

**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 52.2 for definitions of face velocity, net effective filtering area, media velocity, initial 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.

**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 Standard 52.2 for type filter under test and acceptable to Resident Engineer, indicating that filters comply with the requirements of this specification. Filters utilizing partial or complete synthetic media will be tested in compliance with pre-conditioning steps as stated in Appendix J. All testing is to be conducted on filters with a nominal 24 inch by 24 inch face dimension. 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 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 Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no cost to the Government.
- C. Comply with UL Standard 900 for flame test.
- D. 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.
  6. Carbon Filters.
- 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):  
52.2-2007.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size, including Appendix J
- C. American Society of Mechanical Engineers (ASME):  
NQA-1-2008.....Quality Assurance Requirements for Nuclear Facilities Applications
- D. Underwriters Laboratories, Inc. (UL):  
900; Revision 15 July 2009      Test Performance of Air Filter Units

## **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 conforming to UL Standard 900.
- C. Filter Grades, Percent, Average ASHRAE Efficiency and Controlled Containment:
  - 1. Carbon Filters: See Article 2.4.
- D. Filter Media:
  - 1. 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.
  - 2. 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.

<b>Filter Efficiency, Arrestance and MERV Value</b>				
	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	D.

- 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:

<b>Filter Initial and Final Resistance</b>			
		Initial Resistance	Final Resistance
Grade A (Bag)	Merv 14	130 (0.52)	250 (1.00)
Grade A (Rigid Pleated)	Merv 14	185 (0.74)	300 (1.20)
Grade B (Bag)	Merv 13	125 (0.50)	250 (1.00)
Grade B (Rigid Pleated)	Merv 13	150 (0.60)	300 (1.20)
Grade C (Bag)	Merv 11	112 (0.45)	250 (1.00)
Grade C (Rigid Pleated)	Merv 11	100 (0.40)	300 (1.20)
Grade D (2-inch deep)	Merv 7	80 (0.32)	250 (1.0)
Grade D (4-inch deep)	Merv 7	100 (0.40)	250 (1.0)

Table 2.2.F

<b>Filter Initial and Final Resistance</b>			
	Initial Resistance	Maximum Recommended Change Over Pressure Drop	Maximum Final Resistance
MERV 7 (2-inch deep)	78 (0.31)	156 (0.62)	250 (1.00)
MERV 8 (2-inch deep)	95 (0.38)	190 (0.76)	250 (1.00)
MERV 11 (12-inch deep)	60 (0.24)	120 (0.48)	375 (1.50)
MERV 13 (12-inch deep)	125 (0.50)	250 (1.00)	375 (1.50)
MERV 14 (12-inch deep)	170 (0.68)	340 (1.36)	375 (1.50)

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.

<b>Filter Media Area</b>	
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 Gauge) 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 wall insulated, located on one side of the housing; with continuous gasketing on the perimeter and positive locking devices. Provide access doors on both sides only when required as shown on drawings. Design doors to withstand a minimum positive/negative 1.0 kPa (4 inch WG) static pressure. Furnish access doors that are the full size of the housing.

- I. 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.
- J. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

#### **2.4 2-STAGE CARBON FILTERS IN BAG-IN/BAG-OUT HOUSING**

- A. Factory fabricated activated Carbon filters for absorption of trace quantities of Tritium, Carbon 14, Phosphorus 32, Sulfur 35 and Iodine I-125 (volatile).
- B. Two-stage Carbon Absorber shall be specially impregnated with salts and metals to enable the media to react with the specified contaminants (Tritium, Phosphorus 32, Carbon 14, Sulfur 35 and Iodine I-125 (volatile). Absorber shall be KA3510 Nuclear Grade Carbon Filter.
- C. Frame constructed of high strength, moisture resistant and constructed to prevent air leakage and spilling of media.
- D. Initial resistance of 500 FPM air velocity not to exceed 0.76 inch wg with rated average arrestance of 80 percent.
- E. Filter performance data shall conform to ASHRAE Standard 52.1 and pads classified as Class 2 as per testing performed according to UL Standard 900.
- D. Pre-filter: Grade A (MERV 14), 12 inches deep. See Paragraph 2.2.
- E. Bag-In/Bag-Out Housing for MEGA Filters:
  - 1. Housing shall be fabricated of 14 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.

- F. Housing: The filter housing shall be Flanders/CSC BF-Series Filter Housing, BF1-1H1W-GG19-304-D1 Housing or approved substitute bag-in/bag-out housing and shall be manufactured from 14 Ga. & 11 Ga. T-304 stainless steel (unpainted). The housing shall be adequately reinforced to withstand a negative or positive pressure of 10" water gage. The housing shall be side access for filter installation and change-out. Housing design and filter arrangement shall allow air to enter and exit housing without changing direction. The housings shall accommodate fluid seal filters which require the housing to have a knife edge that inserts into a fluid filled perimeter channel on the face of the filter. Prior to leaving the factory, each filter sealing knife edge is checked with an alignment gage to insure proper alignment of the knife edge. Provide sampling ports in either side of each stage of the absorbers for testing the media for saturation.
- G. All "pressure retaining" weld joints and seams shall be continuously welded; weld joints and seams requiring only intermittent welds by design shall not be continuously welded. As a minimum, all weld joints and seams shall be wire brushed and/or buffed to remove heat discoloration, all burrs, and sharp edges. All weld joints and seams that are a portion of any gasket setting surface (i.e., duct connecting flanges) shall be ground smooth and flush with adjacent base metals. All welding procedures, welders, and welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All production welds shall be visually inspected per Flanders/CSC's standard procedure number P-122, "Visual Inspection of Welds", which incorporates the workmanship acceptance criteria described in sections 5 & 6 of ANSI/AWS D9.1-1990, "Specification for Welding of Sheet Metal".
- H. All hardware on the housing and mechanical components of the filter sealing mechanism are 300 series stainless steel except for the access door knobs which are cast aluminum.
- I. The filter sealing mechanism shall be replaceable and shall be operated by a locking handle that is operated through the change-out bag. The sealing mechanism is designed to exert an equal force to the top and

bottom edge of each filter when engaging and disengaging the filter on the knife edge.

- J. The housing shall have a bagging ring around each filter access port that is sealed by a removable, gasketed access door. The door gasket shall be neoprene and shall be manually replaceable after the door has been removed from the housing. The bagging ring shall have two (2) continuous ribs to secure the plastic change-out bag and the ring is hemmed on its outer edge to prevent the bag from tearing. One (1) PVC change-out bag shall be furnished with each filter access port. Bags shall be 8 Mil. thick and yellow in color. Bags have a translucent, taffeta finish and an elastic shock cord hemmed into the mouth of the bag so when stretched around the bagging ring, it is a secure fit. Bag shall include approx. 16" of clear PVC at the mouth of the bag and three (3) glove sleeves built into the bag to assist in the filter change-out. Each bag shall have its stock number rolled in the hem. The bag shall not stick together. One (1) nylon security strap and one (1) cinching strap shall be provided with each filter access port.
- K. Quality assurance and factory testing: The filter housing shall be manufactured under a quality assurance program that addresses the requirements of ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities". Housing shall be tested for filter fit, operation of the filter clamping mechanism, knife edge alignment, and leak tightness before leaving the factory. Both the filter sealing surface and the complete assembly pressure boundary shall be leak tested by the "pressure decay method", in accordance with ANSI/ASME N510-1989 (reaffirmed in 1995), "Testing of Nuclear Air-Cleaning Systems", paragraphs 6 & 7 and have a maximum leak rate of 0.0005 CFM per cubic foot of housing volume at 10" water gage. Test duration shall be 5 minutes with pressure readings recorded at 1 minute intervals.
- L. Inverter: Washdown Duty Inverter, rated for up to 2HP Variable-Torque load on 460/3/60 input at up to 10 KHz carrier frequency, with NEMA 4X/12 Enclosure, NEMA 4X Keypad Control, and all Standard Features. Refer to Section 26 2911, Low Voltage Motor Starts. Manufacturer shall be Dan Foss.
- M. Blower: Airfoil Centrifugal Blower, Clockwise bottom angular up, Class 1, Premium Eff. Motor (min. 86.5%), Wheel Width Reduced 33%, MDSG-120 460V, STL ACC Door-Bolt, Steel Drain, OSHA BG/Weather Cover-STL, Extended Lube Lines, Belt Tension-Rotary, RS-70 Set (6) - Seismic Isolators. Refer to Section 23 3400 HVAC FANS. Capacity = 1150 CFM at 5.5-in.w.g. pressure.



- N. Entire unit consisting of manual isolation damper, inlet transition, Bag-in/Bag-out housing with prefilter section BG1-1H1W-YYF-304-D1 Carbon Housing, two stages of charcoal filtration, outlet transition and dedicated exhaust fan shall be mounted on a single stainless steel structural base. Prefilter: 0-00A-C-08-03-IU-11-00-GG-F. Absorbers: AF-GG19-121-NP, rated for up to 1250 CFM.
- O. Entire filter housing shall be externally insulated with 2-inch thick fiberboard insulation and finished with a waterproof jacket or weather covering. Filter doors and knobs shall remain fully accessible and differential pressure gages shall extend beyond insulation and jacket.
- P. Seismically anchor entire base support rail, filter housing and spring-isolated fan to roof structure.

## **2.5 INSTRUMENTATION**

- A. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage), three inch for HEPA) range. Gauges shall be flush-mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment.
- B. DDC static (differential) air pressure measuring station. Refer to Specification Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.
- D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

## **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 prior to starting air handling systems.
- B. Install or deliver replacement filter units as directed by the Resident Engineer.

### **3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection,

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start up, and contractor testing required above and required by the  
System Readiness Checklist provided by the Commissioning Agent.

- B. Components provided under this section of the specification will be  
tested as part of a larger system. Refer to Section 23 08 00 -  
COMMISSIONING OF HVAC SYSTEMS and related sections for contractor  
responsibilities for system commissioning.

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