

## SECTION 234200 - GAS-PHASE AIR 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. Activated-carbon panel filters.
2. Activated-carbon, deep-V filters.
3. Activated carbon, V-cell filters.
4. Cylindrical-canister filters.
5. Permanganate filters.
6. Supported adsorber bag filters.
7. Front-access filter housings.
8. Side-service housings.
9. Filter gages.

## B. Related Sections:

1. Section 233119 "HVAC Casings" for customized housings used for gas-phase filters.
2. Section 233416 "Centrifugal HVAC Fans" for customized fan and filter units.
3. Section 234133 "High-Efficiency Particulate Filtration" for HEPA filters used in combination with gas-phase filters.
4. Section 234300 "Electronic Air Cleaners" for electronic units combined with gas-phase filters as part of a system.

## 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 Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with applicable requirements in ASHRAE 62.1-2004, 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.

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 or filter bank.
2. Provide [**one**] <Insert number> complete 100 percent refill supply for each filter requiring loose-fill media.
3. Provide [**one**] <Insert number> container(s) of red oil for inclined manometer filter gage.

1.7 QUALITY ASSURANCE

A. ASHRAE Compliance:

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

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

## PART 2 - PRODUCTS

## 2.1 ACTIVATED-CARBON PANEL FILTERS

- A. Description: Factory-fabricated unit with activated-carbon media.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Media: Flat-panel, disposable multilayer filter with an inlet layer of polyester fibers, a layer of activated-carbon granules bonded to fibers, and a layer of polyurethane foam; housed in a cardboard frame.
- D. Media: Flat-panel, disposable honeycombed cellulose with cells filled with activated-carbon granules and a perforated mesh grid; housed in a cardboard frame.
- E. Media: Pleated, multilayer filter with an inlet layer of cotton and synthetic fibers and a layer of activated-carbon granules bonded to synthetic fibers; media formed into deep-V-shaped pleats, held by self-wire grid, and housed in a cardboard frame.
- F. Mounting Frames: Welded, galvanized, sheet-steel frame and galvanized-steel fasteners with **[polyurethane]** gaskets; capable of bolting together into built-up filter banks.
- G. Capacities and Characteristics:
  - 1. 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.
  - 2. Depth: **[1 inch (25 mm)]** **[2 inches (50 mm)]** **[4 inches (100 mm)]** **<Insert dimension>** nominal.
  - 3. System Airflow: **<Insert cfm (L/s)>**.
  - 4. Maximum or Rated Face Velocity: **[500 fpm (2.5 m/s)]** **<Insert value>**.
  - 5. Initial Resistance: **[0.50-inch wg (125 Pa)]** **<Insert value>**.

## 2.2 ACTIVATED-CARBON, DEEP-V FILTERS

- A. Description: Factory-fabricated unit with activated-carbon trays in deep-V arrangement with disposable **[panel prefilter]** **[and]** **[final filter]**.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Module Housing: **0.064-inch- (1.6-mm-)** thick, **[galvanized steel]** **[stainless steel]** **[double-wall casing with 1-inch- (25-mm-) thick insulation]** to hold media-filled panels; with side servicing through gasketed access doors on both sides and able to connect to other housings. Equip housings with metal slide channel tracks to hold activated-carbon trays **[and particulate prefilter]** **[and final filter]**.
  - 1. Finish: Factory **[primed]** **[primed and painted]**, **[outside]** **[inside and outside]** **[inside]**.
  - 2. Pressure tap and fitting.
- C. Media-Holding Panels: **1-inch- (25-mm-)** thick, perforated polystyrene to allow airflow through contained loose-fill media; with removable service cap for recharging.

- D. Media-Holding Panels: [1 inch (25 mm)] [2 inches (50 mm)] [3 inches (75 mm)] deep and containing granular carbon bonded into a briquette form with a [galvanized] [stainless]-steel frame.
- E. Media: [45 lb (20.3 kg)] <Insert value> per 1000 cfm (470 L/s) of [loose-fill] [loose-fill or bonded-briquette] [bonded-briquette] coconut-shell activated carbon.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- F. Media: <Insert lb (kg)> per 1000 cfm (470 L/s) of [loose-fill] [loose-fill or bonded-briquette] [bonded-briquette] activated alumina impregnated with potassium permanganate.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- G. Media: <Insert lb (kg)> per 1000 cfm (470 L/s) of [loose-fill] [loose-fill or bonded-briquette] [bonded-briquette] impregnated carbon.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- H. Media: <Insert lb (kg)> per 1000 cfm (470 L/s) of [loose-fill] [loose-fill or bonded-briquette] [bonded-briquette] blended carbon and alumina impregnated with potassium permanganate.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- I. Capacities and Characteristics:
1. 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.
  2. Depth: [12 inches (300 mm)] <Insert dimension> nominal.
  3. System Airflow: <Insert cfm (L/s)>.
  4. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.

5. Initial Resistance: **[0.50-inch wg (125 Pa)]** <Insert value>.
6. Recommended Final Resistance: <Insert**inches wg (Pa)**>.
7. 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.
  - a. Depth: **[1 inch (25 mm)]** **[2 inches (50 mm)]** **[4 inches (100 mm)]** <Insert dimension>.
  - b. Maximum or Rated Face Velocity: **[500 fpm (2.5 m/s)]** <Insert value>.
  - c. 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>.
  - d. Recommended Final Resistance: <Insert**inches wg (Pa)**>.
  - e. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
  - f. Arrestance: **[85]** <Insert number> percent when tested according to ASHRAE 52.1.
  - g. MERV: **[8]** <Insert value> when tested according to ASHRAE 52.2.
8. 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]**. Size and airflow capacity shall match those of gas-phase filters.
  - a. Depth: **[12 inches (300 mm)]** **[18 inches (450 mm)]** **[24 inches (600 mm)]** <Insert dimension>.
  - b. Maximum or Rated Face Velocity: **[500 fpm (2.5 m/s)]** <Insert value>.
  - c. Initial Resistance: **[1-inch wg (250 Pa)]** **[2-inch wg (500 Pa)]** <Insert value> at **500 fpm (2.5 m/s)**.
  - d. Recommended Final Resistance: <Insert **inches wg (Pa)**>.
  - e. Arrestance: **[85]** <Insert number> percent when tested according to ASHRAE 52.1.

## 2.3 ACTIVATED-CARBON, V-CELL FILTERS

- A. Description: Factory-fabricated, dry, V-shaped cartridges containing loose-fill media with holding frames.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Cartridges: V-cell configuration, plastic enclosure caps, galvanized-steel frame with vertical galvanized-steel channel supports. Integral, **1-inch- (25-mm-)** deep panels constructed of honeycombed paper and nylon mesh.
- C. Fill Media: Coconut-shell activated carbon; **[45 lb (20.3 kg)]** <Insert value> of activated carbon per **1000 cfm (470 L/s)** of airflow.
  1. Ash Content: **[2 to 3]** <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: **[35 to 70]** <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: **[32 lb/cu. ft. (510 kg/cu. m)]** <Insert value>.
  4. Mesh Size: **[4 by 6 inches (100 by 150 mm)]**, 90 percent minimum.

5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- D. Fill Media: Activated alumina impregnated with potassium permanganate; [10.5 lb (4.8 kg)] <Insert value> of adsorbent per 500 cfm (236 L/s) of airflow.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- E. Fill Media: Impregnated carbon; [8.0 lb (3.6 kg)] <Insert value> of adsorbent per 500 cfm (236 L/s) of airflow.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- F. Fill Media: Blended carbon and alumina impregnated with potassium permanganate; [7.0 lb (3.1 kg)] <Insert value> of adsorbent per 500 cfm (236 L/s) of airflow.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- G. Mounting Frames: Welded, galvanized, sheet-steel frame and galvanized-steel fasteners with gaskets; capable of bolting together into built-up filter banks.
- H. Capacities and Characteristics:
1. 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.
  2. Depth: [12 inches (300 mm)] <Insert dimension> nominal.
  3. System Airflow: <Insert cfm (L/s)>.
  4. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
  5. Initial Resistance: [0.50-inch wg (125 Pa)] <Insert value>.
  6. Recommended Final Resistance: <Insert inches wg (Pa)>.
  7. 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.
    - a. Depth: [1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)] <Insert dimension>.
    - b. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.

- c. 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>.
  - d. Recommended Final Resistance: <Insert inches wg (Pa)>.
  - e. Filter Unit Class: UL 900, [Class 1] [Class 2].
  - f. Arrestance: [85] <Insert value> percent when tested according to ASHRAE 52.1.
  - g. MERV: [8] <Insert value> when tested according to ASHRAE 52.2.
8. 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]. Size and airflow capacity shall match those of gas-phase filters.
- a. Depth: [12 inches (300 mm)] [18 inches (450 mm)] [24 inches (600 mm)] <Insert dimension>.
  - b. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
  - c. Initial Resistance: [1-inch wg (250 Pa)] [2-inch wg (500 Pa)] <Insert value> at 500 fpm (2.5 m/s).
  - d. Recommended Final Resistance: <Insert inches wg (Pa)>.
  - e. Filter Unit Class: UL 900, [Class 1] [Class 2].
  - f. Arrestance: [85] <Insert value> percent when tested according to ASHRAE 52.1.
  - g. MERV: [13] <Insert value> when tested according to ASHRAE 52.2.

## 2.4 CYLINDRICAL-CANISTER FILTERS

- A. Description: Factory-fabricated, dry, cylindrical canisters containing loose-fill adsorbent with holding frames.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Cylinders: 0.0455-inch- (1.2-mm-) thick, perforated, [electroplated] [stainless] steel, with end plate.
- C. Fill Media: [5.0 lb (2.3 kg)] [6.7 lb (3.0 kg)] <Insert value> of [coconut-shell activated carbon] [activated alumina impregnated with potassium permanganate] [impregnated carbon] [blended carbon and alumina impregnated with potassium permanganate] per canister.
  - 1. Ash Content: [2 to 3] <Insert number range> percent.
  - 2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  - 3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  - 4. Mesh Size: [4 by 6 inches (100 by 150 mm)] <Insert value>, 90 percent minimum.
  - 5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- D. Mounting Frames: Welded [galvanized, sheet steel with galvanized-steel fasteners] [stainless steel with stainless-steel fasteners] with gaskets; designed for bolting together into built-up filter banks.
- E. Capacities and Characteristics:

1. Face Size: [24 by 24 inches (600 by 600 mm)] [24 by 12 inches (600 by 300 mm)] <Insert dimensions> nominal.
2. Cylinder Length: [18 inches (450 mm)] [24 inches (600 mm)] <Insert dimension> nominal.
3. Housing Depth: [34 inches (860 mm)] <Insert dimension> nominal.
4. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
5. Initial Resistance: [0.50-inch wg (125 Pa)] <Insert value>.
6. Recommended Final Resistance: <Insert inches wg (Pa)>.
7. 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.
  - a. Depth: [1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)] <Insert dimension>.
  - b. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
  - c. 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>.
  - d. Recommended Final Resistance: <Insert inches wg (Pa)>.
  - e. Filter Unit Class: UL 900, [Class 1] [Class 2].
  - f. Arrestance: [85] <Insert value> percent when tested according to ASHRAE 52.1.
  - g. MERV: [8] <Insert value> when tested according to ASHRAE 52.2.
8. 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]. Size and airflow capacity shall match those of gas-phase filters.
  - a. Depth: [12 inches (300 mm)] [18 inches (450 mm)] [24 inches (600 mm)] <Insert dimension>.
  - b. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
  - c. Initial Resistance: [1-inch wg (250 Pa)] [2-inch wg (500 Pa)] <Insert value> at 500 fpm (2.5 m/s).
  - d. Recommended Final Resistance: <Insert inches wg (Pa)>.
  - e. Filter Unit Class: UL 900, [Class 1] [Class 2].
  - f. Arrestance: [85] <Insert value> percent when tested according to ASHRAE 52.1.
  - g. MERV: [13] <Insert value> when tested according to ASHRAE 52.2.

## 2.5 PERMANGANATE FILTERS

- A. Description: Factory-fabricated modules containing loose-fill adsorbent with holding frames.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Modules: Permanent type, 24 inches wide by 24 inches high by 24 inches deep (600 mm wide by 600 mm high by 600 mm deep); shall hold both potassium permanganate and activated carbon. Manufactured in two pieces, each 12 inches (300 mm) wide for ease of installation.
- C. Media: Porous spherical pellets formed from a combination of powdered, activated carbon and other binders, impregnated with potassium permanganate.



1. Leach Test: [180] <Insert number> minutes.
  2. Potassium Permanganate Content: [4] <Insert number> percent minimum.
  3. Moisture Content: [20] <Insert number> percent maximum.
  4. Bulk Density: [34 lb/cu. ft. (0.54 g/mL)] [50 lb/cu. ft. (0.8 g/mL)] <Insert value>.
  5. Crush Strength: [40] [50] [60] percent maximum.
  6. Abrasion: [4] <Insert number> percent maximum.
  7. Nominal Pellet Diameter: [0.125 inch (3.175 mm)] <Insert dimension>.
  8. Percent of Pellet Sizes: [80 to 85] <Insert number range> percent after screening.
- D. Media: High-grade carbon, manufactured from coconut shells, bituminous coal, or a combination of both.
1. Ash Content: [2 to 3] <Insert number range> percent.
  2. Percent Carbon Tetrachloride Activity: [35 to 70] <Insert number range> percent when tested according to ASTM D 3467.
  3. Bulk Density: [32 lb/cu. ft. (510 kg/cu. m)] <Insert value>.
  4. Mesh Size: [4 by 6 inches (100 by 150 mm)], 90 percent minimum.
  5. Hardness Factor: [95] <Insert value> when tested according to ASTM D 3802.
- E. Frame: [Galvanized steel] [Hot-dip galvanized steel] [Aluminum] [Stainless steel], hinged, and with pull and retaining handles fastened to the media.
- F. Capacities and Characteristics:
1. Face Size: <Insert inches (mm)>.
  2. Thickness or Depth: <Insert inches (mm)>.
  3. Surface Area: <Insert sq. ft. (sq. m)>.
  4. Holding Frame Size: <Insert inches (mm)>.
  5. Number of Filters: <Insert number>.
  6. System Airflow: <Insert cfm (L/s)>.
  7. Maximum or Rated Face Velocity: <Insert fpm (m/s)>.
  8. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm (2.5 m/s).
  9. Initial Resistance: <Insert inches wg (Pa)>.
  10. 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.
    - a. Depth: [1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)] <Insert dimension>.
    - b. Maximum or Rated Face Velocity: [500 fpm (2.5 m/s)] <Insert value>.
    - c. Initial Resistance: [0.25-inch wg (62.3 Pa)] [0.35-inch (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>.
    - d. Recommended Final Resistance: <Insert inches wg (Pa)>.
    - e. Filter Unit Class: UL 900, [Class 1] [Class 2].
    - f. Arrestance: [85] <Insert number> percent when tested according to ASHRAE 52.1.
    - g. MERV: [8] <Insert value> when tested according to ASHRAE 52.2.

11. 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]**. Size and airflow capacity shall match those of the gas-phase filters.
  - a. Depth: **[12 inches (300 mm)]** **[18 inches (450 mm)]** **[24 inches (600 mm)]** **<Insert dimension>**.
  - b. Maximum or Rated Face Velocity: **[500 fpm (2.5 m/s)]** **<Insert value>**.
  - c. Initial Resistance: **[1-inch wg (250 Pa)]** **[2-inch wg (500 Pa)]** **<Insert value>** at **500 fpm (2.5 m/s)**.
  - d. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
  - e. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
  - f. Arrestance: **[85]** **<Insert number>** percent when tested according to ASHRAE 52.1.
  - g. MERV: **[13]** **<Insert value>** when tested according to ASHRAE 52.2.

## 2.6 SUPPORTED ADSORBER BAG FILTERS

- A. Description: Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Media: Carbon-filled fibrous material constructed so individual pleats are maintained under rated-airflow conditions in tapered form by flexible internal supports.
- C. Filter-Media Frame: Galvanized steel.
- D. Mounting Frames: Welded, galvanized, sheet-steel frame and galvanized-steel fasteners with gaskets; capable of bolting together into built-up filter banks.
- E. Capacities and Characteristics:
  1. Face Size: **[24 by 24 inches (600 by 600 mm)]** **[24 by 12 inches (600 by 300 mm)]** **<Insert dimensions>**nominal.
  2. Depth: **[21 inches (530 mm)]** **<Insert dimension>** nominal.
  3. System Airflow: **<Insert cfm (L/s)>**.
  4. Maximum or Rated Face Velocity: **[500 fpm (2.5 m/s)]** **<Insert value>**.
  5. Initial Resistance: **[0.56-inch wg (140 Pa)]** **<Insert value>**.
  6. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
  7. Minimum Toluene Removal Efficiency: 90 percent.
  8. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
  9. Arrestance: **[85]** **<Insert number>** percent when tested according to ASHRAE 52.1.
  10. MERV: **[13]** **<Insert value>** when tested according to ASHRAE 52.2.

## 2.7 FRONT-ACCESS FILTER FRAMES

- A. 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. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- B. Prefilters: Incorporate a separate track[ **with spring clips**], 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.

## 2.8 SIDE-SERVICE HOUSINGS

- A. Description: Factory-assembled, side-service housings constructed of **[galvanized steel]** **[aluminum]** with flanges to connect to duct or casing system.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- B. Prefilters: Integral tracks to accommodate **2-inch- (50-mm-)** thick, disposable[ **or washable**] filters.
- C. 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.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

## 2.9 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.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Install filter gage for each filter bank.
- D. 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.
- E. Do not install gas-phase filters until fan system is clean and there is no risk of construction debris loading the filter.
- F. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream of 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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, 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. Test for leakage of unfiltered air while system is operating.
- 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 particulate filter media.

END OF SECTION 234200