SECTION 234133 - HIGH-EFFICIENCY PARTICULATE FILTRATION

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

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.

1.2 SUMMARY

A. Section Includes:

1. HEPA rigid-cell box filters.
2. HEPA V-bank cell filters.
3. HEPA filter diffusers.
4. HEPA filter fan modules.
5. ULPA filters.
6. 95 percent DOP filters.
7. Front- and rear-access filter frames.
8. Side-service housings.
9. Filter gages.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide [**one**] <**Insert number**> complete set(s) of filters for each filter bank. If system includes prefilters, provide only prefilters.
2. Provide [**one**] <**Insert number**> container(s) of red oil for inclined manometer filter gage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Comply with IEST-RP-CC001.5.

C. Comply with UL 586.

D. Comply with IEST-RP-CC007.2.

E. Comply with NFPA 90A and NFPA 90B.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended use.

2.2 HEPA RIGID-CELL BOX FILTERS

A. Description: Factory-fabricated, disposable, packaged air filters with media perpendicular to airflow and with holding frames.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Filter Unit Class: UL 900, [**Class 1**] [**Class 2**].

C. Media: Fibrous material, constructed so individual pleats are maintained under rated-airflow conditions.

1. Internal Separators: [**None**] [**Aluminum in media folds**].
2. Gasket Material: [**None**] [**Neoprene**] [**Blue gel**].
3. Gasket Location: [**None**] [**Upstream**] [**and**] [**Downstream**].
4. Faceguard Material: [**Aluminum**] [**Stainless steel**].
5. Faceguard Location: [**None**] [**Upstream**] [**and**] [**Downstream**].

D. Filter-Media Frames:

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
2. Materials: [**Stainless steel**] [**Fire-retardant plywood**] [**Fabricated aluminum**] [**Fire-retardant particleboard**] [**Galvanized sheet**] [**Non-fire-retardant particleboard**].
3. Style: [**Box**] [**Double-turned flange**] [**Deep channel**] [**Double-turned flange, one side**].

E. Mounting Frames: Welded galvanized steel with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 HEPA V-BANK CELL FILTERS

A. Description: Factory-fabricated, disposable, packaged air filters with media at an angle to airflow and with holding frames.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Filter Unit Class: UL 900, [**Class 1**] [**Class 2**].

C. Media: Fibrous material, constructed so individual pleats are maintained under rated-airflow conditions.

1. Internal Separators: [**None**] [**Aluminum in media folds**].
2. Gasket Material: [**None**] [**Neoprene**] [**Blue gel**].
3. Gasket Location: [**None**] [**Upstream**] [**and**] [**Downstream**].
4. Faceguard Material: [**Aluminum**] [**Stainless steel**].
5. Faceguard Location: [**None**] [**Upstream**] [**and**] [**Downstream**].

D. Filter-Media Frames:

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2. Materials: [**Stainless steel**] [**Fire-retardant plywood**] [**Fabricated aluminum**] [**Fire-retardant particleboard**] [**Galvanized sheet**] [**Non-fire-retardant particleboard**].
3. Style: [**Box**] [**Double-turned flange**] [**Deep channel**] [**Double-turned flange, one side**].

E. Mounting Frames: Welded galvanized steel with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.4 HEPA FILTER DIFFUSERS

A. Description: Factory-fabricated, individually ducted, HEPA filter-holding ceiling modules.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with glass filament separators.

1. Media to Module Side Bond: Urethane sealant.
2. Media to Frame Side Bond: [**Polyurethane foam**] [**Silicone**] [**Neoprene adhesive**] [**Fiberglass-mat packing**] [**Thermosetting sealant**] [**Knife edge in fluid-filled channel**].
3. Application: [**Class 100**] [**Class 10**] [**Class 1**] <**Insert class**> clean room.

C. Casing:

1. Configuration: [**Ducted inlet**] [**Plenum inlet**] [**Plenum inlet with prefilter**].
2. Module Material: Extruded aluminum, 16 gage with mill finish.
3. Suspension: Ceiling grid.

D. Accessories:

1. Diffusion damper.
2. Diffusion-damper adjustment port.
3. Filter test port.

2.5 HEPA FILTER FAN MODULES

A. Description: Factory-fabricated, HEPA filter ceiling module with fan.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Casing:

1. Configuration: [**Ducted inlet**] [**Plenum inlet**] [**Plenum inlet with prefilter**].
2. Module Material: Extruded aluminum, 16 gage with mill finish.
3. Suspension: [**Ceiling grid**] [**Independent**].

C. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with [**aluminum separators**] [**vinyl-coated aluminum separators**] [**separators of ribbons of filter media**].

1. Frame Material: [**3/4-inch- (19-mm-) thick, fire-retardant plywood**] [**3/4-inch- (19-mm-) thick, fire-retardant particleboard**] [**3/4-inch- (19-mm-) thick plywood**] [**3/4-inch- (19-mm-) thick particleboard**] [**Galvanized steel**] [**Aluminized steel**] [**Cadmium-plated steel**] [**Stainless steel**] [**Aluminum**].
2. Media to Frame Side Bond: [**Polyurethane foam**] [**Silicone**] [**Neoprene adhesive**] [**Fiberglass-mat packing**] [**Thermosetting sealant**] [**Knife edge in fluid-filled channel**].
3. Face Gasket: [**Neoprene expanded rubber**] [**Ceramic fiber**] [**Silicone**].
4. Faceguard: [**Plastic**] [**Stainless steel**].

D. Accessories: Filter test port.

E. Control: Variable speed.

F. Motor:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Type: [**Permanent-split capacitor with SCR for speed adjustment**] [**Electronically commutated motor**].
3. Fan-Motor Assembly Isolation: Rubber isolators.
4. Enclosure: [**Open dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
5. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
6. Motor Bearings: <**Insert special requirements**>.
7. Unusual Service Conditions:

    a. Ambient Temperature: <**Insert deg F (deg C)**>.
    b. Altitude: <**Insert feet (m)**> above sea level.
    c. High humidity.
    d. <**Insert conditions**>.

8. Efficiency: Premium efficient.
9. NEMA Design: <**Insert designation**>.
10. Service Factor: <**Insert value**>.
11. Motor Speed: [**Single speed**] [**Multispeed**].

    a. Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.

12. Electrical Characteristics:

    a. Horsepower: <**Insert number**> hp.
    b. Volts: [**120**] [**208**] [**230**] [**460**] <**Insert number**> V.
    c. Phase: [**Single**] [**Poly**].
    d. Hz: 60.
    e. Full-Load Amperes: <**Insert number**> A.
    f. Minimum Circuit Ampacity: <**Insert number**> A.
    g. Maximum Overcurrent Protection: <**Insert number**> A.

2.6 ULPA FILTERS

A. Description: Factory-fabricated, ULPA filters with holding casing.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with [**aluminum separators**] [**vinyl-coated aluminum separators**] [**separators of ribbons of filter media**].

C. Frame Material: [**3/4-inch- (19-mm-) thick, fire-retardant plywood**] [**3/4-inch- (19-mm-) thick, fire-retardant particleboard**] [**3/4-inch- (19-mm-) thick plywood**] [**3/4-inch- (19-mm-) thick particleboard**] [**Galvanized steel**] [**Aluminized steel**] [**Cadmium-plated steel**] [**Stainless steel**] [**Aluminum**].

D. Media to Frame Side Bond: [**Polyurethane foam**] [**Silicone**] [**Neoprene adhesive**] [**Fiberglass-mat packing**] [**Thermosetting sealant**] [**Knife-edge in fluid-filled channel**].

E. Face Gasket: [**Neoprene expanded rubber**] [**Ceramic fiber**] [**Silicone**].

F. Mounting Frames: Construct downstream corners of holding device with cushion pads to protect media. Provide bolted filter-sealing mechanism to mount and continuously seal each individual filter.

2.7 95 PERCENT DOP FILTERS

A. Description: Factory-fabricated, 95 percent DOP filters with holding casing.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats with [**aluminum separators**] [**vinyl-coated aluminum separators**] [**separators of ribbons of filter media**].

C. Frame Material: [**3/4-inch- (19-mm-) thick, fire-retardant plywood**] [**3/4-inch- (19-mm-) thick, fire-retardant particleboard**] [**3/4-inch- (19-mm-) thick plywood**] [**3/4-inch- (19-mm-) thick particleboard**] [**Galvanized steel**] [**Aluminized steel**] [**Cadmium-plated steel**] [**Stainless steel**] [**Aluminum**].

D. Frame Style: [**Box single header**] [**Double header**] [**Double turned flange**] [**3/4-inch- (19-mm-)deep channel**].

E. Media to Frame Side Bond: [**Polyurethane foam**] [**Silicone**] [**Neoprene adhesive**] [**Fiberglass-mat packing**] [**Thermosetting sealant**] [**Knife edge in fluid-filled channel**].

F. Face Guard Material: [**Galvanized**] [**Aluminum**] mesh.

G. Face Guard Location: [**Upstream**] [**and**] [**downstream**].

H. Gasket Material: [**Neoprene expanded rubber**] [**Ceramic fiber**] [**Silicone**].

I. Gasket Location: [**Upstream**] [**and**] [**downstream**].

J. Mounting Frames: Construct downstream corners of holding device with cushion pads to protect media. Provide bolted filter-sealing mechanism to mount and continuously seal each individual filter.

2.8 FRONT- AND REAR-ACCESS FILTER FRAMES

A. Framing System: Aluminum framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Prefilters: Incorporate a separate track, removable from front or back.

C. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.

D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.9 SIDE-SERVICE HOUSINGS

A. Description: Factory-assembled, side-service housings, constructed of 0.064-inch- (1.6-mm-) thick, [**galvanized steel**] [**stainless steel**] [**double-wall casing with 1-inch (25-mm) insulation**] to hold filters. Side servicing is through gasketed access doors on one side, and housings are capable of connection to other housings. Equip housings with metal slide channel tracks with clamping mechanisms to hold filters, and the following:

1. Pressure tap and fitting.
2. DOP/freon test ports.
3. Decontamination ports.
4. Isolation dampers.
5. Lifting lugs.

B. <Double click here to find, evaluate, and insert list of manufacturers and products.>

C. Prefilters: Integral tracks to accommodate 2-, 4-, and 6-inch- (50-, 100-, and 150-mm-)thick disposable filters.

D. Access Doors: Continuous gaskets on perimeter and positive-locking [**swivel**]devices.[**Provide ribbed bagging rim behind access door and PVC bags for bag-in, bag-out arrangement.**] Arrange so filter cartridges can be loaded from an access door for each tier and section of the following:

1. Combination prefilter and HEPA filter.
2. Prefilter.
3. HEPA filter.

4. Upstream and downstream test section.

E. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

F. Accessories:

1. Filter change-out trays.
2. Document-storage pocket.
3. Filter removal rod.

G. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.10 FILTER GAGES

A. Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Diameter: [**4-1/2 inches (115 mm)**] [**2 inches (50 mm)**].
3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg (125 Pa) or Less: 0- to 0.5-inch wg (0 to 125 Pa).
4. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg (125 to 250 Pa) or Less: 0- to 1.0-inch wg (0 to 250 Pa).
5. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg (250 to 500 Pa) or Less: 0- to 2.0-inch wg (0 to 500 Pa).
6. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg (500 to 750 Pa) or Less: 0- to 3.0-inch wg (0 to 750 Pa).
7. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0- to 4.0-Inch wg (750 to 1000 Pa) or Less: 0- to 4.0-inch wg (0 to 1000 Pa).

B. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale, logarithmic-curve tube gage with integral leveling gage; graduated to read from 0- to 3.0-inch wg (0 to 750 Pa) and accurate within 3 percent of full-scale range.

C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

2.11 CAPACITIES AND CHARACTERISTICS

A. Face Area: <**Insert sq. ft. (sq. m)**>.

B. Depth: <**Insert inches (mm)**>.

C. Surface Area: <**Insert sq. ft. (sq. m)**>.

D. Module Size: <**Insert size**>.

E. Number of Filters/Modules: <**Insert number**>.

F. Frame Access Location: <**Insert location**>.

G. System Airflow: <**Insert cfm (L/s)**>.

H. Maximum or Rated Face Velocity: <**Insert fpm (m/s)**>.

I. Initial Resistance: <**Insert inches wg (Pa)**>.

J. Recommended Final Resistance: <**Insert inches wg (Pa)**>.

K. Performance Level: [**HEPA**] [**ULPA**] [**95 percent as tested according to MIL-STD 282**] <**Insert requirement**>.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install filter assemblies on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters that were used during construction and testing with new, clean filters.

F. Install filter-gage static-pressure tips upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

G. Coordinate filter installations with duct and air-handling unit installations.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

1. Operate automatic roll filters to demonstrate compliance with requirements.
2. Test for leakage of unfiltered air while system is operating.
3. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) 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.
4. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to pressure-decay method in ASME N510.

D. Air filter will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

3.4 PROTECTION

A. Protect installed products and accessories from damage during construction.

END OF SECTION 234133