**SECTION 23 41 00**

**PARTICULATE AIR FILTRATION**

**BASED ON DFD MASTER SPECIFICATION DATED 12/28/2017**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**P A R T 1 - G E N E R A L**

**SCOPE**

This section includes specifications for air system filters. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference

 Reference Standards

 Quality Assurance

 Shop Drawings

Operation and Maintenance Data

 Design Criteria

PART 2 - PRODUCTS

 Manufacturers

 Panel Filters

 MERV 7 Filters

 MERV 11 Filters

 MERV 14 Filters

 HEPA Filters

Roll Filter Media

 Activated Carbon Filters

 Housings for Panel Filters

 Housings for MERV 7 Filters

 Side Access Filter Housings

 Roll Filter Housings

 Bag-in/Bag-out Filter Housings

 Filter Holding Frames

PART 3 - EXECUTION

 Installation

 ULPA Filter Media

 Filter Gauges

 Construction Verification

 Agency Training

**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 07 00 - HVAC Insulation

Section 23 08 00 – Commissioning of HVAC

Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units

Section 23 72 00 - Air-to-Air Energy Recovery Equipment

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

ASHRAE Standard 52

UL 181 – Standard for Factory-Made Air Ducts and Air Connectors

UL 586 – Standard for High Efficiency Particulate Air Filter Units

UL 900 – Standard for Air Filter Units

**QUALITY ASSURANCE**

Refer to division 1, General Conditions, Equals and Substitutions.

**SHOP DRAWINGS**

Refer to division 1, General Conditions, Submittals.

Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.

***Provide the follow-up paragraph or similar when the use of tested media is required. Test reports should be included in the shop drawings.***

Independent test reports verifying filter performance, test procedures and ratings.

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

***Delete the following if there are no additional requirements.***

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. ***[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]***

**DESIGN CRITERIA**

Use UL Class 1 or Class 2 filters unless noted otherwise.(Reference applicable UL standard referenced)

Efficiencies indicated in this section are based on ASHRAE Standard 52.

Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

**P A R T 2 - P R O D U C T S**

**MANUFACTURERS**

American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety Appliances, Research Products, BLC Industries or approved equal.

**PANEL FILTERS**

***These filters should be used in cabinet unit heaters, fan coil units, unit ventilators. It is typically used in residential furnace applications.***

Use 1" (or as scheduled) thick fiberglass blanket enclosed in a cardboard frame and reinforced with a perforated metal retainer on the air leaving side, Coat media with flameproof, non- volatile adhesive.

Media nominal rating to be 500 FPM face velocity, 0.15 inch WG initial resistance, 0.50 inches WG recommended final resistance. Average arrestance of filter media shall be 80%.

Provide filter holding frame.

**MERV 7 FILTERS**

***These filters should be used for furnaces, prefilters in air handling units, and as a prefilter for all MERV 11, MERV 14, and HEPA filters.. When used as a prefilter for a higher efficiency filter bank, MERV 7 filters may be located immediately upstream of the higher efficiency filters in the same housing section, or in a separate prefilter section in the system air handler.***

Use 2" thick, pleated panels, 100% synthetic, self supported media fully bonded and sealed in cardboard frame.

Media nominal rating to be 500 FPM face velocity, 0.20 inch WG initial resistance, 1.0 inches WG recommended final resistance., Average arrestance of filter media shall be 90‑92%

Furnish a side access housing or holding frame as scheduled.

Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**MERV 11 FILTERS**

***Use this filter as a final filter in air handling units serving facilities other than health care and research labs.***

Use bag type, non-supported pockets,, polypropylene media with synthetic backing scrim, fully bonded and sealed in a factory fabricated frame.

Media nominal rating to be 500 FPM face velocity, 0.35 inch WG initial resistance, 1.0 inches WG recommended final resistance,.

 ***Filter pressure drop varies with filter depth. Modify the above pressure drop to reflect the filter***

 ***depth specified.***

Furnish a side access filter housing or holding frame as scheduled. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**MERV 14 FILTERS**

***Use these filters as a final filter in air handling units serving health care or research labs. Bag type filters are indicated since they are easier to dispose of than cartridge type filters of the same efficiency.***

Use bag type, ultra fine microglass pleated media, water resistant, plastic or aluminum separators, fully bonded and sealed in a factory fabricated frame. Media pleats to be self-supporting under varying airflow conditions.

Media nominal rating to be 500 FPM face velocity, 0.58 inch WG initial resistance, 1.5 inches WG recommended final resistance,

 ***Filter pressure drop varies with filter depth. Modify the above pressure drop to reflect the filter***

 ***depth specified.***

Optional: Provide a gasket on the vertical sides to prevent leakage between cartridges.

Furnish a side access filter housing or holding frame as scheduled. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**HEPA FILTERS**

Use box type, ultra fine microglass pleated media, water-resistant, aluminum separators, fully bonded and sealed in a factory fabricated metal frame. Media pleats to be self-supporting under varying airflow conditions.

Media nominal rating to be 250 FPM face velocity, 1.0 inch WG initial resistance, 2.0 inch WG recommended final resistance, 99.97% dioctylphthalate (DOP) efficiency Filter cartridges to be listed or classified under UL 586 test standard including factory certification seal.

Furnish a side access housing or holding frame as scheduled. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**ULPA FILTERS**

***Use this filter as a final filter for bio-containment or other high efficiency requirements***

***In some applications there may be a requirement for specialized filtration media described as ultra-low particulate air (ULPA) filters> These filters  are designed to screen particles larger than 0.3 µm. Dioctylphthalate (DOP), an aerosol medium, is used for leak testing and efficiency measurement.

ULPA filters have efficiencies of 99.999% with 0.3 µ DOP particles. Like HEPA filters, ULPA filters are disposable, extended-medium, dry-type filters with a rigid frame; however, ULPA filters have a minimum particle-collection efficiency of 99.999% and a maximum particle penetration of 0.001% for particles in the size range of 0.01 to 0.02 µm, when tested in accordance with IES-RP-CC007, a specification from the Institute of Environmental Science and Technology (IEST).***

***Base on the specific requirement add the performance and construction critiera for this type of filter here. This is a specialized area that would be beyond the scope of a master specification.***

**ROLL FILTER MEDIA**

Use rolled and compressed graduated density fiberglass blanket media, nominally 2 inch thick when expanded, factory sprayed with flameproof, non-drip, non-volatile adhesive. Bond media reinforcing scrim to the downstream side of media to prevent stretching and necking.

Media nominal rating to be 500 FPM face velocity, 0.25 inch WG initial resistance, 0.50 inches WG recommended final resistance, 25-30% dust spot efficiency.

**ACTIVATED CARBON FILTERS**

***Use this filter to remove gaseous contaminants and radioactive gas. All carbon filters must be chosen based on the contaminant to be removed. An applicable filter housing will be required as well.***

Use an assembly consisting of carbon steel, stainless steel, or aluminum casing, pleated bed assembly, and trays; filter servicing trays arranged in a deep V for [upstream] [downstream] [side] servicing; and disposable panel prefilter.

Media to be activated carbon, 34 lb/cu ft density, pelletized or granular, with minimum carbon tetrachloride activity of 60 percent. Assemble media in thin bed trays or pleated bed cartridges with a minimum of 1.42 cu ft of carbon per 1000 CFM nominal air flow capacity.

Media rating at above conditions to be 500 FPM face velocity, 0.45 inch WG initial resistance, and 99.99% efficiency by means of a freon leak test.

**HOUSINGS FOR PANEL FILTERS**

Manufactured by air handling unit manufacturer, filter media manufacturer, or contractor fabricated. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed.

**HOUSINGS FOR MERV 7 FILTERS**

Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**SIDE ACCESS FILTER HOUSINGS**

Galvanized steel housing with aluminum or galvanized steel filter mounting tracks. Mounting tracks and access doors to have gaskets to minimize air bypass around the filters. Housing assembly to be suitable for use in duct systems with \_[ based on design ]\_\_\_\_\_ inches of water static pressure.

Standard filter sections provided by air handling unit manufacturers may be used for MERV 11 and MERV 14 filters but will not be accepted for HEPA filters or activated carbon filters.

Insulate housings where adjacent duct or air handling apparatus is insulated. Insulation to be contained within a 2” thick, double wall steel panel and meet the requirements specified for adjacent duct or apparatus.

Furnish a door on each end of the housing to facilitate filter changing. Doors to be hinged and provided with lever handle latches to secure the door. Doors shall not be secured with nuts, bolts, wing nuts, or sheet metal screws.

Furnish housings for MERV 11, MERV 14, , HEPA filters, or activated carbon filters with a lever action sealing mechanism to secure media in tracks.

***Designer is responsible for determining the appropriate level of leakage, if any, based on the needs and use of the airstream.***

Filter bypass shall be less than [x]% of design cfm.

Include an integral prefilter track for installation of MERV 7 prefilters. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

**ROLL FILTER HOUSINGS**

Roll filter assembly shall consist of a galvanized steel assembly, with drive, controls to feed media across air stream while winding and compressing used media for disposal. Enclose rolls of media with hinged covers. Provide a tension panel to compress used media as it is spooled.

Housing of roll filter assembly must be factory insulated where adjacent duct or air handler assemblies are specified to be insulated.

Drive mechanism to be an electric gear reducer motor which drives the rewind spool through a chain and sprocket assembly. Provide a prewired control package to advance media through a manual switch. Include a media runout switch to stop travel and energize a panel mounted pilot light, a manual disconnect switch, and a control transformer where low voltage control is used.

**BAG-IN/BAG-OUT FILTER HOUSINGS**

***Consultant should evaluate the application for use of stainless steel housing or other special requirements. Also conside the weight of these filters as they are often much heavier than other type of filters.***

Housing to allow a filter change without physical contact with the prefilter or high efficiency filter cartridge. Fabricate housing from carbon steel sheet reinforced to withstand internal or external pressure of 10 inches WG. Use cadmium plated steel, stainless steel, or brass for all internal parts. Include upstream and downstream pressure taps for each filter in the housing.

Provide an integral, spring loaded, positive seal, stainless steel clamping device to secure filter cartridges in tracks. Clamping device to exert sufficient force between filter cartridge and gasket/seal to maintain zero leakage around media.

Construct access openings to permit smooth removal and installation of filter and prefilter when using a plastic bag for isolation. The access opening shall fully contain the plastic bag within the housing when the door is secured. The filter housing, access opening, filter cartridges, and disposal bags shall be designed to meet safety standards required in transferring beta and gamma material in glove box operations.

Finish all carbon steel surfaces with one primecoat and one finish coat of epoxy enamel. Factory leak test housings by pressuring to 10" W.G. Housing to be suitable for exterior installation.

Construct housing assembly with manually operated Class 1 leakage rated dampers at inlet and outlet of filter housing to allow isolation of filter assembly during media changing. Include a damper locking mechanism to prevent unauthorized damper repositioning.

Insulate housings where adjacent ductwork or air handling equipment is insulated. Insulation shall be easily removable for change of filter media.

**FRONT ACCESS FILTER HOLDING FRAMES**

Construct frames of aluminum or corrosion resistant coated steel with provisions for assembly in a bank.

Frames for MERV 11 filters, MERV 14 filters, , HEPA filters, and activated carbon filters to have provisions for installation of MERV 7 prefilters upstream of high efficiency media. Secure prefilters by means of spring clips or a spring loaded mechanism. Spring clips or latches shall be on the upstream side of the prefilter. Provide leakproof gaskets between prefilter media and holding frame. Prefilters shall be removable without removal of final filters.

**P A R T 3 - E X E C U T I O N**

**INSTALLATION**

Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not operate the equipment until specified filter media has been installed. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout the construction period.

Where air handling apparatus is used during the construction period, install new filter media prior to start of air balancing. Additionally, deliver one new set of media to the owner prior to substantial completion.

Install units as shown on drawings and details according to manufacturer's instructions.

Reinforce filter holding frames per manufacturer's instructions.

Maintain necessary clearance for changing filters.

**ULPA FILTER MEDIA**

The filter assembly shall be leak tested and factory certified per referenced ASME and IES standards.

**FILTER GAUGES**

Filter Gauges will be differential pressure transducers with displays and provided under Section 23 09 14.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION