PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chemical Fume Hoods, including bench mounted hoods

B. Clean Room Fume Hoods (Acid)

C. Clean Room Fume Hoods (Solvent)

D. Fume Extractor Arms (Snorkels)

E. Gas Safety Cabinets

1.2 RELATED SECTIONS

A. Section 115310: Laboratory Casework and Other Furnishings

B. Section 115343: Laboratory Service Fittings and Fixtures

C. Division 22: Plumbing

D. Division 23: HVAC

E. Division 26: Electrical

1.3 REFERENCES

A. Chemical fume hoods:

1. ASHRAE 110, Method of Testing Performance of Fume Hoods.

2. Conform to the recommended practices for laboratory fume hoods published by the Scientific Equipment and Furniture Association (SEFA) 1-2010.

1.4 DESCRIPTION

A. Provide equipment complete with accessories as described herein and shown on Laboratory Furnishings drawings.

B. Chemical fume hoods:

1. Fume hoods with accessories shall be pre-piped and pre-wired. Pre-pipe service fittings to single point connection at 6 inches (150 mm) above top of hood or as otherwise shown.

    a. Refer to Section 115343 and details on Laboratory Furnishings drawings for service fittings.

    b. P-trap, waste piping and tailpiece extensions for cupsinks shall be furnished and installed by Division 22. Comply with Division 22 requirements for piping and installation requirements for respective pre-piped services.

    c. Pre-wire all electrical devices to junction box at top of hood. Comply with Division 26 requirements for electrical work.

1.5 SUBMITTALS

A. Refer to the General Conditions and Division 1 “Submittal Procedures” for submittal requirements. In addition to these requirements, provide submittal requirements specified herein.

B. Submittal requirements:

1. Submittal shall be prepared individually for this specification section. Arrange product data, drawings and information for submission in a complete set for this specification section.

2. Submittal shall contain complete data for all items of this specification section. Periodic or partial submittals of individual components within this specification section will be returned as incomplete and rejected.

3. Submittals shall be organized by specification sequence with section and paragraph number identified.

4. Equipment and components being proposed shall be clearly labeled with all options and accessories indicated and shall be for this specific project. All non-applicable options, items and components shall be deleted or struck.

C. Materials List/Product Data: Submit complete materials list, including catalog data of all materials, equipment, and products for Work specified in this Section. Include chemical resistance finish performance test results for any products specified in this section.

D. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations, sections, details and schedules. Show relationship to adjoining materials

and construction. Shop Drawings shall be in the form of reproducibles or photocopies, not to exceed 11 inches x 17 inches (A3) in size. Blueline prints are not acceptable.

E. Submit detailed anchorage and attachment drawings and calculations provided by a licensed Structural Engineer complying with the International Building Code Earthquake Regulations and the California Code of Regulations, Title 24 Seismic Restraint requirements.

F. Samples: Submit two (2) samples of each type of specified finish and color range available.

G. Test Reports: Submit the following performance test reports.

1. "As Manufactured" (AM) Fume Hood Testing in Manufacturing Facility: Provide certification that each type and size of fume hood has passed Flow Visualization and Face Velocity tests, and achieved an AM performance rating equal or better than 0.05 ppm with 4.0 Lpm tracer gas release rate when tested in accordance with ASHRAE 110-1995.

2. Fume Hood Sound Level Certification: Provide certification of fume hood compliance with design criteria for maximum allowable noise within laboratories.

a. At project design operating conditions for sash height and face velocity, test data of octave band analysis verifying hood is capable of a 50 NC or lower value when connected to a 50 NC (minimum) HVAC source. Measurements shall be taken 36 inches (915 mm) in front of open sash.

3. Fume Hood Certification: Submit "As Installed" (AI) test report as described elsewhere in this section.

H. Operations/Maintenance Manuals: Submit under provisions of Section 017800. Submit for Owner's use, complete operating and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, component parts list, and closest factory representative for components and service.

1.6 QUALIFICATIONS

A. Work in this Section shall be performed by a firm having a minimum eight years documented experience, and an established organization and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment required with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have

the demonstrated knowledge, ability and the proven capability to produce the specified equipment of the required quality and the proven capacity to complete an installation of this size and type within the required time limits.

1.7 COORDINATION

A. Work of this Section requires close coordination with Work of Divisions 22, 23 and 26 as well as Work specified in other Sections. Sequence all Work to ensure an orderly progress in the project without removal of previously installed Work and so as to prevent damage to finishes and products.

B. Coordinate, furnish, and install chemical fume hoods designed for variable air volume (VAV) or constant air volume (CAV) operation as indicated in the mechanical drawings. The designed exhaust airflow control method (VAV or CAV) shall be confirmed and coordinated prior to submission and shall be clearly indicated in the submittal product documentation.

1.8 SUBSTITUTIONS

A. Approved Substitution/Approved Equal: In addition to the items required in Division 1, all substitution requests shall include item-by-item comparison of the proposed substitution to this project specification. A copy of the project specification shall be submitted, with each item and subsection of the project specification marked as “Comply” or “Not Comply.” In any cases where “Not Comply” is indicated, an explanation of the relative advantages of the proposed design shall be provided.

B. Substitution shall not affect dimensions shown on Drawings.

C. The Contractor shall pay for changes to the building design, including engineering design, detailing, utility and service requirements, and construction costs caused by the requested substitution.

D. Substitutions shall have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

E. Maintenance and service parts shall be locally available for the proposed substitution.

1.9 WARRANTY

A. Refer to the General Conditions and Division 1 “Product Requirements” for warranty requirements. In addition to these requirements, all products will be warranted to be free from defects in materials and workmanship for a minimum period of one year following

substantial completion. The manufacturer/ dealer/ subcontractor shall repair or replace any products (or parts thereof) that are found to be defective. Replacement will include any parts, labor, shipping, and travel expenses involved.

PART 2 - PRODUCTS

2.1 ACCESSIBILITY FOR PERSONS WITH DISABILITIES

A. Where indicated on Laboratory Furnishings drawings, fume hoods shall be furnished and installed in a manner to make them accessible to persons with disabilities in accordance with the Americans with Disabilities Act and any state or local building code or regulation having jurisdiction. The height of the highest point of access to the work surface above finished floor shall not exceed 34 inches. Fittings for piped services and electrical receptacles and controls shall be of a design and in a location in order to be considered accessible.

2.2 CHEMICAL FUME HOODS

A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be provided by a single manufacturer.

1. Air Master Systems Corporation, 6480 Norton Center Drive, Muskegon, MI 49441 Tel: 231 798-1111.

2. CiF Lab Solutions L.P., 53 Courtland Avenue, Vaughan, ON Canada L4K 3T2 Tel: 905 738-5821.

3. Jamestown Metal Products, Inc., 178 Blackstone Avenue, Jamestown, NY 14701 Tel: 716 665-5313.

4. Kewaunee Scientific Corporation, P O Box 1842, Statesville, NC 28687 Tel: 704 873-7202.

5. Labconco Corporation, 8811 Prospect Avenue, Kansas City, MO 64132 Tel: 800 821-5525.

6. Mott Manufacturing Limited, 452 Hardy Road, P. O. Box 1120, Brantford, ON, Canada N3T 5T3 Tel: 519 752-7825.

7. Approved substitution.

B. Underwriters Laboratory Listing: Fume hoods shall be UL subject 1805 classified. Label shall be attached to the face of each fume hood indicating classification to the UL 1805 standard for Laboratory Fume Hoods.

C. Materials: The following materials shall be provided, unless superseded by the requirements listed below for specific fume hood types.

1. Steel:

a. ASTM A366 mild steel, furniture stock, cold-rolled, pickled, double annealed, and free from rust, scale, scratches, buckles, ragged edges, and other defects.

b. Minimum Thickness: 18 gauge (1.2 mm).

2. Stainless Steel:

a. Type 316, ASTM 240, with exposed surfaces ground and polished to a No. 4 finish.

b. Minimum Thickness: 16 gauge (1.6 mm).

c. Welding: All stainless steel welding material shall be of similar type to sheet material. Welds shall be made without discoloration, ground, polished, and passivated to blend with a No. 4 finish.

3. Liner and Baffle:

a. Typical: Glass-reinforced polyester panel, flame-retardant and self-extinguishing with smooth finish and white color. Flexural strength: 14,000 psi. Flame spread index of 0-25 when tested per UL 723 and ASTM E 84. Baffle shall be same material as liner. Liner thickness: 3/16 inch (4.76 mm); baffle thickness: ¼ inch (6.35 mm), minimum. Liner performance characteristics shall be as specified below.

b. For Radioisotope Hoods: 16 gauge stainless steel. Spot weld liner top to sides. Radius all vertical corners 1 inch maximum.

4. Glass: 7/32 inch (5.56 mm) laminated safety glass. Glass shall not be etched with manufacturer’s name, logo, or any other permanent markings, other than to identify the glass as safety glass. Light fixture lens may be tempered safety glass.

5. Sash guides: Extruded PVC.

6. Sash chains or belts are acceptable

   a. Sash chain: ANSI #35 steel, single strand. Average tensile strength of 2,400 pounds; maximum working load of 480 pounds.

      1). Pulley assembly for sash chain: Finish bored steel drive sprockets and keyed drive, 1/2-inch (12.7 mm) diameter front connector shaft. Rear idler sprockets; double sealed ball bearings type, lubricated. All sprockets steel with zinc dichromate finish.

   b. Sash belt: Two 1/2 inch wide stainless steel-reinforced polyurethane notched belts. Minimum tension cord strength of 840 N.

      1). Pulley assembly for sash belt: Cast aluminum sprocket mated to a steel shaft.

7. Sash pull: Steel with chemical resistant powder coating.

   a. Length: Full width of sash.

8. Gaskets: White 70 durometer PVC for interior access panels. Gasket interior access panels to eliminate air leakage and to retain liquids inside hood.

9. Gaskets: Provide PVC gasket at interior access panels to eliminate air leakage and retain liquids inside hood.

10. Fasteners:

    a. Exterior structural member attachments: Sheet metal screws, zinc plated.

    b. Interior fastening devices shall be concealed; exposed screws are not acceptable. (Screw head “caps” not acceptable).

    c. Exposed exterior fastening devices shall be corrosion-resistant, non-metallic material; exposed screws are not acceptable.

D. Construction:

1. Design: Fume hoods shall be designed for consistent and safe air flow through the hood face opening. Variations of face velocity shall not exceed ±20% of the average face velocity at any designated measuring point.

   a. Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for the design face velocity requirements for each type of fume hood.

2. Superstructure: Rigid, self-supporting assembly of double wall construction, maximum 4 7/8 inch (124 mm) thick. Wall shall consist of a sheet steel outer shell and a corrosion resistant inner liner, and shall house and conceal steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Panels shall be attached to a full frame construction, minimum 14 gauge (2.0 mm) galvanized members. Panels and brackets attached to eliminate screw heads and metallic bracketry from hood interior.

3. Access Panel: Access to fixture valves and piping concealed in wall shall be through flush access panels on the inside liner walls, or through removable front posts. Panels shall be secured with PVC extruded gasket or tamperproof, epoxy coated, countersunk, flat head screws providing a tight fit. Hook and loop type attachments and panels held by gravity are not acceptable.

4. Downdraft bypass: Low resistant type, 18 gauge (1.27 mm) steel chamber; directional louvers are not acceptable. All bypass air shall enter top of bypass chamber and enter hood in a downflow direction. Chamber shall protect user from expelled particulate in the event of an adverse internal reaction.

5. Baffles: Baffles shall be fixed and non-adjustable.

6. Ceiling Closure Panels: Panel shall include simple-to-operate means of access to the hood lighting fixture without the use of tools. Finish shall match superstructure exterior. Closure panel shall conceal view of the sash when the sash is in the open position. Provide sash pocket if required to allow correct operation of the bypass.

    a. Provide 18 gauge steel paneled enclosure from top of hood to 2 inches above the ceiling.

    b. At locations where there are no finished ceiling, Provide 18 gauge steel paneled enclosure from top of hood to 9’0”a.f.f.

7. Bypass Grille: Low-resistant type 18 gauge steel with upward directional louvers.

8. Trim and Side Panels: Provide matching steel trim and side panels, as required, to finish any openings around and between hoods. Finish shall match superstructure exterior.

9. Finished Back: Provide for any fume hood where back of hood is exposed to view. 18 gauge steel sheet. Finish shall match superstructure exterior.

10. Exhaust Duct Collar:

a. Construction: Provide Type 316L stainless steel, minimum 18-gauge, duct collar with 1-½-inch (38 mm) to 2-inch (50 mm) extension above top of fume hood with butt joint termination suitable for welding. Duct collar design shall be bell-mouthed for round or contoured design for rectangular to provide lower static pressure drop and improved noise performance. Duct collar shall be integral to fume hood construction, factory-installed, and welded or permanently sealed airtight to hood.

b. Configuration: For collar size and quantity, refer to Laboratory Equipment Exhaust Schedule on the Laboratory Furnishing drawings.

11. Exhaust Duct Transition Piece: Furnished by the fume hood manufacturer for installation by the mechanical contractor. Provide contoured Type 316L stainless steel, minimum 18-gauge, exhaust duct transition piece to connect to the fume hood exhaust duct collar and Laboratory exhaust duct system as shown on the Mechanical Drawings. Provide butt joint terminations suitable for welding. Note: Transition Piece is not required where hood exhaust duct collar has been provided per the Laboratory Equipment Exhaust Schedule.

12. Cup Sink:

a. Oval with raised rim, material and color to match work surface, sizes in accordance with drawings. Comply with Section 115343 requirements.

b. Raised Rim Height: ½ inch (12.7 mm).

13. Piping shall be as specified in Division 22 for respective system.

14. Service Fittings: As shown on Laboratory Furnishings Drawings and specified in Section 115343, factory-installed and complete with all gaskets, grommets and sleeves. No additional holes in fume hood side posts shall be provided for services beyond those required by the construction documents.

15. Alarm: Coordinate cut out for fume hood alarm to be provided under Division 23. All cut outs for alarm shall be made in the factory; field cutting is not acceptable.

a. Locate at 48 inches or below for all Accessible designated fume hoods.

16. Electrical:

a. Pre-Wiring: All fume hood electrical devices shall be factory-installed and wired to a junction box located on top of the hood. Comply with Division 26 requirements for electrical work.

1). Fume hood receptacles shall be wired such that no more than two duplex outlets and the hood lighting are wired through a single circuit.

b. Receptacles: Flush mounted, 125V / 20A / 60Hz duplex type, single gang, NEMA 5-20R, 3-wire, grounding type receptacle, one or two per side, or as indicated on the Laboratory Furnishings Drawings, with brushed stainless steel cover plate. Each side of the fume hood shall have a GFCI receptacle with feed-through protection of any downstream receptacles.

17. Interior Hood Lighting:

a. Lighting within the hood shall be provided by a UL approved, protected, vapor-proof, fluorescent light fixture with two lamps (32W T8, electronic ballast, rapid start) operated by an exterior switch with a stainless steel cover plate.

1). Lamp size shall not exceed 48 inches; provide multiple light fixtures for hoods wider than 72 inches.

b. Provide safety glass panel cemented and sealed to the hood roof.

c. Light level: Average light level on the work surface shall be 80 foot-candles, minimum.

18. Safety label: Provide self-adhesive polyester label, as described on the Laboratory Furnishing drawings. Labels shall indicate safe operating conditions with respect to fume hood sash position. Labels solely indicating 100 fpm face velocity sash position are not acceptable.

a. Manufacturer: Lab Safety Supply Inc., P.O. Box 1368, Janesville, WI 53547 Tel: 800 356-0783, or approved substitution.

b. Model No. 156.

19. Hood Finish: As specified elsewhere in this Section.

20. Exterior Color: As selected by Architect from manufacturer's full color line and complying with finish requirements.

21. Lattice Rod Assemblies: Provide where indicated on the drawings. Refer to Section 11 53 10.

22. Pass-through: Provide 3 inch I.D. pass-through in fume hood sidewall where indicated on the Laboratory Furnishing drawings. Pass-through shall be flanged and

sealed on the interior of the fume hood, with a threaded end and cap on the exterior.

23. Horizontal Safety Shield: Where indicated on the drawings, provide 16 ¼ inch (413 mm) wide, ¼ inch (6.35 mm) clear polycarbonate sheet suspended from above on stainless steel overhead rolling track (friction type not acceptable) designed for one finger operation. Provide rubber bumper stops for safety shields. Refer to fume hood schedule on Laboratory Furnishings drawings for size and quantity of safety shields.

24. Camera: Provide Ken-A-Vision model Video Flex 5400 Fume Hood Camera, or approved substitution. Holes shall be pre-drilled by the fume hood manufacturer, and minimized to prevent leakage. Camera shall be installed in the field on the side of the fume hood interior. Route camera USB cable inside the fume hood post to the top of the fume hood and connect to data/USB connection. Provide gasket or seal at all penetrations. Refer to Laboratory Furnishings drawings for fume hoods with cameras.

E. Bench Mounted Chemical Fume Hoods:

1. Style: General purpose.

a. Subject to compliance with the requirements listed below, acceptable models include:

1). Eliminator Series Fume Hoods by Air Master Systems Corporation.

2). APEX-Air GP Series by CiF Lab Solutions L.P.

3). Isolator Bench Fume Hood by Jamestown Metal Products, Inc.

4). Supreme LV Fume Hood by Kewaunee Scientific Corporation.

5). Protector XL Benchtop Laboratory Hood by Labconco Corporation.

6). Pro Restricted Bypass Bench Fume Hood by Mott Manufacturing Limited.

2. Exterior depth: 34 1/2 inches, maximum.

3. Interior depth: 23 1/2 inches clear at 1 inch above the work surface, minimum.

4. Design:

a. Restricted bypass fume hoods for variable air volume or constant volume exhaust systems with airfoil. Bypass shall be sufficient in size to allow 25% flow with sash closed. Bypass must be achieved through low resistance opening at top of front lintel panel. Bypass shall be designed to provide a smooth down flow effect.

b. Fume hoods shall be designed to operate safely at face velocities of 100 feet per minute (0.51 m/s) to 125 feet per minute (0.64 m/s).

5. Work Surface: 1 ¼ inch (32 mm) dished epoxy resin, in compliance with Section 115310 requirements. Color: Black.

6. Airfoil: The airfoil shall allow ample room for electrical hospital grade cords to fit beneath the airfoil. Sill must pivot forward to provide cord and trough access. Bottom horizontal foil shall provide nominal 1 inch (25.4 mm) bypass when sash is in the closed position. Bottom foil shall not be removable without use of special tools. Airfoil shall be steel with urethane or epoxy powder coating.

a. Sill shall consist of a half-round bullnose on front edge. The air foil and sill shall be flush with the height of the work surface; airfoil sills that are not flush with the top plane of the work surface dish are not acceptable. A secondary containment trough shall be located in front of the work surface and extend below the airfoil sill.

7. Fume hood sash (Vertical): Full-view, frameless type with clear, unobstructed, side-to-side view of fume hood interior and service fixture connections. Sash to have a 35 inch (890 mm), nominal, sight line.

a. Sash Opening: Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for vertical access height clearance.

b. Split Sashes: Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for the quantity of vertical rising sashes. At fume hoods where 2 vertical sashes are indicated, provide a sash guide that retracts when both sashes are raised. A fixed post between sashes is not acceptable.

c. Counter balance system: Single weight, counter balance system to prevent sash tilting and permit ease of operation at any point along full width pull. Maximum 7 pounds (3 kg) pull required to raise or lower sash throughout its full length of operating sash opening. Design system to hold sash at any

position without creep and to prevent sash drop in the event of suspension system failure.

d. Sash Opening: Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for vertical access height clearance.

e. Sash Stop: To allow manual override with automatic reset for an 18 inch (457 mm) sash opening. Either of the following devices are acceptable:

1). Corrosion-resistant, spring-loaded lever handle integrated with sash track and fume hood side post.

2). Stainless steel spring-loaded barrel-bolt integrated with sash pull and provided with angled stainless steel strike plate.

F. Finish Requirements

1. Preparation:

a. After the units have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish to the metal and to aid in the prevention of corrosion. Physical and chemical cleaning of the metal shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a heated cleaner/phosphate solution and pretreated with iron phosphate spray followed by a neutral final seal prior to application of final finish. The strength of each solution shall be monitored by filtration to insure consistent quality.

b. All treated parts shall be immediately dried in heated ovens and gradually cooled before application of the finish. Treated metal parts shall be clean and properly prepared to provide optimum adhesion of finish and resistance to corrosion.

2. Application: Electrostatically apply powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:

a. All surfaces, exterior or interior, exposed to view, shall receive sufficient powder coat to achieve an average 1.5 mil (38 µm) film thickness with a minimum 1.2 mil (30 µm) film thickness and shall have smooth satin luster.

b. Backs of cabinets and other surfaces not exposed to view shall have sufficient powder coat to achieve an average 1.0 mil (25 µm) film thickness.

c. Concealed interior parts shall receive corrosion-resistant treatment.

d. Stainless steel parts and surfaces shall not be powder coated.

3. Chemical Resistance Finish Performance Requirements:

a. Test Procedure: Apply 10 drops (approximately 0.5 cubic centimeters) of each reagent identified to the surface of the finished test panels laid flat and level on a horizontal surface. Ambient temperature: 68°F to 72°F (20°C to 22°C). After one hour flush away chemicals with cold water and wash surface with detergent and warm water at 150°F (65.5°C) and with alcohol to remove surface stains. Examine surface under 100 foot-candles (1076 lux) of illumination.

b. Evaluation Ratings: Change in surface finish and function shall be described by the following ratings:

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

4. Performance requirements: Test results for powder coat finish shall equal or exceed the following:

Reagent	% by weight	Rating
Acetic acid	50%	1
Acetic acid, glacial	98%	1
Acetone	50%	2
Ammonium hydroxide	25%	1
Amyl acetate		1
Benzene		1
Butyl alcohol		1
Carbon tetrachloride		1
Cresol		1
Dimethyl formamide		2
Dioxane		2
Ethyl alcohol		1
Ethyl acetate		2
Ethyl ether		1
Formaldehyde		1
Furfural		2
Gasoline		1
Glycerin		1
Hydrochloric acid	10%	1
Hydrochloric acid	20%	1
Hydrochloric acid	37%	1
Hydrofluoric acid	48%	2

Reagent	% by weight	Rating
Hydrogen peroxide	30%	1
Kerosene		2
Methyl alcohol		1
Methyl ethyl ketone		2
Monochlorobenzene		1
Naphthalene (dissolved in Toulene)		2
Nitric acid	10%	1
Nitric acid	30%	1
Phenol	85%	2
Phosphoric acid	25%	1
Phosphoric acid	75%	1
Potassium hydroxide	45%	1
Silver nitrate (10% aqueous solution)		1
Sodium carbonate, saturated		1
Sodium chloride, saturated		1
Sodium hydroxide	40%	1
Sodium hydroxide	50%	1
Sodium hypochlorite	5.25%	1
Sodium sulfide, saturated		1
Sulfuric acid	50%	1
Sulfuric acid	70%	1
Tincture of Iodine		2

Reagent	% by weight	Rating
Toulene		1
Trichloroethylene		2
Xylene		1
Zinc chloride, saturated		1

Note: Maximum concentration is to be understood unless a lower concentration is shown in the table.

a. Physical Tests:

1). Abrasion: Finish shall have high abrasion resistance with maximum weight loss of 5.5 mg per 100 cycles as tested on a Taber Abrasion Tester No. E40101 with 1000 gm wheel pressure and Calibrase No. CS10 wheel.

2). Hardness: Finish shall have surface hardness equivalent to 4H or 5H pencil lead.

3). Humidity: Finish shall withstand 1000 hours exposure in saturated atmosphere at 100°F (38°C).

4). Moisture: Finish shall withstand the following procedures with no visible effect:

a). Boiling water flowing over 45 degree inclined surface for 5 minutes.

b). 100 hours continuous contact with water-soaked cellulose sponge, maintained in a wet condition throughout test.

5). Adhesion: Finish shall withstand the following test procedure with at least 95 squares maintaining their finish. Using a razor blade, score the finish surface of the test panel through to the substrate with a pattern of 100 squares, each 1/16 inch x 1/16 inch. Brush away loose particles with a soft brush.

6). Salt spray: Finish shall withstand 200 hours exposure to salt spray test.

G. Fume Hood Liner Test: Polyresin

1. Test No. 1: Spills and Splashes:

   a. Suspend a 42 inches (1067 mm) x 12 inches (305 mm) panel (42 inch (1067 mm) dimension horizontal) in a position to expose the surface to be tested in a vertical plane. Divide the panel vertically into 3/4 inch (19 mm) spaces.

   b. Using an eyedropper, apply five drops of each reagent as listed.

   c. Liquid reagents shall be applied at the top of the panel and permitted to flow down full panel height. (CAUTION! Flush away any reagent drops.)

2. Test No. 2: Fumes and Gases:

   a. Prepare a panel 24 inches (610 mm) x 12 inches (305 mm) by dividing panel into 2 inch (51 mm) squares. Using 100 ml beakers, place 25 ml (approximately 1/2 inch (13 mm) of reagent) into each beaker. Place beakers in position so that test panel may be placed over beaker tops in the proper sequence. Place panel over beakers. Note: Beaker pouring lip permits atmospheric oxygen to enter and participate in the reaction of the reagent fumes.

   b. After a 24 hour time period has elapsed, remove panel, flush off with water, clean with naphtha and detergent, rinse and wipe dry. Evaluate.

3. Evaluating Ratings:

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

4. Performance: Test results shall equal or exceed the following:

Reagent	% by wt.	Spills	Fumes
Acetic acid, glacial		0	0
Acetone		0	0
Acid dichromate		1	1
Ammonium hydroxide	28%	0	0
Amyl acetate		0	0
Benzene		0	0
Butyl alcohol		0	0
Carbon tetrachloride		0	0
Chloroform		0	0
Chromic acid, saturated		3	0
Cresol		0	0
Dichloro acetic acid	93%	0	0
Dimethyl formamide		0	0
Dioxane		0	0
Ethyl acetate		0	0
Ethyl alcohol		0	0
Ethyl ether		0	0
Formaldehyde	37%	0	0
Formic Acid	88%	0	0
Furfural		2	0
Gasoline		0	0
Hydrochloric acid	48%	1	1

Reagent	% by wt.	Spills	Fumes
Hydrofluoric acid	37%	0	0
Hydrogen peroxide	30%	0	0
Methyl alcohol		0	0
Methyl ethyl ketone		0	0
Methylene chloride		0	0
Monochlorobenzene		0	0
Naphthalene		0	0
Nitric acid	20%	0	0
Nitric acid	30%	0	0
Nitric acid	70%	0	0
Phenol	85%	0	1
Phosphoric acid	85%	1	0
Silver Nitrate	10%	1	0
Sodium Hydroxide	10%	1	0
Sodium Hydroxide	20%	1	0
Sodium Hydroxide	40%	1	0
Sodium Hydroxide Flake		0	0
Sodium Sulfide, saturated		2	1
Sulfuric acid	33%	1	0
Sulfuric acid	77%	1	0
Sulfuric acid	93%	1	0
Sulfuric acid/Nitric acid, equal parts	77%/70%	0	1

Reagent	% by wt.	Spills	Fumes
Tincture of Iodine		0	2
Trichloroethylene		0	0
Toluene		0	0
Xylene		0	0
Zinc Chloride		0	0

Note: Maximum concentration is to be understood unless a lower concentration is shown in the table.

2.3 CLEAN ROOM FUME HOODS (ACID)

A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.

1. NuAire, Inc., 2100 Fernbrook Lane, Plymouth, MN 55447 Tel: 800 328-3352.

2. Approved substitution (no known equal).

B. Style: Vertical laminar flow polypropylene fume hood, console type with vented base storage cabinets, appropriate for trace metals analysis; designed for personnel and product protection.

1. Design:

a. Single pass flow through (total exhaust) in which all HEPA filtered downflow work zone air and open sash inflow air is drawn into an exhaust plenum under the work surface via front perforated grilles and rear wall exhaust baffles. All exhausted air is collected and routed up a rear duct/exhaust ductwork for connection to the laboratory exhaust air system.

C. Basis for design: NuAire FumeGard NU-156, or equal, as specified herein.

1. Interior Depth: 30 inches (760 mm).

a. 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.

1). Fume hoods shall be designed to operate safely at face velocities of 100 feet per minute (0.51 m/s) for an 18 inch (457 mm) sash opening.

2. Materials:

a. Polypropylene: 100%, flame retardant, stress-relieved, white polypropylene with seam welded construction unless otherwise noted.

1). Sink for pure water use shall be constructed of stress-relieved, white polypropylene with seam welded construction (without flame retardant additives).

b. Viewscreen: ¼ inch polycarbonate with Marguard. Viewscreen shall not be etched with manufacturer's name, logo, or any other permanent markings.

c. Fasteners: All exposed fasteners shall be non-metallic.

3. Construction:

a. Exposed surfaces shall be metal-free construction.

b. The cabinet shall be constructed to permit maintenance to be performed from the front of the cabinet.

c. Shell and base cabinet:

1). Fully seam welded ½ inch (12.7 mm) polypropylene, with flush access panels, and ¼ inch (6.35 mm) polypropylene doors.

2). Base storage cabinets shall be an integral part of the cabinet construction with hinged swing door access. Provide pull-out fully welded storage tray with heavy duty corrosion resistant glides.

3). Provide a plenum under the work surface constructed of ½ inch polypropylene and sloped toward the rear to effect 100% drainage. A ½ inch polypropylene ball valve shall be provided to drain the plenum into the base cabinet large storage area for continuation to laboratory waste/vent system. Vent tubes shall be provided from the storage area to the exhaust plenum.

4). All cabinet seals/access panels and positive pressure plenums shall be held at vacuum or be surrounded by a vacuum under all operating conditions to absolutely preclude leaks to the ambient.

5). Access Panels: Flush access panels of ¼ inch (6.35 mm) polypropylene shall be provided for service access to piping, and sash components. Access panels shall be attached with non-metallic fasteners.

6). Provide leg levelers.

d. Fume hood sash (Vertical): Full-view, frameless type with clear, unobstructed, side-to-side view of fume hood interior and service fixture connections.

1). Counter balance system: Single PVC weight, polypropylene cable (rope) and PVC pulleys, counter balance system to prevent sash tilting and permit ease of operation at any point along full width pull. Maximum 7 pounds (3 kg) pull required to raise or lower sash throughout its full length of operating sash opening. Design system to hold sash at any position without creep and to prevent sash drop in the event of suspension system failure.

2). Sash Opening: Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for vertical access height clearance.

3). Sash Stop: To allow manual override with automatic reset for an 18 inch (457 mm) sash opening.

4). Airfoil: Sill shall be radiused or chamfered on front edge.

e. View screen:

1). PVC screen wiper.

f. Work surface: See details for work deck segment types.

1). Perforated ½ inch polypropylene, removable.

2). Solid, ½ inch polypropylene, removable except where a sink is installed.

4. Ventilation:

a. HEPA Filter/Blower:

1). Provide polypropylene blower/HEPA filter module. Blower shall have PTFE-coated, backward-inclined, high-capacity, motorized impeller, including PTFE hardware.

2). Provide PVC supply diffuser.

3). The blower/motor shall automatically compensate for airflow as the filter loads with particulate to achieve a fan delivery fall off of no more than10 percent for an 80 percent increase in pressure drop across the filter.

4). Filter:

a). Metal-free (ie. no aluminum) separatorless supply 99.99% effective HEPA filter at 0.3 µm particles.

b). Filter shall be front-loading without requiring viewscreen removal.

b. Exhaust Collar: Provide ¼ inch (6.35 mm) round polypropylene exhaust collar with ANSI pattern bold flange, including transition piece if necessary, to connect to circular exhaust duct by Division 23.

c. Exhaust: Refer to Exhaust Schedule on drawings.

5. Piped Services and Fixtures:

a. Piping: All piping lines shall be housed in a plumbing chase formed by the outer cabinet wall and inter-cabinet work space. Piping material shall be as specified for the respective systems under Division 22. Piping shall be pre-piped to a point of connection 6 inches above the hood.

b. PFA Tubing System: Except for the general service sink drains and for plenum drains, all process utilities (both high-purity and non-rated services) shall be distributed from point-of-service connection to point-of-use in 100% virgin, high purity, high molecular weight, Teflon PFA (perfluoroalkoxy resin) tubing, fittings and connectors, which conform to ASTM D3307.

6. Service Fittings: Factory-installed and complete with all gaskets, grommets and sleeves.

a. Sink: Pure water gooseneck and needle control valve shall be PVDF, PFA, or PTFE wetted parts.

b. DI Spray Gun: Non-recirculating design; PFA or PTFE wetted parts; ¼-inch coiled PFA tubing; Entegris or equal.

c. Nitrogen Spray Gun: ¼-inch coiled PFA tubing; RFA, PTFE, and polyethylene wetted parts with replaceable 0.5 micron PTFE filter membrane; Entegris or equal.

7. Control/Alarm Panel:

a. Cabinet controls shall be mounted at eye level in a single, easily removable control panel.

b. Alarm: Coordinate location for fume hood alarm to be provided under Division 23. All necessary cut outs for alarm shall be made in the factory; field cutting is not acceptable.

c. Control Features (minimum requirements):

1). Blower motor switch.

2). Reset switches for circuit breakers (receptacles and blower).

3). Adjustable motor speed control.

4). Light switch.

8. Electrical:

a. Electrical Junction Box: Provide PVC electrical junction box at the top of the hood.

b. General:

1). Electrical distribution shall be designed for 208vac/3-phase/30-amp supply circuit to be distributed to individual electrical circuits specified herein. Each circuit shall have separate protection with a circuit breaker.

2). Cabinet shall be internally wired with the following circuits (minimum requirements):

a). One circuit for the blower motor(s) and lighting.

b). One 120vac/1-phase/20-amp circuit for the electrical receptacles.

c). One 120vac/1-phase/20-amp spare circuit for future Owner installed equipment.

c. Electrical Receptacles:

1). Receptacles shall have a non-metallic, corrosive resistant, vapor tight gasketed cover, sealed in place with a gasketed screw, and have removable plastic insert to seal outlet contacts when not in use.

d. Interior Hood Lighting:

1). Lighting within hood shall be provided by a serviceable, UL approved, protected LED light fixture with two lamps operated by an exterior switch with non-metallic cover plate. Lamp size shall not exceed 48 inches; provide multiple fixtures as required.

2). Provide Lexan® panel cemented and sealed to the hood roof. Panel shall have amber/gold UV filter to filter wavelengths below 500nm.

3). Light level: Average light level on the work surface shall be 80 foot candles (860 lux), minimum.

9. Safety label: Provide self-adhesive polyester label, as described on the drawings. Labels shall indicate safe operating conditions with respect to fume hood sash position. Labels solely indicating 100 fpm face velocity sash position are not acceptable. Manufacturer: Lab Safety Supply Inc., P. O. Box 1368, Janesville, WI 53547 Tel: 800 356-0783, or approved substitution.

D. Required Options:

1. Magnehelic gauge to monitor supply filter.

2. Seismic restraints.

2.4 CLEAN ROOM FUME HOODS (SOLVENT)

A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.

1. NuAire, Inc., 2100 Fernbrook Lane, Plymouth, MN 55447 Tel: 800 328-3352.

2. Approved substitution (no known equal).

B. Style: Vertical laminar flow polypropylene fume hood, console type with vented base storage cabinets; designed for personnel and product protection.

1. Design:

a. Single pass flow through (total exhaust) in which all HEPA filtered downflow work zone air and open sash inflow air is drawn into an exhaust plenum under the work surface via front perforated grilles and rear wall exhaust baffles. All exhausted air is collected and routed up a rear duct/exhaust ductwork for connection to the laboratory exhaust air system.

C. Basis for design: NuAire NU-S121, or equal, as specified herein.

1. Interior Depth: 30 inches (760 mm).

a. 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.

1). Fume hoods shall be designed to operate safely at face velocities of 100 feet per minute (0.51 m/s) for an 18 inch (457 mm) sash opening.

2. Materials:

a. Stainlesss steel fully welded construction. 316L Stainless steel for work deck. 304 stainless steel elsewhere.

b. Viewscreen: ¼ inch polycarbonate with Marguard. Viewscreen shall not be etched with manufacturer's name, logo, or any other permanent markings.

c. Fasteners: All exposed fasteners shall be stainless steel

3. Construction:

a. The cabinet shall be constructed to permit maintenance to be performed from the front of the cabinet.

b. Shell and base cabinet:

1). Base storage cabinets shall be an integral part of the cabinet construction with hinged swing door access. Provide pull-out fully welded storage tray with heavy duty corrosion resistant glides.

2). Provide a plenum under the work surface constructed of stainless steel and sloped toward the rear to effect 100% drainage. A ½ inch ball

valve shall be provided to drain the plenum into the base cabinet large storage area when needed. Drain shall not be permanently plumbed for drainage to building systems. Vent tubes shall be provided from the storage area to the plenum.

3). All cabinet seals/access panels and positive pressure plenums shall be held at vacuum or be surrounded by a vacuum under all operating conditions to absolutely preclude leaks to the ambient.

4). Access Panels: Flush access panels of shall be provided for service access to piping, and sash components. Access panels shall be attached with fasteners.

5). Provide leg levelers.

c. Fume hood sash (Vertical): Full-view, frameless type with clear, unobstructed, side-to-side view of fume hood interior and service fixture connections.

1). Counter balance system: Single weight, cable (rope) and pulleys, counter balance system to prevent sash tilting and permit ease of operation at any point along full width pull. Maximum 7 pounds (3 kg) pull required to raise or lower sash throughout its full length of operating sash opening. Design system to hold sash at any position without creep and to prevent sash drop in the event of suspension system failure.

2). Sash Opening: Refer to the Laboratory Equipment Exhaust Schedule on the Laboratory Furnishings drawings for vertical access height clearance.

3). Sash Stop: To allow manual override with automatic reset for an 18 inch (457 mm) sash opening.

4). Airfoil: Sill shall be radiused or chamfered on front edge.

d. View screen:

1). PVC screen wiper.

2). Access Opening Alarm: Provide audible alarm to sound when viewscreen is opened above 12 inches (130 mm).

e. Work surface: See details for work deck segment types.

1). Perforated 316L stainless steel, removable.

2). Solid, 316L stainless steel, removable.

4. Ventilation:

a. HEPA Filter/Blower:

1). Provide blower/HEPA filter module. Blower shall have PTFE-coated, backward-inclined, high-capacity, motorized impeller, including PTFE hardware.

2). Provide stainless steel supply diffuser.

3). The blower/motor shall automatically compensate for airflow as the filter loads with particulate to achieve a fan delivery fall off of no more than10 percent for an 80 percent increase in pressure drop across the filter.

4). Filter:

a). Separatorless supply 99.99% effective HEPA filter at 0.3 µm particles.

b). Filter shall be front-loading without requiring viewscreen removal.

b. Exhaust Collar: Provide ¼ inch (6.35 mm) round polypropylene exhaust collar with ANSI pattern bold flange, including transition piece if necessary, to connect to circular exhaust duct by Division 23.

c. Exhaust: Refer to Exhaust Schedule on drawings.

5. Piped Services and Fixtures:

a. Piping: All piping lines shall be housed in a plumbing chase formed by the outer cabinet wall and inter-cabinet work space. Piping material shall be as specified for the respective systems under Division 22. Piping shall be pre-piped to a point of connection 6 inches above the hood.

b. PFA Tubing System: Except for the general service sink drains and for plenum drains, all process utilities (both high-purity and non-rated services) shall be distributed from point-of-service connection to point-of-use in 100% virgin,

high purity, high molecular weight, Teflon PFA (perfluoroalkoxy resin) tubing, fittings and connectors, which conform to ASTM D3307.

6. Service Fittings: Factory-installed and complete with all gaskets, grommets and sleeves.

   a. Nitrogen Spray Gun: ¼-inch coiled PFA tubing; RFA, PTFE, and polyethylene wetted parts with replaceable 0.5 micron PTFE filter membrane; Entegris or equal.

7. Control/Alarm Panel:

   a. Cabinet controls shall be mounted at eye level in a single, easily removable control panel.

   b. Alarm: Coordinate location for fume hood alarm to be provided under Division 23. All necessary cut outs for alarm shall be made in the factory; field cutting is not acceptable.

   c. Control Features (minimum requirements):

      1). Blower motor switch.

      2). Reset switches for circuit breakers (receptacles and blower).

      3). Adjustable motor speed control.

      4). Light switch.

8. Electrical:

   a. Electrical Junction Box: Provide PVC electrical junction box at the top of the hood.

   b. General:

      1). Electrical distribution shall be designed for 208vac/3-phase/30-amp supply circuit to be distributed to individual electrical circuits specified herein. Each circuit shall have separate protection with a circuit breaker.

      2). Cabinet shall be internally wired with the following circuits (minimum requirements):

         a). One circuit for the blower motor(s) and lighting.

b). One 120vac/1-phase/20-amp circuit for the electrical receptacles.

c). One 120vac/1-phase/20-amp spare circuit for future Owner installed equipment.

c. Electrical Receptacles:

1). Receptacles shall have a non-metallic, corrosive resistant, vapor tight gasketed cover, sealed in place with a gasketed screw, and have removable plastic insert to seal outlet contacts when not in use.

d. Interior Hood Lighting:

1). Lighting within hood shall be provided by a serviceable, UL approved, protected LED light fixture with two lamps operated by an exterior switch with non-metallic cover plate. Lamp size shall not exceed 48 inches; provide multiple fixtures as required.

2). Provide Lexan® panel cemented and sealed to the hood roof. Panel shall have amber/gold UV filter to filter wavelengths below 500nm.

3). Light level: Average light level on the work surface shall be 80 foot candles (860 lux), minimum.

9. Safety label: Provide self-adhesive polyester label, as described on the drawings. Labels shall indicate safe operating conditions with respect to fume hood sash position. Labels solely indicating 100 fpm face velocity sash position are not acceptable. Manufacturer: Lab Safety Supply Inc., P. O. Box 1368, Janesville, WI 53547 Tel: 800 356-0783, or approved substitution.

D. Required Options:

1. Magnehelic gauge to monitor supply filter.

2. Seismic restraints.

2.5 FUME EXTRACTOR ARMS (SNORKELS)

A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be provided by a single manufacturer.

1. Alsident System represented by Laboratory Enterprises, 3122 Brinkerhoff Road, Kansas City, KS 66115 Tel: 913 621-7337.

2. Movex Inc., 104 Commerce Drive, Suite C, Northampton, PA 18067 Tel: 610 440-0478.

3. Nederman Inc., 39115 West Warren Road, Westland, MI 48185 Tel: 800-575-0609.

4. Approved substitution.

B. Models: Subject to compliance with the requirements listed below, acceptable models include:

1. System 75 by Alsident System.

2. Terfu by Movex Inc.

3. FX Extractor Arms by Nederman Inc.

C. Type: Ceiling mounted, self-supporting fume extractor arm.

D. Characteristics:

1. Extractor Arm Diameter:

a. 4 inch diameter tubes.

2. Extractor Arm Material:

a. Anodized aluminum.

3. Arm Length: Arms shall be of sufficient length to cover an 18 inch radius area at 48 inches above the finished floor.

a. Assembly shall be positioned so that no component is lower than 90 inches above the finished floor.

4. Swivel Assembly: Hi-grade cast aluminum with 360 degree rotation.

5. Joints: Friction joints with ball bearings and O-ring.

a. Provide external, corrosion-resistant adjustment knobs.

6. Hood (ESD): 10 inch diameter, anodized aluminum (ESD).

7. Ceiling mounted stanchion/bracket for attachment to structure above.

8. Escutcheon suitable to trim any ceiling penetrations.

9. Final connection to the fume exhaust duct system under Division 23. Provide airflow per Equipment Exhaust Schedule.

10. Dampers are not acceptable and shall not be provided.

2.6 GAS SAFETY CABINET

A. Manufacturers: Products, which comply with this specification section as judged and approved by the Owner's representative, may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.

1. Applied Energy Systems, Inc., Malvern, PA 19355 Tel: 610 647-8744.

2. Matheson Tri-Gas, 2200 Houston Avenue, Houston, TX 77007 Tel: 713 869-7351.

3. Praxair, Inc., Oak Brook, IL 60521-2216 Tel: 800 772-9247.

4. Scott Specialty Gases, Inc., Plumsteadville, PA 18949-0310 Tel: 215 766-8861.

5. Spectra Gases, Inc., Irvington, NJ 07111 Tel: 800 932-0624.

6. Approved substitution.

B. Design:

1. Purpose-designed cylinder gas system cabinet with space for systems that provide precise control and purge gas cylinder for total purging capability.

2. Fire protection:

a. UL approved sprinkler system.

3. Door(s): Full-height, self-closing and self-latching door with air intake located at bottom.

4. Air intake: Intake shall provide sufficient free area to limit the total air static pressure drop to 0.5 inches w.c. or less, and limit the noise at the air inlet to 45 NC measured at 36 inches.

5. Window: 1-hour fire rated approved, ¼-inch wire reinforced safety glass.

6. Cabinet shall be securely braced to fixed structure. Individual cylinders shall be braced to cabinet.

7. Door lock: Cabinet shall be equipped with a keyed lock. All gas safety cabinets shall be keyed alike. Furnish two sets of keys for each cabinet.

8. Venting: Provide 6 inch diameter duct exhaust collar for connection to exhaust duct system. Connection to exhaust duct system shall be under Division 23.

9. Codes and Standards:

   a. Cabinet shall comply with national and local building and fire codes and OSHA, NFPA and SEMI standard requirements for the safe handling of hazardous gases.

   b. Cabinet shall meet Article 80 UFC requirements.

   c. All electrical components shall meet Class 1 Division 2 requirements.

10. Accessories

   a. Seismic tie-down kit

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to installation of the Work of this Section, carefully inspect the installed Work specified in other sections and verify that all such Work is complete to the point where this installation may properly commence.

B. Verify that all Work has been installed in complete accordance with the original design, received submittals, and the manufacturer's recommendations.

C. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Work in this Section requires close coordination with Work specified in Division 22, Division 23 and Division 26, as well as installation by Owner of Owner furnished components. Coordinate all Work to ensure an orderly process in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products.

B. Coordinate location and alignment of fume hoods and cabinets for proper connection of all piping and duct work.

C. Install all equipment in accordance with applicable codes and regulations, accepted Shop Drawings, and as necessary for a complete operating system.

3.3 FIELD TESTING

A. Chemical Fume Hoods:

1. Fume hood field tests shall be performed by a qualified independent testing company on each hood.

2. All laboratory supply, general exhaust, and fume exhaust HVAC systems shall be operational during testing.

3. Test and certify each fume hood in accordance with ASHRAE Standard 110-1995 for Section 6.1 Flow Visualization, Section 6.2 Face Velocity Measurements, Section 6.3 Test Method for VAV Fume Hoods, Section 6.4 VAV Response Test, and Section 7 Tracer Gas Test Procedure testing requirements.

4. Flow Visualization: Fume hood shall provide complete containment of the smoke generated within the hood.

5. Face Velocity Measurements: Fume hoods shall be tested at the design operating condition sash opening height indicated in the Chemical Fume Hood Schedule.

a. Fume hoods shall achieve the scheduled design operating condition average face velocity within ±5 fpm.

b. Individual face velocity readings shall not vary by more than 20% of the mean between measurement grid locations.

6. Test Method for VAV Fume Hoods (Not Applicable to CAV Hoods): Perform this test to confirm VAV controls are properly calibrated. Average and individual face velocity reading should meet the performance criteria indicated for Section 6.2 Face Velocity Measurements above.

7. VAV Response Test (Not Applicable to CAV Hoods): Perform this test to verify VAV controls are responding accurately to the opening of the fume hood sash. The time it takes from the start of the sash movement until the face velocity stabilizes shall be less than 5 seconds.

8. Tracer Gas Test Procedure: Fume hoods shall achieve an As-Installed (AI) performance rating equal or better than 0.10 ppm with 4.0 Lpm tracer gas release rate.

9. Cross Drafts: Fume hood testing shall also include measuring and documenting the vertical and horizontal cross-drafts at the face of the hood. Cross-drafts shall not exceed half of the fume hood face velocity.

10. Balancing of the HVAC systems is in the scope of work of Division 23.

3.4 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as approved by the Architect upon completion of installation.

B. Adjust all moving or operating part to function within their design parameters.

C. Clean equipment, touch up as required.

D. Protect all units before, during, and after installation. Damaged materials due to improper protection shall be cause for rejection.

END OF SECTION