SECTION 234200 - GAS-PHASE AIR FILTRATION

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

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

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

Gas-phase panel filters.

Gas-phase, deep-V filters.

Gas-phase, V-cell filters.

Gas-phase, cylindrical-canister filters.

Gas-phase, rigid-cell box filters.

Front- or back-access filter frames.

Side-access filter housings.

Filter gages.

* + - 1. DEFINITIONS
				1. HIPS: High impact polystyrene.
			2. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product. 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.
				5. Shop Drawings: For gas-phase air filters. Include plans, elevations, sections, details, and attachments to other work.

Show filter rack assembly, dimensions, materials, and methods of assembly of components.

Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

* + - * 1. Product Test Reports: For each gas-phase filter, for tests performed by <**Insert qualified testing agency name>.**

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For each type of gas-phase filter and rack to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Retain first subparagraph below if retaining filters in Part 2 that do not have loose-fill media.

Provide [**one**] <**Insert number**> complete set(s) of filters for each filter or filter bank.

Retain first subparagraph below if retaining filters in Part 2 that have loose-fill media.

Provide [**one**] <**Insert number**> complete 100 percent refill supply for each filter requiring loose-fill media.

Provide [**one**] <**Insert number**> container(s) of red oil for inclined manometer filter gage.

* + - 1. QUALITY ASSURANCE

Retain "Testing Agency Qualifications" Paragraph below to require a UL, CE, or ETL marking. Qualification requirements are in addition to those specified in Section 014000 "Quality Requirements," which also defines "NRTL" (nationally recognized testing laboratory).

* + - * 1. Testing Agency Qualifications: An NRTL.
1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. PERFORMANCE REQUIREMENTS
				1. Comply with <**Insert qualified testing agency standard**>.

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

* + - * 1. Seismic Performance: Filters shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

"ASHRAE 62.1 Compliance" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," require compliance with requirements in ASHRAE 62.1 (2007 and 2010 versions, respectively), including requirements for controls, surfaces in contact with the airstream, particulate and gaseous filtration, humidification and dehumidification, drain pan construction and connection, finned-tube coil selection and cleaning, and equipment access. Consult manufacturers to verify availability of units having components and features that comply with these requirements.

* + - * 1. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
				2. Comply with NFPA 90A and NFPA 90B.
			1. GAS-PHASE PANEL FILTERS
				1. Description: Factory-fabricated panel or pleated adsorbent media filter.

Coordinate class in "Filter Unit Class" Paragraph below with retained manufacturers. Most manufacturers do not offer Class 1 for this type of filter.

* + - * 1. Filter Unit Class: UL 900, [**Class 2**] <**Insert class**>.

If Project has more than one type or configuration of filter, delete "Capacities and Characteristics" Paragraph below and schedule filters on Drawings.

* + - * 1. Capacities and Characteristics:

Drawing Tag No.: <**Insert number**>.

Face Size: [**24 by 24 inches (600 by 600 mm)**] [**20 by 24 inches (500 by 600 mm)**] [**24 by 12 inches (600 by 300 mm)**] <**Insert dimensions**> nominal.

Depth: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**] <**Insert dimension**> nominal.

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

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

No. of Filters, Wide by High: <**Insert number wide by number high**>.

Service Access Location (Front, Back, Side): <**Insert access location**>.

Initial Resistance: [**0.50-inch wg (125 Pa)**] <**Insert value**>.

Final Resistance: [**1.0-inch wg (250 Pa)**] <**Insert value**>.

Retain one of three "Media" paragraphs below.

* + - * 1. Media:

Flat-panel or pleated, multilayer filter with an inlet layer of nonwoven polyester fibers, bonded or supported by a grid, to a layer of [**activated carbon**] <**Insert adsorbent media type**>

Housed in a [**beverage board**] <**Insert material**> frame.

Minimum CTC activity level of [**60**] <**Insert number**> percent.

Several manufacturers offer gas-phase panel filters that are also MERV particulate rated. A few offer MERV 8. A few offer MERV 7, but not MERV 8. One offers MERV 5, MERV 6, and MERV 7, but not MERV 8. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," requires compliance with ASHRAE 62.1 (2007 and 2010 versions, respectively), which require a MERV rating of 6 or higher for service to occupied spaces. In order to comply with the LEED Prerequisite and to allow the greatest number of manufacturers to comply for gas-phase filters, delete MERV requirement and utilize a separate particulate filter in addition to the gas-phase filter. If compliance by fewer manufacturers is acceptable, retain combination gas-phase and MERV requirements. Coordinate with retained manufacturers.

* + - * 1. MERV Rating: Minimum [**MERV 6**] [**MERV 8**] <**Insert value**>, according to ASHRAE 52.2.
				2. Maximum Continuous Operating Temperature: [**150 deg F (65 deg C)**] <**Insert temperature**>.
				3. Pre-installation Protection: Package each gas-phase filter in a sealed polyethylene bag to prevent unintentional adsorption prior to installation.
			1. GAS-PHASE, DEEP-V FILTERS
				1. Description: Factory-fabricated modules with adsorbent media trays or self-supporting bonded media panels in deep-V arrangement with disposable [**prefilter**] [**and**] [**final filter**].
				2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

AAF International.

[AirGuard; Clarcor Air Filtration Products, Inc](http://www.specagent.com/Lookup?uid=123457137782).

[Camfil Farr](http://www.specagent.com/Lookup?uid=123457137779).

[Flanders Corporation](http://www.specagent.com/Lookup?uid=123457137780).

[Tri-Dim Filter Corporation](http://www.specagent.com/Lookup?uid=123457137781).

Approved equivalent.

Coordinate class in "Filter Unit Class" Subparagraph below with retained filter type and with retained manufacturers. Most manufacturers do not offer Class 1 for these types of prefilters.

Filter Unit Class: UL 900, [**Class 2**] <**Insert class**>.

If Project has more than one type or configuration of filter, delete "Capacities and Characteristics" Paragraph below and schedule filters on Drawings.

* + - * 1. Capacities and Characteristics:

Not all manufacturers offer each face size and depth. Coordinate with retained manufacturers.

Drawing Tag No.: <**Insert number**>.

Face Size: [**24 by 24 inches (600 by 600 mm)**] [**20 by 24 inches (500 by 600 mm)**] [**24 by 12 inches (600 by 300 mm)**] [**12 by 24 inches (300 mm by 600 mm)**] <**Insert dimensions**> nominal.

Depth: <**Insert dimension**> nominal.

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

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

No. of Tray/Cassette/Panel Modules, Wide by High: <**Insert number wide by number high**>.

Service Access Location (Front, Back, or Side): <**Insert access location**>.

Resistance: [**0.50-inch wg (125 Pa)**] <**Insert value**>.

Recommended Change-out Interval Frequency: [**1 year**] <**Insert change-out interval frequency**>.

Module housing arrangement, materials, and finish vary depending on manufacturer. Coordinate with retained manufacturers.

* + - * 1. Module Housing:

Coordinate options retained in "Frame" Subparagraph below with retained manufacturers. Not all manufacturers offer each type of frame. If intent is to maximize number of manufacturers to comply, retain fourth option.

Frame: [**Galvanized or powder-coated steel**] [**Stainless steel**] [**HIPS**] [**Galvanized steel, powder-coated steel, stainless steel, or HIPS**] to hold adsorbent media-filled trays or panels.

Access: [**Front access**] [**or**] [**Side access through gasketed access doors on both sides**] and able to connect to other housings.

Equip housings with [**metal slide channel tracks to hold adsorbent media trays or self-supporting panels**] [**or**] [**interlocking modular cassettes to hold adsorbent media**] [**and**] [**particulate prefilter**] [**final filter**].

Coordinate options retained in "Finish" Subparagraph below with retained manufacturers and with "Frame" Subparagraph above. Not all manufacturers offer each type of finish.

Finish: [**unfinished HIPS material**] [**or**] [**Steel with treatment(s) as indicated in "Frame" Subparagraph above**], [**factory**] [**primed**] [**primed and painted**], [**outside**] [**inside and outside**] [**inside**].

Pressure tap and fitting.

Media-holding panel type and materials vary depending on manufacturer. Coordinate with retained manufacturers.

* + - * 1. Media-Holding Panels:

[**Refillable**] [**Disposable**] [**or**] [**Incinerable**] adsorbent media trays or self-supporting panels.

Retain one of six "Media" paragraphs below on the basis of contaminant types that need to be adsorbed. See the Evaluations. Not all manufacturers offer each media type. Coordinate with retained manufacturers.

Activated carbon in first "Media" Paragraph below is typically used for VOC and ozone removal.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-panel**] coconut-shell activated carbon.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Potassium-permanganate-impregnated media in first "Media" Paragraph below is typically used for formaldehyde and acid gas removal.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-panel**] activated alumina or zeolite impregnated with potassium permanganate.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Caustic sodium-hydroxide-impregnated activated carbon is typically used for acid gas removal.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-briquette**] caustic sodium-hydroxide-impregnated activated carbon.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Blended activated carbon and potassium-permanganate-impregnated media in first "Media" Paragraph below are generally used for VOC, ozone, formaldehyde, and acid gas removal.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-panel**], 50/50 blended activated carbon and alumina or zeolite impregnated with potassium permanganate.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Phosphoric-acid-impregnated activated carbon in first "Media" Paragraph below is generally used for ammonia and amine removal.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-panel**] activated carbon impregnated with phosphoric acid.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of [**loose-fill**] [**loose-fill or bonded-panel**] [**bonded-panel**] <**Insert media and adsorbent**>.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of<**Insert type of media and adsorbent**>.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: <**Insert number**> percent minimum.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: <**Insert number**>, when tested according to ASTM D3802.

Retain "Prefilter" and "Final Filter" subparagraphs below if required for Project.

Prefilter: Comply with requirements in Section 234100 "Particulate Air Filtration" for [**flat**] [**pleated**] [**ring**] panel. Size and airflow capacity shall match those of gas-phase filters.

Depth: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**] <**Insert dimension**>.

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**0.25-inch wg (62.3 Pa)**] [**0.35-inch wg (87.2 Pa)**] [**0.45-inch wg (112.1 Pa)**] [**0.60-inch wg (150 Pa)**] <**Insert value**> at [**350 fpm (1.8 m/s)**] [**500 fpm (2.5 m/s)**] <**Insert value**>.

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

Retain "Minimum Efficiency Reporting Value and Average Arrestance" Subparagraph below if requiring MERV 1, 2, 3, or 4.

Minimum Efficiency Reporting Value and Average Arrestance:

MERV Rating: [**MERV 1**] [**MERV 2**] [**MERV 3**] [**MERV 4**] <**Insert value**>, according to ASHRAE 52.2.

Retain "Minimum Efficiency Reporting Value" Subparagraph below if inserting requirements for MERV 5 and higher. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," requires compliance with ASHRAE 62.1 (2007 and 2010 versions respectively), which require a MERV rating of 6 or higher for service to occupied spaces. LEED 2009 IEQ Credit 5 and LEED v4 IEQ Credit, "Enhanced Indoor Air Quality Strategies," require MERV 13 or higher. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: [**MERV 6**] [**MERV 13**] <**Insert value**>, according to ASHRAE 52.2.

Final Filter: Comply with requirements in Section 234100 "Particulate Air Filtration" for [**supported bag**] [**unsupported bag**] [**rigid-cell box**] [**V-bank cell**] [**self-supported pocket**] filter. Size and airflow capacity shall match those of gas-phase filters.

Depth: [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] <**Insert dimension**>.

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**1-inch wg (250 Pa)**] [**2-inch wg (500 Pa)**] <**Insert value**> at 500 fpm (2.5 m/s).

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

Coordinate class in "Filter Unit Class" Subparagraph below with retained filter type and with retained manufacturers.

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

LEED 2009 IEQ Credit 5 and LEED v4 IEQ Credit, "Enhanced Indoor Air Quality Strategies," require MERV 13 or higher for service to occupied spaces. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: [**MERV 13**] <**Insert value**>, according to ASHRAE 52.2.

* + - * 1. Pre-installation Protection: Package each gas-phase filter in sealed polyethylene bag to prevent unintentional adsorption prior to installation.
			1. GAS-PHASE, V-CELL FILTERS
				1. Description: Factory-fabricated, dry, V-shaped cartridges containing loose-fill adsorbent media with holding frames.

If Project has more than one type or configuration of filter, delete "Capacities and Characteristics" Paragraph below and schedule filters on Drawings.

* + - * 1. Capacities and Characteristics:

Drawing Tag No.: <**Insert number**>.

Face Size: [**24 by 24 inches (600 by 600 mm)**] [**20 by 24 inches (500 by 600 mm)**] [**24 by 12 inches (600 by 300 mm)**] <**Insert dimensions**>nominal.

Depth: [**12 inches (300 mm)**] <**Insert dimension**> nominal.

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

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

No. of Filters, Wide by High: <**Insert number wide by number high**>.

Service Access Location (Front, Back, or Side): <**Insert access location**>.

Resistance: [**0.50-inch wg (125 Pa)**] <**Insert value**>.

Recommended Change-out Interval Frequency: [**1 year**] <**Insert change-out interval frequency**>.

* + - * 1. Cartridges: V-cell configuration; plastic enclosure caps; galvanized-steel, HIPS, or ABS frame with vertical galvanized-steel, HIPS, or ABS channel supports. Integral, [**1-inch (25-mm)**]<**Insert media bed thickness**> thick panels constructed of honeycombed paper and nylon mesh or mini-pleats on each side of adsorbent media.

Retain one of six "Media" paragraphs below on the basis of contaminant types that need to be adsorbed. See the Evaluations. Not all manufacturers offer each media type. Coordinate with retained manufacturers.

Activated carbon in first "Media" Paragraph below is typically used for VOC and ozone removal.

* + - * 1. Media: Coconut-shell activated carbon; <**Insert lb (kg)**> of activated carbon per 1000 cfm (470 L/s)of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Potassium-permanganate-impregnated media in first "Media" Paragraph below is typically used for formaldehyde and acid gas removal.

* + - * 1. Media: Activated alumina or zeolite impregnated with potassium permanganate; <**Insert lb (kg)**> of adsorbent per 500 cfm (236 L/s) of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**]<**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Caustic sodium-hydroxide-impregnated carbon is typically used for acid gas removal.

* + - * 1. Media: Caustic sodium-hydroxide-impregnated carbon; <**Insert lb (kg)**> of adsorbent per 500 cfm (236 L/s) of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Blended activated carbon and potassium permanganate in first "Media" Paragraph below is typically used for VOC, ozone, formaldehyde and acid gas removal.

* + - * 1. Media: 50/50 blended carbon and alumina or zeolite impregnated with potassium permanganate; <**Insert lb (kg)**> of adsorbent per 500 cfm (236 L/s) of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Phosphoric-acid-impregnated activated carbon in first "Media" Paragraph below is generally used for ammonia and amine removal.

* + - * 1. Media: Activated carbon impregnated with phosphoric acid; <**Insert lb (kg)**> of adsorbent per 500 cfm (236 L/s) of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of <**Insert type of media and adsorbent**>.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: <**Insert number**>, when tested according to ASTM D3802.

Profitless and final filters are optional features. Retain "Prefilter" and "Final Filter" subparagraphs below if required for Project.

Prefilter: Comply with requirements in Section 234100 "Particulate Air Filtration" for [**flat**] [**pleated**] [**ring**] panel. Size and airflow capacity shall match those of gas-phase filters.

Depth: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**] <**Insert dimension**>.

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**0.25-inch wg (62.3 Pa)**] [**0.35-inch wg (87.2 Pa)**] [**0.45-inch wg (112.1 Pa)**] [**0.60-inch wg (150 Pa)**] <**Insert value**> at [**350 fpm (1.8 m/s)**] [**500 fpm (2.5 m/s)**] <**Insert value**>.

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

Coordinate class in "Filter Unit Class" Subparagraph below with retained filter type and with retained manufacturers. Most manufacturers do not offer Class 1 for these types of prefilters.

Filter Unit Class: UL 900, [**Class 2**] <**Insert class**>.

Retain "Minimum Efficiency Reporting Value and Average Arrestance" Subparagraph below if inserting requirement for MERV 1 to 4.

Minimum Efficiency Reporting Value and Average Arrestance:

MERV Rating: [**MERV 1**] [**MERV 2**] [**MERV 3**] [**MERV 4**], according to ASHRAE 52.2.

Retain "Minimum Efficiency Reporting Value" Subparagraph below if inserting requirements for MERV 5 and higher. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," require compliance with ASHRAE 62.1 (2007 and 2010 versions respectively), which require a MERV rating of 6 or higher for service to occupied spaces. LEED 2009 IEQ Credit 5 and LEED v4 IEQ Credit, "Enhanced Indoor Air Quality Strategies," require MERV 13 or higher. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: [**MERV 6**] [**MERV 13**] <**Insert value**>, according to ASHRAE 52.2.

Final Filter: Comply with requirements in Section 234100 "Particulate Air Filtration" for [**supported bag**] [**unsupported bag**] [**rigid-cell box**] [**V-bank cell**] [**self-supported pocket**] filter. Size and airflow capacity shall match those of gas-phase filters.

Depth: [**12 inches (300 mm)**] [**18 inches (450 mm)**] [**24 inches (600 mm)**] <**Insert dimension**>.

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**1-inch wg (250 Pa)**] [**2-inch wg (500 Pa)**] <**Insert value**> at 500 fpm (2.5 m/s).

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

Coordinate class in "Filter Unit Class" Subparagraph below with retained filter type and with retained manufacturers.

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

LEED 2009 IEQ Credit 5 and LEED v4 IEQ Credit, "Enhanced Indoor Air Quality Strategies," require MERV 13 or higher for service to occupied spaces. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: [**MERV 13**] <**Insert value**>, according to ASHRAE 52.2.

* + - * 1. Pre-installation Protection: Package each filter in a sealed polyethylene bag to prevent unintentional adsorption prior to installation.
			1. GAS-PHASE, CYLINDRICAL-CANISTER FILTERS
				1. Description: Factory-fabricated, dry, cylindrical canisters containing loose-fill adsorbent with holding frames.

Coordinate class in "Filter Unit Class" Paragraph with retained filter type and with retained manufacturers. Most manufacturers do not offer Class 1 for these types of filters.

* + - * 1. Filter Unit Class: UL 900, [**Class 2**] <**Insert class**>.

If Project has more than one type or configuration of filter, delete "Capacities and Characteristics" Paragraph below and schedule filters on Drawings.

* + - * 1. Capacities and Characteristics:

Drawing Tag No.: <**Insert number**>.

Module Face Size: [**24 by 24 inches (600 by 600 mm)**] [**24 by 12 inches (600 by 300 mm)**] <**Insert dimensions**> nominal.

Cylinder Diameter: [**6 inches (150 mm)**] <**Insert dimension**> nominal.

Cylinder Length: [**18 inches (450 mm)**] [**24 inches (600 mm)**] <**Insert dimension**> nominal.

System Airflow: [**Insert cfm (L/s)**].

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

No. of Modules, Wide by High: <**Insert number wide by number high**>.

Service Access Location (Front, Back, Side): <**Insert access location**>.

Resistance: [**0.50-inch wg (125 Pa)**] <**Insert value**>.

Recommended Change-out Interval Frequency: [**1 year**] <**Insert change-out frequency**>.

* + - * 1. Cylinders: [**Disposable plastic, 105 deg F (41 deg C) maximum continuous operating temperature)**] [**Factory-refillable stainless steel, 140 deg F (60 deg C) maximum continuous operating temperature**].
				2. Media: 1-inch- (25-mm-) thick adsorbent bed, 1.5 lbs (0.68 kg) <**Insert lbs. (kg)**> of adsorbent per 6-inch- (150-mm-) diameter cylinder of [**activated carbon**] [**activated alumina or zeolite impregnated with potassium permanganate**] [**caustic sodium-hydroxide-impregnated carbon**] [**50/50 blended carbon and alumina or zeolite impregnated with potassium permanganate**] [**activated carbon impregnated with phosphoric acid**] <**Insert media type**> per canister.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: <**Insert number**>, when tested according to ASTM D3802.

Retain either "Cylinder-Canister Filter-Mounting Frames" or "Cylinder-Canister Filter Side Access Housing Modules" Paragraphs below.

* + - * 1. Cylinder-Canister Filter-Mounting Frames: [**Disposable plastic**] [**Factory-refillable stainless steel**] <**Insert material**> with adsorbent cylinder air paths and mounting perforations; designed for connecting together into built-up filter banks. Secure cylinders to mounting frame with bayonet mounts and gasket seals.
				2. Cylindrical-Canister Filter Side Access Housing Modules: [**16-gage aluminized steel**] <**Insert material**>, gasketed dual access doors, [**anodized-aluminum**] <**Insert material**> filter tracks for cylindrical-canister filters[**, with separate track for**] [**2-inch (50-mm)**] <**Insert prefilter thickness**> prefilters; individual modules designed for connecting together into built-up filter banks.

Prefilters are optional features. Retain "Prefilter" Paragraph below if required for Project. Only prefilters are included as an option, because only prefilters are available as an option for cylindrical-canister filters.

* + - * 1. Prefilter: Comply with requirements in Section 234100 "Particulate Air Filtration" for [**flat**] [**pleated**] [**ring**] panel. Size and airflow capacity shall match those of gas-phase filters.

Depth: [**2 inches (50 mm)**] <**Insert dimension**>.

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**0.25-inch wg (62.3 Pa)**] <**Insert value**> at [**500 fpm (2.5 m/s)**] <**Insert value**>.

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

Retain "Minimum Efficiency Reporting Value and Average Arrestance" Subparagraph below if inserting requirements for MERV 1 to 4.

Minimum Efficiency Reporting Value and Average Arrestance:

MERV Rating: [**MERV 4**] <**Insert value**>, according to ASHRAE 52.2.

Retain "Minimum Efficiency Reporting Value" Subparagraph below if inserting requirements for MERV 5 and higher. LEED IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," require compliance with ASHRAE 62.1 (2007 and 2010 versions respectively), which require a MERV rating of 6 or higher for service to occupied spaces. LEED 2009 IEQ Credit 5 and LEED v4 IEQ Credit, "Enhanced Indoor Air Quality Strategies," require MERV 13 or higher. Insert values appropriate to Project sustainability goals.

Minimum Efficiency Reporting Value:

MERV Rating: [**MERV 6**] [**MERV 13**] <**Insert value**>, according to ASHRAE 52.2.

* + - * 1. Pre-installation Protection: Package each gas-phase filter in a sealed polyethylene bag to prevent unintentional adsorption prior to installation.
			1. GAS-PHASE, RIGID-CELL BOX FILTERS
				1. Description: Factory-fabricated, adsorbent media bonded to nonwoven deep pleats with plastic pleat spacers, contained in a rigid-cell box.
				2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[AAF International](http://www.specagent.com/Lookup?uid=123457137790).

[AirGuard; Clarcor Air Filtration Products, Inc](http://www.specagent.com/Lookup?uid=123457137798).

[Camfil Farr](http://www.specagent.com/Lookup?uid=123457137792).

[Filtration Group](http://www.specagent.com/Lookup?uid=123457137793).

[Flanders Corporation](http://www.specagent.com/Lookup?uid=123457137794).

[Koch Filter Corporation](http://www.specagent.com/Lookup?uid=123457137795).

[Purafil, Inc](http://www.specagent.com/Lookup?uid=123457137796).

[Tri-Dim Filter Corporation](http://www.specagent.com/Lookup?uid=123457137797).

Approved equivalent.

Coordinate class in "Filter Unit Class" Paragraph with retained manufacturers.

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

If Project has more than one type or configuration of filter, delete "Capacities and Characteristics" Paragraph below and schedule filters on Drawings.

* + - * 1. Capacities and Characteristics:

Drawing Tag No.: <**Insert number**>.

Face Size: [**24 by 24 inches (600 by 600 mm)**] [**24 by 12 inches (600 by 300 mm)**] <**Insert dimensions**> nominal.

Depth: [**12 inches (300 mm)**] <**Insert dimension**> nominal.

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

Maximum or Rated Face Velocity: [**500 fpm (2.5 m/s)**] <**Insert value**>.

Initial Resistance: [**0.50-inch wg (140 Pa)**] <**Insert value**>.

Recommended Final Resistance: [**1.5 in wg (370 Pa)**] <**Insert inches wg (Pa)**>.

Minimum Toluene Removal Efficiency: [**90**] <**Insert value**> percent.

Retain one of three "Media" paragraphs below on the basis of contaminant types that need to be adsorbed. See the Evaluations. Not all manufacturers offer each media type. Coordinate with retained manufacturers.

Activated carbon in first "Media" Paragraph below is typically used for VOC and ozone removal.

* + - * 1. Media: Activated carbon; <**Insert lb (kg)**> of activated carbon per 1000 cfm (470 L/s)of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)value**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

Blended activated-carbon- and potassium-permanganate-impregnated media in first "Media" Paragraph below is generally used for VOC, ozone, formaldehyde and acid gas removal.

* + - * 1. Media: 50/50 blended carbon and alumina or zeolite impregnated with potassium permanganate; <**Insert lb (kg)**> of adsorbent per 1000 cfm (470 L/s) of airflow.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number range**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft. (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

* + - * 1. Media: <**Insert lb (kg)**> per 1000 cfm (470 L/s) of <**Insert type of media and adsorbent**>.

Ash Content: <**Insert number range**> percent.

Percentage of CTC Activity: [**60**] <**Insert number range**> percent minimum, when tested according to ASTM D3467.

Bulk Density: <**Insert lb/cu. ft (kg/cu. m)**>.

Mesh Size: [**4 x 6 U.S. standard mesh (4.75 x 3.35 mm)**] <**Insert mesh size**>, [**90**] <**Insert number**> percent minimum.

Hardness Factor: [**95**] <**Insert number**>, when tested according to ASTM D3802.

* + - * 1. Filter-Media Frame: [**Galvanized steel**] <**Insert material**>.
				2. Pre-installation Protection: Package each gas-phase filter in a sealed polyethylene bag to prevent unintentional adsorption prior to installation.
			1. FRONT- OR BACK-ACCESS FILTER FRAMES

This article is an example of filter-mounting frames for front or back loading.

* + - * 1. Framing System: [**Galvanized-steel**] [**Aluminum**] framing members with access for upstream (front) 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. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13104) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[AAF International](http://www.specagent.com/Lookup?uid=123457137763).

[AirGuard; Clarcor Air Filtration Products, Inc](http://www.specagent.com/Lookup?uid=123457137768).

[Flanders Corporation](http://www.specagent.com/Lookup?uid=123457137765).

[Koch Filter Corporation](http://www.specagent.com/Lookup?uid=123457137766).

[Purafil, Inc](http://www.specagent.com/Lookup?uid=123457137767).

Approved equivalent.

* + - * 1. Prefilters: Incorporate a separate track[**with spring clips**], removable from front [**or**] [**back**].
				2. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.
			1. SIDE-ACCESS FILTER HOUSINGS

This article is an example of filter-holding frames for side loading.

* + - * 1. Description: Factory-assembled, side-access housings constructed of [**galvanized steel**] [**aluminum**] <**Insert material**> with flanges to connect to duct or casing system.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=13103) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[AAF International](http://www.specagent.com/Lookup?uid=123457137756).

[AirGuard; Clarcor Air Filtration Products, Inc](http://www.specagent.com/Lookup?uid=123457137762).

[Camfil Farr](http://www.specagent.com/Lookup?uid=123457137758).

[Flanders Corporation](http://www.specagent.com/Lookup?uid=123457137759).

[Koch Filter Corporation](http://www.specagent.com/Lookup?uid=123457137760).

[Purafil, Inc](http://www.specagent.com/Lookup?uid=123457137761).

Approved equivalent.

* + - * 1. Prefilters: Integral tracks to accommodate [**2-inch- (50-mm-)**] <**Insert thickness**> thick, disposable[**or washable**] filters.
				2. Access Doors: [**Hinged with continuous**] [**Continuous**] gaskets on perimeter and with positive-locking devices. Arrange so filter cartridges can be loaded from either access door.
				3. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.
			1. FILTER GAUGES
				1. Diaphragm type, with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=3543) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[AirGuard; Clarcor Air Filtration Products, Inc](http://www.specagent.com/Lookup?uid=123457137754).

[Dwyer Instruments, Inc](http://www.specagent.com/Lookup?uid=123457137753).

Approved equivalent.

Diameter: [**4-1/2 inches (115 mm)**] [**2 inches (50 mm)**].

Revise ranges in subparagraphs below to match expected pressure differences.

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).

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).

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).

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).

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).

* + - * 1. 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.
				2. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.
1. EXECUTION
	* + 1. EXAMINATION
				1. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION
				1. Position each filter unit with required clearance for service and maintenance. Anchor filter-mounting frames to substrate.
				2. Install filters in position to prevent passage of unfiltered air.

Air-handling units should not be used for temporary heating and ventilating unless expressly approved by Director’s Representative. If used during construction, see SMACNA's "IAQ Guidelines for Occupied Buildings under Construction" for procedures to protect HVAC system.

* + - * 1. Do not operate fan system until particulate filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
				2. Do not install gas-phase filters until fan system is clean and there is no risk of construction debris loading the filter.
				3. Install filter-gauge, static-pressure taps upstream and downstream from each filter bank. Install filter gauges on filter banks with separate static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gauges.
				4. Coordinate filter installations with duct and air-handling-unit installations.
				5. Install all manufacturer-provided accessories in accordance with manufacturer's written installation instructions.
			1. CONTROL CONNECTIONS
			2. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" Paragraph below if Director’s Representative will hire an independent testing agency.

* + - * 1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain "Testing Agency" Paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections, and retain option to require Contractor to arrange for the assistance of a Company Service agent.

* + - * 1. Perform the following tests and inspections[**with the assistance of a factory-authorized service company field advisor**]:

Test for leakage of unfiltered air while system is operating.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

Air filters will be considered defective if they do not pass tests and inspections.

* + - * 1. Prepare test and inspection reports.
			1. CLEANING
				1. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new particulate filter media.
				2. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new particulate filter media.
			2. DEMONSTRATION
				1. [**Engage a factory-authorized service representative to train**] [**Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain filters.

END OF SECTION 234200