SECTION 11 53 00 - LABORATORY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
   1. *Uniform General Conditions for Construction Contracts*, State of Texas, 2010 (UGC).
   2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction.*

1.2 SUMMARY

A. Section includes:

   1. Bench mounted fume hoods.

   2. Radioisotope fume hoods.

   3. Fume hood work surface.

   4. Fume hood base cabinet.

   5. Cupsinks in fume hoods.

   6. Water, laboratory gas, and electrical service fittings and fixtures in fume hoods.

   7. Face Velocity Monitor for Constant Volume fume hoods.

   8. Face Velocity Control System User Interface for Variable Air Volume fume hoods.

   9. Accessories and safety signage.

   10. Fume hood commissioning.

B. Related Requirements:
   1. Division 12 30 00 Section "Laboratory Casework" for casework, work surfaces, and service fittings and fixtures.

2. Division 15 – Mechanical: Plumbing Piping.
3. Division 15 – Mechanical: Plumbing Fixtures.
4. Division 15 – Mechanical: Exhaust Ducts; connection from fume hood duct collar to building exhaust system.
5. Division 15 – Mechanical: Exhaust Blowers.
6. Division 16 – Electrical: Final hook up of the fume hood to power.

1.3 ALLOWANCES

Include products and work included in this Section that are covered by cash or quantity allowance. Do not include amounts. Insert descriptions of items in Part 2 or 3 to provide information affecting the cost of the Work that is not included under the allowance.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] .

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer's catalog data, specification sheets, and product manuals.

B. Shop Drawings:

1. Submit shop drawings for fume hoods showing the following:

a. Plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto.

b. Details and location of anchorages, fittings, scribes, and filler panels to floors, walls, fume base cabinets, and base.

c. Layout of units with relation to surrounding walls, doors, windows, lighting and air conditioning fixtures, and building components.

d. Connection to hood exhaust system; location of access doors, cutoff valves, and junction boxes.

e. Coordinate shop drawings and other work involved.

f. Indicate in-wall blocking and rough-in requirements for coordination with other trades.

g. Face openings, air volume, and static pressure drop.

C. Samples for Verification: Samples will be reviewed for color, texture, and pattern only.

1. Hood enclosure: 6 x 6 inch, two samples of each color specified.

2. Front panel: 6 x 6 inch, two samples of each color specified.

3. Liner: 6 x 6 inch, two samples of each material and color specified.

4. Operation signage: One actual size sample of each sign.

D. Certificates : .
1. Certify compliance with ASHRAE Std 110 for each model provided.
2. Certify that fume hoods meet the performance requirements specified herein.

E. Operation Data : Submit two copies of operating and maintenance instructions for each fume hood, provided in booklet form providing information on adjustment, operation, and maintenance of hoods.

1.6 QUALITY ASSURANCE

A. Source Limitations: Provide all laboratory fume hoods, and accessories through one source from a single manufacturer.

B. Fume Hood Standard: Provide fume hoods complying with the requirements of SEFA 1, “Laboratory Fume Hoods – Recommended Practices”.

C. Provide factory testing of each type of fume hood specified to demonstrate fume hood performance. Provide testing facility, instruments, equipments, and materials needed for tests.

D. Maintain testing facility at manufacturer’s place of business for testing and evaluating laboratory fume hoods under both ideal and adverse conditions, in accordance with ASHRAE Std 110.

E. Make manufacturing facility, testing facility, and quality control procedures available for Owner inspection.

F. Manufacturer Qualifications:
1. Minimum five years of manufacturing fume hoods as a principal product.
2. Ten installations of equal or larger size and requirements.

G. Installer Qualifications:
1. Factory certified by manufacturer.
2. Ten installations of equal or larger size requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fume hoods, work surfaces, and accessories free of damage.

B. Ship fume hoods disassembled to fit easily through corridors and doorways at the site.

C. Store and handle in a manner to prevent damage to fume hoods, work surfaces, accessories, or adjacent work.

1.8 PROJECT CONDITIONS

A. Coordinate fume hood and service fitting installation with size, location and installation of service utilities.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Rooms in which fume hoods are to be installed shall be broom clean.

1.9 WARRANTY

A. Special Project Warranty: Provide special project warranty, signed by Contractor, Installer, and Manufacturer, agreeing to replace, repair, or restore defective materials and workmanship of laboratory fume hoods during warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the terms and conditions of the Contract Documents.

B. Warrant against defects in materials and workmanship on fume hoods, work surfaces, and accessories; include labor and replacement parts (except lamps).

C. Warranty Period: One year from date of substantial completion or two years from date of purchase, whichever is sooner.

D. Provide a five year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 - PRODUCTS

2.1 PRODUCT OUTLINE

A. General Purpose Fume Hood, General Purpose Fume Hood – ADA Compliant, Radioisotope Fume Hood.
   1. Physical Type: Reference Fume Hood Schedule.
   2. Operational Features:
      a. Operational Type: Reference Fume Hood Schedule.
      b. Face Velocity: 100 ft per minute.
   3. Sash:
      a. Sash Type: Reference Fume Hood Schedule.
      b. Sash Stop:
         1) Manual Type.

2) Location: 18 inches

4. Size:
   a. Depth: 31-3/4 inch
   b. Width: Reference Fume Hood Schedule
5. Exterior Material: Painted, 18 gauge cold rolled steel.
6. Exterior Color: As selected by Architect from manufacturer standard.
7. Interior Liner: for General Purpose Fume Hood, Polyresin. For Radioisotope Fume Hood, stainless steel.
8. Work Surface: for General Purpose Fume Hood: Cast Epoxy Resin; for Radioisotope Fume Hood, stainless steel.
9. Service Fixtures:
   a. Reference Fume Hood Schedule.
10. Face Velocity Monitor for Constant Volume Fume Hoods; Face Velocity Control System User Interface for Variable Air Volume Fume Hoods:
    a. Reference Division 15. Coordinate cutout in fume hood fascia panel with Monitor/Alarm System manufacturer.

B. Provide factory installed pipes and wires for plumbing and electrical services as indicated on Fume Hood Schedule.
   1. Pre-piped Configuration: Piped to 6 inches above top of hood.
   2. Pre-piped Material:
      a. Water: Copper
      b. Compressed Air: Copper
      c. Natural Gas: Black Iron
      d. Nitrogen: Copper
      e. Specialty Gas: Stainless steel

2.2 MANUFACTURERS

List manufacturers' names in alphabetical order.

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hotpack.
2. Kewaunee Scientific Corp.
3. Labconco Corporation.
4. ThermoFisher Scientific.
5. Substitutions: see section 01 25 00 – Substitution Procedures.

2.3 OPERATIONAL FEATURES

1. Open Bypass Fume Hood for Use with Constant Volume (CV) Exhaust System (Reference Fume Hood Schedule): Open Bypass Fume Hood shall incorporate an automatic air

bypass feature above sash opening, which open as sash is closed, to limit the increase in face velocity.

2. Face velocity at the sash shall not exceed 120 cfm.

B. Restricted Bypass Fume Hood for Use with Variable Air Volume (VAV) Exhaust System (Reference Fume Hood Schedule):

1. Exhaust air volume varies proportionally to the hood opening to maintain a constant average face velocity when used with a hood face velocity control system.
2. Face velocity control system furnished and installed in accordance with the requirements of Division 15.

2.4 FABRICATION / MATERIAL-BENCH MOUNTED HOODS

A. Enclosure Construction:

1. Exterior Shell Material: Cold-rolled sheet steel; ASTM A 1008, Designation CS; minimum 18 gauge.
2. Fabricate fume hoods in double wall construction, prefinished, cold-rolled steel exterior shell, with an interior liner and baffle of chemical resistant material as noted.
3. Framework: Frame shall be heavy gauge, welded steel members, reinforced, braced and assembled with exterior shell and interior liner to form a rigid, self-supporting enclosure unit.
4. Screw together component parts to allow removal of interior liner, end panels, front end fascia pieces, top fascia and air foil strips, and to allow access to plumbing lines and service fixtures.
5. End Panels:
   a. Double wall construction; not more than 5 inches wide; without projecting corner posts or obstructions to interfere with smooth, even flow of air.
   b. The area between double walls shall house and conceal framing, attaching brackets, remote operating service fixture mechanisms, sash counterbalances and vent pipes, if necessary, from base cabinets.
   c. Access panel to service fixture mechanisms concealed between walls shall be provided by full overlap design, removeable gasketed (70 durometer polyvinylchloride or equivalent) access panels on the inside liner walls, or through front corner covers.
   d. Terminate end panels flush with interior lining.
6. Corner Covers:
   a. Prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
   b. For Radioisotope fume hoods, 20 gauge stainless steel, prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
   c. Mount corner covers vertically on each side of hood sash openings to access plumbing lines and valve connections from front of hoods.
7. Face Opening: Splay or radius top and of face opening to provide an aerodynamic airfoil section to ensure smooth, even flow into the hood.

B. Airfoil Vane:

1. Low profile, ergonomically designed to provide obstruction-free access to hood interior.

2. Mounted flush to top front edge of work surface.
3. Airfoil design shall assure a flow of air rearward along work surface at all hood operating face velocities.
4. On all bench mounted and distillation hoods, provide a removable airfoil vane across bottom of face opening. Profile of airfoil shall match profile of side sections.
5. Mount airfoil with minimum 3/4 inch air space between the foil and top front edge of the work surface to direct positive flow of air across the work surface and to prevent backflow. Extend airfoil under sash line so that sash closes on top of foil.
6. Allow for power cord/tube pass-through near each side post.
7. Material and finish: 14 gauge stainless steel; No. 4 satin finish.

C. Plenum Chamber:
1. Provide plenum with adequate volume for hood dimensions, extending full width of hood to equalize incoming air flow.

D. Bypass Grilles:
1. Provide bypass grilles to conceal plenum.
2. Bypass grilles shall be low resistance type, directionally louvered upward, or can function from above with non-directional grill in the Ceiling closure panel.

E. Interior Liners Material:
1. Polyresin for General Purpose Fume Hoods:
   a. Material: Chemical and abrasion resistant, 1/4 inch thick, fiber reinforced thermoset composite material, defined as any of the following:
      1) White modified epoxy resin with fiberglass reinforced sheet.
      2) White polyester with fiberglass reinforced sheet.
      3) White press-molded, heat-converted catalyzed glass polyester sheet.
   b. Fabrication: Chemically welded seams.
2. Stainless Steel for Radioisotope Hoods:
   a. Material for liner, baffle, top panel, and duct collar: Stainless steel, No. 4 satin finish.
      1) Radioisotope hoods: ASTM A 666 Type 304.
      2) Back and end liner panels: 14 gauge.
      3) Baffle and top liner panels: 16 gauge.
   b. Fabrication:
      1) Fully welded seams with stainless steel fillers, ground smooth, and blended to specified finish.
      2) Grind exposed edges smooth and slightly rounded, without sharp edges. Integral bottom and trough.
      3) Inside back and end panels: One-piece, wrap-around construction, welded to the work top forming smooth 1/2 inch radius corners. Do not provide access openings at end panels.
      4) Top liner: Spot weld to back and end panels.
      5) Front fascia panel: Punch to accept front loaded service fittings if required.
      6) Interior corners: 1/2 inch radius, welded, seamless appearance.
      7) Reinforcing: Provide angles and plug hats; weld stainless steel hood liner to for a self-supporting assembly.
   c. Fasteners: Stainless steel screws.

F. Baffles:
1. Same material as hood liner.
2. Multiple sections with continuous horizontal slot at the worksurface.

3. Baffle position shall be factory-set for optimal airflow characteristic. Field adjustment shall not be required.
4. Each baffle panel shall be easily removable from the interior, without requiring liner disassembly.
5. Configuration: Full width, with adjustable openings at top and bottom to allow adjusted flow of air through hood to compensate for type of gas, apparatus, or heat source used. Baffles shall be removable for cleaning.
6. Adjustment:
    a. Stop: Provide stop at baffle openings to provide a minimum opening of 1 inch.
    b. Flow restriction limits: The baffle design shall be such that it is impossible, by adjustment, to restrict the volume of air exhausted through the fume hood by more than 20 percent.
    c. Adjustment: Control airflow at top or bottom form a single point, with acid resistant plastic or stainless steel knobs mounted on within end panel enclosure and near front of fume hood.
    d. Baffle designs that require insertion of the operator's head or shoulders for adjustment are not acceptable.
7. Accessories:
    a. Fasteners:
        1) Enclosure panel assembly: Stainless steel truss head screws or rivets; not countersunk type.
        2) Hood baffle to cleats: Stainless steel screws.
    b. Removable plug buttons for holes not used for fixtures.

G. Sash:
1. Vertical Rising Sash (Reference Fume Hood Schedule):
    a. Vertical rising 1/4 inch thick laminated safety float glass sash, epoxy-coated steel sash track, single counterbalance weight.
2. Combination Sash (Reference Fume Hood Schedule):
    a. Four horizontal sliding frameless sash panels.
    b. Reduced frame profile vertical rising sash.
    c. Sash counter balance system.
    d. Incorporate mechanism for latching sash in the full-open position for hood set-up.
    e. Equipped with full-width aerodynamically designed handle and sash frame.
    f. Designed to provide clear view of hood interior.
3. Glazing:
    a. Glass: Safety glass composed of two sheets of double-strength "B" quality, clear sheet glass permanently laminated with a sheet of clear plasticized polyvinyl butyral.
        1) Laminated with 0.015 inch thick clear, plasticized, polyvinyl butyral interlayer; comply with ASTM C 1172.
        2) Comply with ASTM C 1048, Condition A uncoated, Type 1, transparent, clear, flat, Class 1, q5 Glazing B Quality.
        3) Comply with ANSI Z97.1.
4. Sash Tops:
    a. Factory installed, cam style permanent sash stops.
    b. Location: 18 inch above the fume hood work surface.
5. Blank off panel: On bypass to reduce effective opening.
6. Signage: Provide label on fume hood at this point and a sign to read. "Operating conditions 100 fpm - do not work in hood with sash bottom above this mark."
7. Alarm console: The alarm console shall produce an alarm signal if sash stops are overridden.

H. Exhaust:
1. Entry Cones and Exhaust Connection: Hood manufacturer shall supply and install an acoustical duct transition from hood exhaust collar to the size required for building exhaust duct. Verify diameter dimension of exhaust duct size and location with mechanical drawings.
2. Transition to be equivalent material and finish to building exhaust duct and to conform to industrial ventilation standards. On fume hoods where two exhaust points exist, provide transition as required to accept two exhaust points to mate, as described above, with mechanical system.
3. Exhaust Connection Rings for Radioisotope Hoods: ASTM 666 Type 304 stainless steel.

I. Utility Service Fittings and Fixtures:
1. Reference Fume Hood Schedule and typical fume hood elevations for model and location of Utility service fittings and fixtures.
2. Orient valves to be readily accessible without exposing operator's breathing zone to fume hood interior.
3. Factory installed for services as indicated on Fume Hood Schedule.
4. Operation: Remote control.
5. Finish : color coded epoxy. See '12350 Laboratory Casework, Laboratory Service Fittings, Indexes Color and Identification Code' for index colors.
6. Fixtures Location: Plumbing service fixtures shall be located maximum 12 inch from the inside of the sash and shall be on a common vertical centerline.
7. Hose Connectors: Injection molded PVDF - Kynar®.
8. Hose Connectors for Radioisotope Fume Hoods: Chrome-plated brass.
9. Hood Service Fittings: 1/4 inch copper tubing, forged brass valves and seats, TFE-coated silicone bronze stem, TFE packing, and injection-molded PVDF 10-serration hose connectors.
    a. Fixture Handles: Anti-snag, round plastic without projections; color-code and label for designated service.
10. Valves: CSA International labeled with brass-lined copper service lines.

J. Lights:
1. Type: Two-tube, rapid-start fluorescent light fixture of longest practicable length.
2. Ballast: Electronic ballast and be suitable for T-8 lamps.
3. Shield: 1/4 inch thick safety glass or 1/8 inch thick tempered glass panel, sealed air tight into hood body with chemical resistant rubber channels.
4. Lamps: Furnished in accordance with requirements of Division 16.
5. Include light switch, controls interface, and all internal wiring to circuit junction boxes located in upper right and/or left front of plenum area.
6. Toggle Switch: Refer to Division 16 for switch installation requirements. Location shall be on top left sash post.
7. Set units so that fluorescent tubes are replaceable from outside hood.
8. Provide only fixtures that carry UL label.
9. Average interior illumination levels of the work area: 80-foot candles minimum.

K. Electrical Services:
1. Electrical Outlets: Prewire fume hoods for a single point connection. Receptacles to be GFIC type.
2. Closure Strips: Metal to match adjoining surfaces. Provide to close openings between fume hood base cabinet and super-structure and adjacent building wall.
3. Holes: Provide holes for passage of piping, conduit, fixtures, and fittings furnished elsewhere.
4. Fasteners: Stainless steel where exposed to fumes in hood.

5. Signs:
   a. Type: Corrosion resistant plate.
   b. Location: Fume hood exterior.
   c. Content: Condensed information covering recommended locations for apparatus and accessories, baffle settings, and use of sash.
6. Lattice Rod Assembly: Solid 1/2 inch aluminum rod lattice and hardware to support interior hood apparatus where indicated on drawings, reference Fume Hood Schedule.
7.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Exterior Sheet Steel Surfaces: Properly prepared and coated, electrostatically applied.
   1. Hood Exterior: Epoxy coating, dry powder.
   2. Hood Front Panel: Same color and finish with hood exterior shell.
   3. Color: Architect to select from manufacturers standard colors.

C. Stainless Steel: Finishes as specified.

D. Chemical and Physical Resistance of Finishes: Test finishes for resistance to chemical reagents in accordance with SEFA 8, and meets Level 1 rating - slight change in color or gloss, and with no loss of adhesion and no loss of film protection.
   1. Finishes to meet testing requirements:
      a. Exterior fume hood finish.
      b. Liners.
      c. Work surfaces.
   2. Moisture Resistance: No visible effect when finish surface exposed to the following:
      a. Tested in accordance with SEFA 8.
      b. Constant Moisture using a 2 inch x 3 inch x 1 inch cellulose sponge, soaked with water, in contact with surface for 100 hours.
   3. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 degrees F for 60 minutes to 125 degrees F for 60 minutes.
   4. Adhesion and Flexibility:
      a. Adhesion: Tested in accordance with SEFA 8; ninety or more squares of the test sample shall remain coated after the scratch adhesion test.
      b. Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a 1/2 inch diameter mandrel.
   5. Hardness: Tested in accordance with SEFA 8 for surface hardness equivalent to 4H or 5H pencil.
   6. Abrasion resistance: Maximum weight loss of 5.5 mg. per 100 cycle when tested on a Taber Abrasion Tester #E40101 with 1000 gm wheel pressure and Calibrate #CS10 wheel.
   7. Humidity resistance: Withstand 1000 hour exposure in saturated humidity at 100 degrees F.
   8. Salt spray: Withstand minimum 200 hour salt spray test.

2.6 WORK SURFACE

A. Cast Epoxy Resin Work Surface:
   1. Material: Cast epoxy resin.
   2. Thickness: 1 inch.
   3. Color: Black
   4. Fabrication:
      a. 3/8 inch deep dish rim to contain spills.
      b. Front edge: 6 inch wide by 1/2 inch thick raised edge.
      c. Edge at sides and rear: 1/2 inch wide by 1/2 inch thick raised edge.
      d. Edge attachment: Bond to working surface to make a watertight retaining pan.
      e. Provide penetrations in raised edge of fume hood to accept 2" o.d.owner-furnished and installed vacuum line from vacuum pump base cabinets beneath fume hoods.
      f. Provide penetrations in raised edge of fume hood to accept exhaust from vacuum pump fume hood base cabinets and acid storage fume hood base cabinets beneath fume hoods. Coordinate with Fume Hood Base Cabinets, 12350 Laboratory Casework.
   5. Polyresin Cupsink:
      a. Size: 7 1/2 inch by 4 1/2 inch.
      b. Mount flush with recessed top of work surface.
      c. Coordinate cupsink location so that gooseneck faucet empties directly into cupsink drain.

B. Stainless Steel Work Surface:
   1. Material: 14 gauge stainless steel; No. 4 satin finish.
      a. Radioisotope hoods: ASTM A 666 Type 304.
   2. Cup sink: ASTM A 666 Type 304 stainless steel; 5 inch diameter with 1-1/2 inch drain.
   3. Mount flush with top of recessed work surface.
   4. Coordinate cupsink location so that gooseneck faucet empties directly into cupsink drain.
   5. Load bearing capacity: Reinforce work surface to support the following loads:
      a. Uniform loading: Minimum 200 lb.
      b. Maximum loading: 1000 lb per fume hood or base cabinet section.
   6. Fabrication:
      a. Radioisotope fume hoods: 1/4 inch deep by 6 inch wide safety ledge across the front edge; dished to contain spillage; watertight.
      b. Fully welded seams with stainless steel fillers, ground smooth, and blended to specified finish.
      c. Edge fabrication: Extend top down to 1 inch thick exposed edge. unless noted otherwise, and 1 inch return flange under frame.
      d. Work surface and back and end liner panels shall be one piece without seams or joints.
      e. Provide a raised marine edge around perimeter of work surface containing sinks. Pitch top surface two-ways to bowl to provide adequate drainage without channeling or grooving.
      f. Where stainless steel sinks occur in stainless steel tops, factory assemble sinks and tops into one integral unit with welds ground and polished. Reinforce work surface at sinks and other penetrations.
      g. Seams and joints: Fully welded with stainless steel fillers; grind smooth; and blend to specified finish.
      h. Reinforcing: Carbon steel channels welded to the underside of the work surface to prevent twisting, oil canning, and buckling.

i. Provide one coat of heavy build mastic sound deadening material on underside of the work surface. Do not apply to exposed surfaces.

2.7 FUME HOOD BASE CABINETS

A. Material
   1. Sheet Steel:
      a. Mild, cold rolled and leveled unfinished steel.
      b. Minimum gauges:
         1) 20 gauge: Interior door fronts, filler panels, shelves.
         2) 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, and uprights.
         3) 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails.
         4) 14 gauge: Door and case hinge reinforcements and front corner reinforcements.
   2. Sound Deadening Material: Inorganic, for sandwich panel fabrication.

B. Design: Flush Front.

C. Color and Finish: Match fume hood.

D. Acid Storage Cabinets:
   1. One piece corrosion resistant interior liner, including the backside of doors and shelf surfaces.
   2. One-piece corrosion resistant insert tray with 2 inch lip for containment of spills at bottom of cabinet.
   3. One shelf with 1 inch lip, adjustable on 1 inch increments.
   4. Vented with a minimum 1-1/2 inch I.D. corrosion resistant vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the working surface.
   5. Vent pipe shall be close to rear of hood as possible. Seal opening between working surface and pipe with chemical resistant material.
   6. Exhaust ports shall have fire screens.
   7. Non-metal door catch or strike plate.
   8. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "ACID".

E. Flammable Liquids Storage Cabinets:
   1. Identified for flammable and combustible liquids shall be constructed in compliance with UL, OSHA, NFPA Standard No. 30, and UFC Article 79.
   2. Self closing and self latching doors synchronized so that both doors will always fully close.
   3. Bottom of the cabinet liquid tight to a height of 2 inches.
   4. Cabinet shall not have vent outlet.
   5. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "FLAMMABLE - KEEP FIRE AWAY".

F. Vacuum Pump Cabinets:
   1. Provide louvered door for exhaust airflow.
   2. Vented with a minimum 1-1/2 inch I.D. corrosion resistant vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the work surface.
   3. Provide 110V Duplex outlet in back of cabinet.

4. Provide ON/OFF switch on face of fume hood base cabinet apron rail, powering 110V duplex in back of vacuum pump base cabinet.
5. Provide penetrate in top of base cabinet to accept 2" o.d.owner-furnished and installed vacuum line from vacuum pump base cabinets beneath fume hoods.
6. Attach toe kick to door. Provide base cabinet without bottom - vacuum pump to rest on finished floor.
7. Provide 110V Duplex outlet on face of fume hood base cabinet apron rail where noted on Fume Hood Schedule.

2.8 FACE VELOCITY MONITOR FOR CONSTANT VOLUME FUME HOODS

A. Operation, Face Velocity Monitor:
   1. Face velocity monitor furnished and installed in accordance with the requirements of Division 15.
   2. Power requirements: 120 volt AC; prewired to the fume hood.
   3. Coordinate cutout in fume hood fascia panel with manufacturer of face velocity monitor.

B. Components, Face Velocity Monitor
   1. Alarms:
      a. Digital Display: Liquid crystal display indicating current status.
      b. Audible Alarm Indicator: Minimum intensity of 80 decibels at 4 inch.
      c. Visual Alarm Indicator: Green LED light for normal condition, Red LED warning light for low flow and high flow.
      d. Audible alarm and red warning light shall operate simultaneously to indicate an unsafe operating condition.

C. System Adjustment: Calibrate and adjust the Face Velocity Monitor after the building air handling system has been balanced.

D. Console Mounting: Mount the Face Velocity Monitor on the front of the fume hood as shown on drawings , facing front of hood.

E. Notification Plate: Mount plate on the front of the fume hood housing, adjacent to Face Velocity Monitor. Notification shall read as follows:
   1. Alarm will activate when unsafe exhaust condition exists. Red lamp and audible alarm will activate. SHUT DOWN EXPERIMENT AS RAPIDLY AS POSSIBLE. Close sash. Report condition to Safety Office personnel.

F. Signage:
   1. Lettering: Manufacturer's standard lettering, background colors, and mounting.
   2. Signage Messages: In accordance with requirements of NFPA 45.

2.9 FACE VELOCITY CONTROL SYSTEM USER INTERFACE FOR VARIABLE AIR VOLUME FUME HOODS

A. Operation, Face Velocity Control System User Interface:
   1. Face velocity control system and face velocity control system user interface furnished and installed in accordance with the requirements of Division 15.
   2. Coordinate cutout in fume hood fascia panel with manufacturer of face velocity control system user interface.
   3. Measure and record fume face velocity.

4. Signals unsafe operating conditions whenever fume hood exhaust volumes fall below 80% of that specified for the fume hood or as indicated. Set to activate alarm whenever face velocity deviates from the following:
    a. Sash in position for operating condition: Less than 80 ft/min; greater than 120 ft/min.
5. Remote alarm relay output capability.
6. Alarm delay capability.
7. Power requirements: 120 volt AC; prewired to the fume hood.

B. Components, Face Velocity Control System User Interface:
1. Alarms:
    a. Digital Display: Liquid crystal display indicating current status.
    b. Audible Alarm Indicator: Minimum intensity of 80 decibels at 4 inch.
    c. Visual Alarm Indicator: Green LED light for normal condition, Red LED warning light for low flow and high flow.
    d. Audible alarm and red warning light shall operate simultaneously to indicate an unsafe operating condition.
2. Silencer switch: When the silencer switch is activated, the red warning light shall remain "ON" until the unsafe condition is corrected and the alarm unit is manually reset.

C. System Adjustment: Calibrate and adjust the Face Velocity Control System User Interface after the building air handling system has been balanced.

D. Console Mounting: Mount the Face Velocity Control System User Interface on the front of the fume hood as shown on drawings, facing front of hood.

E. Notification Plate: Mount plate on the front of the fume hood housing, adjacent to Face Velocity Control System User Interface. Notification shall read as follows:
1. Alarm will activate when unsafe exhaust condition exists. Red lamp and audible alarm will activate. SHUT DOWN EXPERIMENT AS RAPIDLY AS POSSIBLE. Close sash. Report condition to Safety Office personnel.

F. Signage:
1. Lettering: Manufacturer's standard lettering, background colors, and mounting.
2. Signage Messages: In accordance with requirements of NFPA 45.

2.10 ACCESSORIES

A. Ceiling Enclosures: Provide ceiling enclosure with removable access panel located on the lower portion of the front panel.
1. Color and finish to match fume hood structure.
2. Ceiling enclosures shall extend to within 1 inch of acoustical lay-in ceiling. Field dimension before manufacture of ceiling enclosures.

B. Distillation Rack:
1. Provide lattice rod assemblies of solid 1/2 inch aluminum rod. Reference Fume Hood Schedule for locations.

2.11 SOURCE QUALITY CONTROL

A. Test one fume hood of each type manufactured according approved shop drawing before shipment.

B. Factory Testing Requirements:
   1. Test Room: Set up test hood in a test room of sufficient size with a minimum of 5 feet clear space in front of the hood and on both sides of the hood for viewing the test.
   2. ASHRAE 110- As Manufactured (AM) test shall includes.

C.

2.12 SOURCE QUALITY CONTROL

A. Test one fume hood of each type manufactured according approved shop drawing before shipment.

B. Factory Testing Requirements:
   1. Test Room: Set up test hood in a test room of sufficient size with a minimum of 5 feet clear space in front of the hood and on both sides of the hood for viewing the test.
   2. ASHRAE 110- As Manufactured (AM) test shall includes.
      a. Exhaust Stability Test
      b. Local Visualization Challenge (Low -Volume Smoke Test).
      c. Large-Volume Visualization Challenge (High-Volume Smoke Test).
      d. Face Velocity Testing:
         1) 100 ft/min; with deviation of plus or minus 20 ft/min
      e. Tracer Gas Containment Testing:
         1) Test to a control level of AM 0.05 ppm or better.

C. Static Pressure Loss for Bench Mounted Fume Hoods:
   1. Face velocity of 75 ft/min: Maximum 1.4 inch of water gauge.
   2. Face velocity of 100 ft/min: Maximum 1/2 inch of water gauge.
   3. Face velocity of 120 ft/min: Maximum 1/2 inch of water gauge.
   4. Constant volume fume hoods with bypass: Static pressure and exhaust volume shall be relatively constant regardless of sash position.

D. Face Velocity at Sash Opened 6 inch: Maximum 3 times face velocity at sash fully opened.

E. Provide documentation showing the test result. Report of tests previously performed on the same design are acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment rough-in before proceeding with work, including rough opening dimensions required for fume hood installation.

B. Coordinate for proper installation of mechanical, plumbing and electrical services.

3.2 PREPARATION

A. Repair, replace, and fix irregularities that will affect the quality of the execution of the work specified.

3.3 INSTALLATION

A. Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in locations indicated. .

B. Provide filler panels between top of hood and ceiling.

C. Securely attach access panels but provide for easy removal and secure re attachment.

D. Do not install any damaged units.

E. Affix one copy each of the following to an unobscured exterior side panel of each fume hood prior to Substantial Completion.
   1. "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Research Council, Washington, DC.; National Academy Press, 1995: www.nap.com.

3.4 INTERFACE WITH OTHER WORK

A. Coordinate with the schedule and other requirements of other work being performed in the area including, but not limited to, casework and work surface installation, mechanical and electrical connections to and in the fume hoods.

3.5 FIELD QUALITY CONTROL

A. Fume Hood Performance Testing Requirements:
   1. Test fume hoods after installation of fume hoods is complete, and the building ventilation and control system has been balanced, and utilities and services connections have been made.
   2. Test fume hood in accordance with SEFA 1 recommendations.
   3. Use ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods to determine a benchmark performance.

B. Testing Responsibilities:
   1. ASHRAE 110, As Installed (AI) test: By Fume hood Manufacturer.
      a. Test all fume hood units installed in the Work of this Project.
      b. (AI) Test methods includes:
         1) Face Velocity Measurements.
            a) Face velocity grid test: 100 ft/min; with deviation of plus or minus 20 ft/min.

C. Correcting Deficiencies and Retest:

1. If test results of testing specified above are not satisfactory, Fume hood manufacturer and Contractor shall take the following actions:
   a. Determine probable cause of deficiencies.
   b. Generate solutions for the problems determined in step "a" above.
   c. Implement a mitigation plan that include the solutions in step "b" above.
2. Retest the fume hoods and compare the pre- and post-mitigation results to determine the effectiveness of the remedial work on the fume hoods.
3. Repeat the effort until test result is accepted by owner.
4. Remedial work and retest shall not add cost and time delay to the Owner.

3.6 ADJUSTING AND CLEANING

A. Adjust operating equipment and moving parts, with the exception of air handling motors, for smooth and efficient operation for intended use.
   1. Sashes: Smooth, near-silent, and accurate operation with one hand and uniform contact of rubber bumpers. Ensure counterbalances operate without interference.
   2. Vertical-Rising Sashes: Operate smoothly without tilting when raised or lowered from either end; remain at rest in any open position.
   3. Horizontal Sliding Sashes: Operate smoothly without binding.
   4. Baffles: Set with all openings adjusted to maximum open position.

B. Clean equipment, casework, work surfaces, light fixture lens, both sides of sash, and other surfaces as recommended by manufacturers, rendering work in new and unused appearance.

C. Clean adjacent construction and surfaces soiled in the course of installation of this work.

D. Touch up minor damaged surfaces caused by installation.

E. Replace damaged and defective components that cannot be repaired to new condition.

3.7 PROTECTION

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

3.8 DEMONSTRATION AND TRAINING

A. Demonstrate fume hood operations and functions to Owner designated representatives at completion of installation.

END OF SECTION 11 53 00