SECTION 12 3553.13
METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes:
1. Metal laboratory casework.
2. Utility-space framing at backs of base cabinets.
3. Filler and closure panels.
4. Laboratory countertops.
5. Tables.
7. Laboratory sinks.
8. Gas Cylinder Storage Cabinets
9. Acid and Corrosive Storage Cabinets
10. Flammable Storage Cabinets
11. Laboratory accessories.

B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to metal laboratory casework.

1.02 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Confer conference at Project site.

1.03 COORDINATION
A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachment details.
1. Indicate types and sizes of cabinets.
2. Indicate locations of hardware and keying of locks.
3. Indicate locations and types of service fittings.
4. Indicate locations of blocking and reinforcements required for installing laboratory casework.
5. Include details of utility spaces showing supports for conduits and piping.
6. Include details of support framing system.
7. Include details of exposed conduits, if required, for service fittings.
8. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
9. Include coordinated dimensions for laboratory equipment specified in other Sections.
C. Samples for Verification: For each type of cabinet finish and each type of countertop material, in manufacturer's standard sizes.

1.05 INFORMATIONAL SUBMITTALS
A. Qualification Data: For manufacturer.
B. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard and system structural performance specified in "Performance Requirements" Article.
C. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.06 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

1.07 QUALITY ASSURANCE
A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 M.

1.08 DELIVERY, STORAGE, AND HANDLING
A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.09 FIELD CONDITIONS
A. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.
B. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements, provide Kewaunee Scientific Corporation Alpha System or comparable product by one of the following:
   1. Kewaunee Scientific Corporation (Basis-of-Design)
   2. Mott
C. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
D. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer’s catalog numbers. Other manufacturers’ laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 01 60 00 “Product Requirements.”

2.02 PERFORMANCE REQUIREMENTS
A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
   4. Shelves: 40 lb/sq. ft.

2.03 CASEWORK, GENERAL
A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."
B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by FM Approvals.
C. 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.

2.04 METAL CABINET AND TABLE MATERIALS
A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
B. Nominal Metal Thickness:
   1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch. Except for flammable liquid storage cabinets, bottoms may be 0.036 inch thick.
2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch except 0.048 inch for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches long.

3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch.

4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch.

5. Leveling and Corner Gussets: 0.105 inch.

2.05 AUXILIARY CABINET MATERIALS

A. Acid Storage-Cabinet Lining: 1/4-inch-thick, polyethylene or polypropylene.

B. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.06 COUNTERTOP TABLETOP, SHELF, and SINK MATERIALS

A. Chemical-Resistant Plastic Laminate:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

2. High-pressure decorative laminate, complying with NEMA LD 3, that has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

   a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), amyl acetate, benzene, butyl alcohol, carbon tetrachloride, chloroform, dimethyl formamide, dioxane, ethyl acetate, ethyl alcohol, ethyl ether, formaldehyde (37 percent), gasoline, gentian violet, hydrogen peroxide (3 percent), methyl alcohol, methyl ethyl ketone, methylene chloride, monochlorobenzene, naphthalene, toluene, trichloroethylene, xylene, and zinc chloride (saturated).

   b. Slight Effect: Cresol, tincture of iodine, sodium sulfide (15 percent).

3. Color: As selected by Architect from chemical-resistant, plastic-laminate manufacturer’s full range.

4. Core Materials for Plastic Laminate:

   a. Certified Wood: Core materials shall be produced from wood and wood products certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

   b. Particleboard: ANSI A208.1, Grade M-2; made with binder containing no urea formaldehyde.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Durcon Incorporated

2. Physical Properties:

   a. Flexural Strength: Not less than 10,000 psi.

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

   c. Hardness (Rockwell M): Not less than 100.

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

   e. Heat Distortion Point: Not less than 260 deg F.

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

   a. 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.

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

4. Color: Match Durcon "Graphite".
2.07 METAL CABINETS AND TABLES

A. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt- and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.

B. Cabinet Style: Flush Overlay

C. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

D. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.

E. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.

F. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal.

G. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.

H. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.

I. Tables: Welded tubing legs, not less than 2 inches square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.

J. Leg Shoes: Satin-finished, stainless-steel, open-bottom, slip-on type.

K. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.

1. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from back-to-back panels or of hollow construction to eliminate exposed hemmed or flanged edges.

2. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.

3. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.

2.08 METAL CABINET FINISH

A. General: Prepare, treat, and finish welded assemblies after assembling. 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.

B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework 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.

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

2. Colors for Metal Laboratory Casework Finish: As selected by Architect from manufacturer's full range.
2.09 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.

C. Hinged Door and Drawer Pulls: Solid-aluminum, stainless-steel, or chrome-plated-brass, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
   1. Design: As selected from manufacturer's full range.
   2. Overall Size: As selected from manufacturer's full range.

D. Door Catches: Nylon-roller spring catches. Provide two catches on doors more than 48 inches high.

E. Drawer Slides: Side mounted full extension, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
   1. Provide Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
   2. Provide Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
   3. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-overtravel-extension, ball-bearing type.

F. Locks: Cam or half-mortise type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, Type E07261, Type E07111, or Type E07021.
   1. Provide a minimum of two keys per lock and two master keys.
   2. Provide at all doors, pairs of doors, and drawers.
   3. Keying: Key locks alike within each room; key each room separately.
   4. Master Key System: Key all locks to be operable by master key.

2.10 COUNTERTOPS, SHELVES AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.
   1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2, unless otherwise indicated.
   2. Overflows: Where indicated, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.

C. Epoxy Countertops, Tabletops, and Sinks:
   1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.
      a. Countertop Configuration: Flat, 1 inch thick, with beveled edge and corners, and with drip groove and applied backsplash.
      b. Countertop Construction: Uniform throughout full thickness.
   2. Tabletop Fabrication:
      a. Tabletop Configuration: Flat, 1 inch thick, with beveled edge and corners, and with drip groove at perimeter.
      b. Tabletop Construction: Uniform throughout full thickness.
   3. Sink Fabrication: Molded in one piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch minimum thickness.
      a. Provide with polypropylene strainers and tailpieces.
      b. Provide sinks for drop-in installation with 1/4-inch-thick lip around perimeter of sink.
      c. Provide manufacturer's recommended adjustable support system for table- and cabinet-type installations.

2.11 OVERHEAD SERVICE CARRIERS

A. Unistrut channels supported from structure above equally spaced at 48" on center maximum
   1. Where width of ducts and other construction produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install
supplemental suspension members and hangers in the form of trapezes or equivalent devices.

2. Do not connect or suspend from ducts, pipes, or conduit.

3. Assembly shall be provided with powder coat finish selected from standard colors.

1.4. Services Supported:
   a. Compressed Air
   b. Vacuum
   c. Electrical and Data services as indicated on drawings

B. Cable tray system as manufactured by P/W Industries, Cope Cable Tray or equal, to be suspended from Overhead Service Carrier.

2.12 CEILING SERVICE LINEAR (CSL)

A. 8-inch wide ceiling service linear panel

B. Provide Alpha System Ceiling Service Panel as manufactured by Kewaunee Scientific Corporation. Provide linear panel pre-plumbed and pre-wired for utilities indicted. Coordinate with Mechanical and Electrical Documents

2.12.13 GAS CYLINDER CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Matheson Model 1170 gas cylinder cabinet.

C. Product Requirements:
   1. Meets or exceeds Article 80 UFC requirements
   2. Cabinet: 12 gauge cold rolled steel
   3. Gaskets: Neoprene with oil resistant adhesive
   4. Window: 1/4” wire reinforced safety glass
   5. Paint: 2-part polyurethane; interior and exterior –light gray
   6. Cabinet Floor: Zinc-plated steel
   7. Doors: 1 and 2 cylinder cabinets – one door with left hand hinge
   8. Doors: 3 cylinder cabinet – double door with off-center post
   9. Integral Sprinkler: Fuse rating of 155°F and flow capacity of 35 GPM @ 40 psi
   10. Water Pipe Connection: 1/2” NPT Female

2.132.14 ACID AND CORROSIVE STORAGE CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:


C. Product Requirements:
   1. Doors: Self-close and self latching
   2. Shelves: 1
   3. Capacity: 30 gallon
   4. Dimensions: 46” high x 43” wide x 18” deep

2.142.15 FLAMMABLE STORAGE CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:


C. Product Requirements:
   1. Doors: Self-close and self latching
   2. Shelves: 1
   3. Capacity: 30 gallon
   4. Dimensions: 46” high x 43” wide x 18” deep

2.152.16 LABORATORY ACCESSORIES

A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop unless otherwise indicated.

B. Drying Rack: Polypropylene, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.
   1. Provide tubing from drain outlet to sink
C. Cylinder Restraints:
   1. USA Safety Cylinder Restraint Bracket; Model GB200FS, or equal.

D. Retaining Lip
   1. Wall mounted opening adjustable shelving units.
      a. 3/4” retaining lip at lower shelf only.

E. Three Joint Snorkel Exhaust
   1. Provide Movex model Terfu MT-1500-75 snorkel, Nederman Inc., or equal.
   2. Ceiling mounted Terfu ceiling bracket MTI or equal; coordinate with exhaust duct size and requirements.
   3. Hood type: As selected by owner from manufacturer’s full range.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF CABINETS
   A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
      1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
      2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
      3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
      5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
   B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
      1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
   C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
   D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
   E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF COUNTERTOPS
   A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where indicated on Shop Drawings.
   B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
      1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer’s written instructions to exert a uniform heavy pressure at joints.
   C. Fastening:
      1. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
      2. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch, and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
   D. Provide required holes and cutouts for service fittings.
   E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.04 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

C. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

3.05 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.06 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 12 3553.13
SECTION 23 34 19
LABORATORY MECHANICAL SYSTEMS

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. Section 23 0100 “Basic Mechanical Requirements” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY
A. This Section includes the following:
   1. Air volume control products associated with laboratory fume hoods and rooms.
   2. Fan Filter Units (FFU)
B. Related Sections: The following Sections contain requirements that relate to this Section.
   1. Division 23 Section “Metal Ductwork” contains requirements that relate to this Section.
   2. Division 23 Section “Duct Accessories” for duct flexible connectors.
   3. Division 23 Section “Control Systems” for control devices.

1.3 PERFORMANCE REQUIREMENTS
A. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS
A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound power ratings.
   3. Material gages and finishes, including color charts.
   4. Dampers, including housings, linkages, and operators.
   5. Manufacturer’s standard color chart.
C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
D. Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that include air flow, static pressure, and sound power levels for each of the second through sixth octave bands in dBA.
E. Certifications: Certify that air capacities, pressure drops, and selection procedures meet or exceed specified requirements.
F. Manufacturer’s Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearance requirements.
G. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
H. Maintenance data for air-handling units to include in the operation and maintenance manual specified in Division 01 and in Division 23 Section “Basic Mechanical Requirements.”
I. Operation and Maintenance Data: For fan filter units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE
A. Documented aspiration tests shall have been performed in conjunction with the fan performance test.
B. Sound testing shall be in accordance with AMCA 300.
C. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Lift and support units with the manufacturer’s designated lifting or supporting points.

1.7 PROJECT CONDITIONS
A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

1.8 COORDINATION AND SCHEDULING
A. Coordinate the installation of equipment supports.

1.9 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents for each modular air-handling unit.
   1. Filters: Furnish one (1) additional set for each fan filter unit.
   2. Gaskets: Furnish one (1) additional complete set for each fan filter unit.

1.10 WARRANTY
A. Provide 18-month manufacturer warranty from the date of shipment for all fan filter units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Volume Boxes: Subject to compliance with requirements, provide laboratory air volume control products by one of the following:
   1. Phoenix Controls Corporation.
   4-2. Accutrol, LLC.

B. Fan Filter Units: Subject to compliance with requirements, provide fan filter unit products by one of the following:
   2. Terra Universal Incorporated

2.2 LABORATORY AIRFLOW CONTROL SYSTEM
A. All laboratory airflow controls shall be provided to allow all supply air, general exhaust and fume hood exhaust to operate in a variable flow configuration. All electric actuators shall only be high speed on all control valves.
B. A laboratory airflow control system shall be furnished and installed to control the airflow into and out of laboratory rooms and reheat coils within those rooms. The exhaust flow rate of a laboratory fume hood shall be precisely controlled to maintain the indicated minimum and maximum airflow into the fume hood. The fume hood control shall be of variable air volume type. The laboratory control system shall vary the amount of makeup/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain laboratory pressurization in relation to adjacent spaces (positive or negative) as indicated on the Drawings. The plans and specifications for the laboratory airflow control system are based on systems and equipment manufactured by Phoenix Controls Corporation.
C. Laboratory Airflow Control System Warranty: Warranty shall commence upon the date of shipment and extend for a period of thirty-six (36) months, whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the Owner.
D. Each laboratory space shall have a dedicated laboratory airflow control system.
E. The laboratory airflow control system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood’s exhaust airflow to maintain a constant face velocity.

F. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be between 1.0 to 1.5 feet per second.

G. The hood exhaust airflow control device shall be automatically switched between in-use and standby levels based on operator presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use command value in less than one second from moment of detection with no more than a 5% overshoot or undershoot.

H. The laboratory airflow control system shall maintain specific airflow (+/- 5% of signal) within one second of a change in duct static pressure regardless of the magnitude of the pressure change (within 0.3-inch to 3.0-inch w.c., for low pressure valves, and 0.6-inch to 3.0-inch w.c. for medium pressure valves), airflow change, or quantity of airflow control devices on the manifold.

I. The laboratory airflow control system shall maintain a specific airflow (+/- 5% of signal) with a minimum 16 to 1 turndown to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

J. Airflow Control Valves (ACV):
   1. The airflow control valve shall be a venturi air valve.
   2. All valve controllers shall be shut-off type and high-speed electric actuators only. Coordinate location of each airflow control valve controller installation location individually with floor plans and all Contractor trades. Controllers must be installed in an accessible location for service. All field required changes shall be at the cost of this Contractor and not the Owner.
   3. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure, irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
   4. The airflow control device shall maintain accuracy within ± 5% of signal over an airflow turndown range of no less than 16 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
   5. The airflow control device shall be constructed of one of the following two types, Class A or Class B as described below.
   6. Class A – The airflow control device for non-corrosive airstreams such as supply and general exhaust shall be constructed of 16 gauge aluminum. The device’s shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be spring grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, or polyester, or PPS (polyphenylene sulfide) composite.
   7. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
   8. Class B – The airflow control device for corrosive airstreams such as fume hoods shall have a baked-on corrosion resistant phenolic coating. The device’s shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of Teflon or PPS (polyphenylene sulfide) composite.
9. An electric actuator shall be factory mounted to the valve. Loss of control power shall cause normally open valves to fail to maximum position, and normally closed valves to fail to minimum position.

10. Certification: Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of at least ± 1% of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to ± 5% of signal at a minimum of eight different airflows across the full operating range of the device.

11. All airflow control devices shall be individually marked with device specific, factory calibration data. As a minimum, it should include; tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

12. The airflow control device shall use closed loop control to linearly regulate airflow based on a 0 to 10 volt control signal. The device shall generate a 0 to 10 volt feedback signal that is linearly proportional to its airflow.

K. Neutralizer: Provide a neutralizer to be used in conjunction with general exhaust and supply air valves. See plans for locations.

1. The attenuator shall consist of resonator chambers that are tuned to the output frequencies of the air valve, providing a reduction in sound power levels over the entire sound spectrum.

2. Construction: 24 gauge galvanized steel.

3. Field provided square to round transition is required for single valve units.

4. The pressure drop across the device shall be less than 0.1-inch w.c.

2.3 FAN FILTER UNITS

A. General:

1. The fan filter unit shall be supplied to provide unidirectional supply air at controlled discharge velocities. The units shall include a High Efficiency Particulate Air (HEPA).

2. Modules sizes, electrical characteristics, efficiencies, capacities, and options shall be as scheduled on drawings.

B. Performance:

1. The unit shall provide filtered air tested at an average velocity of 90 fpm (+/- 15 fpm) measured 12 inches from the face of the unit in accordance with IEST-RP-CC0022.2.

2. The room sound level shall be less than 55 dBA when measured at 30 inches from the filter face at 90 fpm average face velocity in accordance with IEST-RP-CC0022.2.

3. The unit is to be factory sealed and tested to assure leakage is consistent with the filter.

C. Construction:

1. Plenum material shall be:
   a. Aluminum.

2. Face material shall be:
   a. Expanded metal grille with powder-coat paint finish

3. Plenum shall be walkable up to 250 lbs.

4. The diffuser plenum shall feature four (4) eyebolts at each plenum corner for securing the unit to structural supports above the ceiling.

5. The 51% free-area perforated distribution plate shall be secured to the face using quarter-turn fasteners with anti-slip, snap-in retainers and stainless steel retainer cables for ease of installation and removal.

6. Inlet: standard round or optional rectangular collar for non-ducted applications.

7. Eye bolts for hanging shall be mounted on the top four (4) corners of the plenum and capable of each supporting 75 lbs.

D. Filters:
1. The filter shall be framed in extruded aluminum with an integral cavity filled with a urethane gel to provide a leak-tight seal between the filter frame and the border.
2. Filter type shall be:
3. High Efficiency Particulate Air (HEPA) filter shall provide 99.997% efficiency on .30 μm particulate, with an initial pressure drop of 0.45” wg at 100 fpm.
4. Filter shall be UL 900 classified.
5. Filter pack depth shall be 2.5”.
6. Filter media shall be borosilicate micro-fiberglass.
7. Filter shall be:
   a. Bench top removable and replaceable, mounted in an extruded aluminum frame with an upstream gasket. Bench top replaceable filters shall be supplied with a room-side accessible static pressure port in an extruded aluminum center divider.

E. Plenum Finish shall be:
1. All aluminum components shall have B12 White baked-on powder coat finish.
   a. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
   b. The paint film thickness shall be a minimum of 2.0 mils.
   c. The finish shall have a hardness of 2H.
   d. The finish shall withstand a minimum salt spray exposure of 1000 hours.
   e. The finish shall have an impact resistance of 80 in-lb.

F. Face and frame finish shall be:
1. All aluminum components shall have White B12 Standard baked-on powder coat finish.
   a. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
   b. The paint film thickness shall be a minimum of 2.0 mils.
   c. The finish shall have a hardness of 2H.
   d. The finish shall withstand a minimum salt spray exposure of 1000 hours.
   e. The finish shall have an impact resistance of 80 in-lb.

G. Fan:
1. The centrifugal type fan shall be supplied with rubber mounts to isolate the motor/blower assembly from the diffuser plenum. Fans are to be of metal construction with a direct drive:
   a. Forward curved impeller
   b. Backward curved impeller
2. Plastic construction shall not be acceptable.

H. Electrical Systems:
1. Single point power connection.

I. Fan Motor:
1. The fan motor shall be:
   a. Electrically Commutated Motor (ECM):
      1) Constant Torque Program
         a) A constant torque program shall be provided to allow the ECM to vary the airflow with fluctuations in both upstream static pressure and filter pressure drop.
         b) The constant torque program shall prevent unexpected motor operation or motor shutdown due to upstream static pressure fluctuations.
         c) The constant torque program shall be used for ducted applications where fluctuations in upstream pressure may occur.
      2) Constant Flow Program
a) A constant flow program shall be provided to allow the ECM to compensate for fluctuations in both upstream static pressure and filter pressure drop, providing constant airflow.

b) The constant flow program shall be used for non-ducted applications where the inlet static pressure is zero or slightly negative.

c) Fan motor shaft directly connected to fan and isolated from casing to prevent transmission of vibration.

2. Fan motor shall have internal thermal and overload protection.
3. Fan motor shaft shall be directly connected to the fan impeller, and isolated from casing to prevent transmission of vibration.
4. Fan motor shall be supplied with a motor speed controller (select one):
   a. ECM standard speed controller
      1) The ECM speed controller shall operate on 24 VAC supply voltage.
      2) The ECM speed controller shall have dual outputs to control up to two motors simultaneously.
      3) The ECM speed controller shall be supplied with a BAS interface to accept 2-10 VDC signal for variable speed remote control, as well as be able to remotely shut off via BAS signal.
      4) The ECM speed controller shall be supplied as a wall mounted kit, shipped loose for field installation.

J. Options:
  1. Filter replacement style:
  2. Bench Top replaceable filter

K. Pre-filter:
  1. Non-ducted units:
     a. Unit shall be provided with 25-30% MERV 4 washable pre-filter.
  2. Ducted units:
     a. Unit shall be provided with 25-30% MERV 4 washable pre-filter with side access filter housing.

L. Disconnect Switch: A factory supplied disconnect switch shall be provided for disconnection of power to the terminal block.

M. Power cord:
  1. An eight foot (2.4 m) power cord shall be supplied for use with a 115 V power supply.

N. Motor/blower access:
  1. Room side access

O. Filter status indicator shall be communicated by:
  1. LED Indicator light:
     a. The LED indicator light shall be visible from the occupied area to determine the filter loading status without opening the diffuser.
     b. The LED light shall turn from green to yellow when the pressure drop across the filter exceeds the specified limit.
     c. The LED kit shall be provided with a switch, factory pre-calibrated for 150% of initial clean filter pressure drop.
     d. The LED kit shall operate on a 24 VAC power supply, provided by others.

P. Motor status shall be communicated by:
  1. Motor status LED:
     a. The LED indicator light shall be visible from the occupied area to determine the motor operating status without opening the diffuser.
     b. The motor LED shall be green to indicate normal motor operation, and that the unit static pressure is above 0.2" wg.
c. The motor LED shall turn from green to red when the motor is not in operation, and when the unit static pressure is below 0.2” wg.

2. Motor status BAS signal:
   a. The factory- calibrated motor BAS signal shall close a dry contact to generate a BAS signal when the motor is not operating.
   b. Unit shall be field wired to the terminal block according to manufacturer’s instructions.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the fans, laboratory air volume control products, and other system components. Do not proceed with installation until unsatisfactory conditions have been corrected.
   B. Verify that conditions are suitable for installation.
   C. Verify that field measurements are as shown on the drawings.

3.2 INSTALLATION
   A. Install fans according to manufacturer’s written instructions.
   B. Install units with clearances for service and maintenance.
   C. Install in accordance with manufacturer’s instructions.
   D. See drawings for the size (s) and locations of fan filter unit inlets.
   E. Support components individually from structure in accordance with SMACNA (SRM).
   F. Do not support components from ductwork.
   G. Laboratory Airflow Control System Installation:
      1. Install the sash sensors, interface boxes, and fume hood monitor on the fume hood under initial supervision of the laboratory airflow control system supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.
      2. Install the laboratory control unit (if panel-mounted) and wall-mounted power supply (as required) in an accessible location in the designated laboratory room.
      3. Terminate and connect all cables as required. In addition, integrated laboratory control unit connectors shall be furnished by this contractor.
      4. Install all airflow control devices in the ductwork and connect all airflow control valve linkages.
      5. Connect Neutralizer with sheet metal screws. Seal any gaps with duct sealant. Assemble multiple units according manufacturer’s recommendation. Install attenuator with airflow direction arrow pointing in the direction of airflow. The attenuator shall be installed between the valve and the first air device (diffuser, grille, or register).
      6. Perform all controls work in complete and strict accordance with Division 23 Section “Control Systems.”

3.3 CONNECTIONS
   A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories.
   B. Electrical: Conform to applicable requirements in Division 26 Sections. Connect wiring and ground equipment according to Division 26 Sections.

3.4 FIELD QUALITY CONTROL
   A. Manufacturer’s Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.5 ADJUSTING & CLEANING
   A. Adjust damper linkages for proper damper operation.
   B. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
C. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.
D. Lubricate all bearings.
E. Ensure supply air to the fan filter units by performing pitot traverse on the main supply duct.
F. Balance outlets according to manufacturer’s recommendations.
G. Verify that field measurements are as shown on the drawings.

3.6 COMMISSIONING
A. Perform the following operations and checks before startup of exhaust fans:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices, and that connections for ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operation. Reconnect fan drive system.
   5. Verify lubrication for bearings and other moving parts.
   6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
B. Starting procedures for fans are as follows:
   1. Energize motor; verify proper operation of motor, drive system, and fan wheel.
   2. Adjust fan to indicated RPM.
   3. Measure and record motor voltage and amperage.
   4. Replace fan and motor as required to achieve design conditions.

3.7 DEMONSTRATION
A. Train Owner’s maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
B. Review data in the operation and maintenance manuals. Refer to Division 01.
C. Schedule training with Owner, through Architect, with at least 7 days’ advance notice.
D. Demonstrate operation of products specified in this Section. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each product.
E. Laboratory Airflow Control System Start-Up: System start-up shall be provided by a factory authorized representative of the laboratory airflow control system manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, and general exhaust) and system programming.
F. The laboratory airflow control system supplier shall furnish a minimum of four hours of owner training, by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves, and general troubleshooting procedures. Operation and Maintenance manuals, including as-built wiring diagrams and component lists shall be provided for each training attendee.

END OF SECTION