

SECTION 11 53 13 – LABORATORY FUME HOODS AND RELATED PRODUCTS

PART 1: DESCRIPTION OF WORK

1.00 SUMMARY

A. Section Includes:

Based on Kewaunee Scientific Corporation's Supreme Air Venturi Series fume hood design, furnish and install all fume hoods, work tops, and understructures. Furnishing and installing all filler panels, knee space panels and scribes as shown on drawings.

B. Accessorization (Choose one):

Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings. Fittings attached to the fume hood superstructure shall be mounted at the factory.

Or

Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings. Plumbing fittings mounted on the fume hood superstructures shall be pre-plumbed per section 2.01.I. Electrical fixtures shall be prewired per section 2.01.J. The fume hood superstructure shall be listed to UL Standards for Safety by Underwriters Laboratories Inc. (UL). Final plumbing and electrical connections are the responsibility of those contractors fulfilling requirements of Divisions 15 and 16.

C. Removal of all debris, dirt and rubbish accumulated as a result of the installation of the fume hoods to an on-site container provided by others, leaving the premises clean and orderly.

D. Related Divisions:

1. Division 12: Laboratory Casework
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical

E. Related Publications:

1. ASHRAE Standard 110.2016 - Method of Testing Performance of Laboratory Fume Hoods
2. NIH03-112C - National Institute of Health Specification
3. UL - Underwriters Laboratories
4. ASTM D552 - Bending Test
5. NFPA-45 - National Fire Protection Association

1.01 BASIS OF WORK

A. It is the intent of this specification to use Kewaunee Scientific Corporation, Statesville, North Carolina, as the standard of construction for laboratory fume hoods. The construction standards of the Kewaunee Supreme Air Venturi fume hood shall provide the basis for quality and functional installation.

B. Supply all equipment in accordance with this specification. The offering of a product differing in materials and construction from this specification requires written approval. This approval must be obtained seven (7) days before the proposal deadline.

C. General Contractors should secure a list of approved fume hood manufacturers from the architect as a protection against non-conformance to these specifications.

- D. 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.
- E. Submittals:
1. **Manufacturer's Data:**
Submit manufacturer's data and installation instructions for each type of fume hood. Provide data indicating ASHRAE Standard 110.2016 has been successfully completed per section 1.02 C along with manufacturers "As Manufactured" testing procedure.
 2. **Samples:**
Samples if called for will be reviewed for color, texture, and pattern only. Submit the following:
 - a. Hood interior lining, 6 by 6 inches.
 - b. Hood enclosure, 6 by 6 inches, of color selected.
 - c. Operation sign(s).
 3. **Shop Drawings:**
 - a. Submit shop drawings for fume hoods showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fittings:
 - b. Coordinate shop drawings with other work involved.
 - c. Provide roughing-in drawings for mechanical and electrical services when required.
 - d. Provide face opening, air volume, and static pressure drop data.
 4. **Non-Specified Manufacturer's Samples:**
A sample from each non-specified manufacturer will be required and reviewed per specification. This sample shall be delivered, at no cost to the architect or owner to a destination set forth by the architect or owner. The sample must then be tested per section 1.02.C by an independent test agency hired by the submitting company and approved by the owner/architect. A passing test and owner/architect approval of the prototype must be written and approved seven (7) days before quotation deadline as a condition of acceptance for any quotation participant.

1.02 STANDARD FUME HOOD PERFORMANCE REQUIREMENTS

- A. Fume hoods shall be Kewaunee's Supreme Air Venturi model with belted counterweight sash design, electronic sash stop and adjustable LED lighting. Sash and air entry framework of the hood shall minimize eddying of air currents at the hood face, and vertical rear baffle system shall minimize turbulence and vortexes in all portions of the hood interior.

- B. Standard Venturi Fume Hood Types (Choose One)

Constant Volume Fume Hood

1. Constant Volume Fume Hood designed to yield 80 FPM face velocity at 18" sash opening
2. Maximum sash opening to be 28", yielding 55 FPM face velocity
3. Notched belt and sprocket sash system
4. Electronic sash stop at 18"
5. LED lighting, with variable intensity and color range
6. Unobstructed viewing height to be minimum 38.5"

Or

Variable Air Volume (VAV) Fume Hood:

1. VAV Fume Hood designed to yield ____FPM face velocity at ____" sash opening
2. Notched belt and sprocket sash system
3. Electronic sash stop at 18"
4. LED lighting, with variable intensity and color range
5. Unobstructed viewing height to be minimum 38.5"

C. Containment:

1. The purpose of this specification is to pre-qualify the performance of the bidder's laboratory fume hood before award of contract. At their option, owners or their representatives may require the same tests to be performed and the same performance be achieved before acceptance of the hood after award of contract. The owner or their representative shall witness the tests. Failure to meet the performance specified shall be cause for rejection of the bidder.

2. Test Method:

The hood shall be tested per the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 110-2016.

3. Location of Tests and Test Facility:

All tests referenced herein shall be performed in the bidder's fume hood test facility. Field-testing is described in Section 3.01.F.

The test facility shall meet the following requirements:

- a. The test facility shall have sufficient area so that a minimum of 5 feet of clear space is available in front of and on both sides of the hood for viewing tests.
- b. The facility's ventilation system shall have adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.
- c. Standard room air currents in the test area shall be less than 15 FPM.
- d. The hood exhaust system shall be properly calibrated so that the desired exhaust air volumes can be easily attained.
- e. Make-up air to the test room shall be ceiling-supplied as in a standard chemical laboratory.

4. Instrumentation, Equipment and Test Personnel:

Qualified personnel to perform the tests shall be supplied by the bidder. Instrumentation and equipment required shall be supplied by the bidder at their expense. Required instrumentation shall include but not be limited to the following items:

- a. Thermal anemometer capable of measuring air velocities from 10 to 600 ft./minute
- b. One-half minute smoke candles or other source of high volume smoke
- c. Smoke tubes or other source of localized smoke
- d. Miran 103 analyzer calibrated to indicate concentration of sulfur hexafluoride or equivalent.
- e. Flowmeter - 15 L/minute capacity
- f. Tank of sulfur hexafluoride with a two-stage regulator or other tracer gas suitable for detector to be used
- g. Adjustable mannequin, 5' 0" to 5'8" in height, with reasonable human proportions and arms hanging at its side
- h. ASHRAE 110-1995 tracer gas ejector

5. ASHRAE Test (Choose One):

Standard 110-2016 Test

Hood shall be tested with a face velocity of 50 FPM with the sash at the maximum opening, 28".

The hood shall have a performance rating in the static portion of ASHRAE 110-2016 (Section 7.1-7.10) of AM 0.01 or better wherein:

4.0 = tracer gas release in liters/minute

AM = as manufactured

0.01 = 5 minute time average level of control of tracer gas in parts per million (PPM)

Or

Standard 110-2016 Test

Hood should be tested with the sash at the maximum opening 28", with a face velocity that corresponds to the volume indicated in Paragraph 1.02 B. The hood shall have a performance rating in the static portion of ASHRAE 110-1995 (Section 7.1-7.10) of AM 0.01 or better wherein:

4.0 = tracer gas release in liters/minute

AM = as manufactured

0.01 = 5 minute time average level of control of tracer gas in parts per million (PPM)

6. ASHRAE 110-2016 Perimeter, Sash Movement Tests, and Cross Draft Requirements:
 - a. The hood shall have a maximum perimeter reading (Section 7.11) of 0.01 PPM or less.
 - b. The hood shall have a maximum sash movement value (Section 7.12) of 0.05 PPM or less.
7. Twisting Manikin Test
A manikin mounted to a twisting base will be placed in standard ASHRAE 110 position. Arms will be altered to hold objects similar in dimension to two 600 ml beakers inside the hood. Manikin twist angle will be such that at the extreme right and left rotational positions, one "beaker" is outside the sash plane. At a rotation rate of 4 cycles per minute, a four-minute run will be undertaken with a sensor in the manikin breathing zone. Average breathing zone concentration shall remain less than 0.05 PPM.

1.03 QUALITY ASSURANCE

- A. The laboratory fume hood manufacturer shall provide fume hood work tops and casework all manufactured or shipped from the same geographic location to assure proper staging, shipment and single source responsibility.
- B. General Performance: Provide certification that fume hoods meet the performance requirements described in section 1.02.C.

PART 2 - PRODUCTS

2.00 MANUFACTURERS

- A. The basis of this specification is the Supreme Air Venturi fume hood as manufactured by Kewaunee Scientific Corporation, 2700 West Front Street, Statesville, North Carolina.
- B. All laboratory equipment covered by the specification shall be the product of one manufacturer and be fabricated at one geographic location to assure shipping continuity and single-source responsibility. All quotations from a manufacturer other than Kewaunee Scientific shall contain a review of the following capabilities:
 1. List of shop facilities
 2. List of engineering and manufacturing personnel
 3. Proof of financial ability to fulfill the contract
 4. List of a minimum of ten installations over the last five years of comparable scope
 5. Proof of project management and installation capabilities
- C. The selected manufacturer must warrant for a period of one-year starting (date of acceptance or occupancy, whichever comes first) that all products sold under the contract referenced above shall be free from defects in material and workmanship. Purchaser shall notify the manufacturer's

representative immediately of any defective product. The manufacturer shall have a reasonable opportunity to inspect the goods. The purchaser shall return no product until receipt by purchaser of written shipping instructions from the manufacturer.

2.01 MATERIALS AND CONSTRUCTION

- A. **Fume Hood Superstructure Frame:**
A structure of steel support members shall be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the baffle panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels.
- B. **Fume Hood Side Walls:**
Double wall ends, not more than 4.5" wide, with sash track flush with front vertical fascia, shall be provided to maximize interior working area. This fascia shall contain space for the required service controls and electrical devices. The front vertical fascia shall be in a plane 45° from the hood face and incorporate a Venturi port to provide accelerating air through the lower corners of the face opening.
- C. **Fume Hood Dimensions:**
Double wall end panel thickness shall not exceed 4.5". Interior clear working height shall be not less than 48" at any location in the interior of the hood on bench hoods. Interior depth from the back of the sash to the front of the rear baffle shall not be less than 24". The sash opening shall be not less than 28" in height above the worksurface on bench hoods.
- D. **Fume Hood Airfoil:**
A 12 gauge painted steel, (optional stainless steel) convergence z-cross section airfoil shall be mounted flush to the worksurface immediately in front of the sash plane. It shall nest into the Venturi port on each side, and provide no open space between it and the top front edge of the worksurface. Raised airfoils, or flush designs that create openings within the hood chamber, are not acceptable.
- E. **Fume hood top panel shall incorporate a Venturi type dynamic barrier bypass providing a clean air stream behind the sash plane.**
- F. **Fume Hood Baffles:**
The fume hood baffles shall be fixed, and constructed of the same material as the hood lining. They shall consist of multiple sections with vertical slots and a continuous horizontal slot at the worksurface. Each baffle panel shall be easily removable from the interior, without the use of tools, or requiring liner disassembly. Mechanical or manually adjustable baffles are not acceptable.
- G. **Fume Hood Duct Collar:**
Each fume hood up to six feet in length shall contain one (1) 12" diameter FRP (optional stainless steel) duct collar in the hood roof for exhausting the hood. Fume hoods over six feet in length shall contain two (2).
- H. **Fume Hood Lighting:**
An LED light fixture of the size given below shall be provided in the hood roof. The light shall provide (15) intensity adjustment levels, and (3) color options. Illumination at the worksurface shall be at 100 foot-candles at the full intensity setting. The light fixture shall be isolated from the hood interior by a 1/4" thick tempered glass panel sealed from the hood cavity. Fixture shall be UL listed.
- I. **Fume Hood Vertical Sash:**
A vertical rising sash of 1/4" laminated safety glass shall be provided. The sash shall have a neutral colored polyvinyl chloride horizontal member at the top and a painted full-length aerodynamic aluminum support rail with integral finger pull at the bottom. The sash shall be counterbalanced with

a single weight to prevent tilting and binding during operation. The sash shall be connected to the counterweight system with two, 1/2" wide steel-reinforced polyurethane notched belts that engage two sprocket shaft drives. The sash shall provide a 38-1/2" viewing height, with a maximum opening of 28".

OR

Fume Hood Horizontal Sash:

A horizontal sliding sash consisting of multiple 1/4" laminated safety float glass panels shall be mounted on metal rollers on an aluminum track. The panels shall be configured into two tracks and shall allow for up to a 50% access of the fume hood face opening.

OR

Fume Hood Combination Sash:

A combination sash shall be provided. The sash shall have horizontal sliding glass panels in a vertical rising steel frame. The bottom of the sash frame shall have a full length metal handle. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The sash shall be connected to the counterweight system with two, 1/2" wide steel-reinforced polyurethane notched belts that engage two sprocket shaft drives. The glass panels shall be top hung 1/4" laminated safety float glass mounted with metal rollers in an aluminum track.

J. Fume Hood Services (Choose one):

Front Mounted Remote Control Fittings:

Service fitting valves shall be needle valve design and mounted on the hood front vertical fascia with the working components of the valve accessible from the hood exterior. Valves shall be furnished with molded nylon hooded handles with color-coded index buttons and color-coded service outlet.

Or

Rod Type Remote Control Fittings:

Service fitting valves shall be needle valve design and be mounted to the hood interior sidewall liner with extension rods to the front vertical fascia. Valves shall be furnished with molded nylon handles with color-coded index buttons and color-coded service outlet.

(Optional)

All plumbing fittings shall be factory installed and piped between the valve and the outlet. Inlet piping shall be carried to a point 6" above the fume hood roof or 6" below the work top rear corner depending on the rough-in locations shown in the drawings. Points of final service connection by other trades shall be at the stub provided by the fume hood manufacturer.

K. Fume Hood Electrical Fixtures (Choose one):

(Recommended)

The hood superstructure shall be pre-wired and contain a UL label certifying acceptable wire gauge, connections, fixtures and wire color-coding. Electrical fixtures shall be specification grade and consist of two side-by-side duplex receptacles per vertical fascia, and a light switch. The receptacles shall be 20 Amp., 125 volt AC, and 3-wire polarized grounded. Each fascia shall be prewired to a single circuit and have a minimum of (1) ground fault interruption device. The light, light switches and electronic sash stop shall be low voltage. Final wiring and circuit dedication shall be by others.

L. Hood Worksurface (Choose one):

Epoxy Resin:

Hood worksurface shall be 1-1/4" thick molded epoxy resin made in the form of a watertight pan, not less than 1/2" deep to contain spillage. Top shall be manufactured at the same manufacturing location as the fume hood to assure proper cutout alignment and coordinated shipping.

Or

Stainless Steel:

Hood worksurface shall be 14-gauge, Type 304L stainless steel with a No. 4 finish made in the form of a watertight pan, 1/2" deep to contain spillage.

Or

Stainless Steel:

Hood worksurface shall be 14-gauge, Type 316LL stainless steel with a No. 4 finish made in the form of a watertight pan, 1/2" deep to contain spillage.

(optional)

A cup drain flush with the recessed worksurface, or raised above the worksurface shall be provided when shown.

M. Interior Service Access:

Access to services shall be through a trapezoid shaped gasketed panel constructed of the same material as the liner. The panel shall be easily removable without the use of tools.

N. Fume Hood Liners (Choose one):

KMER Epoxy Resin Lining:

KMER epoxy resin liner shall be the manufacturing standard for liners in this specification. To assure proper punching and coordination with remaining pieces of assembled fume hood superstructure, this liner material must be manufactured at the same geographic location as the fume hood superstructure. Interior liner panels shall be 1/4" thick epoxy resin sheets of a neutral color. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads. The material shall have an ASTM E84 Class A flame spread rating (25 or less). Fiberglass reinforced plastics or polyesters shall not be acceptable substitute liner materials for epoxy resin.

Or

KEMGLASS Fiberglass Reinforced Polyester Lining:

Interior liner panels shall be 1/4" thick fiberglass reinforced polyester sheet. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads. The material shall have an ASTM E84 Class A flame spread rating (25 or less).

Or

Reinforced Phenolic Resin Lining:

Interior liner panels shall be 1/4" thick made from a compression molded cellulose fiber reinforced phenolic resin core with integrally cured white melamine surfaces. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads.

Or

Stainless Steel Lining:

Interior liner panels shall be 16 gauge Type 304 stainless steel with a No. 4 finish. Interior liner panels shall be fastened using stainless steel screws.

O. Fume Hood Base Cabinets

1. Standard Steel

Unless otherwise indicated base units under hoods shall be fabricated of cold rolled prime grade roller leveled furniture steel. Gauges of steel used in construction shall be 18 gauge except as follows:

- a. Corner gussets for leveling bolts and apron corner braces, 12 gauge.
- b. Hinge reinforcements, 14 gauge.
- c. Top and intermediate front horizontal rails, apron rails and reinforcement gussets, 16 gauge.
- d. Door assemblies and adjustable shelves, 20 gauge.
- e. Performance of the painted surfaces shall match that of the fume hood outer panels.

2. Special Purpose Cabinets for Use Under Fume Hoods:

a. Acid Storage Cabinets:

Where indicated acid storage cabinets shall use the same gauges of steel and construction features as other base cabinets. In addition, they shall have a one-piece liner insert made of linear low-density polyethylene. The liner insert shall form a one-inch pan at the bottom to retain spillage. Each door will have a set of louvers at the top and bottom. The door shall be lined with a polyethylene sheet. Each cabinet shall be vented into the fume hood with a 1-1/2" flexible vent pipe, providing a positive airflow directly into the fume hood exhaust system.

b. Solvent Storage Cabinets:

Solvent storage cabinets shall be FM or UL labeled and specifically designed for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UFC, OSHA, and NFPA No. 30 - 2003. The bottoms, top, sides and doors shall be fabricated of 18-gauge steel and shall be all double panel construction with a 1-1/2" air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated. The right hand door shall be equipped with a three point latching device and the left-hand door shall have a full height astragal. The doors shall be self-closing and synchronized so that both doors will always fully close. The right hand door shall be equipped with a three-point latching system that automatically engages when the doors close. Each door shall be equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 24" long shall have only one door, self-closing, and equipped with a three-point latching system and hold-open feature. A 2" deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A full-depth adjustable shelf shall also be provided. The shelf shall be perforated to allow air circulation within the cabinet. Two diametrically opposed vents with spark screens shall be provided in the back of the cabinet as well as a grounding screw. The cabinet shall have an interior finish the same as the exterior and shall be labeled: "FLAMMABLE - KEEP FIRE AWAY".

Accessories:

1. Digital Face Velocity Alarm System (Optional):

Fume hoods shall be provided with an alarm system (Kewaunee Air Alert 600) to detect low and high hood face velocities. The alarm system shall indicate the actual face velocity of the hood regardless of sash position. The system shall have an air velocity sensor mounted on the

interior side liner of the hood where it is easily accessible for cleaning. The velocity monitor shall have a digital display of the air velocity through the hood face in feet per minute. The alarm signals shall activate any time the face velocity falls below the low velocity alarm set point. There shall be both visual and audible alarm signals. The audible alarm shall have a mute. Low and high alarm contacts shall be provided for remote monitoring. An hour-long "event timeline" detailing low velocity episodes shall be part of the alarm readout.

2. Power Sash Controller (Optional):

- a. A push button sash controller (Kewaunee PSC1000) shall allow one button up and down electronic sash control.

3. Auto Sash return to 18" (Optional):

The Auto sash return option provides an automatic sash return that lowers the sash to 18" from the full-open set-up position. When the sash is raised to the full open position, a sash lock holds the sash open for set-up purposes. By pressing the electronic sash stop release button, the sash automatically closes to the 18" operating height.

4. Automatic Sash Operator (Optional):

- a. Description: The Automatic Sash Operator, as manufactured by Kewaunee Scientific Corporation, shall close the sash of a Ventrui fume hood slowly and safely when the fume hood is not actively being used by laboratory personnel. A motion sensor, mounted in the top front panel of the fume hood shall monitor movement in front of the hood. When no movement is detected within a programmable amount of time, the sash shall automatically close. When personnel are present, the sash shall be able to be opened and closed manually.

In addition to the motion sensor, a photoelectric sensor placed on the sash creates a light beam, which scans the sash area for obstructions in the path of the sash. When an obstruction exists, the sash shall halt its descent, and a warning light shall signal that an obstruction exists. Once the obstruction is removed, the Sash Operator warning light shall reset, and the unit reengage.

The Automatic Sash Operator shall be factory installed on the fume hood with all required mechanical connections to the sash shaft for proper operation, and prewired to a junction box located on the top of the hood.

- b. Controller: The Automatic Sash Operator shall include a microprocessor controller programmed to close the sash after a set time when no motion in the fume hood operator area is detected, and no obstruction in the sash plane exists. Controller shall be user programmable from 0 to 9999 seconds.
- c. Drive Motor: The Automatic Sash Operator shall include a gear motor, coupled by chain and sprocket to the sash drive shaft. The motor shall be capable of closing the sash throughout the full range of motion. The motor shall be internally overload protected, and UL and CE approved.
- d. Operator Presence Sensor: The Operator Presence Sensor shall be an active infrared sensor with a detection range of nine (9) feet and an operating temperature range of -4 degrees F to 131 degrees F.

P. Fume Hood Finish:

After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate

solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

The completed finish in standard colors shall meet the performance test requirements specified under Section 2.02 A. Steel Paint Finish Performance Test Results.

Q. Fume Hood Finish:

After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

The completed finish in standard colors shall meet the performance test requirements specified under Section 2.02 A. Steel Paint Finish Performance Test Results.

2.02 PERFORMANCE REQUIREMENTS

A. Steel Paint Finish Performance Test Results (Chemical Spot Tests):

1. Testing Procedure:

Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77° ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

2. Test Evaluation:

Evaluation shall be based on the following rating system.

Level 0 – No detectable change.

Level 1 – Slight change in color or gloss.

Level 2 – Slight surface etching or severe staining.

Level 3 – Pitting, cratering, swelling, or erosion of coating.

Obvious and significant deterioration.
 After testing, panel shall show no more than three (3) Level 3 conditions.

3. Test Reagents:

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformamide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

4. Performance Test Results (Heat Resistance):
Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.
5. Performance Test Results (Impact Resistance):
A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.
6. Performance Test Results (Bending Test):
An 18 gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.
7. Performance Test Results (Adhesion):
Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".
8. Performance Test Results (Hardness):
The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one-that is, the hardest pencil that will not rupture the film is then used to express or designate the hardness.

B. Fume Hood Liner Performance:

1. Chemical Spot Tests - 24 Hours:
Chemical spot test shall be made by applying 10 drops (approximately 1/2 cc) of each reagent to the surface to be tested. Each reagent (except those marked **) shall be covered with a 1-1/2" diameter watch glass, convex side down to confine the reagent. Spot tests of volatile solvents marked ** shall be tested as follows: A 1" or larger ball of cotton shall be saturated with the solvent and placed on the surfaces to be tested. The cotton ball shall then be covered by an inverted 2-ounce, wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire 24-hour test period and at a temperature of 77 degrees F. + 3 degrees F. At the end of the test period, the reagents shall be flushed from the surfaces with water and the surface scrubbed with a soft bristle brush under running water, rinsed, and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Spots where dyes have dried shall be cleaned with a cotton swab soaked in alcohol to remove the surface dye. The test panel shall then be evaluated immediately after drying.
2. Legend / Ratings:
1 - KMER (Kewaunee Modified Epoxy Resin) A = No effect or slight change in gloss

- 2 - Glass Reinforced Polyester
- 3 - Stainless Steel 304
- 4 - Stainless Steel 316
- 5 - Reinforced Phenolic Resin

- B = Slight change in gloss or color
- C = Slight etching or severe staining
- D = Swelling, pitting, or severe etching

3. RESULTS:	1	2	3	4	5
1. Acetic Acid 98%	A	C	B	B	A
2. Acetone **	A	A	A	A	A
3. Acid Dichromate	A	B	A	A	A
4. Ammonium Hydroxide ** 28%	A	A	B	B	A
5. Amyl Acetate **	A	A	A	A	A
6. Benzene **	A	A	A	A	A
7. Butyl Alcohol **	A	A	A	A	A
8. Carbon Tetrachloride **	A	B	A	A	A
9. Chloroform **	A	B	A	A	A
10. Chromic Acid 60%	B	C	C	C	A
11. Cresol	A	A	A	A	A
12. Dichloroacetic Acid	A	A	B	A	A
13. Dimethylformamide	A	A	A	A	A
14. Dioxane **	A	A	A	A	A
15. Ethyl Acetate **	A	A	A	A	A
16. Ethyl Ether **	A	A	A	A	A
17. Ethyl Alcohol **	A	A	A	A	A
18. Formaldehyde	A	A	A	A	A
19. Formic Acid 90%	A	B	A	A	A
20. Furfural **	B	C	A	A	C
21. Gasoline **	A	A	A	A	A
22. Hydrochloric Acid 37%	A	A	B	B	A
23. Hydrofluoric Acid 48%	B	A	D	D	A
24. Hydrogen Peroxide 30%	A	A	A	A	A
25. Methyl Ethyl Ketone **	A	A	A	A	A
26. Methyl Alcohol **	A	A	A	A	A
27. Methylene Chloride **	A	B	A	A	A
28. Monochlorobenzene **	A	A	A	A	A
29. Naphthalene **	A	A	A	A	A
30. Nitric Acid 20%	B	A	B	A	A
31. Nitric Acid 30%	B	B	B	A	A
32. Nitric Acid 70%	B	B	B	A	A
33. Phenol ** 85%	A	A	A	A	A
34. Phosphoric Acid 85%	A	A	B	A	A
35. Silver Nitrate	B	C	A	A	C
36. Sodium Hydroxide 40%	A	A	A	A	A
37. Sodium Hydroxide 20%	A	A	A	A	A
38. Sodium Hydroxide 10%	A	A	A	A	A
39. Sodium Hydroxide Flake	A	A	A	A	A
40. Sodium Sulfide	A	A	A	A	A
41. Sulfuric Acid 77%	A	A	C	A	A
42. Sulfuric Acid 96%	C	B	C	A	C
43. Sulfuric Acid 33%	A	A	C	A	A
44. Tincture of Iodine	A	C	B	B	A
45. Toluene **	A	A	A	A	A
46. Trichlorethylene **	A	A	A	A	A
47. Xylene **	A	A	A	A	A
48. Zinc Chloride	A	A	B	A	A
49. Nitric 70%/Sulfuric Acid 77%*	B	B	B	A	A

*Equal parts of Nitric Acid 70% and Sulfuric Acid 77%.

**Indicates these solvents tested with cotton and jar method

PART 3 - EXECUTION

3.00 SITE EXAMINATION

- A. The owner and/or his representative shall certify building conditions conducive to the installation of a finished goods product, including all critical dimensions.

3.01 INSTALLATION

- A. Preparation:
Prior to beginning installation of fume hood, check and verify that no irregularities exist that would affect quality of execution of work specified.
- B. Coordination:
Coordinate the work of the Section with the schedule and other requirements of other work being performed in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.
- C. Performance:
Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in proper location, in accordance with manufacturer's instructions and the approved shop drawings. Provide filler panels between top of hood and ceiling. Securely attach access panels but provide for easy removal and secure reattachment. Do not install any damaged units.
- D. Adjust and Clean:
 - 1. After installations are complete, adjust all moving parts for smooth operation.
 - 2. Remove all packing materials and debris resulting from this work, and turn over the fume hoods to the Owner clean and polished both inside and out.
 - 3. Repair or remove and replace defective work, as directed by owner and/or his representative upon completion of installation.
- E. Protection:
 - 1. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.
 - 2. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.
- F. Certification:
 - 1. Fume Hood Manufacturer shall field test a random sample of 20% of the installed units using ANSI/ASHRAE 110-2016 to a control level of AI 0.02 ppm or better.
 - 2. Project substantial completion shall be withheld until all required fume hood certification letters, tests, and reports have been submitted to and approved by the Architect