

SECTION 15861 – FILTERS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide filters, filter frames, filter housings, and filter gauges of size, capacity, location and types shown and scheduled on the drawings and hereinafter specified.

1.2 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.3 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. ARI 850 – Commercial and Industrial Air Filter Equipment.
 - 2. ASHRAE 52.1 – Gravimetric and dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 3. ASHRAE 52.2, Method of Testing General Ventilation Air-cleaning Devices For Removal Efficiency by Particle Size. (Minimum efficiency Reporting Value.)
 - 4. MIL-STD-282 – Filter Units, Protective Clothing, Gas-Mask Components, and Related Products; Performance – Test Methods; current edition.
 - 5. UL 586 – Test Performance of High Efficiency Particulate, Air Filter Units.
 - 6. UL 867 – Electrostatic Air Cleaners.
 - 7. UL 900 – Test Performance of Air Filter Units.

1.4 SUBMITTALS

- A. See Section 15050 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Manufacturer's Instructions; Indicate installation instructions and recommendations.

- D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: company specializing in manufacturing the Products specified in this section with minimum five (5) years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 PREFILTERS TYPE "A"

- A. Acceptable manufacturers subject to compliance with the specifications:
 - 1. Flanders (Type 62R)
 - 2. Camfil/Farr (30/30)
 - 3. Purolator Air Filter (MK80D)
 - 4. American Air Filters (300x)
 - 5. Filtration Group Inc (FGI) (Aerstar Series 400 HC)
- B. Prefilter shall be 4' thick: throwaway, medium efficiency, pleated, disposable type as shown on the drawings. Each filter shall consist of a non-woven fabric media, support grid and enclosing frame. The filter shall be UL listed as Class II.
- C. Filter media shall be of the non-woven fabric. The filter media shall have an average efficiency of 30% to 35% and an average arrestance of 90% to 92% in accordance with ASHRAE 52.1, and MERV 8 Rating per ASHRAE 52.2.
- D. The effective filter media shall be at least 7.0 sq.ft. of media per 1.0 sq.ft. of filter face area
- E. Initial resistance at 500 fpm approach velocity shall not exceed 0.35" w.g (7.0 sq ft per 1.0 sq ft face area, 11 pleats per linear ft.).
- F. The media support shall be a welded wire grid or expanded metal with an effective open area of at least 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull-away. The media support grid shall be formed in such a manner that it affects radial pleat design, allowing total use of filter media.
- G. The enclosing frame shall be constructed of a rigid, heavy duty, high wet strength beverage board, with diagonal support members bonded to the air entering and exiting side of each pleat

to ensure plate stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.

- H. Provide holding frames, factory fabricated of a minimum of 16 gauge stainless steel and equipped with gaskets and (4) spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without deforming the gaskets and without the use of tools. Frames shall be dimpled for proper centering and shall be designed so that filters of other efficiencies and depths can be used, at the owner's discretion, merely by change of fasteners.

2.2 FINAL FILTER TYPE "C".

- A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. Flanders Rigid Air - 95
2. Camfil/Farr (Riga Flo/200)
3. Purolator Air Filter (Aerocell-95)
4. Filtration Group Inc. (FGI) (Aerostar Rigid Cell Synthetic 95)

- B. Air filter shall be 12" deep, high performance, deep pleated, totally rigid.

- C. Filter media shall consist of a completely synthetic, electrostatic ally charged microfiber graded mat, with a light spun bonded top sheet and a heavyweight spun bonded support scrim. The filter shall have an average efficiency of 90-95% on ASHRAE 52.1-92 MERV 14 per 52.2. It shall have an average arrestance of not less than 99.5% on that standard. Filters shall be UL listed as Class II.

- D. Initial resistance at 500 fpm approach velocity shall not exceed 0.70" w.g.

- E. The media support shall be a welded wire grid with an effective open area of at least 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull-away. The media support grid shall be formed in such a manner that it affects a tapered radial pleat design. The grid shall be designed to support the media both vertically and horizontally.

- F. Contour stabilizers shall be galvanized steel and shall be permanently installed on both the air entering and air exiting sides of the filter media pack to ensure that the tapered radial pleat configuration is maintained throughout the life of the filter. There shall be four contour stabilizers on the air entering side and six on the air exiting side. The filter shall be capable of withstanding 10" w.g. pressure drop without noticeable distortion of the media pack.

- G. The enclosing frame shall be constructed of stainless steel. It shall be assembled in such a manner that a rigid and durable enclosure for the filter pack is affected. The media pack shall be mechanically and chemically bonded to the inside periphery of the enclosing frame, thus eliminating the possibility of air bypass. The enclosing frame shall be equipped with stainless steel, protective diagonal support braces on both the air entering and air exiting sides of the filter. The diagonal support braces shall be mechanically fastened to each contour stabilizer. (Cardboard is not permitted).

2.3 FINAL FILTER TYPE "C1".

- A. Same as C except offering is 80- 85%, MERV 13
- B. Initial resistance at 500 fpm approach velocity shall not exceed 0.50"w.g.

2.4 FINAL FILTER TYPE "C2".

- A. C-2 Same as C except offering is 60- 65%, MERV 11
- B. Initial resistance at 500 fpm approach velocity shall not exceed 0.35"w.g.

2.5 FILTER TYPE "D" V CELL HIGH PERFORMANCE RIGID FILTER

- A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - 1. Flanders (Superflow V)
 - 2. Camfil/Farr (Durafil)
 - 3. Purolator Air Filter (Servacell V)
 - 4. American Air Filter
 - 5. Filtration Group Inc. (FGI) (Aerostar FP V-Bank)
- B. Filter shall be 24" x 24" x 12".
- C. The filter unit shall be similar to Flanders Superflow V-95 mini-pleated microglass fiber filter media packs with fiberglass thread separators. The filter packs shall be assembled in a V-bank configuration for low-pressure drop and extended service life. The filter framing system shall include molded plastic flanges, galvanized steel channels, and extruded aluminum supports. All materials used will be fire-retardant and self-extinguishing in accordance with Underwriters Laboratories UL 900 Classification. Filter shall have 200 sq.ft. of media and 90-95% per ASHRAE and MERV and 14 per test method 52.2
 - 1. The filter shall be Class II.
- D. Initial resistance at 500 fpm approach velocity shall not exceed 0.37"w.g.

2.6 FINAL FILTER TYPE "D1"

- A. Same as D except offering is 80- 85%, MERV 13
- B. Initial resistance at 500 fpm approach velocity shall not exceed 0.27"w.g.

2.7 FINAL FILTERS TYPE "E"

A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. Flanders (Alpha 2000)
2. Camfil/Farr
3. American Air Filters
4. Filtration Group Inc. (FGI) (Aerostar HC HEPA 99.99%)

B. Filters shall be similar to Flanders Alpha 2000 with a minimum efficiency of 99.99% on 0.3 micron particles when tested with thermally generated DOP in accordance with the latest Industry and Military Standards. The media shall be micro glass paper fiber with an acrylic resin binder. Filters shall be factory constructed and assembled of 20 gauge, galvaneal steel frame, fire retardant, adhesive separators and fire retardant polyurethane sealant.

C. The filter shall be Class II.

D. Initial resistance at 500 fpm approach velocity shall not exceed 1.45" w.g.

E. Similar to Flanders Alpha 2000

F. Frame for Type "E" filter shall be similar to, Flanders Alpha Grid, constructed of 11 gauge stainless steel with swing rods to hold the filter. No individual frames are permitted. Contractor shall weld the filter into the plenum and seal the entire periphery to ensure a leak free seal.

G. The frame shall be designed to also accept Type C filters, without any change to the Grid other than fasteners.

H. For individual frames in field erected filter banks, Frame shall be Flanders A-4 of 14 ga. stainless steel construction with alignments bars, and locking arms Contractor shall assemble frames into a filter bank as noted on drawings. All joints shall be sealed to prevent leakage.

I. Each HEPA filter module shall be factory tested for efficiency and scan tested for pinhole leaks. The module shall be certified at 99.97% efficient on 0.3 micrometer particles. A decal listing Serial Number and performance data shall be affixed to each filter.

2.8 FINAL FILTER TYPE "F"

A. **Acceptable manufacturers subject to compliance with the specifications shall be as follows:**

1. Flanders
2. Filtration Group Inc. (FGI)
3. Camfil/Farr
4. American Air Filter

B. **The filter unit shall be similar to Flanders S2K consisting of 27.5mm mini-pleated microglass fiber filter media packs with fiberglass threads separators. The filter packs shall be assembled in a V-bank configuration for low pressure drop and extended service life. The filter framing system shall include extruded aluminum channels and supports. All materials used will be fire-retardant and self-extinguishing in accordance with Underwriters Laboratories UL 586 Classification.**

1. Technical Data

Filter size	24" x 24" x 12"	
Air Flow	CFM	2000
Initial Pressure Drop	Inches WG	1.0 in. WG
DOP Eff. Per MIL-STD 282		99.97%
Initial Filtration EFF. Against		
0.1 – 0.15 μ m particles	%	99.97%
0.2 – 0.25 μ m particles	%	99.98%
0.35 – 0.4 μ m particles %		99.998%
Final Pressure Drop	Inches WG	2.0 In. WG
Effective Area	ft. ²	430 ft. ²

2. The filter shall be Class II.

C. Frame for Type "F" filter shall be similar to, Flanders Alpha Grid, constructed of 11 gauge stainless steel with swing rods to hold the filter. No individual frames are permitted. Contractor shall weld the filter into the plenum and seal the entire periphery to ensure a leak free seal.

D. The frame shall be designed to also accept Type C filters, without any change to Magna Grid other than fasteners.

E. For individual frames in field erected filter banks, Frame shall be Flanders A-4 of 14 ga. stainless steel construction with alignments bars, and locking arms Contractor shall assemble frames into a filter bank as noted on drawings. All joints shall be sealed to prevent leakage.

F. Each HEPA filter module shall be factory tested for efficiency and scan tested for pinhole leaks. The module shall be certified at 99.97% efficient on 0.3 micrometer particles. A decal listing Serial Number and performance data shall be affixed to each filter.

2.9 TYPE "I" FILTER

A. Diesel and Aircraft Exhaust

1. Molecular filters specified for installation shall be similar to series 3651 as manufactured by Flanders. The filter shall be constructed of a non-woven media to which sorbent particles are bonded directly to the fiber without any type of adhesive additive. The filter shall be constructed in such a way as to provide essentially dust free operation. Nominal 24" x 24" x 12" filters.

2. Initial resistance at 500 fpm approach velocity shall not exceed 0.45" w.g.

3. Filter Media – The filter shall contain a carbon loaded non-woven media containing 500 g/m² of activated carbon with 1100m²/g of total surface area in the base carbon. In

addition the media shall be a blend of high activity activated carbon and impregnated carbon. The media shall be suitable for the removal of aldehydes, acid gases, VOC's and ozone. Nominal 24"x24"x12" filters shall contain 104 ft² of media surface area.

4. The filter shall be Class II.
5. Frame Enclosure – The frame shall be of rigid construction. A sealant shall be used to encapsulate the media to the filter casing, preventing any bypass. Each frame shall be labeled with size, type, and airflow.
6. Packaging – The filter shall be packaged into a non-porous bag to inhibit adsorption during shipping and storage.
7. Performance – Each filter shall evidence a minimum initial efficiency of not less than 95% for specified contaminants when laboratory tested under dynamic conditions. The filters shall have been evaluated for contaminant removal performance at 500 fpm.
8. The filter shall be installed in a holding frame or housing by filter manufacturer constructed of not less than 16-gauge stainless steel. They shall be equipped with polyurethane foam gaskets and filter centering dimples. The four sealing flange corners shall be flush mitered and secured in order to form a uniform sealing and gasketing surface. The in-line depth shall be not less than 2.69" in order to effect adequate bearing surface for built-up filter banks. Filter fasteners shall be capable of being installed without the requirement of tools, nuts or bolts. The Type 8 Holding Frame shall be designed to accommodate standard size filters with the application of the appropriate type fastener. The filters shall be installed in the air-entering frame.

2.10 SPECIAL FILTERS AND HOUSINGS

A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. Flanders Charcoal Service Corp (CSC) Series Bag In /Bag Out Housing.
2. Camfil/Farr
3. Precisionaire

B. Gasket Seal

1. The housing shall be provided with side access for filter installation and change-out with separate doors for the prefilter and final filter. It shall be designed to accommodate gasket seal filters and shall use a removable linkage clamping mechanism operated by means of a wrench from outside the housing. The clamping mechanism shall include two (2) pressure channel assemblies with eight (8) springs per standard filter (24"x24"x11 ½"), exerting a minimum sealing force of 1400 lb. per filter, applied as an even, uniform load along at least 80% of the top and bottom of each filter outer frame. Prior to leaving the factory, each filter-sealing surface is checked with a flatness gauge to guarantee the flatness tolerance for filter mounting frames recommended in ERDA 76.21, 6.2.2 Housing Construction, "Nuclear Air Cleaning Handbook," Table 4-2. The clamping mechanism drive shaft shall be sealed through the housing wall with a silicone gasket seal material which is sealed to the outside of the housing using a bolted seal front cover.

C. Housing Construction

1. Housing shall be manufactured from 14 gauged and 11-gauged type 304 stainless steel. The housing shall be adequately reinforced to withstand negative or positive pressure of 12". The housing shall be side access type for filter installation and changeout. Housing design and filter arrangement shall allow air to enter and exit the housing without changing directions. The housing shall accommodate standard size filters that do not require any special attachments or devices to function properly in the housing.

D. Welding and Cleaning

1. All "pressure retaining" weld joints and seams shall be continuously welded. . Housing will be free of all burrs and sharp edges. All weld joints and seams that are a portion of any gasket setting surface (i.e. duct connection flanges and filter sealing surfaces) shall be ground smooth and flush with adjacent base metals. All welded 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 by qualified personnel following the workmanship acceptance criteria described in Sections 5 & 6 of ANSI/AWS D9.1-1990 "Specification for Welding of Sheet Metal."

E. Hardware

1. All hardware (i.e., bolts, nuts, washers, springs, etc.) on the housing and filter linkage clamping mechanism are 300 Series stainless steel [except for the brass nuts on the gasket seal-type filter clamping mechanism (GB Series only)] Aluminum hand knobs are used for clamping or sealing the filter access door, to prevent galling of stainless steel male threaded parts per ERDA 76-21, 6.2.2 Housing Construction.

F. Multi-Wide Housing

1. Multi-wide housing shall be equipped with filter removal rod to pull the filters to the changeout position. The removal rod shall operate from inside the filter changeout bag.

G. Changeout Bag

1. One (1) manufactured PVC changeout bag shall be furnished with each filter access port. Changeout bags shall be non-sticking and shall be 8 mil. Thick with a yellow translucent, matte, textured finish (double-layer heavy duty bottom as an option). A 1/4" diameter elastic shock cord shall be hemmed into the opening of the bag so that, when stretched around the bagging flange, the bag filters securely. Bag shall include [2-standard] or [3-optional] glove ports built into the bag to assist in the filter changeout. Each PVC bag shall be individually factory leak tested per Federal Specification LP-375C and constructed in accordance with ERDA Paragraph 6.2.3. Manufacturer shall submit individual test report for each bag furnished. One (1) nylon-cinching strap shall be furnished per filter access port to prevent excess bag material from pulling into the housing.

H. Factory Testing and Quality assurance

1. The filter housing shall be manufactured under a quality assurance program that addresses the requirements as ANSI/ASME. Each housing shall be tested for filter fit, operation of filter linkage clamping mechanism and [knife edge alignment (FB Series)] [seal surface flatness (GB Series)]. 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 "Testing of Nuclear Air Cleaning Systems," Paragraphs 6 & 7. The filter sealing surface shall be tested at 10" w.g. and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume. Overall system pressure boundary shall be leak tested at design pressure. Housing, filter elements and changeout bags shall be a product of the same manufacturer. Manufacturer shall have a minimum of five (5) years' experience in the containment industry as demonstrated by field-installed product.

I. Housing

1. Contractor to furnish stainless steel inlet and outlet transition with manual (or electric) operating, bubble tight dampers as shown on the plans.
2. Damper Blade shall be of two (2) pieces, 11-gauge stainless steel, round in design (diameter of blades depends on damper size).
3. Factory Testing and Quality Assurance
4. The bubble type damper shall be manufactured under a quality assurance program that addresses the requirements of ANSI/ASME. The complete assembly pressure boundary shall be leak tested by the Pressure Decay Method, in accordance with ANSI/ASME N510-1989 "Testing of Nuclear Air-Cleaning Systems", paragraph 6 & 7 The damper blade sealing surface shall be tested at 10" w.g. the overall system pressure boundary shall be leak tested at design pressure.

J. Decontamination Ports

1. Filter housings serving bio-hazard exhausts (Isolation Rooms, Bronchoscopy, etc.) shall be provided with valved and capped decontamination ports up and downstream of the filters. The ports shall facilitate the injection of a neutralizing gas into the filter housing to "kill" any viable bio-hazard agents captured in the filter media or contained within the filter housing, prior to filter change-out.

K. All filters and housings shall be of the same manufacturer for a single source responsibility.

2.11 FILTER GAUGES

- A. Provide filter gauges as hereinafter specified at all filter locations, in-duct and air handling unit installations. The HVAC Contractor shall also coordinate the filter frames with the air-handling units provided to ensure compatibility of systems and equipment.

- B. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - 1. F.W. Dwyer Model 2000
 - 2. Deiterich Standard Corp.
 - 3. Bacharach Instrument Co.
- C. Provide (1) filter gauge for each filter bank. The scale shall be selected so that it allows for 1" w.c. greater than the final filter resistance.
- D. Provide suitable decal at the gauge for each filter system containing servicing information.
- E. Static pressure taps shall be located in the airstreams as recommended by the manufacturer and connected to gauges located on air handling unit casings or on walls for in-duct HEPA filter locations as directed, with 1/4" o.d. aluminum tubing.
- F. Provide gauges similar to Dwyer photohelic pressure switch/gauges 3 in 1 indicating gauge with 2 phototransistor actuated DPDT relays. Similar to Dwyer Series A3000

2.12 FILTER HOLDING RACK – SIDE ACCESS

- A. General
 - 1. Provide side access, one or two-stage filter system similar to Flanders Sureseal, consisting of a housing, access doors, tracks. Housing shall accommodate any 2" prefilter and various final filters with efficiencies of 45%-95%, per ASHRAE 52-76.
- B. Leakage
 - 1. Leakage at rate airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1% at 3" w.g. differential. Leakage into housing from ambient atmosphere at rated airflow shall be less than 0.5% at 3" w.g. negative. Manufacturer shall submit substantiating test reports.
- C. Housing
 - 1. Housing shall be factory fabricated and assembled of 16-gauge stainless steel with corner posts of Z-channel bracing to eliminate racking. Each housing shall be equipped with two (2) access doors and 1.5" standing flanges with prepunched holes to facilitate field installation. Flanges shall be notched to provide water runoff. Housings must be weatherproof and suitable for rooftop/outdoor installation.
- D. Access Doors
 - 1. Access doors shall be constructed of a minimum of 16-gauge stainless steel and positioned to facilitate removal and replacement of filters from either side of the housing. Each door shall be equipped adjustable and replaceable positive seating latches and replaceable hinges.

The peripheral gasket material shall be of high memory sponge neoprene. Holding frame to door contact shall be gasketed with 1"x1.25" polyurethane foam to affect a leak proof seal.

E. Tracks

1. Tracks shall be field adjustable and replaceable, heavy gauge, anodized aluminum extrusion designed to accommodate Camfil/Farr Universal Holding Frames. Each extrusion shall be equipped with a replaceable, non-woven pile encased, aluminum backed, polypropylene finned seal providing an air barrier between the extrusion and Universal Holding Frame.

PART 3 EXECUTION

3.1 FILTER, FILTER FRAMES, FILTER HOUSING AND FILTER GAUGES

- A. Filters, filter frames, filter housings, and filter gauges shall be installed in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.
- B. Filters shall be installed so as to ensure easy accessibility for service, removal and replacement of filters.
- C. No system shall be operated without filters.
- D. During temporary ventilation:
 1. The units shall not be operated without filters. Provide the following temporary filters during initial start-up and temporary operation. Contractor shall provide multiple sets of filters during temporary operation. Filters shall be replaced every 3 months and as needed when filter pressure drop limits are reached.

<u>Specified filter</u>	<u>Temporary Filter</u>	<u>Temporary Filter Change-out Limit (inches w.g.)</u>
TYPE A	TYPE A	0.75
TYPE C	TYPE C2	0.75
TYPE C1	TYPE C2	0.75
TYPE C2	TYPE C2	0.75
TYPE D	TYPE D1	0.60
TYPE E	TYPE C	1.50
TYPE F	TYPE C	1.50
TYPE I	TYPE I	----

2. Prior to owner occupancy all temporary filters shall be replaced with the specified filter.
- E. Prior to air balance, install design set of per- and final filters in air handling units, and leave (1) new spate set of filters with the Owner.

END OF SECTION