

SECTION 237313 – MODULAR CENTRAL STATION AIR HANDLING UNITS

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(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

- A. This section includes the requirements for modular indoor central station air handling units as follows: <Edit below for particular project>
 - 1. Unit casings.
 - 2. Fans, drives and motors.
 - 3. Coil selections.
 - 4. Air filtration.
 - 5. Dampers and filter mixing sections.
 - 6. Air to air energy recovery system.
- B. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing dampers, etc.

1.3 PERFORMANCE REQUIREMENTS <Edit for particular project>

- A. Delegated Design: Design vibration isolation and seismic restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self supporting and capable of withstanding 133% of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.
- C. Seismic Performance: Air handling units shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified [and the unit will be fully operational after the seismic event]." <Edit for project>

1.4 ACTION SUBMITTALS

- A. Product Data: For each air handling unit indicated.
1. Unit dimensions and weight.
 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 3. Fans:
 - a. Certified fan performance curves with system operating conditions indicated.
 - b. Certified fan sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 4. Certified coil performance ratings with system operating conditions indicated.
 5. Dampers, including housings, linkages, pressure drop data and operators.
 6. Filters with performance characteristics, including pressure drop data.
- B. Leed Submittals: <Delete if not LEED project>
1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Delegated Design Submittal: For vibration isolation [and seismic restraints] indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 2. Design Calculations: Calculate requirements for selecting vibration isolators [and seismic restraints] and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Mechanical room layout and relationships between components and adjacent structural and mechanical elements.
 2. Support location, type, and weight.
 3. Field measurements.

- B. Seismic Qualification Certificates: For air handling units, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Source quality control reports.
- D. Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of the final approved submittal for each product in the operation and maintenance manuals.
- B. Maintenance Material Submittals: <Edit for particular project>
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Filters: One set(s) for each air handling unit.
 - b. Gaskets: One set(s) for each access door.
 - c. Fan Belts: One set(s) for each air handling unit fan.

1.7 QUALITY ASSURANCE

- A. 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.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air handling units and their components shall be factory tested according to ARI 430, "Central-Station Air Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

- F. Comply with NFPA 70.

1.8 QUALITY CONTROL

- A. Fan Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural steel support members, if any, with actual equipment provided.

1.10 WARRANTY/GUARANTEE

- A. See Division 23 Specification Section "Basic Mechanical Requirements – HVAC" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Modular indoor central station air handling units shall be designed and selected, for the intended use, in accordance with the scheduled capacities on the drawings and the requirements of this specification.
- B. Manufacturers:
- C. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. Air Enterprises, Inc.
 - 2. Carrier Corporation; a member of the United Technologies Corporation Family.
 - 3. Dunham Bush, Inc.
 - 4. McQuay International
 - 5. Trane; American Standard Inc.

6. YORK International Corporation.

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings: Comply with the following:

1. Forming: Form walls, roofs, and floors with at least two (2) breaks at each joint.
2. Medium and high pressure units shall be constructed with additional bracing and supports. Units rated at 5.5 inches wg and higher shall be connected to accessories sections with double thickness neoprene coated flexible connection. <Delete if total static pressure less than five (5) inch wg>
3. Casing Joints: Sheet metal screws or pop rivets.
4. Sealing: Seal all joints with water resistant sealant.
5. Factory Finish for Galvanized Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Casing Insulation and Adhesive: Comply with the following:

1. Materials: ASTM C 1071, Type II.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Mechanical fasteners shall be galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner Materials: Liner materials applied in this location shall have airstream surface coated with a temperature resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
3. Location and Application: Encased between outside and inside casing. <Retain when specifying double wall AHUS>

C. Inspection and Access Panels and Access Doors: Comply with the following:

1. Panel and Door Fabrication: Panels and doors shall be formed and reinforced, single wall or double wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:

- a. Fasteners: Provide two (2) or more camlock type for panel lift out operation. Arrangement shall allow panels to be opened against air pressure differential.
 - b. Gasket: Neoprene gaskets shall be applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air handling unit's internal components.
3. Access Doors: Comply with the following:
- a. Hinges: Provide a minimum of two (2) ball-bearing hinges or stainless steel piano hinge and two (2) wedge lever type latches, operable from inside and outside. Arrange doors to be opened against air pressure differential.
 - b. Gasket: Neoprene gaskets shall be applied around entire perimeters of panel frames.
 - c. Windows: Fabricate windows in fan section doors of double glazed, wire reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals. <Delete if not required>
4. Locations and Applications: Comply with the following:
- a. Fan Section: Doors.
 - b. Access Section: Doors.
 - c. Coil Section: Inspection and access panel.
 - d. Damper Section: Inspection and access panels.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - f. Mixing Section: Doors.
- D. Condensate Drain Pans: Comply with the following: <Edit for Project.>
1. Slope: Drain pans shall be fabricated with [1%] [2%] slope in at least two (2) planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.

<Retain options below fro LEED projects>
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - b. Depth: A minimum of two (2) inches deep.
 2. Single-wall, stainless steel sheet. <Edit for project>
 3. Double-wall, stainless steel sheet with space between walls filled with foam insulation and moisture tight seal. <Edit for project>

4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one (1) end of pan.
 - a. Minimum Connection Size: NPS 1.
 5. Pan-Top Surface Coating: Surface coating shall be asphaltic waterproofing compound.
 6. Intermediate Drain Pan - Stacked Coils: Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- E. Air Handling Unit Mounting Frame: Provide formed galvanized steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" when air handling unit frame is anchored to building structure.

2.3 FAN, DRIVE, AND MOTOR SECTION

- A. General: Sound power level ratings shall comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from Laboratory Test Data" and shall be the result of tests made in accordance with AMCA standard 300 "Test Code for Sound Rating" Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- B. Fan Performance Rating: Unit's fans performance ratings for flow rate, pressure, power, air density, speed or rotation, and efficiency shall be factory tested and ratings established in accordance with AMCA Standard 210/ASHRAE Standard 51 – Laboratory Methods of Testing Fans for Rating.
- C. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
 1. Shafts: Shafts shall be designed for continuous operation at maximum rated fan speed and motor horsepower, and with field adjustable alignment.
 - a. Turned, ground, and polished hot rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70% of first critical speed at top of fan's speed range.
- D. Centrifugal Fan Housings: Housings shall be formed and reinforced steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1. Bracing: Provide steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal Flanged, Split Housing: Bolted construction.
 3. Housing for Supply Fan: Attach housing to fan section casing with metal-edged flexible duct connector.
 4. Flexible Connector: Factory fabricated with a fabric strip [3-1/2 inches] [5-3/4 inches] wide attached to two (2) strips of 2-3/4 inch wide, 0.028 inch thick, galvanized steel sheet or 0.032 inch thick aluminum sheets; select metal compatible with casing. <Edit for Project>
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
 - 1) Fabric Minimum Weight: 26 oz./sq. yd..
 - 2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3) Fabric Service Temperature: - 40°F to + 200°F.
- E. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.
- F. Fan Wheels: Fan wheels shall be as follows: <Edit for Project>
 1. Backward Inclined, Centrifugal Fan Wheels: Single width single inlet and double width double inlet construction with curved inlet flange, backplate, backward inclined blades welded or riveted to flange and backplate; cast iron or cast steel hub riveted to backplate and fastened to shaft with set screws.
 2. Forward Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast steel hub swaged to backplate and fastened to shaft with set screws.
 3. Airfoil, Centrifugal Fan Wheels: Smooth curved inlet flange, backplate, and hollow die formed airfoil shaped blades continuously welded at tip flange and backplate; cast iron or cast steel hub riveted to backplate and fastened to shaft with set screws.
- G. Axial Fans: Fan wheel and housing, straightening vane section, factory mounted motor with [belt drive] or [direct drive], an inlet cone section, and accessories. <Edit for Project>
 1. Variable Pitch Fans: Internally mounted [pneumatic] [electric] [electronic] actuator, externally mounted positive positioner, and mechanical blade pitch indicator. <Edit for Project>
 2. Housings: [Steel] [Galvanized steel] [Aluminum]. <Edit for Project>

- a. Inlet and Outlet Connections: Flange type.
 - b. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.
- H. Fan Shaft Bearings: Comply with the following:
1. Grease Lubricated Bearings: Self aligning, pillow block type, ball or roller bearings with adapter mount and two (2) piece, cast iron housing with grease lines extended to outside unit.
- I. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.4 service factor based on fan motor. <Delete if Direct Drive Fans are specified>
1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 2. Motor Pulleys: Adjustable pitch for use with 15 hp motors and smaller; fixed pitch for use with motors larger than 15 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple belt drives.
 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046 inch thick, three quarter (3/4) inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
- J. Discharge Dampers: Heavy duty steel assembly with channel frame and sealed ball bearings, and [opposed] [parallel] blades constructed of two (2) plates formed around and welded to shaft, with blades linked out of air stream to single control lever. <Edit for Project>
- K. Internal Vibration Isolation and Seismic Control: Fans shall be factory mounted on steel channel base with manufacturer's standard [restrained] vibration isolation mounting devices having a minimum static deflection of one (1) inch. <Edit for Project>
1. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" when fan-mounting frame and air handling unit mounting frame are anchored to building structure. <Retain when seismic is required>
- L. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Specification Section "Motor Requirements for HVAC Equipment."
1. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.

2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
4. Mount unit mounted disconnect switches on interior of unit.

M. Variable Frequency Drives See Division 26 Specification Section “Variable Frequency Drives” for requirements.

2.4 COIL SECTION

A. General Requirements for Coil Section: Comply with the following:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.
5. Coils shall be counter flow design, air to water.
6. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" when coil mounting frame and air handling unit mounting frame are anchored to building structure.

B. Coils, General: Drainable, rigidly supported across the full face of the coil, and pitched to allow drainage.

1. Fins: Aluminum or copper, constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.
2. Tubes: Seamless copper.
3. Coil Casing: Galvanized steel.
4. Headers for Water Coils: Steel or cast iron, with connections for drain valve and air vent and threaded piping connections. <Coils are also available with red brass tubes for higher operating pressures.> <Edit for Project>

C. Direct Expansion Refrigerant Coils: <Delete if not applicable to project> Designed and fabricated in compliance with ASHRAE Standard 15, “Safety Code for Mechanical Refrigeration.” Coils shall have the following features:

1. Suction Headers and Distributor Tubes: Seamless copper.
2. Venturi type refrigerant distributor, designed for low pressure drop, arranged for down feed with solder connections, and having a maximum of twelve (12) circuits for each distributor.

- a. Coils with more than twelve (12) circuits shall have two (2) distributors.
- b. Split circuit coils shall have two (2) distributors.

2.5 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section: Comply with the following:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
4. Spare Filters: Provide two (2) sets of spare filters for each type of filter media. One (1) set of spare of filters shall be installed in the air handling unit for the testing and balancing procedure. The second set of spare filter media shall be turned over to the owner.
5. Air Handling Unit Operation during Construction: When the air handling units need to be operated during construction the contractor shall provide the filters for the air handling unit. These filters shall be separate from the specified filter media. Install specified filter media prior to final test and balance of air handling systems.

B. Filter Types: Comply with the following:

1. Disposable Pre Filter Media:
 - a. Filter Media: Filter media shall have an average efficiency of 25% to 30% and an average arrestance of 90% to 92% in accordance with ASHRAE Test Standard 52.2. <Select one of the below list>
 - 1) Four (4) inch Filter: Filter face area shall contain not less than 11 pleats per linear foot. Initial resistance at 500 fpm shall not exceed .27 inch wg.
 - 2) Two (2) inch Filter: Filter faced area shall contain not less than 15 pleats per linear foot. Initial resistance at 500 fpm shall not exceed .28 inch wg.
 - 3) One (1) inch Filter: Filter face area shall contain not less than 16 pleats per linear foot. Initial resistance at 350 fpm shall not exceed .25 inch wg.
 - b. Media Support Grid: Grid shall be welded wire on one (1) inch centers with an open area of not less than 96%. Grid shall be bonded to the media

to eliminate oscillation and pull away. The grid shall be formed to affect a radial pleat, allowing total use of media.

- 1) Enclosing Frame: The frame shall be a rigid, high wet-strength beverage board, with diagonal support members bonded to the air entering and exiting side of each pleat. The enclosing frame shall be chemically bonded to the filter pack.

c. Final Filter Media – Pleated Type:

- 1) Air filters shall be high performance, deep pleated, totally rigid and totally disposable type. Each filter shall consist of high density media, media support grid, contour stabilizers, diagonal support bracing and enclosing frame. <Select one of the below list>
 - a) 40% to 45% Efficient – Filter media shall be of high density micro fine glass fibers, laminated to a reinforcing backing to form a lofted filter blanket. The filter media shall have an average efficiency of 40-45% on ASHRAE Test Standard (52.2). It shall have an average arrestance of not less than 96% on that standard. Filters shall be listed by Underwriters' Laboratories as Class (2) (1). <Select Class>
 - b) 60% to 65% Efficient - Filter media shall be of high density micro fine glass fibers, laminated to a reinforcing backing to form a lofted filter blanket. The filter media shall have an average efficiency of 60-65% on ASHRAE Test Standard (52.2). It shall have an average arrestance of not less than 97% on that standard. Filters shall be listed by Underwriters' Laboratories as Class (2) (1). <Select Class>
 - c) 80% to 85% Efficient - Filter media shall be of high density micro fine glass fibers, laminated to a reinforcing backing to form a lofted filter blanket. The filter media shall have an average efficiency of 80-85% on ASHRAE Test Standard (52.2). It shall have an average arrestance of not less than 98% on that standard. Filters shall be listed by Underwriters' Laboratories as Class (2) (1). <Select Class>
 - d) 90% to 95% Efficient – Filter media shall be of high density micro fine glass fibers, laminated to a reinforcing backing to form a lofted filter blanket. The filter media shall have an average efficiency of 90-95% on ASHRAE Test Standard 52.2). It shall have an average arrestance³ of not less than 99% on that standard. Filters shall be listed by Underwriters' Laboratories as Class (2) (1). <Select Class>

- 2) Media Support Grid – The media support shall be a welded wire gird with an effective open area of not less than 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away. The media support grid shall be formed in such a manner that it affects tapered radial pleat design. The grid shall be designed to support the media both vertically and horizontally.
 - 3) Contour Stabilizers – Contour stabilizers shall be galvanized steel and shall be permanently installed on both the air entering and air exiting sides of the filter media pack to insure that the tapered radial pleat configuration is maintained throughout the life of the filter. There shall be four contour stabilizers on the air entering side and six on the air exiting side. The filter shall be capable of withstanding 10 inch wg. pressure drop without noticeable distortion of the media pack.
 - 4) Enclosing Frame – The enclosing frame shall be constructed of galvanized steel. It shall be assembled in such a manner that a rigid and durable enclosure for the filter pack is affected. The media pack shall be mechanically and chemically bonded to the inside of the periphery of the enclosing frame, thus eliminating the possibility of air by-pass. The enclosing frame shall be equipped with galvanized steel protective diagonal support braces on both the air entering and air exiting sides of the filters. The diagonal support braces shall be mechanically fastened to each contour stabilizer.
- d. Final Filter Media – Bag Type:
- 1) Air filters shall be high performance extended area disposable type filters. Each filter shall consist of high density glass microfiber media with a chemically bonded backer, individual pockets and a corrosion resistant galvanized steel enclosing frame. **<Select from efficiencies below>**
 - a) 35% to 45% Efficient: Filter media shall be of high density glass microfibers, reinforced with a backing to form a lofted filter blanket. The filter media shall have an average efficiency of 35-40% on ASHRAE 52.2 and shall have an average arrestance of not less than 96% on that standard. **<Select one>**
 - b) 45% to 50% Efficient: Filter media shall be of high density glass microfibers, reinforced with a backing to form a lofted filter blanket. The filter media shall have an average efficiency of 45-50% on ASHRAE 52.2 and shall have an

- average arrestance of not less than 96% on that standard.
<Select one>
- c) 60% to 65% Efficient: Filter media shall be of high density glass microfibers, reinforced with a backing to form a lofted filter blanket. The filter media shall have an average efficiency of 60-65% on ASHRAE 52.2 and shall have an average arrestance of not less than 97% on that standard.
<Select one>
 - d) 80% to 85% Efficient: Filter media shall be of high density glass microfibers, reinforced with a backing to form a lofted filter blanket. The filter media shall have an average efficiency of 80-85% on ASHRAE 52.2 and shall have an average arrestance of not less than 98% on that standard.
<Select one>
 - e) 90% to 95% Efficient: Filter media shall be of high density glass microfibers, reinforced with a backing to form a lofted filter blanket. The filter media shall have an average efficiency of 90-95% on ASHRAE 52.2 and shall have an average arrestance of not less than 99% on that standard.
<Select one>
- 2) Pocket Construction – Pocket shall consist of glass microfibers chemically bonded to a reinforced UL Class 1 or Class 2 backing.
<Select one> the pockets shall be equipped with a minimum of 40 support points per square foot of the filter media. All stitching points shall be completely sealed with Foam-seal adhesive. The pockets shall be chemically adhered around the periphery of the galvanized steel retainers. Retainers shall have rolled edges to reduce possible cuts to media, or lacerations to installers.
 - 3) Enclosing Frame- Enclosing frame shall be constructed of a “J” return channel of galvanized steel. The channel shall be 7/8 inch, or optional 1-1/8 inch.
2. Mounting Frames: Downstream corners of holding device shall have cushion pads to protect media. Bolted filter sealing mechanism shall mount and continuously seal each individual filter.
- C. Filter Gauge: Comply with the following:
- 1. Three and one half (3-1/2) inch diameter, diaphragm actuated dial in metal case.
 - 2. Vent valves.
 - 3. Black figures on white background.
 - 4. Front recalibration adjustment.
 - 5. 2% of full scale accuracy.

6. Range: [0 to 0.5 inch wg] [0 to 1.0 inch wg] [0 to 2.0 inch wg] [0 to 3.0 inch wg] [0 to 4.0 inch wg]. <Edit for Project>
7. Accessories: Static pressure tips with integral compression fittings, one quarter (1/4) inch [aluminum] [plastic] tubing, and two (2) or three (3) way vent valves. <Edit for Project>

2.6 DAMPERS AND COMBINATION FILTER MIXING SECTION

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2% of air quantity at two thousand (2,000) fpm face velocity through damper and four (4) inch wg pressure differential.
- B. Damper Operators: Comply with requirements in Division 23 Specification Sections for "Building Automation Systems."
- C. Face and Bypass Dampers: Opposed blade, galvanized steel dampers with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized steel frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
- D. Outdoor and Return Air Mixing Dampers: Parallel blade, galvanized steel dampers mechanically fastened to steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
- E. Mixing Section: Multiple blade, air mixer assembly located immediately downstream of mixing section.
- F. Combination Filter and Mixing Section:
 1. Cabinet support members shall hold two (2) inch thick, pleated, flat, permanent or throwaway filters.
 2. Multiple blade, air mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

2.7 AIR TO AIR ENERGY RECOVERY SYSTEMS

- A. Energy Recovery Systems: See Division 23 Section "Custom Air Handling Units and Energy Recovery Systems" for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

- B. Examine casing insulation materials and filter media before air handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing in for hydronic, piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

- 1. Install air handling units on cast in place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Architectural Specification Section's "Cast in Place Concrete." and/or "Miscellaneous Cast in Place Concrete."
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
- B. Suspended Units: Suspend [and brace] units from structural steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems." Arrange installation of units to provide access space around air handling units for service and maintenance.
 - C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
 - D. Install filter gauge, static pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air handling unit to allow service and maintenance. Pipe coils for counter flow arrangement.
- C. Connect piping to air handling units mounted on vibration isolators with flexible connectors.

- D. Connect condensate drain pans using [NPS 1-1/4] <Insert pipe size>, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. <Edit for Project>
- E. Hot and Chilled Water Piping: Comply with applicable requirements in Division 23 Specification Section “HVAC Piping Systems and Specialties.”
- F. Refrigerant Piping: Comply with applicable requirements in Division 23 Specification Section “HVAC Piping Systems and Specialties.”
- G. Connect duct to air handling units with flexible connections. Comply with requirements in Division 23 Specification Section "HVAC Duct Systems and Accessories."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Automatic Roll Filter Operational Test: Operate filters to demonstrate compliance with requirements. Test for leakage of unfiltered air while system is operating.
 - 5. HEPA Filter Operational Test: Pressurize housing to a minimum of three (3) inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
 - 6. HEPA Filter Operational Test: Pressurize housing to a minimum of three (3) inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter for air leaks according to ASME N510, pressure decay method.
 - 7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connection's to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations.
 - 5. Verify that bearings, and other moving parts are lubricated with factory-recommended lubricants.
 - 6. Verify that face and bypass dampers provide full face flow.
 - 7. Verify that outdoor and return air mixing dampers open and close, and maintain minimum outdoor air setting.
 - 8. Comb coil fins for parallel orientation.
 - 9. Install new, clean filters.
 - 10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air handling units include the following:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
 - 2. Measure and record motor electrical values for voltage and amperage.
 - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 23 Specification Section "Testing, Adjusting, and Balancing HVAC Systems" for air handling system testing, adjusting, and balancing.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air handling unit and air distribution systems and after completing startup service, clean air handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the owner's maintenance personnel to adjust, operate, and maintain air handling units.

END OF SECTION 237313