: No detectable change in working surface material.

Excellent: Slight detectable change in color or gloss, but no change to the function or life of the working surface material.

Good: A clearly discernable change in color or gloss, but no significant impairment of working surface function or life.

Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over a period of time.

Failure: Pitting, cratering or erosion of working surface material. Obvious and significant deterioration.

Test results are duplicated on next page. Copies of independent laboratory's analytical report are available upon request.

TEST RESULTS OF CHEMICAL RESISTANCE OF PAINTED FINISH

Reagent	Results
Acetate, Amyl	Excellent
Acetate, Ethyl	Excellent
Acetic Acid, 98%	Excellent
Acetone	Excellent
Acid Dichromate, 5%	No Effect
Alcohol, Butyl	No Effect
Alcohol, Ethyl	Excellent
Alcohol, Methyl	Excellent
Ammonium Hydroxide, 28%	No Effect
Benzene	No Effect
Carbon Tetrachloride	No Effect
Chloroform	Excellent
Chromic Acid, 60%	No Effect
Cresol	Good
Dichlor Acetic Acid	Failure
Dimethylformanide	No Effect
Dioxane	Good
Ethyl Ether	No Effect
Formaldehyde, 37%	No Effect
Furfural	Fair
Gasoline	No Effect
Hydrochloric Acid, 37%	Good
Hydrochloric Acid, 48%	No Effect
Hydrofluoric Acid, 48%	Failure
Hydrogen Peroxide, 3%	No Effect
Iodine, Tincture of	Good
Methyl Ethyl Ketone	Excellent
Methylene Chloride	Excellent
Mono Chlorobenzene	Excellent
Naphthalene	No Effect
Nitric Acid, 20%	No Effect
Nitric Acid, 30%	No Effect
Nitric Acid, 70%	Good
Phenol, 90%	Good
Phosphoric Acid, 85%	No Effect
Potassium Hydroxide, 40%	No Effect
Silver Nitrate, Saturated	Good
Sodium Carbonate	No Effect
Sodium Chloride	No Effect
Sodium Hydroxide, 10%	No Effect
Sodium Hydroxide, 20%	No Effect
Sodium Hydroxide, 40%	No Effect
Sodium Hydroxide, Flake	No Effect
Sodium Sulfide, Saturated	No Effect
Sulfuric Acid, 33%	No Effect
Sulfuric Acid, 77%	Good
Sulfuric Acid, 85%	Good
Sulfuric Acid, 96%	Fair
Sulfuric Acid (77%) and Nitric Acid (70%), equal parts	Good
Toluene	No Effect
Trichloroethylene	No Effect
Xylene	No Effect
Zinc Chloride, Saturated	No Effect