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1.0 SCOPE

This specification is for the procurement of High-Efficiency Particulate Air (HEPA) filters used in nuclear safety-related air or gas treatment facilities or systems. This specification covers Fire and Moisture Resistant (FMR) filters, Hydrogen Fluoride and Caustic Resistant (HFRCR) filters, and Fire, Moisture, and Chemical Resistant (FMCR) filters.

The filter sizes and media furnished in accordance with this specification shall comply, as a minimum, with the requirements of American Society of Mechanical Engineers (ASME) AG-1-1991 (latest addenda), Section FC and Appendix FC-I, except as noted herein.

The requirements for compliance with AG-1 are set forth in Washington Administrative Code (WAC), Chapter 246-247.

2.0 PURPOSE

The purpose of this specification is to ensure that HEPA filters used in containment systems are acceptable in all aspects of performance, design, construction and testing.

3.0 APPLICABILITY

This specification applies to extended-media dry type filters for use in air and gas streams with a 250E F (121E C) maximum continuous temperature and are Type A, B or C.

This specification shall meet the requirements of ASME AG-1, Articles FC-3000 (Materials), FC-4000 (Design), FC-5000 (Inspection), FC-6000 (Fabrication), FC-7000 (Packaging, Shipping and Storage), FC-8000 (Quality Assurance), FC-9000 (Nameplates), all figures and tables, and mandatory Appendix FC-I, unless specifically identified to be different in this specification.

4.0 LIMITATIONS

This specification does not cover self-contained filters (also known as nipple-connected HEPA filters), round HEPA filters, or filter sizes not shown in Table FC-4000-1 of ASME AG-1.

5.0 DEFINITIONS AND TERMS

1. Acceptance Test

Inspection and test of a qualified filter to verify certain specified characteristics or properties, the results of which determine the acceptance or rejection of that filter.

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2. Testing Method

Testing method per Article FC-5120.

3. Fire, Moisture and Chemical Resistant (FMCR) Filter

A filter meeting the functional and design requirements of a fire, moisture and chemical resistant HEPA filter.

4. Fire and Moisture Resistant (FMR) Filter

A filter meeting the functional and design requirements of a fire and moisture resistant HEPA filter.

5. Hydrogen Fluoride and Caustic Resistant (HFCR) Filter

A filter meeting the functional and design requirements of a hydrogen fluoride resistant HEPA filter.

6. High Efficiency Particulate Air (HEPA) Filter

A filter having a fibrous medium with a particle removal efficiency of at least 99.97% for 0.3 micrometer particles of an approved test aerosol.

7. Penetration

The amount of leakage through or bypassing a filter, expressed as a percentage of the upstream concentration of an approved test aerosol, when the filter is encapsulated in a test chamber (chuck) and operated under specified conditions.

8. Qualification Test

A test, often destructive, of a prototype or randomly selected production filter to establish its capability to meet certain functional and specification requirements, the results of which are considered to typify subsequent filters of the same design (includes materials and configuration, size may vary) and manufactured by the same process. The test is performed per Article FC-5100.

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6.0 REFERENCED DOCUMENTS

The standards and specifications designated below are a part of this specification to the extent specified herein. The most current revisions of standards and specifications apply.

1. American Society of Mechanical Engineers (ASME)

- ! ASME AG-1 Code on Nuclear Air and Gas Treatment
 - Division I General Requirements, Section AA, Common Articles
 - Division II Ventilation Air Cleaning and Ventilation Air Conditioning, Section FC, HEPA Filters
- ! ASME N 509 Nuclear Power Plant Air Cleaning Units and Components

2. American Society for Testing and Materials (ASTM)

- ! ASTM A 167, Rev A Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ! ASTM A 176 Standard Specification for Stainless and Heat-Resisting Chromium-Steel Plate, Sheet, and Strip
- ! ASTM A 240/A 240M Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
- ! ASTM A 653/A 653M Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
- ! ASTM D 3359 Standard Test Methods for Measuring Adhesion by Tape Test

3. American Wood-Preservers Association (AWPA)

- ! AWPA C27 Plywood--Fire-Retardant Pressure Treatment

4. National Institute of Standards and Technology (NIST)

- ! NIST PS 1 NIST Voluntary Product Standard, Construction and Industrial Plywood

5. Washington Administrative Code (WAC)

- ! Chapter 246-247 Radiation Protection - Air Emissions

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7.0 MATERIALS

1. General

For Manufacturer proprietary material or materials listed as "Manufacturer's option," the Seller shall submit the material specification to the Buyer for information as a part of the bid quotation. Materials shall conform to Article FC-3000.

2. Filter Media

The filter media shall comply with Appendix FC-I-3000, except as noted below:

- FMCR: Filter media shall not contain more than 7% by weight of carbonaceous fibers.
- HFCR: Filter media shall contain at least 5% but not more than 7% of aromatic polyamide fibers.

3. Case

Case Material shall comply with Articles FC-3110 and FC-3210, except as noted below:

a. **Galvanized Carbon Steel**

- FMR: In accordance with ASTM A 653/A 653M, coating weight designating G90 maximum, 14 gage (2 mm) minimum sheet thickness.

b. **Stainless Steel**

- FMR: In accordance with ASTM A 176, Type 409 (muffler grade ferritic stainless steel), 14 gage (2 mm) minimum sheet thickness.
- HFCR: In accordance with ASTM A 167 or ASTM A 240, Type 304, 304L, 316, or 316L, 14 gage (2 mm) minimum sheet thickness.
- FMCR: In accordance with ASTM A 167 or ASTM A 240, Type 304, 304L, 316, or 316L, 14 gage (2 mm) minimum sheet thickness.

c. **Plywood**

Plywood shall be in accordance with NIST PS-1, Type III or IV per Article FC-3110. The plywood shall be fire retardant treated in accordance with AWPA C27.

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4. Separators

The separators shall comply with Articles FC-3160 and FC-4150, except as noted below:

- HFCR and FMCR separators shall be coated with teflon, epoxy resin, thermoset vinyl, or other acid resistant material. The coating shall be colored (to permit defects in the coating to be discerned); shall be tightly adherent and not crack or delaminate when the material is corrugated; and shall be at least 0.0001 to 0.0002 in. (2.5 to 5 micrometer) thick (dry film). After corrugation and subsequent flattening, the coating shall exhibit an adhesive peel resistance of 3A or greater when tested in accordance with Method A of ASTM D 3359.

5. Adhesives

The adhesives shall comply with Article FC-3150, except as noted below:

- FMR: Resistance to water, oil, ozone, and radiation
- HFCR: Resistance to water, oil, ozone, acid, caustic, and radiation
- FMCR: Resistance to water, oil, ozone, chemical, and radiation

6. Gaskets and Seals

Two methods are currently employed for sealing the filter to its mounting frame, flat gasket and gelatinous seal. The gelatinous seal requires a specially designed mounting frame that is not compatible with flat-gasket-sealed filters.

- **Gasket** - Article FC-3120 and Figure FC-4100-1
- **Gelatinous Seal** - Article FC-3122 plus the following:
 - a. Applicable temperature range shall be -70E F to 390E F (-56.7E C to 198.9E C).
 - b. Flash Point shall be measured according to ASTM D92, Open Cup Method, and shall show no flash at 450E F (232.2E C).
 - c. Shall be fire retardant and have an H-O rating as tested by UL-94 method.
 - d. Hardness shall be measured using a Brookfield LVT Penetrometer #3 and having a penetration of 0.14 to 0.25 inch (5.0 to 8.0 mm) at 80E F.
 - e. Shall be resistant to 20 X 10⁶ Rads of gamma radiation at 77E F (25E C). Radiation exposure at these levels will not affect the sealing properties of the compound.
 - f. Shall not support biological growth.

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7. **Faceguards**

The faceguards shall comply with Article FC-3140, except as noted below:

- FMCR and HFCR: 4 X 4 mesh, 23 gage (.566 mm) stainless steel hardware cloth, Type 304 or 316, standard grade

8. **Fasteners**

The use of fasteners in the filter assembly is the manufacturer's option. Fasteners shall comply with Article FC-6000. For FMR and FMCR filters, fasteners shall be made of corrosion resistant material or have a corrosion resistant coating. For HFCR filters, fasteners shall be made of 300 series stainless steel.

8.0 **DESIGN REQUIREMENTS**

1. The filters and media furnished shall be constructed as shown in Figures FC-4100-1, FC-4100-2, FC-4100-3 and FC-4100-4.
2. Each filter shall be designated Type A, Type B or Type C, and include the specific material requirements of Section 7 of this specification for a FMR, FMCR or HFCR filter
3. Filter splices and patches, cases and pack shall meet Articles FC-4110, FC-4120 and FC-4130, unless specifically identified to be different.
4. Filters shall pass the following performance tests:
 - **Resistance to Airflow** Article FC-5110
 - **Test Aerosol Penetration** Article FC-5120
 - **Resistance to Rough Handling** Article FC-5130
 - **Resistance to Pressure** Article FC-5140
 - **Resistance to Heated Air** Article FC-5150
 - **Spot Flame Resistance** Article FC-5160
 - **Production Testing** Article FC-5200

9.0 **INSPECTION AND TESTING**

1. **Qualification Testing**

The filter Manufacturer shall be able, on request, to show evidence that qualification tests have been conducted by an independent laboratory in accordance with and meet the requirements of Articles FC-5100 and FC-8200. These tests shall be performed under acceptably controlled conditions, either by the filter Manufacturer or a qualified agent. Records shall be prepared and maintained which show evidence that the tests are performed in an acceptably controlled manner.

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a. **Filter Media**

For filter media, documented tests performed by the media Manufacturer or a testing lab can be used to demonstrate compliance with filter media requirements.

Resistance to Radiation - as identified in Appendix FC-I-3000 and FC-I-4000.

b. **Filters**

Filters for qualification shall be either prototypes of the proposed design or production filters of the specific design randomly selected from the Manufacturer's stock. The number of filter units required for qualification testing shall be as specified in Article FC-5100.

- Resistance to Airflow - Article FC-5110, or specify different functional requirements
- Test Aerosol Penetration - Article FC-5120, or specify different functional requirements
- Resistance to Rough Handling - Article FC-5130, or specify different functional requirements
- Resistance to Pressure - Article FC-5140, or specify different functional requirements
- Resistance to Heated Air - Article FC-5150, or specify different functional requirements
- Spot Flame Resistance - as identified in Article FC-5160, or specify different functional requirements
- Production Testing - as identified in Article FC-5200, or specify different functional requirements
- Recertification and Qualification - The Buyer may have qualification tests, or verifications of materials, performed on any filters furnished to them. Failure of filters submitted for qualification testing to meet any requirement shall be cause for a re-evaluation of the Supplier's quality assurance program.

2. **Production**

Production testing shall meet the requirements of Article FC-5200.

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10.0 FABRICATION

Each filter shall be assembled from materials identified in Section 7 and shall be manufactured and assembled to meet all tolerances. The media shall be installed with quality workmanship. The fabrication shall meet Articles FC-6200, FC-6210, FC-6211, FC-6212, FC-6220 and FC-6300.

11.0 PACKAGING, SHIPPING AND STORAGE

Packaging, shipping and storage shall comply with Article FC-7000.

1. Loading in Public Carriers

Pallets shall not be stacked without sufficient support(s) to prevent damage to the bottom filters. Other materials shall not be stacked on top of the boxes during shipment.

2. Shipment

If possible, shipment shall be arranged so that the filter assemblies are not disturbed after they leave the Seller until they are received at the address designated by the Buyer. For large shipments, it is recommended that the entire shipment be shipped in a sealed dedicated trailer or rail car. At all times, the filters must be handled with care and orientated properly. The common carrier shall be instructed that the Buyer's personnel will be responsible for unloading at the Buyer's receiving.

12.0 QUALITY ASSURANCE PROVISIONS

1. Supplier Quality Assurance Program

- a. The Supplier shall have a documented quality program that is in compliance with ASME AG-1, Articles FC-8000 and AA-8000. The quality program shall ensure that the supplied products and services meet or exceed contract requirements. This program shall be evaluated by the Buyer's Quality Assurance organization. The Seller must successfully disposition any resulting findings or observations prior to award of contract.
- b. The Supplier's program shall be subject to review at all times by the Buyer. The Buyer reserves the right to verify the quality of work at the Supplier's facility, including any subcontractor's facility.
- c. The Supplier shall, during the performance of this Purchase Order, submit proposed changes to the quality assurance program to the Buyer for review prior to implementation.

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2. **Acceptance Inspection and Testing**

- a. Each shipment shall be accompanied by a Supplier certificate of conformance which meets the requirements of Article FC-8200.
- b. The Seller shall supply evidence of compliance with the requirements of this specification.
- c. Payment will not be made by the Buyer until each filter has been Accepted by Quality Assurance. Failure to meet inspection, test, or verification requirements shall be cause for rejection.
- d. The Seller shall be notified by the Buyer of rejected filters including the nature of the rejection. The Seller shall provide replacement filters until the stipulated quantity of filters has been found acceptable, unless otherwise negotiated between the Buyer and Seller. The Seller shall provide, at the discretion of the Buyer, replacement filters and/or credit for any rejected filters.

3. **Optional Testing**

The Buyer may elect to have additional testing performed by an independent laboratory. In addition to the aforementioned testing and acceptance criteria, Buyer acceptance of the filters shall be dependent on meeting these additional test requirements.

4. **Quality Assurance Program, Procedures, and Documentation**

Filters shall be manufactured and shipped under a quality assurance program meeting the requirements of Articles FC-8000 and AA-8000.

13.0 **NAMEPLATES**

The filter package nameplate and marking shall comply with Articles FC-9100 and FC-9200.

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14.0 **APPENDIX: INSTRUCTIONS FOR COMPLETING THE DESCRIPTION PORTION OF THE PURCHASE DOCUMENT**

The following steps are instructions for completing the filter description portion of the Purchase Document which uses this specification.

1. Attach a copy of this specification to the Purchase Document.
2. Provide the following information in the Purchase Document (order and format):

FILTERS SHALL BE IN ACCORDANCE WITH SPECIFICATION HNF-S-0552.

Exceptions: _____

Name and Acronym of Filter: _____

Number Designation (per Table FC-4000-1, e.g., Number 6): _____

Filter Type (per Section 8 and Article FC-1121): _____

Case - Construction Material Type: _____

Case - Style (flanges): _____

Case - Hardware: _____

Filter/mounting frame seal material type: _____

Filter/mounting frame seal location: _____

Faceguard Material: _____

Faceguard Location(s): _____

Requirements of ASME N509, Section 5.1, not covered in this specification: _____

QA Clauses: B01 -- QA Program Submittal and Pre-award Survey
B04 -- Supplier Quality Program Evaluation
B52 -- Inspection and Test Report
B79 -- Certificate of Conformance

PACKAGING, SHIPPING AND STORAGE SHALL BE IN ACCORDANCE WITH ASME AG-1, ARTICLE FC-7000, AND SECTION 6 OF HNF-S-0552.

Additional Shipping Instructions: _____