SECTION 115313 - LABORATORY FUME HOODS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
   * + 1. RELATED DOCUMENTS
          1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
       2. SUMMARY
          1. Section Includes:

Bench-top laboratory fume hoods.

Floor-mounted laboratory fume hoods.

Retain first subparagraph below for fume hoods that are prewired and prepiped; such fume hoods may result in union jurisdiction problems in certain localities. Fume hoods that are not prewired and prepiped may result in problems with code officials because UL label does not apply to field-installed wiring and piping.

Piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.

Retain applicable subparagraphs below; fume hood base cabinets, work tops, sinks, and service fittings in fume hoods are specified in this Section by referencing the appropriate laboratory casework Section.

Fume hood base cabinets.

Retain first subparagraph below if base stands are used to provide accessibility for people with disabilities. If fume hoods are large enough, base cabinets can be arranged to provide required knee and toe space.

Fume hood base stands.

Work tops within fume hoods.

Laboratory sinks and cup sinks in fume hoods.

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

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Usually retain one of first two subparagraphs below if seismic restraint is required.

**[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood blocking for anchoring fume hoods.

Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring fume hoods.

Usually retain first subparagraph below.

Section 096513 "Resilient Base and Accessories" for resilient base applied to fume hood base cabinets.

Retain first subparagraph below if field quality-control testing is specified in Division 23. See Evaluations. If retaining, coordinate requirements with Project's mechanical engineer. Delete if field quality-control testing is not required or is included in this Section.

Section 230593 "Testing, Adjusting, and Balancing for HVAC" for field quality-control testing of fume hoods.

Retain subparagraph below if VAV controls for fume hoods are specified in Division 23 instead of in this Section.

Section 230923 "Direct Digital Control (DDC) System for HVAC" for VAV controls for fume hood exhaust.

* + - 1. PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" Paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Conference: Conduct conference at Project site.
      1. COORDINATION

Usually delete first paragraph below and indicate reinforcements on Drawings. Delete if fume hoods are installed directly against masonry.

* + - * 1. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.
        2. Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.
      1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Submittals Package: Provide all submittals, except samples and closeout submittals, as a single submittal package.
         5. Product Data: For each type of product.
         6. Shop Drawings: For laboratory fume hoods.

Include plans, elevations, sections, and attachment details.

Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.**[ Include calculations demonstrating that anchorages comply with seismic performance requirements.]**

Indicate locations and types of service fittings together with associated service supply connection required.

Indicate duct connections, electrical connections, and locations of access panels.

Include roughing-in information for mechanical, plumbing, and electrical connections.

Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from the above items.

Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.

Include coordinated dimensions for laboratory equipment specified in other Sections.

* + - * 1. Samples: For **[fume hood exterior finishes] [interior lining] [epoxy sinks] [epoxy work tops] [and] [phenolic-composite work tops]**.

Retain "Delegated-Design Submittal" paragraph below if design services have been delegated to Contractor.

* + - * 1. Delegated-Design Submittal: For fume hoods indicated to comply with seismic performance requirements and design criteria.

Retain "Product Test Reports" paragraph below if source quality-control testing is not specified.

* + - * 1. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.
        2. Source quality-control reports.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting. Delete below if field testing is included in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

* + - * 1. Field quality-control reports.
      1. MAINTENANCE MATERIAL SUBMITTALS
         1. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.
      2. DELIVERY, STORAGE, AND HANDLING
         1. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.
      3. FIELD CONDITIONS

Revise or delete "Environmental Limitations" paragraph below if fume hoods contain no wood products.

* + - * 1. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
        2. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. MANUFACTURERS
         1. Constant Volume Fume Hoods with Steel Exterior:

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:

BMC, Inc.

Lab Crafters, Inc.

Labconco Corporation.

Approved equivalent.

* + - * 1. Constant Volume Fume Hoods with Fiberglass Exterior:

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:

HEMCO Corporation.

Labconco Corporation.

Approved equivalent.

* + - * 1. Constant Volume Fume Hoods with Polypropylene Exterior:

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:

NuAire.

Approved equivalent.

* + - * 1. Constant Volume Fume Hoods with VAV Control and Steel Exterior:

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:

Air Master Systems Corporation.

BMC, Inc.

[Labconco Corporation](http://www.specagent.com/Lookup?uid=123457104453).

Approved equivalent.

* + - * 1. Constant Volume Fume Hoods with VAV Control and Fiberglass Exterior:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=7320) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[HEMCO Corporation](http://www.specagent.com/Lookup?uid=123457104456).

[Labconco Corporation](http://www.specagent.com/Lookup?uid=123457104457).

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Steel Exterior:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=7321) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[BMC, Inc](http://www.specagent.com/Lookup?uid=123457104461).

[Lab Crafters, Inc](http://www.specagent.com/Lookup?uid=123457104468).

[Labconco Corporation](http://www.specagent.com/Lookup?uid=123457104467).

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Fiberglass Exterior:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=7322) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[HEMCO Corporation](http://www.specagent.com/Lookup?uid=123457104475).

[Labconco Corporation](http://www.specagent.com/Lookup?uid=123457104476).

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Stainless Steel Exterior:

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:

Baker Company (The).

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Polypropylene Exterior:

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:

NuAire.

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Auxiliary Air and Steel Exterior:

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:

BMC, Inc.

Jamestown Metal Products.

Labconco Corporation.

Approved equivalent.

* + - * 1. Bypass Fume Hoods with Auxiliary Air and Fiberglass Exterior:

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:

HEMCO Corporation.

Labconco Corporation.

Approved equivalent.

"Restricted-Bypass Fume Hoods with Steel Exterior" paragraph below is for use with VAV controls specified in Section 230923 "Direct Digital Control (DDC) System for HVAC. " Restricted-bypass fume hoods are designed primarily for VAV control.

* + - * 1. Restricted-Bypass Fume Hoods with Steel Exterior:

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:

Air Master Systems Corporation.

Lab Crafters, Inc.

Labconco Corporation.

Approved equivalent.

* + - * 1. Restricted-Bypass Fume Hoods with VAV Control and Steel Exterior:

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:

Air Master Systems Corporation.

Labconco Corporation.

Approved equivalent.

* + - * 1. Restricted-Bypass Fume Hoods with VAV Control and Fiberglass Exterior:

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:

Labconco Corporation.

Approved equivalent.

* + - * 1. Source Limitations: Obtain laboratory fume hoods from single manufacturer.

Retain option in subparagraph below if required. Some of the best fume hoods are made by manufacturers that do not make casework; conversely, some manufacturers of high-quality casework do not make fume hoods.

Obtain laboratory fume hoods from same source from same manufacturer as laboratory casework.

Retain "Product Designations" paragraph below if manufacturer's catalog numbers are used on Drawings. If retaining, revise to suit office practice.

* + - * 1. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' fume hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Section 016000 "Product Requirements."
      1. PERFORMANCE REQUIREMENTS

Usually retain "Containment" paragraph below. Delete option if standard ASHRAE 110 test is acceptable. See Evaluations.

* + - * 1. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110**[ as modified below]**:

SEFA 1 requires an AM rating of not less than 0.05. SEFA 1 also notes: "AM 0.05 can be achieved with a properly designed laboratory fume hood. It shall not be implied that this exposure level is safe. Safe exposure levels are application specific and should be evaluated by properly trained personnel."

As-Manufactured (AM) Rating: **[AM 0.05 (0.05 ppm)] [AM 0.02 (0.02 ppm)] [AM 0.01 (0.01 ppm)] [As indicated in the Fume Hood Schedule]**.

Rating in "As-Installed (AI) Rating" subparagraph below requires field quality-control testing to verify; SEFA recommends that all fume hoods be tested AI at least annually. Delete if not required. HVAC design may affect Contractor's ability to achieve AI rating. See Evaluations.

As-Installed (AI) Rating: **[AI 0.10 (0.10 ppm)] [AI 0.05 (0.05 ppm)] [As indicated in the Fume Hood Schedule]**.

Average Face Velocity: 100 fpm plus or minus 10 percent with sashes fully open.

Note that variation in "Face-Velocity Variation" subparagraph below compares face-velocity measurement at various locations at the face of the hood. It does not compare face-velocity measurements at various sash openings.

Face-Velocity Variation: Not more than **[10] [15] [20]** percent of average face velocity across the face opening with sashes fully open.

Sash Position: Fully open.

Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.

Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.

Release rate specified in ASHRAE 110 is 4.0 L/min.

Release Rate: **[4.0 L/min.] [6.0 L/min.]**

"Test Setup Modifications" and "Walk-by Test" subparagraphs below are based on modifications to ASHRAE 110, specified by the NIH, to mimic actual in-use conditions. Delete both if standard ASHRAE 110 test is acceptable. See Evaluations.

Test Setup Modifications: Conduct tests with a minimum of three and a maximum of five people in the test room and with two 1-gal. round paint cans, one 12-by-12-by-12-inch cardboard box, and three 6-by-6-by-12-inch cardboard boxes in the fume hood during the test. Position items from 6 to 10 inches behind the sash, randomly distributed, and supported off the work surface by 2-by-2-inch blocks.

Walk-by Test: At the conclusion of containment test, execute three rapid walk-bys at 30-second intervals, 12 inches behind the mannequin. Test-gas concentration during each walk-by shall not exceed 0.1 ppm and shall return to specified containment value within 15 seconds.

Usually retain "Static-Pressure Loss" paragraph below. SEFA 1 requires that static-pressure loss for bench-top hoods not exceed 1/4-inch wg for a face velocity of 75 fpm and 1/2-inch wg for a face velocity of 100 and 120 fpm.

* + - * 1. Static-Pressure Loss: Not more than **[1/2-inch wg] at [100-fpm]** face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for seismic design.

* + - * 1. Delegated Design: Engage a qualified professional engineer, licensed in the State of New York, to design fume hoods for seismic performance.

Retain "Seismic Performance" Paragraph below for projects requiring seismic design. Delete paragraph below if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Fume hoods, including attachments to other work, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

Design earthquake spectral response acceleration, short period (Sds) is determined by Project's location and site classification. This information is usually provided in structural notes on Drawings.

Design earthquake spectral response acceleration, short period (Sds) for Project is **<Insert value>**.

Component Importance Factor: 1.5.

* + - 1. FUME HOODS

Provisions in this Section are generally as stringent as those in UL 1805, but authorities having jurisdiction may require that fume hoods be UL listed and labeled. See Evaluations.

* + - * 1. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.

Retain one or more of "Constant-Volume Fume Hoods," "Bypass Fume Hoods," and "Restricted-Bypass Fume Hoods" paragraphs below to suit fume hood types required. If more than one fume hood type is required, retain "where indicated" option and indicate on Drawings or in a schedule where each type is required.

Hoods described in "Constant-Volume Fume Hoods" paragraph below are sometimes called "conventional hoods." If VAV control is not used with constant-volume hoods, face velocity increases substantially (and possibly unacceptably) as sash is closed.

* + - * 1. Constant-Volume Fume Hoods: Provide constant-volume fume hoods without bypass where indicated.

Hoods described in "Bypass Fume Hoods" paragraph below are often called "open bypass."

* + - * 1. Bypass Fume Hoods: Provide bypass fume hoods where indicated. Compensating bypass above the sash opens as sash is closed. Provide sufficient bypass capacity so that face velocity with sash opening of 6 inches does not exceed 3 times the face velocity with sash fully open.

Hoods described in "Restricted-Bypass Fume Hoods" paragraph below are designed primarily for VAV control. Revise characteristics to suit Project.

* + - * 1. Restricted-Bypass Fume Hoods: Provide restricted-bypass fume hoods where indicated. Partial compensating bypass above the sash opens after sash is closed to less than [20] [40] percent open. Design partial bypass to maintain exhaust capacity of at least 25 cfm per sq. ft. of work surface regardless of sash position.

Retain "VAV Control" paragraph below if VAV control is required and is supplied by fume hood manufacturer.

* + - * 1. VAV Control: Where indicated, equip fume hoods with an electronic control unit with a sensing device that monitors face velocity, and a motorized damper on the exhaust connection that maintains a constant face velocity by controlling air volume in response to control unit. Equip units with manual override switch that opens motorized damper to provide maximum exhaust capacity regardless of sash position.

Before retaining first subparagraph below, verify availability with manufacturers.

Provide output transmitter on electronic control unit that produces zero- to 10-V dc signal proportional to fume hood exhaust volume for interface with building's HVAC control system.

Feature in subparagraph below is offered by Labconco; before specifying, verify availability with manufacturers.

Provide electronic control unit that also monitors sash position and anticipates changes in face velocity caused by abrupt changes in sash position.

Auxiliary air can be used to limit exhausting of conditioned air with fume hoods that do not have VAV control; delete if not required. See Evaluations. Revise percentage of auxiliary air if required.

* + - * 1. Auxiliary Air: Where indicated, equip fume hoods with auxiliary-air outlet for connection to a system that supplies air from an external source equal to 70 percent of the exhausted air volume. Auxiliary-air system introduces air directly above and immediately in front of hood face. Capture efficiency of hoods shall be 90 percent minimum.
      1. MATERIALS
         1. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008; matte finish; suitable for exposed applications.
         2. Stainless Steel Sheet: ASTM A240 or ASTM A666, Type 304, stretcher-leveled standard of flatness.

For perchloric acid fume hoods, use Type 316L instead of Type 304.

* + - * 1. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E84.

Retain "Epoxy" paragraph below if liners are made of epoxy.

* + - * 1. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.

Physical properties and chemical resistance of epoxy products vary among manufacturers. Requirements in "Physical Properties" and "Chemical Resistance" subparagraphs below are lowest common properties; revise if required after verifying availability with manufacturers.

Physical Properties:

Flexural Strength: Not less than 10,000 psi.

Modulus of Elasticity: Not less than 2,000,000 psi.

Hardness (Rockwell M): Not less than 100.

Water Absorption (24 Hours): Not more than 0.02 percent.

Heat Distortion Point: Not less than 260 deg F.

Flame-Spread Index: 25 or less according to ASTM E84.

Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.

Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

Color: **[Black] [Gray] [Beige] [White] [As selected by Director’s Representative from manufacturer's full range]**.

* + - * 1. Polypropylene: Unreinforced polypropylene complying with ASTM D4101, Group 01, Class 1, Grade 2.

Glass in fume hood sashes should generally be laminated because laminated glass still contains fumes if broken.

* + - * 1. Glass: Clear, laminated tempered glass complying with ASTM C1172, Kind LT, Condition A, Type I, Class I, Quality-Q3;**[ with two plies not less than 3.0 mm thick and]** with clear, polyvinyl butyral interlayer.

Verify, with manufacturers, availability of ultraclear glass before specifying.

Ultraclear Glass: Glass plies each have visible light transmission not less than 91 percent.

Safety Glass: Provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

Retain subparagraph below if applicable.

Permanently mark safety glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

Polycarbonate glazing is used instead of glass if resistance to hydrofluoric acid, which etches glass, is required.

* + - * 1. Polycarbonate Glazing: Clear, uncoated polycarbonate sheet manufactured by extrusion process and complying with the following requirements:

Impact Resistance: 12 to 16 ft-lbf/in. according to ASTM D256, Method A.

Elongation and Modulus of Elasticity: 110 percent maximum and 340,000 psi, respectively, according to ASTM D638.

Heat Deflection: 270 deg F at 264 psi according to ASTM D638.

Flame-Spread Index: 25 or less according to ASTM E84.

Delete "Electrical Components, Devices, and Accessories" paragraph below and require that fume hood assemblies be listed and labeled according to UL 1805 if required by authorities having jurisdiction. See Evaluations.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain "Fasteners" paragraph below if fasteners are allowed to be used where exposed to fumes.

* + - * 1. Fasteners: Provide stainless steel fasteners where exposed to fumes.
      1. FABRICATION
         1. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.
         2. Steel Exterior: Fabricate from steel sheet, 0.048 inch (18 ga) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
         3. Stainless Steel Exterior: Fabricate from stainless steel sheet, 0.050 inch (18 ga) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings.

Retain "Fiberglass Exterior" paragraph below if fiberglass fume hoods are acceptable or preferred.

* + - * 1. Fiberglass Exterior: Fabricate from glass-fiber-reinforced polyester components not less than 1/4 inch thick, bonded together to maximum extent practical. Trim edges of panels with PVC extrusion. Limit removable parts to access panels, front fascia, and airfoil.
        2. Polypropylene Exterior: Fabricate from fully stress-relieved polypropylene sheet, 1/2 inch thick, with welded seams. Access panels shall be 1/4 inch thick, flush mounted, and fastened with flat-head polypropylene screws.

Retain "Product Option" paragraph below if either type of construction is acceptable.

* + - * 1. Product Option: Provide either steel or fiberglass exterior as specified above.
        2. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
        3. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
        4. Interior Lining: Provide**[ one of]** the following unless otherwise indicated:

Hood lining materials in first three subparagraphs below are typical, general-purpose types; all three may be retained as choices for maximum competition.

Glass-fiber-reinforced polyester, not less than 3/16 inch thick.

Epoxy, not less than 1/4 inch thick.

Glass-fiber-reinforced epoxy, not less than 3/16 inch thick.

Hood lining materials in four subparagraphs below are more chemical resistant or more specialized than those in three subparagraphs above. See Evaluations.

Stainless steel, not less than 0.050 inch thick[ with epoxy coating].

Phenolic composite, not less than 1/4 inch thick.

Polypropylene, not less than 1/4 inch thick.

Unplasticized PVC, not less than 1/4 inch thick.

Retain "Lining Assembly" paragraph below for all types of linings except molded glass-fiber-reinforced polyester and stainless steel. Revise to suit lining materials and manufacturers.

* + - * 1. Lining Assembly: Unless otherwise indicated, assemble with stainless steel fasteners or epoxy adhesive, concealed where possible. Seal joints by filling with chemical-resistant sealant during assembly.

Retain one of first two subparagraphs below.

Fasten lining components together with **[stainless]**steel cleats or angles to form a rigid assembly to which exterior panels are attached.

Fasten lining components to a rigid frame assembly fabricated from**[ stainless]** steel and to which exterior panels are attached.

Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.

* + - * 1. Molded Glass-Fiber-Reinforced Polyester Lining: Molded unit consisting of end panels, back panel, preset rear baffle, and top bonded together into a single piece; reinforced to form a rigid assembly to which exterior is attached.

Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.

* + - * 1. Stainless Steel Lining Assembly: Welded unit consisting of end panels, back panel, top, and work top; reinforced to form a rigid assembly to which exterior is attached.

For perchloric acid and radioisotope fume hood linings, cove corners and weld seams completely, and grind surfaces smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

Delete "Rear Baffle" paragraph below if only molded glass-fiber-reinforced polyester linings are used, because they include integral rear baffle.

* + - * 1. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom. Secure baffle to cleats at rear of hood with stainless steel screws. Fabricate baffle for easy removal for cleaning behind baffle.

Retain one or more of four subparagraphs below. Preset baffles eliminate tampering and improper adjustment by those who do not know how to properly adjust baffles. Remote control allows baffles to be adjusted while fume hood is in use; adjustment strips do not.

Provide preset baffles**[ unless otherwise indicated]**.

Provide adjustable baffles with control adjustment strips at top and bottom with plastic or stainless steel knobs**[ unless otherwise indicated][ where indicated]**.

Provide adjustable baffles with remote-control adjustment from outside front of fume hood**[ where indicated]**.

Provide epoxy-coated, stainless steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.

* + - * 1. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.

Duct-Stub Material: **[Epoxy-coated steel] [stainless steel] [or] [glass-fiber-reinforced polyester] <Insert duct material>[ unless otherwise indicated]**.

Duct-Stub Material for **[Perchloric Acid] [and] [Radioisotope]** Hoods: Stainless steel.

* + - * 1. Bypass Grilles: Provide grilles at bypass openings of fume hoods.
        2. Sashes: Provide operable sashes of type indicated.

Retain first subparagraph below if frameless sashes are not required or allowed. Revise if other materials and construction are acceptable.

Fabricate from **[0.050-inch-(18 ga) thick stainless steel] [0.048-inch (18 ga) - thick steel sheet, with chemical-resistant finish] [or] [PVC extrusions]**. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.

Usually retain first subparagraph below.

Glaze with laminated safety glass.

Retain first subparagraph below if required for resistance to hydrofluoric acid.

Glaze with 0.236-inch- thick polycarbonate glazing where indicated.

Counterbalance vertical-sliding sash with sash weight and stainless steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless steel guides, and stainless steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.

Retain first subparagraph below if applicable.

Fabricate horizontal-sliding sashes hung from adjustable nylon-tired, ball-bearing sheaves supported on an overhead stainless steel track. Provide a lower track for guiding sashes only. Sashes shall bypass and be removable. Provide flush finger pulls and rubber bumpers at both stiles of each sash.

Retain subparagraph below and delete five subparagraphs above for polypropylene fume hoods.

Fabricate sashes from 0.236-inch- thick, unframed polycarbonate sliding in polypropylene tracks. Counterbalance sashes with PVC-encased weights hung from polypropylene ropes that run over polypropylene pulleys.

Although 1-inch space between airfoil and work top is generally measured vertically, some manufacturers locate airfoil 1 inch in front of front edge of work top; if a particular configuration is required, revise "Airfoil" paragraph below.

* + - * 1. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.

Fabricate airfoil from stainless steel**[ coated with polytetrafluoroethylene or polyvinylidene fluoride]**.

* + - * 1. Light Fixtures: Provide vaporproof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch- thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.

Revise first subparagraph below if a different color is required.

Provide fluorescent tubes with color temperature of 3500 K and minimum color-rendering index of 85.

Retain subparagraph below for perchloric acid or radioisotope fume hoods. Revise if explosion-proof fixtures are required.

Provide vaporproof, acid-resistant, incandescent light fixtures complete with 100-W, Type A, long-life bulbs instead of fluorescent fixtures at perchloric acid and radioisotope fume hoods. Provide two fixtures for hoods up to 60 inches long and one fixture for every 24 inches of length for longer hoods.

* + - * 1. Perchloric Acid Fume Hood Washdown System: Provide perchloric acid fume hoods with washdown system consisting of stainless steel spray nozzles, washdown valve, and associated piping. Design system to thoroughly rinse all surfaces of fume hood interior, including areas behind and above baffles, and to direct rinse water toward drain trough at rear of work top. Provide T-fitting for extending system to additional spray nozzles in exhaust ducts.
        2. Filler Strips: Provide as needed to close spaces between fume hoods**[ or fume hood base cabinets]** and adjacent building construction. Fabricate from same material and with same finish as fume hoods**[ or fume hood base cabinets, as applicable]**.
        3. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.
        4. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.

Retain paragraph below if fume hoods are prewired and prepiped.

* + - * 1. Comply with requirements in other Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.
      1. FUME HOOD **[BASE CABINETS] [BASE STANDS] [WORK TOPS] [TROUGHS] [SINKS] [AND] [SERVICE FITTINGS]**

Coordinate first paragraph below with Drawings and laboratory casework Section. If fume hoods are standalone units with base cabinets that are not similar to laboratory casework used on Project or if no additional laboratory casework is required other than fume hood base cabinets, consider deleting paragraph and copying appropriate requirements from applicable laboratory casework Section and inserting them below.

* + - * 1. Comply with **[Section 123553.13 "Metal Laboratory Casework."] [Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework."] [Section 123553.19 "Wood Laboratory Casework."][ Provide metal base cabinets in finish matching fume hood exterior finish.]**

Note that for a phenolic-composite work top to have a raised edge, the raised edge must be adhesively laminated to the top. A groove that acts as a gutter routed into the surface of the work top around its perimeter might serve as a substitute for a raised edge.

* + - * 1. Work Tops: **[Epoxy] [Phenolic composite] [Epoxy or phenolic composite] [Stainless steel] [As indicated]**.

Revise "Work-Top Configuration" subparagraph below if required. NFPA 45 requires that hoods be provided with a means of containing minor spills.

Work-Top Configuration: Raised (marine) edge with **[beveled] [or] [rounded]** edge and corners.

Where acid storage cabinets are indicated beneath fume hoods, provide holes in work tops as need to accommodate cabinet vents.

Where epoxy sinks occur in epoxy work tops, provide integral sinks bonded to tops with invisible joint line.

Revise first subparagraph below if underside mounting is used.

Where epoxy sinks occur in phenolic-composite work tops, provide drop-in sinks with 1/4-inch thick lip around perimeter of sink.

Where stainless steel sinks, cup sinks, or troughs occur in stainless steel tops, factory weld into one integral unit.

For perchloric acid fume hoods, provide stainless steel work tops with 1/2-inch raised front edge and integral drain trough at back of top with top sloped to trough.

* + - * 1. Cup Sinks: **[Epoxy] [Polypropylene] [Stainless steel], [3-by-6-inch oval] [3-by-9-inch oval] [5-inch diameter] [Material and size as indicated]**.

Provide with **[polypropylene] [stainless steel]** strainers and integral tailpieces.

Provide **[epoxy] [and] [polypropylene]** cup sinks with polypropylene strainers and integral tailpieces.

Provide stainless steel cup sinks with stainless steel strainers and integral tailpieces.

Delete "Work Surface of Floor-Mounted Fume Hoods" paragraph below if room floor serves as work surface of floor-mounted fume hoods or if not applicable. Floor-mounted hoods are sometimes called "walk-in" hoods, but manufacturers prefer not to use this term because it is inherently unsafe to walk into a fume hood. For this reason, it should not be necessary to make floor-mounted fume hood work surfaces accessible to people with disabilities; verify with authorities having jurisdiction. If necessary, insert requirements for appropriate bevel on raised (marine) edge and for access ramp.

* + - * 1. Work Surface of Floor-Mounted Fume Hoods: Integral floor with 1/2-inch- high, raised (marine) edge.

Retain one of three subparagraphs below or revise to suit Project.

Solid epoxy floor, 1 inch thick.

Solid phenolic-composite floor, 1 inch thick.

Stainless steel floor pan.

* + - * 1. Structural Performance of Radioisotope Fume Hood Components: Capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of cabinet drawers and doors:

Work Tops: 200 lb/ft..

Base Cabinets: 75 lb/ft. within cabinets, 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood.

Retain "Fume Hood Base Stands" paragraph below if base stands are used to provide accessibility for people with disabilities. If fume hoods are large enough, base cabinets can be arranged to provide required knee and toe space.

* + - * 1. Fume Hood Base Stands: Welded steel tubing legs, not less than 2 inches square with channel stretchers and aprons. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to aprons. Provide leveling device welded to bottom of each leg.

Structural Performance**[ except for Fume Hood Base Stands for Radioisotope Hoods]**: Capable of withstanding 50-lb/ft. work top, 75 lb/ft. on work top, plus weight of hood, without permanent deformation or excessive deflection.

Structural Performance of Fume Hood Base Stands for Radioisotope Hoods: Capable of withstanding 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood, without permanent deformation or excessive deflection.

"Knee Space" subparagraph below is based on requirements in ICC A117.1.

Knee Space: Provide clear floor space not less than **[30 inches] [36 inches]** wide by 25 inches deep by 27 inches high within fume hood base stands unless otherwise indicated.

Retain one of two options in "Leg Shoes" subparagraph below or delete subparagraph if leg shoes are not required.

Leg Shoes: **[Black vinyl or rubber] [Satin-finished stainless steel]**, open-bottom, slip-on type.

* + - 1. CHEMICAL-RESISTANT FINISH
         1. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
         2. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
         3. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

Insert other chemical-resistance requirements based on specific chemicals to be used in Project's laboratories if required.

Retain one of three options in "Colors for Fume Hood Finish" subparagraph below. If retaining first, indicate colors in a separate schedule.

Colors for Fume Hood Finish: **[As indicated by manufacturer's designations] [Match Director’s Representative's samples] [As selected by Director’s Representative from manufacturer's full range]**.

* + - 1. ACCESSORIES

Usually retain "Airflow Indicator( and Alarm)" paragraph or one of or both "Airflow Indicator" and "Airflow Alarm" paragraphs below. NFPA 45 requires a "measuring device for hood airflow" that is "permanently installed" and indicates "adequate or inadequate hood airflow."

* + - * 1. Airflow Indicator**[ and Alarm]**: Provide each fume hood with manufacturer's standard airflow indicator[ with audible and visual alarm that activates when airflow sensor reading is outside of preset range].

If retaining "Airflow Indicator" and "Airflow Alarm" paragraphs below, coordinate sensor requirement with indicator type chosen.

* + - * 1. Airflow Indicator: Provide each fume hood with airflow indicator of**[ one of]** the following type(s):

Indicator Type: Direct-reading aneroid (Magnehelic-type) gage that measures exhaust duct static pressure of fume hood as an indication of airflow.

Indicator Type: Thermal anemometer that measures fume hood face velocity and indicates whether it is below normal, normal, or above normal.

Indicator Type: Thermal anemometer that measures fume hood face velocity and displays data as digital readout.

* + - * 1. Airflow Alarm: Provide fume hoods with audible and visual alarm that activates when airflow sensor reading is outside of preset range.

Provide with **[thermal-anemometer] [or] [aneroid (Magnehelic-type) gage]** airflow sensor.

Provide with reset and test switches.

Provide with switch that silences audible alarm and automatically resets when airflow returns to within preset range.

"Sash Alarm," "Sash Stops," and "Bypass Grille Blank-off Panel" paragraphs below describe optional features available from most manufacturers for reducing exhaust volume; retain if required.

* + - * 1. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.

Provide with silence and test switches.

* + - * 1. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

Retain "Bypass Grille Blank-off Panel" paragraph below only with bypass fume hoods.

* + - * 1. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
          2. Proceed with installation only after unsatisfactory conditions have been corrected.
       2. INSTALLATION
          1. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

Coordinate first paragraph below with Drawings and with Section 123553.13 "Metal Laboratory Casework," Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework," or Section 123553.19 "Wood Laboratory Casework." If fume hoods are standalone units with base cabinets that are not similar to laboratory casework used on Project or if no additional laboratory casework is required other than fume hood base cabinets, consider deleting below and copying and inserting applicable requirements from Section 123553.13 "Metal Laboratory Casework," Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework," or Section 123553.19 "Wood Laboratory Casework."

* + - * 1. Comply with requirements in **[Section 123553.13 "Metal Laboratory Casework"] [Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework"] [Section 123553.19 "Wood Laboratory Casework"]** for installing fume hood base cabinets, work tops, and sinks.

Delete paragraph below if installation of service fittings is specified elsewhere or if fume hoods are prewired and prepiped.

* + - * 1. Comply with requirements for installing water and laboratory gas service fittings and electrical devices.

Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods unless otherwise indicated.

* + - 1. FIELD QUALITY CONTROL

NFPA 45 requires that fume hoods be field tested when installed. If field testing is included in Section 230593 "Testing, Adjusting, and Balancing for HVAC," delete this article and coordinate requirements with Project's mechanical engineer. If field testing is included in this Section, retain one of two paragraphs below. Retain first paragraph and delete options in subparagraph if AI rating is not specified in "Performance Requirements" Article. Retain first or second paragraph if AI rating is specified in "Performance Requirements" Article. Procedure in second paragraph is more stringent and more expensive than procedure in first paragraph.

* + - * 1. Field test installed fume hoods according to "Flow Visualization and Velocity Procedure" requirements in ASHRAE 110.

Test one installed fume hood, selected by Director’s Representative, for each type of hood installed, according to ASHRAE 110**[ as modified in "Performance Requirements" Article].[ If tested hood fails to meet performance requirements, field test additional hoods as directed by Director’s Representative.]**

* + - * 1. Field test installed fume hoods according to ASHRAE 110**[ as modified in "Performance Requirements" Article]** to verify compliance with performance requirements.

Retain both subparagraphs below with one of two paragraphs above.

Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.

After making corrections, retest fume hoods that failed to perform as specified.

* + - 1. ADJUSTING AND CLEANING
         1. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
         2. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Director’s Representative.
      2. FUME HOOD SCHEDULE
         1. Bench-Top Fume Hood Type**[ FH-<#>]**:

Exterior: **[Steel with chemical-resistant finish] [Fiberglass] [Steel with chemical-resistant finish or fiberglass] [Stainless steel] [Polypropylene]**.

Fifth option in "Ventilation Type" subparagraph below is for use with VAV controls specified in Section 230923 "Direct Digital Control (DDC) System for HVAC. " Restricted-bypass fume hoods are designed primarily for VAV control.

Ventilation Type: **[Constant volume] [Constant volume, with VAV control] [Bypass] [Auxiliary-air bypass] [Restricted bypass] [Restricted bypass, with VAV control]**.

ASHRAE 110 As-Manufactured (AM) Rating: **[AM 0.05 (0.05 ppm)] [AM 0.02 (0.02 ppm)] [AM 0.01 (0.01 ppm)]**.

Rating in "ASHRAE 110 As-Installed (AI) Rating" subparagraph below requires field quality-control testing to verify. HVAC design may affect Contractor's ability to achieve AI rating. See Evaluations.

ASHRAE 110 As-Installed (AI) Rating: **[AI 0.10 (0.10 ppm)] [AI 0.05 (0.05 ppm)]**.

Sash Configuration:

Retain one of three "Operation" subparagraphs below.

Operation: Vertical-sliding, single-hung sash.

Operation: **[Two] [Three] [Four]** horizontal-sliding, bypassing sashes.

Operation: Combination sash consisting of **[two] [three] [four]** horizontal-sliding, bypassing sashes retained in a vertical-sliding, single-hung frame.

Opening Height: 27 to 30 inches.

Work Top: **[Epoxy] [Phenolic composite] [Epoxy or phenolic composite] [Stainless steel]**.

Cup Sinks: **[Epoxy] [Polypropylene] [Stainless steel], [3-by-6-inch oval] [3-by-9-inch oval] [5-inch diameter]**.

Service Fittings:

Water: **[One] [Two]** remote-control, rigid, gooseneck, single-service faucet(s) with vacuum breaker and removable serrated outlet.

Laboratory Gas for **[Air] [Gas (Fuel Gas)] [Vacuum]: [One] [Two] flange-type fitting(s) with [straight] [angled]** outlet and remote-control **[ground-key cock] [ball valve] [needle valve]**.

Electrical: **[One duplex receptacle] [Two duplex receptacles] [One switched receptacle] [One duplex receptacle, switch, and pilot light]** at **[one] [both]** end(s) of hood, mounted on exterior front face of end pilaster.

Provide **[GFCI] [TVSS]** receptacles.

Additional Requirements: Comply with requirements for **[perchloric acid] [radioisotope]** fume hoods.

* + - * 1. Floor-Mounted Fume Hood Type**[ FH-<#>]**:

Exterior: **[Steel with chemical-resistant finish] [Fiberglass] [Steel with chemical-resistant finish or fiberglass] [Stainless steel] [Polypropylene]**.

Fifth option in "Ventilation Type" subparagraph below is for use with VAV controls specified in Section 230923 "Direct Digital Control (DDC) System for HVAC. " Restricted-bypass fume hoods are designed primarily for VAV control.

Ventilation Type: **[Constant volume] [Constant volume, with VAV control] [Bypass] [Auxiliary-air bypass] [Restricted bypass] [Restricted bypass, with VAV control].**

**ASHRAE 110 As-Manufactured (AM) Rating: [AM 0.05 (0.05 ppm)] [AM 0.02 (0.02 ppm)] [AM 0.01 (0.01 ppm)]**.

Rating in "ASHRAE 110 As-Installed (AI) Rating" subparagraph below requires field quality-control testing to verify. HVAC design may affect Contractor's ability to achieve AI rating. See Evaluations.

ASHRAE 110 As-Installed (AI) Rating: **[AI 0.10 (0.10 ppm)] [AI 0.05 (0.05 ppm)]**.

Sash Configuration:

Retain one of two "Operation" subparagraphs below.

Operation: Vertical-sliding, independently operable, double-hung sashes.

Operation: **[Two] [Three] [Four]** horizontal-sliding, bypassing sashes with a 2-inch opening below sashes.

Opening Height: **[58 inches] [66 inches]**.

Floor: **[Epoxy] [Phenolic composite] [Epoxy or phenolic composite] [Stainless steel]**.

Cup Sinks: **[Epoxy] [Polypropylene] [Stainless steel], [3-by-6-inch oval] [3-by-9-inch oval] [5-inch diameter]**.

Service Fittings:

Water: **[One] [Two]** remote-control, rigid, gooseneck, single-service faucet(s) with vacuum breaker and removable serrated outlet.

Laboratory Gas for **[Air] [Gas (Fuel Gas)] [Vacuum]**: **[One] [Two]** flange-type fitting(s) with **[straight] [angled]** outlet and remote-control **[ground-key cock] [ball valve] [needle valve]**.

Electrical: **[One duplex receptacle] [Two duplex receptacles] [One switched receptacle] [One duplex receptacle, switch, and pilot light]** at **[one] [both]** end(s) of hood, mounted on exterior front face of end pilaster.

Provide **[GFCI] [TVSS]** receptacles.

END OF SECTION 115313