

SECTION 23 40 00
HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air filters for heating, ventilating and air conditioning.
- B. Definitions: Refer to ASHRAE Standard 52.1 for definitions of face velocity, net effective filtering area, media velocity, resistance (pressure drop), atmospheric dust spot efficiency and dust-holding capacity. ASHRAE Standard 52.1 measures arrestance, dust spot efficiency and dust holding capacity of filters.
- C. Refer to ASHRAE Standard 52.2 for definitions of MERV (Minimum Efficiency Reporting Value) PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE Standard 52.2 measures particle size efficiency (PSE).

1.2 RELATED WORK

- A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Filter housing and racks: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

1.3 QUALITY ASSURANCE

- A. Air Filter Performance Report for Extended Surface Filters:
 - 1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE Standards 52.1 and 52.2 for type filter under test and acceptable to Resident Engineer, indicating that filters comply with the requirements of this specification. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.
 - 2. Government Option: The Government at its option may take one of the filters for each different type submitted and run an independent test to determine if the filter meets the requirements of this specification. When the filter meets the requirements, the Government will pay for the test. When the filter does not meet the specification requirements, the manufacturer will be required to pay for the test and replace the filters with filters that will perform as required by the specifications.
 - 3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be

- required to maintain the minimum efficiency shown on the ASHRAE Standard 52.2 report throughout the time the filter is in service. Within the first 6-12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE Standard 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency in any of the 12 channels shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.
- B. Filter Supplier Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life. Defective filters shall be replaced at no cost to the Government.
 - C. Comply with UL Standard 586 for flame test.
 - D. Filters shall maintain minimum initial efficiency after 6 weeks in service.
 - E. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL classification, and file number.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Extended surface filters.
 - 2. Holding frames. Identify locations.
 - 3. Side access housings. Identify locations, verify insulated doors.
 - 4. HEPA filters.
 - 5. Magnehelic gages.
- C. Air Filter performance reports.
- D. Suppliers warranty.
- E. Field test results for HEPA filters as per paragraph 2.3.E.3.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
 - 52.1-92.....Gravimetric and Dust-Spot procedures for Testing
Air Cleaning Devices Used in General Ventilation
for Removing Particulate Matter

52.2-99.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

C. American Society of Mechanical Engineers (ASME):

NQA-1-02.....Quality Assurance Requirements for Nuclear Facilities Applications

D. Underwriters Laboratories, Inc. (UL):

586-00.....High-Efficiency, Particulate, Air Filter Units

900-99.....Air Filter Units

SPEC WRITER NOTE: Update material requirements to agree with applicable requirements (types, grades, classes, and other related items) specified in the referenced Applicable Publications.

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

- A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS, provide one complete set of additional (replacement) filter elements.
- B. The Resident Engineer will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

- A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.
- B. Filter Classification: UL approved Class 1 or Class 2 conforming to UL Standard 900.
- C. Filter Grades, Percent, Average ASHRAE Efficiency and Controlled Containment:
 - 1. Grade A: 90-95 after-filter, when handling 0.3 to 1.0 micron particles.
 - 2. Grade B: 80-85 after-filter, when handling 0.3 to 1.0 micron particles.
 - 3. Grade C: 50-65 pre-filter, when handling 1.0 to 3.0 micron particles.
 - 4. Grade D: 25-30 pre-filter, when handling 3.0 to 10.0 micron particles.
 - 5. HEPA: See Article 2.3.

6. Carbon Filters: See Article 2.4.

D. Filter Media:

1. Grade A, B and C Non-supported (Bag) Type: Construct media of high density glass fibers or other suitable fibers. Enclose or pocket each pleat in woven or non-woven backing material. Seal and fasten stitch or weld to maintain pocket shape in a proper frame to insure no air leakage for life of filter. Staples and stays are prohibited.
2. Grade A, B and C Supported (Rigid Pleated) Type: Media shall be composed of high density glass fibers or other suitable fibers. Fastening methods used to maintain pleat shape, (metal backing or aluminum separators) shall be sealed in a proper enclosing frame to insure no air leakage for life of filter. Staples and stays are prohibited.
3. Grade D (Pleated) Type: Media shall be composed of synthetic/natural fibers. Media shall maintain uniform pleat shape and stability for proper air flow and maximum dust loading. The media frame shall be constructed of aluminized steel. Bond the pleated media pack on all four edges to insure no air leakage for the life of the filter. Staples and stays are prohibited.

E. Filter Efficiency and Arrestance: Efficiency and arrestance of filters shall be determined in accordance with ASHRAE Standard 52.1, and MERV value in accordance with ASHRAE Standard 52.2. Atmospheric dust spot efficiency and synthetic dust weight arrestance shall not be less than the following:

Filter Efficiency, Arrestance and MERV Value				
	Percentage of Initial Efficiency	Percentage of Average Efficiency	Percentage of Average Arrestance	MERV Value
Grade A	75.4	86.4	99.0	14
Grade B	58.0	79.0	98.0	13
Grade C	25.0	53.0	97.0	11
Grade D	Less than 20.0	22.0	89.0	7

F. Maximum initial and final resistance, Pa (inches of water), for each filter cartridge when operated at 150 m/min (500 feet per minute) face velocity:

Filter Initial and Final Resistance		
	Initial Resistance	Final Resistance
Grade A (Bag)	130 (0.52)	250 (1.00)

Grade A (Rigid Pleated)	185 (0.74)	300 (1.20)
Grade B (Bag)	125 (0.50)	250 (1.00)
Grade B (Rigid Pleated)	150 (0.60)	300 (1.20)
Grade C (Bag)	112 (0.45)	250 (1.00)
Grade C (Rigid Pleated)	100 (0.40)	300 (1.20)
Grade D (2-inch deep)	80 (0.32)	250 (1.0)
Grade D (4-inch deep)	100 (0.40)	250 (1.0)

- G. Minimum Media Area: The minimum net effective media area in square meter (square feet) for each 600 mm by 600 mm (24 inches by 24 inches) (face area) filter at 150 m/min (500 fpm) face velocity shall be at least the values listed below. For other filter sizes the net effective media area shall be proportionally higher or lower.

Filter Media Area	
Grade A (Bag) 8 pockets, 765 mm (30 inch) deep	8.5 (91.0)
Grade A (Rigid Pleated), 300 mm (12 inch) deep	5.3 (57.0)
Grade B (Bag) 8 pockets, 765 mm (30 inch) deep	8.5 (91.0)
Grade B (Rigid Pleated) 300 mm (12 inch) deep	5.3 (57.0)
Grade C (Bag) 8 pockets, 765mm (30 inch) deep	8.5 (91.0)
Grade C (Rigid Pleated) 300 mm (12 inch) deep	5.3 (57.0)
Grade D 50 mm (2 inch deep)	1.4 (14.8)
Grade D 100 mm (4 inch deep)	2.1 (23.0)

H. Side Servicing Housings:

1. Minimum 1.6 mm (16 gage galvanized steel, or aluminum, completely factory assembled with upstream and downstream flanges for connection into the duct system. Furnish housing length sufficient to provide for fully extended operating filter elements.
2. Access doors: Double skin insulated, at each end of the housing with continuous gasketing on the perimeter and positive locking devices. Design doors to withstand a minimum positive/negative 1.0 kPa (four inches of water) static pressure.
3. Filter slide channels: Channels shall incorporate a positive-sealing gasket material to seal the top and bottom of the filter cartridge frames to prevent bypass. Provide factory installed gasketing to prevent leakage between cartridges, and between cartridges and doors.

I. Holding Frame System:

1. Minimum 1.6 mm (16 gage) galvanized steel, 100 mm (4 inches) deep, factory-supplied hardware necessary for field assembly, suitable for

either upstream or downstream filter servicing. All members shall be cut to size and prepunched for easy assembly into modules of the size and capacity noted in the schedules.

2. The framing members shall be permanently gasketed to prevent the bypass of unfiltered air. If required, furnish suitable vertical support members to prevent deflection of horizontal members. The vertical support members shall not interfere with either the installation or operation of the filters.
3. The framing system shall incorporate a factory installed positive sealing device for each row of filters. This device shall allow for easy installation and removal of cartridges and shall insure the seal between the gasketed filter elements while the bank is in operation.

J. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage) range, flush mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment. Provide one gage for each extended surface filter section. Provide Petcocks for each gauge.

K. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.3 HEPA FILTERS

- A. High Efficiency Particulate Air (HEPA) filters shall be individually tested and certified to be 99.97 percent minimum efficient meeting minimum MERV value of 17 when handling 0.3 micron or smaller particles in accordance with DOP test method. Filters shall be factory scanned. The DOP efficiency along with filter serial number and name of manufacturer shall be marked on the filter. HEPA filter shall have pressure drop of 250 Pa (1 inch WG) when clean at rated flow with a final pressure drop of 500 Pa (2 inch WG).
- B. Filter media: Factory constructed by pleating a continuous sheet of media into closely spaced pleats with kraft or aluminum separators. Sealer shall be self-extinguishing.
- C. Enclosing frame shall be 16 gauge galvanized steel. Provide pre-filters in the same housing with a separate removal assembly that operates independently from the HEPA filters.
- D. Pre-filter: Type D, 2 inches deep. See Paragraph 2.2.
- E. Bag-In/Bag-Out Housing for HEPA Filters:
 1. Housing shall be fabricated of 15 gauge type 304 stainless steel.
 2. Housing shall be equipped with weather covers, drilled face flanges and factory mounted Magnehelic gauges with Petcocks housed in stainless steel brackets.

3. Housing shall be pressure tested in factory for high quality to withstand a positive or negative pressure of 10 inch WG.
4. Housing shall incorporate a spring loaded clamping mechanism that is operated from outside and which is capable of exerting a 5340 N (1,200 lb.) sealing force across the top and bottom of each filter.
5. Housing shall have a bagging ring around the access port, sealed by a removable, gasketed access door. The bagging ring shall have two (2) continuous ribs to secure the plastic change-out bag and be hemmed on its outer edge to prevent the bag from tearing.
6. One 8 mil thick PVC change-out bag shall be supplied for each access door. The bag shall include approximately 300 mm (12 inches) of transparent PVC at the open end and three glove sleeves built into the body to assist in filter change-out. Bag-In/Bag-Out housings shall be manufactured under a quality assurance program that addresses the requirements of ASME NQA1, "Quality Assurance Requirements for Nuclear Facilities Applications."
7. Comply with U.L. Standard 586.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supports, filters and gages in accordance with manufacturer's instructions.
- B. Label clearly with words "Contaminated Air" on exhaust ducts leading to the HEPA filter housing.

3.2 START-UP AND TEMPORARY USE

- A. Clean and vacuum air handling units and plenums to the satisfaction of the Resident Engineer prior to starting air handling systems.
- B. Install or deliver replacement filter units as directed by the Resident Engineer.

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