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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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PANEL FILTERS

02/16

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SECTION 23 41 13.00 40

PANEL FILTERS
02/16

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NOTE: This guide specification covers the requirements for basic types of filters for use with air handling equipment.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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PART 1 GENERAL

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NOTE: Specify any required extra media, filters, and adhesive. Indicate overall physical features, dimensions, ratings, service requirements, and equipment weights on drawings.
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NOTE: If Section 23 30 00 HVAC AIR DISTRIBUTION is not included in the project specification, insert applicable requirements therefrom and delete the first paragraph.
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[Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

] Provide panel filter[s] [system] complete with all components and accessory equipment as specified in this section.

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME AG-1	(2019) Code on Nuclear Air and Gas Treatment

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D92	(2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 14644-1	(2015) Cleanrooms and Associated Controlled Environments Part 1: Classification of Air Cleanliness

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-282	(2015; Rev B) Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50544	(Basic; Notice 2) Radiators, Heating, Steam and Hot Water, Cast Iron

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 900	(2015) Standard for Air Filter Units

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes

following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Air Filters; G[, [____]]

Filter Gages; G[, [____]]

Manometers; G[, [____]]

SD-06 Test Reports

Test Reports

SD-07 Certificates

Air Filters

Filter Gages

Manometers

PART 2 PRODUCTS

2.1 FILTERS

Submit manufacturer's catalog data, including physical characteristics and performance data for panel filter[s] [system].

Submit physical characteristics information and performance data for air filters consisting of use life, system functional flows, safety features, and mechanical automated details. Also submit curves indicating tested and certified equipment responses and performance characteristics.

Provide air filters with a net effective filtering area and a face area to provide the required airflow at the indicated initial pressure-drop.

Provide sufficient clearance for maintenance and operation in and around filter assembly.

Construct filter-holding frames of [extruded aluminum] [type 300 corrosion-resistant steel] [corrosion-resistant coated 1.6 millimeter 16-gage (minimum) steel] [not less than 1.6 millimeter 16-gage galvanized carbon steel conforming to ASTM A653/A653M with not less than 0.38 kilogram of zinc per square meter 1.25 ounces of zinc per square foot of two-sided surface] [wood-pulp products]. Provide frame assemblies and fasteners constructed of corrosion-resistant metal or carbon steel with a corrosion-resistant finish to preclude surface degradation.

[Make viscous-impingement framed panel filter gaskets from a material inert to filter impregnates, with a minimum thickness after compression of 3 millimeter 1/8-inch.

][Provide dry filter gaskets of closed-cell foamed neoprene or urethane elastomer of sufficient hardness to compress to not more than 40 percent of original thickness when filter is in position.

]2.1.1 Filters, Disposable Type

Listed below is the minimum acceptable performance for the air filter:

DIMENSIONS (Millimeter)	INITIAL RESISTANCE (pascal)	ARRESTANCE (Percent)	DUST-HOLDING CAPACITY (Gram/Sq Ft)
350 by 500 by 25	10	65	1560
400 by 500 by 25	10	65	1560
400 by 650 by 25	10	65	1560
500 by 500 by 25	10	65	1560
500 by 650 by 25	10	65	1560
400 by 500 by 25	20	75	2050
400 by 650 by 50	20	75	2050
500 by 500 by 50	20	75	2050
500 by 650 by 50	20	75	2050

DIMENSIONS (Inches)	INITIAL RESISTANCE (Inch WG)	ARRESTANCE (Percent)	DUST-HOLDING CAPACITY (Gram/Sq Ft)
14 by 20 by 1	0.04	65	145
16 by 20 by 1	0.04	65	145

DIMENSIONS (Inches)	INITIAL RESISTANCE (Inch WG)	ARRESTANCE (Percent)	DUST-HOLDING CAPACITY (Gram/Sq Ft)
16 by 25 by 1	0.04	65	145
20 by 20 by 1	0.04	65	145
20 by 25 by 1	0.04	65	145
16 by 20 by 2	0.08	75	190
16 by 25 by 2	0.08	75	190
20 by 20 by 2	0.08	75	190
20 by 25 by 2	0.08	75	190

For all sizes of filters, ensure the final resistance value is 125 pascal 0.50-inch, with air volume of 0.6 cubic meter per second 1,200 cubic feet per minute, and airflow velocity of 1.5 meter per second 300-feet per minute.

2.1.2 Filters, Cleanable Type

Provide nonwoven synthetic-fabric-type filtering element, supported on rigid pleats of suitable grid material, with a nominal overall depth of [50 millimeter] [100 millimeter] [2-inches] [4-inches]. Seal filter element into an enclosing frame of rigid chipboard, providing a unit that will not rack. Verify initial pressure drop at a face velocity of 2.5 meter per second 500 fpm is [62] [55] pascal [0.25] [0.22]-inch wg, with average dust-spot efficiency of [10 percent] [18 percent] and arrestance of [85 percent] [87 percent] when filter is operated to a final pressure drop of 250 pascal 1-inch wg. Verify, under these circumstances, the dust-holding capacity is [485] [750] grams per square meter [45] [70] grams per square foot of face area.

Use test method in accordance with ASHRAE 52.2.

2.1.3 Filters, Replaceable Type

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NOTE: Mil STD-282 is a controlled document. Do not specify unless Contractor has access to Standard.
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Provide filters conforming to CID A-A-50544, Type I or Type II. Base filter efficiency on ASHRAE 52.2. Efficiency, by definition, is dust-spot efficiency using atmospheric dust. Arrestance is weight efficiency using test dust.[Provide Type III filter arrestance efficiencies in accordance with MIL-STD-282 DOP test.]

Provide each air filter with a permanent corrosion-resistant holding frame and a replaceable factory-assembled filter element. Supply the permanent holding frame with suitable gaskets designed to maintain a positive pressure seal between the frame and the filter element(s).

Design and construct air filters to facilitate field maintenance. Make adjustments and ensure replaceable accessories are readily accessible.

Conditions which may be hazardous to personnel or deleterious to equipment are not permitted.

Provide antiallergenic and nontoxic filter element, with no detectable odor, which have no adverse effect on the health of personnel handling or served by the filter element.

Use adhesive coatings on filters with a flashpoint of not less than 163 degrees C 325 degrees F conforming to ASTM D92.

[Provide Type I, Grade A filters with 30 percent commercially rated efficiency conforming to UL 900, Class 2, and requirements specified herein. Provide filters, when operated at rated capacity of [_____] cubic meter per second cfm, that have an initial pressure drop of not more than [_____] pascal [_____]-inch wg, and a final pressure drop not exceeding [_____] pascal [_____]-inch wg. Ensure filter initial efficiency is not less than 20 percent, and the average efficiency is not less than 25 percent. Verify dust-holding capacity (grams per square meter foot), at a rated air flow (cubic meter per second feet per minute), is not less than [_____] at [_____] [6460 at 0.7] [10800 at [0.9] [1.2]] [600 at 1,500] [1,000 at 2,000] [1,000 at 2,500].

][Provide Type I, Grade B filter with 40 percent commercially rated efficiency conforming to UL 900, Class 2, and requirements specified herein. Provide filters, when operated at rated capacity of [_____] cubic meter per second cfm, that have an initial pressure drop of not more than [_____] pascal [_____]-inch wg and a final pressure drop not exceeding [_____]pascal-inch wg. Ensure filter initial efficiency is not less than 20 percent, and the average efficiency is not less than 35 percent, with dust-holding capacity (grams per square meter foot), at a rated air flow (cubic meter per second feet per minute), of not less than [_____] at [_____][5380 at 0.7] [6460 at 0.9] [7535 at 1.2] [500 at 1,500] [600 at 2,000] [700 at 2,500].

][Provide Type II, Grade C filter with 85 percent commercially rated efficiency [minimum of 58 percent per ASHRAE 52.2 using atmospheric dust] conforming to UL 900, [Class 2] [Class 1] and requirements specified herein. Provide filters, that when operated at rated capacity of [_____] cubic meter per second [_____] cfm, having an initial pressure drop of not more than[_____] pascal [_____]-inch wg, and final pressure drop not exceeding [_____] pascal [_____]-inch wg, with an initial filter efficiency of not less than 58 percent, and an average efficiency not less than 76 percent. Verify the dust-holding capacity (grams per square meter foot), at a rated air flow (cubic meter per second feet per minute) is not less than [_____] at [_____] [3230 at 0.7] [4300 at 0.9] [5060 at 1.2], [300 at 1,500] [400 at 2,000] [470 at 2,500].

][Provide Type II, Grade D filter with 95 percent commercially rated efficiency [minimum of 78 percent per ASHRAE 52.2 using atmospheric dust] conforming to UL 900, [Class 2] [Class 1] and requirements specified herein. Provide filters, that when operated at rated capacity of [_____] cubic meter per second cfm, having an initial pressure drop of not more than [_____] pascal [_____]-inch wg, and final pressure drop not exceeding [_____] pascal [_____]-inch wg. Verify filter initial efficiency is not less than 80 percent, and the average efficiency is not less than 90 percent, a with dust-holding capacity (grams per square meter foot), at a rated air flow (cubic meter per second feet per minute) of not less than [_____] at [_____] [2370 at 0.7] [3230 at 0.9] [4090 at 1.2] [220 at 1,500] [300 at 2,000] [380 at 2,500].

][Provide Type III, Grade E filter 95 percent rated efficiency [DOP test using 0.2-micrometer particles] conforming to UL 900, [Class 2] [Class 1] and requirements specified herein. Provide filters with an initial pressure drop not exceeding [250 pascal with face velocity of 1.7 meter per second on 150 millimeter deep filter] [250 pascal with face velocity of 2.5 meter per second on 300 millimeter deep filter] [[_____] pascal with face velocity of [_____] on [_____] millimeter deep filter] [1.0-inch wg with a face velocity of 325 fpm on 6-inch deep filter] [1.0-inch wg with a face velocity of 500 fpm on 12-inch-deep filter] [[_____] inch wg with a face velocity of [_____] fpm on [_____] inch-deep filter], and a final pressure drop not exceeding [500 pascal with face velocity of 1.7 meter per second on 150 millimeter deep filter] [500 pascal with face velocity of 2.5 meter per second on 300 millimeter deep filter] [[_____] pascal with face velocity of [_____] on [_____] millimeter deep filter] [2.0-inches wg with a face velocity of 325 fpm on 6-inch-deep filter] [2.0-inches wg with a face velocity of 500 fpm on 12-inch-deep filter] [[_____] inches wg with a face velocity of [_____] fpm on [_____] inch deep filter].[Verify the filter efficiency is not less than 95 percent as determined in accordance with MIL-STD-282, using a 0.3-micrometer particle of thermally generated DOP smoke.]

][2.1.4 Filters, Automatic Type

Provide automatic renewable filtering element type filters in which a roll of the element is unwound across the airstream by a mechanism regulated by a timer or a differential-pressure control, or a combination of both.

Provide a unit suitable for 120-volt, single-phase, 60-hertz power.

Submit manufacturer established filter performance data established in accordance with ASHRAE 52.2 dynamic loading test procedures. Verify initial resistance does not exceed 5 pascal 0.20-inch wg at an airstream velocity of 2.5 meter per second 500 fpm, and(when operating at its specified rate of airflow) has a dust-holding capacity of 700 grams per square meter 65 grams per square foot when the resistance to airflow is maintained between 112 and 137 pascal 0.45 and 0.55-inch wg. Provide filtering element with an average dust-spot efficiency of not less than 20 percent and an arrestance of 85 percent.

Provide a viscous-impingement progressively graded density UL, Class 2, fibrous-glass type filter with a continuous material element. Filter to have a normal depth of 50 millimeter 2-inches when clean and not compress more than 6 millimeter 1/4-inch when subject to air velocity of 2.5 meter per second 500 fpm. Reinforce element in both length and width. Support element so that no leakage of unfiltered air occurs. Wind dirty element with the dirty surface inward and ensure it re-rolls automatically under tension. Provide each spool of filtering element with guide keys to ensure correct installation, and possessing compressibility that will allow 20 meter 65-feet to be wound to a maximum of 400 millimeter 16-inches in diameter on the used roll. Ensure each roll of filtering element is not less than 20 meter 65-feet long.

Wind the dirty filtering element and feed the clean element so that no blowoff of collected dirt can occur. Otherwise, contain clean and dirty elements in steel enclosures in reverse-flow units and in horizontal units where the element is wound outside of airstream.

Provide filter widths of uniform size for all project air-handling units.

Provide electrically driven type timer, readily adjustable in the field without special tools. Electrically interlock the timer with the fan motor to start and stop the filter element advancing mechanism, as required, when the fan is operating. Adjust initially such that the pressure-drop through the filter element will be maintained at approximately 112 pascal 0.45-inch wg. If used, the differential-pressure control can adjust to any cut-in and cutout with a differential of 12 to 25 pascal 0.05 to 0.10-inch wg. Initially adjust to 137 pascal 0.55-inch cut-in to 112 pascal 0.45-inch wg cutout. Install controls out of the airstream.

Equip master section with a runout switch to stop the feed movement and operate a signal light when the element from one of the sections runs out. Furnish a manual feed-advance switch with each drive unit to advance the element to the end of the roll as required. Locate signal light on the air-handling unit temperature-control panel.

Fabricate filter-supporting structural members of not less than 2 millimeter 14-gage mill-galvanized carbon steel for the base and side panels and 1.6 millimeter 16-gage mill-galvanized carbon steel for the top panel. Provide galvanized steel sheet in accordance with ASTM A653/A653M.

]2.1.5 Filters, High-Efficiency Particulate Air (HEPA)

Provide fire-resistant type HEPA filters capable of withstanding a minimum of 90-percent relative humidity determined dynamically at temperatures between 21 and 38 degrees C 70 and 100 degrees F.

Provide filtering elements conforming to ASME AG-1. Individually certify that each filter has an efficiency of not less than 99.97 percent by a test method other than the DOP test specified in ISO 14644-1. An acceptable method for certification is to remove a filter from a production run prior to testing, then test the five filters before and after the removed filter in accordance with the DOP test (99.97 percent). Successful passing of the test by the five filters before and five filters after the untested filter is the acceptance criteria for the untested filter. Verify the clean filter static pressure drop does not exceed 250 pascal 1.0 inch wg when the filter is tested at rated capacity.

Provide filtering elements containing no holes, cracks, slits, or other visual imperfections, with every splice required in the assembly of a filter pack joined with not less than 40 millimeter 1-1/2 inches of fire-retardant adhesive for a continuous coating along the entire width of the element, with filter element made of glass paper with a minimum tensile strength of 525 newton per meter 3 pounds per inch of width and retain 50 percent of its tensile strength when folded flat upon itself. Verify elongation before rupture is a minimum of 1 percent, and element is water-proofed, retaining 50 percent of its original tensile strength after being immersed in water.

Register the results of test penetration on the frame of the filter unit, legibly and indelibly. Include the test resistance, test flow rate, together with direction of test airflow, manufacturer's name, model number, and serial number of the filter unit.

Provide elements with 19 millimeter 3/4-inch plywood frames, Grade A-B EXT-DFPA or better, conforming to NIST PS 1. Treat plywood to exhibit a flame-spread of not more than 30 when tested according to UL 723 or

ASTM E84. Countersink flathead wood screws after drilling lead holes. Create a positive seal at corner joints by coating adjoining surfaces with a suitable adhesive having the characteristics specified below. Particle board conforming to the flame-spread requirements specified for plywood may be used in lieu of plywood.

Coat entire inside face of frame members with an adhesive before assembly with filter pack. Following assembly, form a continuous bead of the same adhesive to seal between cut edges of filter pack and edges of abutting frame member on both faces of the filter unit. Ensure filter unit is square to a diagonal tolerance of 3 millimeter 1/8-inch.

Provide a resilient and water-resistant adhesive able to withstand a temperature of 121 degrees C 250 degrees F for 8 hours after curing. If capable of ignition, provide a self-extinguishing adhesive which meets general operating conditions without change in physical properties and without loss of seal. Ensure the cured adhesive contains no cracks, checks, alligatoring, or separation.

Provide HEPA filters conforming to UL 586.

[Provide with 2.0 millimeter 14-gage [aluminum sheet] [zinc] [aluminum] [cadmium-coated 1.6 millimeter 16-gage steel sheet] frames, with all corner joints given a positive seal by coating adjoining surfaces with a suitable adhesive having the characteristics indicated.

] Provide separators constructed of [aluminum] [_____] that do not contribute to fire, will remain structurally intact under fire exposure, and are not damaged by exposure to the humidity and temperature.

Provide 6 millimeter 1/4-inch thick closed cellular construction neoprene gaskets, or gaskets with an elastomer of 20 to 40 Shore A durometer hardness. Attach gasketing firmly and continuously to the frame with rubber-based adhesive.

Assemble filter unit to provide uniformity of materials and construction, surface smoothness and finish, cleanliness, and freedom from protrusions and obvious flaws.

2.2 FILTER GAGES AND MANOMETERS

Provide air-filter gages or manometers for each type filter assembly.

Provide dial-indicator type gages, graduated to read 0 to 500 pascal 0 to 2-inches wg, except that gages for HEPA filters are to read 0 to 750 pascal 0 to 3-inches wg. Provide manometers measuring from minus 125 to 750 pascal 0.5 to 3-inches wg, equipped with a built-in indicator bubble. Connect gage or manometer to static-pressure ports of approved design and located so that resistance to airflow will be correctly indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Coordinate filter supports and retention elements to provide a substantial, structurally sound, leakproof installation.

3.1.1 Holding Frame Installation

Provide installation drawings in accordance with referenced standards in this section.

Install gasket [to holding frames on perimeter][caulked to each other][to supplementary steel][to closures with elastomeric compounds recommended by the filter manufacturer]. Prepare substrate in accordance with the elastomer manufacturer's instructions, including the priming of surfaces in areas where the elastomer is not confined.

3.2 FIELD QUALITY CONTROL

Submit test reports in accordance with ASHRAE 52.2.

-- End of Section --