

## SECTION 234100 – LABORATORY FILTER HOUSINGS AND FILTERS

Latest Update: 08-16-2020 See Underlined Text for Edits

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

#### 1.2 SUMMARY

- A. This section includes the requirements for filter housings, filters and accessories for special exhaust systems for laboratories as follows:
  - 1. Bag In/Bag Out filter housings.
  - 2. Bubble tight dampers.
  - 3. Filter media, pre filters, HEPIA filters, carbon filters.
  - 4. Hepa filter ceiling modules.
  - 5. Hepa filter modules-fan powered.
  - 6. Filter gauges.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.
- B. For each specified product:
  - 1. 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.
- C. LEED Submittals: <Delete if not LEED Project>
  - 1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
  - 2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
  - 3. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product

requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- D. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
  - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
  - 3. Include diagram for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.
- B. 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.
  - 2. Provide one complete set(s) of filters for each filter bank. If system includes pre filters, provide only pre filters.

#### 1.6 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: All coating, and adhesive exposed to airstream shall meet a flame spread rating not over twenty five (25) and a smoke developed rating no higher than fifty (50) as required in NFPA 90A.
- B. Filter Housing: Filter housing shall be manufactured under quality assurance program that meets all the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities"
- C. Welding: All production welds shall be visually inspected per the workmanship acceptance criteria described in Sections 5 and 6 of ANSI/AWS D9.1-1990. "Specifications for Welding Sheet Metal".
- D. Testing: Housing shall be tested in accordance with ASME N510-1995 "Reaffirmed".

- E. Manufacturer Qualifications: Filter housing shall be manufactured by qualified unit manufacturer that has been making containment housings for at least ten (10) years, and shall carry manufacturer's nameplate. Unit manufacturer shall be held responsible for specified performance of units.
- F. ASHRAE Compliance: Comply with ASHRAE 52.2 for MERV for methods of testing and rating air filter units.
- G. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Deliver filter housings as a factory assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

#### 1.8 EXTRA MATERIALS

- A. Install filter media prior to air balance, testing and commissioning.
- B. If filters remain in the system for longer than six months prior to substantial completion or if filter pressure drop exceeds 25% of the design filter pressure drop at substantial completion, provide a complete set of new filters prior to building turnover to Owner.

#### 1.9 WARRANTY AND GUARANTEE

- A. See Division 23 Specification Section “General Mechanical Requirements – HVAC” for warranty and guarantee requirements.

### **PART 2 - PRODUCTS**

#### 2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Laboratory filter housings, filters and accessories shall be designed and selected in accordance with the scheduled capacities on the drawings and the requirements of this specification.
- B. Basis of Design: The basis of design for laboratory filter housings, filters and accessories shall be as manufactured by:
  - 1. Bag In/Bag Out Filter Housing – Flanders/CSC
  - 2. Dampers – Flanders/CSC

3. Filter Media – Flanders/CSC
  4. Filter Ceiling Module – Flanders/CSC
  5. Fan Powered Filter Module – Flanders/CSC
  6. Filter Gauges – Dwyer Instruments Inc.
- C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide Laboratory filter and housing assemblies by one (1) of the following:
1. Bag In/Bag Out Filter Housing – American Air Filter Corp., Camfil/Farr
  2. Dampers – Camfil/Farr, Ruskin Dampers
  3. Filter Media – American Air Filter Corp., Camfil/Farr
  4. Filter Ceiling Module – American Air Filter Corp., Camfil/Farr
  5. Fan Powered Filter Module – American Air Filter Corp., Camfil/Farr
  6. Filter Gauges – Cambridge Filter Corp.
- D. Other Filter Media: For filter media serving air handling units, fan coil units, cabinet heaters and self-contained A/C units see the Division 23 Specification Sections for that equipment.

## 2.2 BAG IN/BAG OUT FILTER HOUSING ASSEMBLY

- A. General: Filter housing shall be bag in/bag out assembly allowing filter change without physical contact with filter cartridge.
- B. Housing Construction: Housing shall be fabricated from 14 gauge Type 316 stainless steel all welded and suitably reinforced to withstand a minimum internal and external pressure of 10" WG in accordance with ANSI-N509-1980. All welding procedures, welders and welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All internal parts shall be constructed of Type 316 stainless steel. All pressure retaining weld joints and seams shall be continuously welded with no pores allowed. All production welds shall be visually inspected per the workmanship acceptance criteria described in sections 5 and 6 of ANSI/AWS D9.1-1990. "Specifications for Welding Sheet Metal". Filter housing shall be manufactured under quality assurance program that meets all the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities".
- C. Positive Seals: Positive seal clamping device shall be designed as complete stainless steel replaceable integrated mechanism. To facilitate filter removal and installation, filter clamping mechanism must have minimum travel of 5/8" from full-open to full-close position. Design sealing device shall exert minimum of 1,400 lbs force on filter. This force shall be supplied by pre-loaded springs, which will insure tight seal after gasket takes permanent set.
- D. Test Sections: Filter housings shall be provided with test sections upstream and downstream of each stage of HEPA/Carbon filter section. Provide DOP test ports in accordance with ANSI N510 and straightening diffusers for DOP testing. Flow

straightening diffusers shall be capable of being raised into and out of test position from a manual handle located on exterior of unit. Test sections shall meet same requirements as filter housings.

- E. Decontamination Ports: Provide decontamination ports upstream and downstream of each filter section. Each decontamination port shall be one and one half (1-1/2) inch in diameter and have lockable stainless steel high-pressure ball valve with sanitary connection with cap.
- F. Filter Removable Trays: Filter removable tray shall be provided to support filter that is being removed from housing and replacement filter during change-out. Shelf shall be fastened to housing by means of door latches following removal of door.
- G. Filters: Provide filters for each filter housing section. See paragraph 2.5 below.
- H. Bubble Tight Dampers: Furnish housing assembly with bubble-tight isolation dampers upstream and downstream of filter housing to facilitate filter changing. See paragraph 2.4 below.
- I. Factory Test: Housing shall be tested for filter fit, operation of filter clamping mechanism, and leak tightness before leaving factory. Both filter sealing surface and complete assembly pressure boundary shall be leak tested by "Pressure Decay Method", in accordance with ASME N510-1995 "Reaffirmed", "Testing of Nuclear Air Treatment Systems", paragraphs 6 and 7. Pressure readings are recorded once a minute until pressure decays to 75% of test pressure or for five (5) minutes. There shall be a maximum leak rate of 0.0005 cfm per cubic foot of housing volume at 10 inch wg.
- J. System Connections: Provide transitions/plenums from filter housing to bubble-tight dampers or system ductwork connections as shown on drawings. Transitions shall meet construction requirements as specified for filter housings. Filter housing shall be complete factory package unit.
- K. Static Pressure Taps: Static pressure taps shall be quarter (1/4) inch NPT half coupling, Type 316 stainless steel and be provided in housing so that pressure drop can be measured across each filter element in each bank. Provide factory-mounted photohelic pressure gauges equal to Dwyer Series 3,000, on each unit to read across each type of filters. Provide in-line HEPA filter in gauge piping.
- L. Supports: Filter housings shall be supported from their base off floor.

## 2.3 BUBBLE TIGHT DAMPERS

- A. General: Dampers shall be flanged round, heavy duty industrial butterfly bubble tight dampers. Dampers shall be leakage rated for bubble-tight conformance per ANSI/ASME N510. Furnish dampers with two (2) flanges for connection to flanges in ductwork.

- B. Damper Rating: Damper shall be rated for minimum 10 inch wg. pressure, 3,900 fpm velocity and 250°F temperature.
- C. Damper Size: Size dampers as close as possible to duct size, but in no case shall damper size be less than duct size.
- D. Damper Construction: Materials of construction shall be as follows:
  - 1. Frame: Type 316 stainless steel
  - 2. Blade: Type 316 stainless steel
  - 3. Axel: Type 316 stainless steel, continuous, extended six (6) inches beyond frame
  - 4. Seals: Silicone blade seal; double gland shaft seal
  - 5. Bearings: Relubricatable ball bearings outboard of shaft seals and damper frame
  - 6. Actuators: Manual, worm gear with cast iron or steel hand wheels
- E. Damper Actuators Assemblies: Actuator assemblies shall be installed outside airstream, linked to damper by jackshaft penetrating through tandem seals for airtight seal. Actuator shall be capable of closing damper at pressures encountered in system.

## 2.4 FILTER MEDIA

- A. General: Filter media for the bagin/bagout filter housing assemblies shall comply with the following:
- B. Disposable Rigid Cartridge Type Air Filters (Pre Filter):
  - 1. Similar to Farr E-Series RIGA-FLO or Flanders Precisionaire.
  - 2. High performance deep pleated, rigid, disposable type filters. Each filter shall consist of high efficiency media, enclosing frame, contour stabilizers on both air entering and exiting sides and support grilles. Filters shall be designed to withstand minimum differential pressure of six (6) inch wg without structural damage to filter frame, seals or media.
  - 3. Unless otherwise scheduled, initial resistance of MERV 11 filters (average efficiency of 60% - 65% based on ASHRAE Test Standard 52.1) at 500 fpm face velocity shall not exceed 0.31 inch wg.
- C. High Efficiency Particulate Air (Hepa) Filters:
  - 1. Filter size, capacity, and static pressure drop shall be as scheduled.
  - 2. Filters shall be individually tested and certified shall be 99.99% minimum efficient with handling 0.3m (micron) particles in accordance with DOP test method. DOP efficiency along with filter serial number and name of manufacturer shall be marked on filter.
  - 3. Each filter element shall consist of glass fiber media, fire retardant epoxy or self-extinguishing neoprene rubber sealer and neoprene gasket all contained in suitable

protected steel frame. Each filter element shall be constructed without use of spacers of any kind, including separators, tape, string or strips of medium by self-supporting pleating continuous sheet of formed, corrugated medium.

4. Filters shall be listed or classified under UL 586 test standard

D. Gas Phase Filters (Carbon Adsorbers):

1. Filter size, capacity, and static pressure drop shall be as scheduled.
2. Filter frame shall be constructed of 14 gauge Type 316 stainless steel with two (2) inch deep beds arranged in V-bank configuration. Adsorber screens shall be perforated 26 gauge Type 316 stainless steel. Adsorber shall be filled with 12 x 30 mesh, weatherized carbon that meets requirements of U.S. NRC Reg. Guide 1.52 and Article FF-5000 of ASME/ANSI AG-1-1991. At rated flow of 1,000 cfm, each adsorber shall provide 0.125 second residence time with approximate pressure drop of 1.45" wg. Adsorber to exhibit minimum mechanical efficiency of 99.9% when tested in accordance with IES Designation RP-8.

## 2.5 HEPA FILTER CEILING MODULES

- A. Furnish and install replaceable cartridge, fluidic seal type, FIEPA filter ceiling modules of sizes with 99.99% efficiency. Modules shall be one and one half (1-1/2) inch gasketed tee grid ceilings installed on twenty four (24) inch by twenty four (24) inch or twenty four (24) inch x forty eight (48) inch centers, AAF two (2) inch x one and one half (1-1/2) inch grids aid also with gypsum board or plastered ceilings.
- B. Replaceable cartridge type terminal HEPA filter housing shall be factory fabricated from '062 mill finish aluminum with all seams welded. The housing shall include an integral ten (10) inch diameter inlet collar. The collar shall be two (2) inches high and compatible with ten (10) inch round duct. Dimpled projections shall be provided on the periphery of the collar to retain the duct drawband in position to prevent slipping of the duct connection.
- C. The filter housing shall include a butterfly type damper, operable from the room side of the module by means of a screwdriver operated flexible shaft, terminating at the face of the module.
- D. Housing shall be furnished with a flush mounted removable face guard of 22 gauge, perforated 304 stainless steel. Perforation pattern shall be one eighth (1/8) inch holes on three sixteenth (3/16) inch staggered centers with 40% free area. Face guard will be attached to housing by stainless steel acorn nuts and washers connected to four 3/8" stud bolts.
- E. Housing sides shall be fabricated from a single piece of 14 gauge aluminum with a double thickness turned out flange terminating as an integral knife edge. Filter seal. All joints and seams of the housing shall be welded and assembled without the use of rivets.

- F. The replaceable HEPA filter cartridge shall be fabricated with 2.875 inch **<Adjust for filter depth>** deep anodized extruded aluminum cell sides and assembled without the use of screws, pop rivets or other mechanical fasteners which could cause contamination of the filter with metal shavings. Filter corner joints shall be mitered and covered by self-locking ribbed external splines. The filter corner joint design shall be self-aligning with interference fit up and include provision for penetration and distribution of adhesive to permanently bond and seal the corners. Butted and screwed filter corner joints will not be allowed.
- G. The HEPA filter design shall be the AAF LPD series mini-pleat and shall be listed in the current UL building materials directory as UL 900 Class 1. The filter extrusion shall include a continuous one half (1/2) inch wide gel filled pocket around the outside periphery of the leaving air side of the filter. The sealant shall be AAF Ultrage1, a non-hardening, factory installed yellow urethane gel.
- H. Filter to housing seal shall be accomplished by inserting the filter cartridge upward until the continuous knife edge within the housing is embedded into the matching gel filled pocket around the periphery of the filter. The seated filter cartridge shall be retained in place by four captive one quarter (1/4) turn latches. All latching hardware shall be of stainless steel with three eighth (3/8) inch diameter stainless bolts.
- I. The HEPA filter cartridge shall be factory sealed into a polyethylene bag and individually packaged into a heavy duty cardboard carton. The filter shall remain sealed in the factory carton until site conditions are sufficiently clean and appropriate for installation of HEPA filters into the housing.
- J. The HEPA filter pack shall be a two (2) inch **<Also available in four (4) inch>** deep mini-pleat separatorless design. All prime filter components shall comply with the requirements of UL-586. Only ribbons of media shall be used to space the pleats of media in the filter pack. The use of deformed media or inclusion of flammable or organic spacer materials such as glue flammants or adhesive impregnated strings will not be accepted. All pleats in the filter pack shall be straight and parallel to the filter sides within +/- one quarter (1/4) inch.
- K. The housing shall be equipped with a static pressure port to measure resistance across the filter and to sample a test aerosol concentration on the upstream side of the filter when leak testing. The connection shall be a five sixteenth (5/16) inch rivnut with a slotted machine-head screw.
- L. Packaging - All filters shall be packaged in a flanged, tight-fitting linerboard sleeve that fits within its carton, leaving a minimum one and one half (1-1/2) inch dead-air space on the four sides of the filter. The top and bottom of the filter shall be protected with a folded linerboard cushion.
- M. The filter pack shall be permanently bonded to the anodized aluminum cell sides by potting into a UL listed, white polyurethane adhesive.



- N. Filters shall be factory tested and certified per I.E.S., submit certification sheets with turn over documents.

## 2.6 HEPA FILTER MODULES – FAN POWERED

- A. The module plenum shall consist of extruded aluminum sides and a sealed aluminum top plate. Acoustical foam shall cover the interior surfaces of the plenum. The filter media shall be sealed in the plenum to be leak-free. A perforated anodized aluminum grille shall be mounted beneath the module to protect the filter media. Holes for suspension hangers shall be provided at each top corner of the module.
- B. The filter shall be made of all-glass boron silicate microfiber treated with a wet-strength, water-repellent binder per MIL-F-51079. The filter pack shall be formed without the use of spacers or separators of any kind, including aluminum, tape, strings or strips of media, by pleating a continuous sheet of media back and forth upon itself so that it is self-supporting. Minimum filter efficiency shall be: **<select one from below>**
1. 99.99% on 0.3 micron particles as tested per IES-RP-1 for Type C filters.
  2. 99.9995% on 0.12 micron particles, exceeding the requirements of IES-RP-1 for Type D filters.
- C. A label indicating compliance by the manufacturer with the requirements of IES-RP-I, including individual test results, shall be attached to each module.
- D. A washable foam prefilter shall be provided at the top inlet of the unit.
- E. The module shall deliver airflow at ninety (90) FPM +/- twenty (20) FPM average velocity as measured six (6) inches from the grille +/- airflow capacity shall be adjustable from sixty (60) FPM to one hundred ten (110) FPM to maintain laminar airflow up to a static pressure drop of 0.75 inch wg.
- F. Airflow shall be delivered by an energy-efficient 1/4 hp. motor/blower unit, precision balanced as an assembly for quiet, vibration-free operation. Power requirements shall be standard 115-volt, single phase, 60hz. Rated amps shall be 1.9 (minimum) through 2.3 (maximum). **<Select from the following list of options>**
1. CRS Grille (Painted White).
  2. Stainless Steel Grille.
  3. Ten (10) foot Power Cord.
  4. Insulation.
  5. Duct Connection, one quarter (14) inch.
  6. Unit Mounted Switch/Speed Control for fine tuning and balancing unit.
  7. Coordinate with the BAS contractor to provide DP sensor for the filters and a current sensor for the fan motor with alarms to the BAS.

## 2.7 FILTER GAUGES

- A. Diaphragm type gauge with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
  - 1. Diameter: Four and one half (4-1/2) inches.
  - 2. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5 Inch wg or Less: 0 to 0.5 inch wg.
  - 3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5 to 1.0 Inch wg or Less: 0 to 1.0 inch wg.
  - 4. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0 to 2.0 Inch wg or Less: 0 to 2.0 inch wg.
  - 5. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0 to 3.0 Inch wg or Less: 0 to 3.0 inch wg.
  - 6. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0 to 4.0 Inch wg or Less: 0 to 4.0 inch wg.
- B. Manometer-Type Filter Gauge: Molded plastic, with epoxy coated aluminum scale and logarithmic-curve tube gauge with integral leveling gauge, graduated to read from 0 to 3.0 inch wg, and accurate within 3% of the full-scale range.
- C. Accessories: Static pressure tips, tubing, gauge connections, and mounting bracket.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of filter housings.
- B. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Equipment Mounting:
  - 1. Install filter assemblies on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Architectural Specification Section "Miscellaneous Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic-control devices specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."
  - 3. Comply with requirements for vibration isolation devices specified in Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems."

- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Install filter gauge for each filter bank.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- F. Install filter-gauge, static pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gauges on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gauges.
- G. Coordinate filter installations with duct and air handling unit installations.

### 3.3 CONNECTIONS

- A. Comply with requirements for ductwork specified in Division 23 Specification Section "HVAC Duct Systems and Accessories." Drawings indicate general arrangement of ductwork, fittings, and specialties.

### 3.4 PROTECTION OF OPENINGS

- A. Protect openings on housings during construction against entry of foreign matter and construction dirt.

### 3.5 START UP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check filters and gauges
  - 3. Check door operation and seals
  - 4. Check filter removal mechanism
- B. Prepare test and inspection startup reports.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. 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.

### 3.7 CLEANING

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

END OF SECTION 234100