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DOE TECHNICAL STANDARD

Specification for HEPA Filters Used by DOE Contractors



**U.S. Department of Energy
Washington, D.C. 20585**

AREA SAFT

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FOREWARD

This U.S. Department of Energy (DOE) standard supersedes DOE-STD-3020-97 and is approved for use by DOE and its contractors.

This standard was developed primarily for application in DOE programs. It provides guidance to DOE contractors for procurement and required testing of High Efficiency Particulate Air (HEPA) filters used in DOE nuclear facilities. Required testing is performed by the filter manufacturer and by DOE at a designated Filter Test Facility (FTF). This standard was designed to achieve technical coordination among individuals of recognized authority from affected DOE programs, including manufacturers, purchasers, users, and technical experts. This procedure utilized a writing group to prepare the standard and a group of subject matter experts to provide formal review and comment.

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may improve this document should be sent to Subir K. Sen, U.S. Department of Energy, Office of Quality Assurance Programs EH-31/270 CC, 1000 Independence Avenue, SW, Washington, D.C. 20585

DOE technical standards, such as this standard, do not establish requirements. However, all or part of the provisions in a DOE standard can become requirements under the following circumstances:

- (1) they are explicitly stated to be requirements in a DOE requirements document; or
- (2) the organization makes a commitment to meet a standard in a contract or in an implementation plan or program plan required by a DOE requirements document.

Throughout this standard, the word “shall” is used to denote actions that must be performed if the objectives of this standard are to be met. If the provisions in this standard are made requirements through one of the two ways discussed above, then the “shall” statements would become requirements. It is not appropriate to consider that “should” statements would automatically be converted to “shall” statements as this action would violate the consensus process used to approve this standard. This standard in part incorporates the HEPA testing requirements described in the Secretary of Energy’s June 4, 2001 letter to the Defense Nuclear Facilities Safety Board.

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1. SCOPE

1.1 **Scope:** This standard establishes specifications and quality assurance requirements for High Efficiency Particulate Air (HEPA) filters procured to protect workers, the public, and the environment when installed in DOE nuclear facilities. It provides guidance to DOE contractors for procurement and required testing of HEPA filters used in DOE nuclear facilities. Required testing is performed by the filter manufacturer and by DOE at a designated Filter Test Facility (FTF). The standard specifies minimum requirements to be included in contractor specifications.

1.2 **Applicability:** This Standard applies to procurement of HEPA filters that:

- are to be installed in confinement ventilation systems for containing radioactive particulates in DOE nuclear facilities, and
- handle a minimum of 20 actual cubic feet per minute (ACFM) airflow (42 m³/hr) at an initial maximum of 1.3 inch (in) water gauge (wg) (325 Pa) resistance.

2. **APPLICABLE DOCUMENTS:** The following documents either form a part of this standard to the extent specified herein or specify materials of HEPA filter construction. Unless otherwise stated, the current issue date and revision number of a referenced document shall apply, including addenda and/or amendments. In the event of a conflict between provisions of this standard and provisions of the referenced documents, the text of this standard shall take precedence. The Application Guide in subpart 4.5 of ASME NQA-1-2004 describes how ASME NQA-1-2000 addresses the DOE quality assurance requirements.

2.1 **Department of Energy (DOE) Rules, Orders and Standards**

- 10 CFR 830, Nuclear Safety Management
- 40 CFR 261, Identification and Listing of Hazardous Waste
- DOE O 414.1C, Quality Assurance
- DOE-STD 3009, Preparation Guide for U. S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses
- DOE -STD 3022, DOE HEPA Filter Test Program
- DOE-STD 3025, Quality Assurance Inspection and Testing of HEPA Filters
- DOE-STD 3026, Filter Test Facility Quality Program Plan
- DOE-HDBK-1169, DOE Handbook Nuclear Air Cleaning Handbook

2.2 National Consensus Standards

2.2.1 American Society for Testing and Materials (ASTM)

ASTM A 193, Standard Specification for Alloy-Steel and Stainless Bolting Materials for High-Temperature Service

ASTM A 194, Standard Specification for Carbon and Alloy-Steel Nuts and Bolts for High Pressure of High Temperature Service or Both

ASTM A 320, Standard Specification for Alloy-Steel and Stainless Bolting Materials for Low-Temperature Service

ASTM A 581, Standard Specification for Free Machining Stainless Steel Wire and Wire Rods

ASTM D 92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D 217, Test Method for Cone Penetration of Lubricating Grease

ASTM E 2016, Standard Specification for Industrial Woven Wire Cloth

ASTM F 1667, Standard Specification for Driven Fasteners: Nails, Spikes and Staples

2.2.2 American Society of Mechanical Engineers (ASME)

ASME AG-1, Code on Nuclear Air and Gas Treatment

ASME NQA -1, Quality Assurance Program Requirements for Nuclear Facilities

ASME B 18.21.1, Plain Washers

ASME B 18.22.1, Lock Washers (inch Series)

2.2.3 Society of Automotive Engineers (SAE)

SAE AS-8660C, Silicone Compound, NATO Code Number S -726

3. DEFINITIONS

Air Density: Air density equals 0.075 lb/ft³ (1.201 kg/m³) for standard air. This corresponds to air at a pressure of 29.92 inches Hg (760 mm Hg) at a temperature of 69.8°F (21°C) with a specific volume of 13.33 ft³/lb (0.832 m³/kg)

Airflow (ACFM): Airflow expressed in terms of actual cubic feet of air per minute (ACFM). ACFM is a cubic foot of air at actual existing conditions.

Airflow Resistance: The resistance to airflow at the manufacturer rated airflow of the clean filter when tested in accordance with ASME AG-1, FC-5000.

Approved Test Aerosol: Particle-generating materials approved by DOE for penetration testing. Test aerosols approved by the DOE for tests conducted in the Filter Test Facility are di-octyl phthalate (DOP), also known as DEHP and di-octyl sebacate (DOS), also known as DEHS. Others may be approved after DOE evaluation.

Effective Filter Media Area: The effective surface area of the filter media in the assembled filter element (without adhesive areas) through which the air stream is passed.

Filter Media Face Velocity: The rated airflow divided by the effective filter media area.

Filter Test Facility (FTF): A facility contracted by DOE specifically to conduct performance quality assurance inspections and tests of HEPA filters.

FTF Quality Assurance Test: Inspection and testing of a HEPA filter at the FTF to verify certain characteristics or properties which ensure the appropriate level of quality assurance in the design, integrity and performance of HEPA filters.

High Efficiency Particulate Air (HEPA) Filter: A throwaway, extended-media, dry type filter with a rigid casing enclosing the full depth of the pleats. The filter shall exhibit a minimum efficiency of 99.97% at a test aerosol diameter of 0.3 micrometer.

HEPA Filter Types:

Open Face Filters : A filter with no restrictions over the ends or faces of the unit, as opposed to the enclosed filter with reduced-size end connections.

Radial Flow Filters : A filter constructed from a continuous length of glass fiber filter paper folded back and forth into pleats in a rigid annulus, with airflow in essentially a

perpendicular direction outward from the centerline of the upstream inside side face of the filter or conversely inward.

Enclosed (Encapsulated) Filters : A filter that is completely enclosed on all sides and both faces except for reduced end connections or nipples for direct connection into a duct system.

Nuclear Facility: A reactor or nonreactor nuclear facility where an activity is conducted for or on behalf of DOE and includes any related area, structure, facility, or activity to the extent necessary to ensure proper implementation of the requirements established by 10 CFR 830.

Penetration: The downstream test aerosol concentration, expressed as a percentage of the upstream test aerosol concentration.

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 the test are considered to typify individual items or model numbers which are of the same design and are manufactured by the same process.

Rated Airflow: The designated airflow capacity of a HEPA filter in ACFM.

4. **GENERAL REQUIREMENTS:** All HEPA filters specified in the scope of this standard that are to be used for protection of workers, the public, the environment or that are necessary to enable other safety related air cleaning equipment to function properly, shall be purchased and tested according to the general requirements of this Section (Section 4), and the specific requirements of Sections 5 and 6.

In addition, this standard may be used to purchase other filters that prevent the build up of radioactive material in and around air cleaning systems which may limit personnel access during operations and maintenance in DOE nuclear facilities.

- 4.1 As directed by the Secretary of Energy's June 4, 2001 memorandum, *100 percent Quality Assurance Testing of HEPA Filters at the DOE Filter Test Facility*, prior to use in DOE facilities, filters meeting the following criteria shall be delivered to the FTF for additional quality assurance testing.

4.1.1 HEPA filters that are used in confinement ventilation systems in Category 1 and Category 2 nuclear facilities that perform a safety function in accident situations, or are designated as important to safety (i.e., safety class or safety significant per DOE-STD-3009-94).

4.1.2 HEPA filters necessary for habitability systems (e.g., filters that protect workers who must not evacuate in emergency situations because of the necessity to shutdown or control the situation).

4.1.3 For all other applications where HEPA filters are used in confinement ventilation systems for radioactive airborne particulate, develop and document an independent tailored filter QA testing program that achieves a high degree of fitness for service. The program should include the testing of a sample of filters at the FTF. The size of the sample to be tested should be large enough to provide sufficient statistical power and significance to assure the required level of performance.

- 4.2 HEPA filters shall be qualified per ASME AG-1 and Section 6.1 of this standard. The filter media shall comply with ASME AG-1.

- 4.3 All HEPA filters shall be tested by the manufacturer and in addition, those identified in Section 4.1 shall be tested by the FTF to the following criteria:

- Penetration at 100% of manufacturer rated airflow
- Penetration at 20% of manufacturer rated airflow for filters rated at 125 ACFM and greater
- Airflow resistance at rated airflow. Maximum acceptable resistance for selected filter sizes is specified in Table 5.1.

The FTF is exempt from performing an airflow resistance test on enclosed filters for the purposes of meeting requirements of this standard.

5. HEPA FILTER PROCUREMENT

5.1 **General:** HEPA filters to be installed in facilities operated under contract to DOE shall be purchased in compliance with the specifications of this standard. For those filters specified in Section 4.1 requiring FTF quality assurance testing, the purchaser shall provide the FTF a copy of the purchase order, including any special requirements for the filter product, as a means to assure that the purchase order includes proper specifications, and that the manufacturer meets the stipulations of the purchase order. Deviations from purchase order specifications shall be referred to the purchaser by the FTF manager before FTF testing of the filters.

5.2 **Performance Requirements:** Mandatory performance requirements for HEPA filters are set out below. These performance requirements shall be demonstrated by test and inspection by the manufacturer. These performance requirements shall also be demonstrated by test and inspection by the FTF when applicable (see Section 4.1).

5.2.1 **Penetration:** Aerosol penetration for any HEPA filter shall not exceed 0.03% (0.0003) at 0.3 micrometer particle size.

5.2.2 **Resistance:** Airflow resistance across the HEPA filter shall conform to the limits listed in Tables 5.1, 5.3, 5.4, and 5.5 except as noted in Section 4.3. Tests for resistance to airflow shall be conducted at flow rates expressed in ACFM.

TABLE 5.1
DIMENSIONS, AIRFLOW RATINGS, and MAXIMUM
RESISTANCE FOR OPEN FACE ASME AG-1, HEPA FILTERS

Size (Note 3)	Dimension (inches) (Note 1)	Dimension (millimeters) (Note 1)	Rated Airflow (Note 2)		Maximum Resistance	
			ACFM	m ³ /hr	In wg	Pa
1	8 x 8 x 3-1/16	203x203x78	25	42	1.3	325
2	8 x 8 x 5-7/8	203x203x149	50	85	1.3	325
3	12 x 12 x 5-7/8	305x305x149	125	212	1.3	325
4	24 x 24 x 5-7/8	610x610x149	500	850	1.0	250
5	24 x 24 x 11-1/2	610x610x292	1000	1700	1.0	250
6	24 x 24 x 11-1/2	610x610x292	1250	2125	1.3	325
7	24 x 24 x 11-1/2	610x610x292	1500	2550	1.3	325
8	24 x 24 x 11-1/2	610x610x292	2000	3400	1.3	325
9	12 x 12 x 11-1/2	305x305x292	250	424	1.3	325

Notes:

1. Dimensions are height by width by depth.
2. Rated airflow in ACFM is based on tests performed indoors at atmospheric pressure close to sea level. The temperature and pressure under which the tests have been conducted are to be recorded but are not to be used to correct rated flow.
3. Size 4 filters of this size and design must be qualified independently of the qualification of any larger similar filter sizes.

5.3 **Materials Requirements:** Construction materials for HEPA filters shall be selected to avoid generation of Environmental Protection Agency (EPA) regulated wastes as specified in 40 CFR 261, Identification and Listing of Hazardous Waste. For this reason, cadmium is no longer acceptable for treatment of filter cases, nor is asbestos acceptable as a HEPA filter component. State and local regulations may contain additional restrictions.

5.3.1 **Filter Media:**

5.3.1.1 **Fibrous Filter Media:** Fibrous filter media shall be in accordance with the provisions of ASME AG-1, FC-3000.

5.3.1.2 **Asbestos:** Asbestos is not acceptable as a filter media component.

5.3.2 **HEPA Filter Case Materials:**

5.3.2.1 **Structural Material:** Metal or wood filter case material shall be in accordance with ASME AG-1, FC-3000, except that Type I cases are not acceptable due to the use of cadmium.

5.3.2.2 **Fire Retardant Material:** Filter case material that must be fire retardant shall be in accordance with ASME AG -1, FC-3000.

5.3.3 **Separator Material:** Separator material including acid resistant separators shall be in accordance with ASME AG-1, FC-3000. In addition to the requirements of ASME AG-1, the separator shall be provided with a “turned edge” prior to corrugation to protect the filter media.

5.3.4 **Adhesives:** Adhesives shall be in accordance with ASME AG-1, FC-3000.

5.3.5 **Gaskets and Seals:** Two acceptable methods for sealing the filter to its filter case are elastomer gaskets and gelatinous seals. Two different methods or materials shall not be used on the same filter case.

5.3.5.1 **Elastomer Gasket:** Elastomer gasket materials shall be in accordance with ASME AG-1, FC-3000

5.3.5.2 **Gelatinous Seal:** The sealant material shall be in accordance with ASME AG-1, FC-3000. The sealant shall be nonflammable as defined in ASTM D 92; e.g., no flash at 450⁰ F (232⁰ C) or below; with a fire retardant rating of V-0 per UL-94. The

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gelatinous seal substance shall be corrosion resistant, shall not relax, crack, separate, or stick or adhere to the knife-edge, and shall be insoluble in water. Evaporation shall be less than 2% when tested in accordance with SAE AS-8660C for 24 hours at 390⁰ F (198⁰ C).

- 5.3.6 **Face Guards:** Face guards shall be installed in each face of the filter in accordance with ASME AG-1, FC-3000 with a ¼" x ¼" mesh size or fabricated from 18 or 22 gauge 4x4 mesh stainless steel (304 or 304L) hardware cloth in accordance with ASTM E 2016 when specified.
- 5.4 **Filter Construction:** HEPA filter construction shall conform to ASME AG-1, FC-4000 and FC-6000 unless otherwise noted.
- 5.4.1 **Dimensions:** The configuration and dimensions of open face rectangular HEPA filters have been standardized and listed in Table 5.1. Dimensional tolerances of standard HEPA filters should conform to those specified in Table 5.2. All other filter configurations are considered "special" filters as described in Section 5.5. Use of standard HEPA filters is encouraged where practical.
- 5.4.2 **Filter Pack Construction:** Filter packs shall be constructed in accordance with ASME AG-1, FC-4000 and 6000 except that no splices or patches are allowed in the filter media. Repair of pin holes and other defects is not acceptable.
- 5.4.2.1 **Separator Filters:** Filters with corrugated separators shall be in accordance with ASME AG-1, FC-4000, Type A. Separators shall extend at least 1/8 in. (3 mm) beyond the pleats of filter media. Separator fixed ends, when viewed from the upstream and downstream faces shall be embedded in the adhesive/sealant. Filters with glue separators shall be in accordance with ASME AG-1, FC-4000, Type B.
- 5.4.2.2 **Separatorless Filters:** Filters without separators shall be in accordance with ASME AG-1, FC-4000, Type C. Dividers shall be provided as appropriate for additional support of the case and media. The trimmed edges of the filter element shall be firmly embedded into the sealant. The two end flap edges shall have sufficient sealant to secure them to the case sides.

5.4.2.3 **Media Velocity (Effective Media Area):** The total effective media area provided within the filter pack shall be such that average face velocity (rated airflow divided by the effective filter media area) shall not exceed 5.0 ft/min (1.52 m/min) at the rated airflow.

5.4.3 **Filter Case:** The case shall be fabricated in accordance with the provisions of Section 5.3.2. The completed case, less gaskets, shall conform to the dimensions listed in Table 5.1, unless alternative dimensions are specified in procurement documents. Table 5.2 lists the acceptable tolerances.

TABLE 5.2
TOLERANCES FOR ASME AG-1, FILTER CASES

Face Dimensions less than 24 in. (610 mm)	$-\frac{1}{16}$ in. / +0 in. (-1.6 mm / +0 mm)
Face Dimensions 24 in. (610 mm) and greater	$-\frac{1}{8}$ in. / +0 in. (-3 mm / +0 mm)
Depth	$+\frac{1}{16}$ in. / -0 in. (+1.6 mm / -0 mm)
Width of Gasket Surface	$\frac{3}{4}$ in. \pm $\frac{1}{16}$ in. (19 mm \pm 1.6 mm)
Squareness for Filter Face Dimensions	Face diagonals to be equal with the following tolerance: $+\frac{1}{8}$ in. (3 mm) total
Gasket Sealing Surfaces - Flat and parallel	$+\frac{1}{16}$ in. (1.6 mm) total allowance when measured with one face of the filter resting on a flat surface
	Square with sides of case (within 3°)

5.4.3.1 **Wooden Cases:** Case panels shall be joined with rabbetted joints which are assembled by gluing with an adhesive meeting the requirements of Section 5.3.4 and assembled using fasteners that comply with Section 5.4.3.3. The end points of the fasteners shall not penetrate the inside or outside surfaces of the case. Faces, edges, and inner surfaces of the case shall be thoroughly coated with sealant to minimize permeability. Case face sealant shall not reduce the ability of the gasket to adhere to the case. There shall be no rough edges that might penetrate or cut workers' gloves or injure the fingers of personnel handling the filters.

5.4.3.2 **Metal Cases:** Metal cases shall have a double-turned, 3/4 in. (19 mm) wide flange on each face or a gelatinous seal socket or sleeve as specified in the procurement documents. Cases shall be assembled by riveting or bolting the corners with fasteners that comply with Section 5.4.3.3. Panels shall be assembled into the case by potting a subassembly consisting of the filter pack and side panels into the top and bottom panels (but not the corners), using an adhesive meeting the requirements of Section 5.3.4. For mechanically joined panels the space between abutting panels shall be sealed with an adhesive meeting the requirements of Section 5.3.4. There shall be no rough edges that might penetrate or cut workers' gloves or injure the fingers of personnel handling the filters.

5.4.3.3 **Fasteners:** Approved fasteners for the assembly of metal HEPA filter cases are listed below:

- Stainless steel bolts: 300 series per ASTM A 320 or ASTM A 193
- Stainless steel nuts: 300 series per ASTM A 194
- Stainless steel lock washers: 300 series per ASME B18.21.1
- Stainless steel plain washers: 300 series per ASME B18.22.1
- Stainless steel rivets: 300 series per ASTM A 581

Approved fasteners for the assembly of wooden HEPA filter cases are listed below:

- Nails: carbon steel, galvanized, zinc coated, aluminum per ASTM F 1667
- Staples: carbon steel, galvanized, zinc coated, aluminum per ASTM F 1667

5.4.4 **Gaskets:** Gaskets shall be glued firmly and continuously to the case. Loose, peeling, or distorted gaskets shall be cause for rejection of the filter. The gasket shall not extend more than 1/16 in. (1.6 mm) over either side of the seating surface at any point. Gaskets may be of one-piece or made up of strips joined at the corners by keyhole, keystone, or other interlocking type joints. Edges of the joint area shall be thoroughly coated with adhesive (sealant meeting requirement of Section 5.3.4) before assembly.

5.4.5 **Face Guards:** Face guard edges shall be firmly embedded in adhesive and fabricated so that projecting wires or edges do not form a puncture hazard to personnel handling the filter and do not project onto or beyond the gasket mounting surface. Wire edges formed when slitting or shearing face guards shall be smoothed on both surfaces of the material before installation.

- 5.5 **Special HEPA Filters:** Filter configurations other than those listed in Table 5.1, are considered "special" filters and their dimensions and tolerances shall be specified in the procurement documents.

Materials shall conform to ASME AG-1, FK-3000. Design shall conform to ASME AG-1, FK-4000. Inspection and testing shall conform to ASME AG-1, FK-5000. Fabrication and tolerances shall conform to ASME AG-1, FK-6000.

Tables 5.3, 5.4, and 5.5 provide the nominal ratings and performance requirements for special radial and axial flow HEPA filters.

TABLE 5.3
RADIAL FLOW HEPA FILTERS – NOMINAL RATINGS
 (Note1)

Maximum Rated Air Flow (Note 2)		Maximum Resistance	
(ACFM)	(m ³ /hr)	In wg	Pa
40	68	1.3	325
100	170	1.3	325
250	425	1.3	325
500	850	1.3	325
1000	1700	1.3	325
1500	2550	1.3	325
2000	3400	1.3	325

Notes:

1. Reprinted from ASME AG-1, by permission of the American Society of Mechanical Engineers. All rights reserved.
2. Rated airflow in ACFM is based on tests performed indoors at atmospheric pressure close to sea level. The temperature and pressure under which the tests have been conducted are to be recorded but are not to be used to correct rated flow.

TABLE 5.4
AXIAL FLOW CIRCULAR HEPA FILTERS – NOMINAL RATINGS
 (Note 1)

Maximum Rated Air Flow (Note 2)		Maximum Resistance	
(ACFM)	(m ³ /hr)	In wg	Pa
20	34	1.0	250
35	60	1.0	250
100	170	1.0	250

Notes:

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2. Rated airflow in ACFM is based on tests performed indoors at atmospheric pressure close to sea level. The temperature and pressure under which the tests have been conducted are to be recorded but are not to be used to correct rated flow.

5.5.1 **Enclosed Filters:** Filters with inlet and/or outlet connections as shown in Table 5.5 are commonly referred to as enclosed filters or encapsulated (nipple-connected, closed face, or self-contained) HEPA filters. These filters are not qualified in accordance with ASME AG-1 and fail to meet all the requirements contained in this standard. When designing and constructing new nuclear facilities, enclosed HEPA filters shall not be used in nuclear ventilation systems or in habitability systems where HEPA filters are used to protect workers.

TABLE 5.5
AXIAL FLOW RECTANGULAR HEPA FILTERS WITH INLET/OUTLET
CONNECTIONS(S) - NOMINAL SIZES AND RATINGS
 (Note1)

Size (Note 2)		Maximum Rated Air Flow (Note 4)		Maximum Resistance (Note 3)	
(Inches)	(mm)	(ACFM)	(m ³ /hr)	In wg	Pa
8 x 8 x 10	203 x 203 x 254	80	136	1.3	325
12 x 12 x 12	305 x 305 x 305	125	212	1.3	325
12 x 12 x 16	305 x 305 x 406	250	425	1.3	325
24 x 24 x 12	610 x 610 x 305	500	850	1.3	325
24 x 24 x 16	610 x 610 x 406	1000	1700	1.3	325

Notes:

1. Reprinted from ASME AG-1, by permission of the American Society of Mechanical Engineers. All rights reserved.
2. Dimensions are height by width by depth. Depth includes the casing only and does not include the length of the nipple connection(s).
3. Maximum resistance shall be as measured in ASME AG-1, FK-5621.
4. Rated airflow in ACFM is based on tests performed indoors at atmospheric pressure close to sea level. The temperature and pressure under which the tests have been conducted are to be recorded but are not to be used to correct rated flow.

6. QUALITY ASSURANCE

6.1 **Manufacturer's Quality Assurance Program, Procedures, and**

Documentation: Filters shall be manufactured under a Quality Assurance Program which has been evaluated with documented evidence of compliance to the requirements of ASME NQA-1. Procurement and fabrication activities shall allow positive identification of the grades of source materials used in construction, and permit positive identification of the roll (or production run for separatorless filters) of filter media used in the completed filter. Penetration and resistance production tests and inspections shall be conducted in accordance with ASME AG-1, FC-5000 or FK-5000 and with documented manufacturer's procedures. The results shall be traceable to specific lots of completed filters. Non-conformances with the above items and documentation of problems and their resolution shall be addressed in the manufacturer's Quality Assurance Program.

6.1.1 **Qualification:** Filter manufacturers shall be required to show evidence that HEPA filters have successfully passed the qualification and requalification testing in accordance with ASME AG-1. As specified in this Section, qualification tests are to be performed and certified by an independent test laboratory as defined in ASME AG-1. Tests performed on a filter manufacturer's equipment by an independent testing organization are not acceptable.

A filter design shall be requalified when any change is made to design or construction or composition of construction materials that could affect filter performance including normal service and off-normal service. Examples of changes that require requalification include: composition of filter media, manufacture of gasket or sealant materials, and materials or methods used to assemble filter cases.

If a filter fails any or all of the requalification tests, the test organization shall provide the manufacturer with the test results. The manufacturer shall notify DOE and the FTF that the filter model failed requalification. DOE shall notify DOE contractor organizations that the filter model is no longer acceptable for use in DOE facilities, pending requalification.

In order to reduce costs associated with qualification testing, successful tests of filters with known material components for filter frames, filter media, cases and adhesives that have been produced by a single manufacturer, can be used to qualify filters of similar construction. Similar construction is defined as manufactured using the same method, material, equipment and processes.

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Qualification testing of a filter listed in Table 5.1 qualifies all filters with a lower flow rate, which have similar construction except:

- The size 4 filters shall be qualified separately.
- The size 2 filters cannot qualify a size 1 filter.

For qualification testing of special HEPA filters described in Section 5.5, refer to ASME AG-1, FK-5000.

DOE reserves the right to randomly select HEPA filters from existing storage at DOE sites and perform the tests defined in Section 6.1.2. If failures are noted, the manufacturer, the FTF, and DOE contractor procurement specialists shall be informed that the failed filter model is no longer acceptable for use in DOE facilities, pending requalification.

6.1.2 **Qualification Testing:** Qualification tests of filter components shall be conducted in accordance with requirements of ASME AG-1, FC-5000 or FK-5000. Filters selected for qualification testing may be prototypes of the proposed design or production filters of the specific design randomly selected from the manufacturer's stock as long as they have been manufactured using the same method, material, equipment and processes as will be used during regular production. The number of filter units required for qualification testing shall be as specified in ASME AG-1.

6.1.3 **Production Testing:** The manufacturer shall perform production tests for each filter manufactured in accordance with Section 5.0. The results of the penetration and resistance tests shall be documented and identified by serial number for each individual filter unit.

6.1.4 **HEPA Filter Labeling:** HEPA filters and shipping containers shall be labeled as specified in ASME AG-1, FC-9000. In addition, the label shall include the date of the tests and the effective filter media area.

6.2 DOE Quality Assurance Testing, Inspection and Labeling:

6.2.1 **Quality Assurance Inspection and Testing:** Those filters specified in Section 4 requiring a FTF Quality Assurance test shall be tested at a DOE designated FTF. Acceptance is contingent upon satisfactory completion of inspections and tests specified in DOE Standards. Filters will be inspected for physical damage to the packaging and filter, and for compliance with specification requirements which can be checked visually. Each filter shall be tested for penetration and resistance in accordance with the tests specified in Section 6.1.3. The penetration at each specified airflow and the resistance at

rated airflow shall be marked clearly and indelibly on the case of the filter unit tested. The FTF may advise the purchaser to request the manufacturer to supply evidence of compliance with qualifications tests and materials requirements of the specification. Failure to meet inspection, test, or verification requirements shall be cause for rejection of the filter(s). After the testing and inspection is completed, each filter will bear a FTF test label indicating acceptance or rejection.

7. PACKAGING, SHIPPING, AND STORAGE

- 7.1 **Packaging, Shipping and Storage:** Packaging, shipping, and storage shall be in accordance with ASME AG-1 and ASME NQA-1, Level B requirements. Filter containers shall be designed so that they can be opened and the filter removed without damage to the container or the filter and, that the container can be reused for shipment to alternate destinations. It is recommended that sturdy wooden crates with the lid/top secured with removable screws or lag bolts be used for packaging. When shipping small packages, Styrofoam "peanuts" or shredded material should not be used as this creates handling problems. Barrier and wrap materials shall be non-corrosive and shall not be otherwise harmful to packaged filters. Filters with gelatinous seals shall be packaged in a manner so as to prevent contact with or contamination of the gelatinous seal during transport or un-packaging.
- 7.2 **Preparation for Delivery:** The purchaser's shipping instructions shall specify that HEPA filter cartons be crated or placed on a pallet to minimize unit handling, particularly at public carrier interchange points. Plywood shall be securely fastened to the sides and top of the palletized filter cartons. Filters should not be stacked more than three (3) high. 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 shall be handled with care and properly orientated.
- 7.3 **Shipping:** HEPA filters to be tested by the DOE designated FTF shall be shipped to the address below, freight prepaid, as agreed to by the purchaser and the manufacturer.

Air Techniques International
Filter Test Facility
1708 Whitehead Road
Baltimore, Maryland 21207

- 7.4 **Reshipment:** Following satisfactory completion of inspections and tests specified in Section 6.2, the FTF shall repack the tested filters in a manner comparable to the received packaging, and forward them to the address specified by the purchaser

freight collect. Storage of the filters at the FTF shall be in accordance with ASME NQA-1, Level B requirements.

7.5 **Shipping Directly to the Site:** HEPA filters that are not required to be tested by the FTF shall be shipped directly to the address specified by the purchaser.

7.6 **Rejected Filters :**

7.6.1 **FTF Rejected Filters :** Rejected filters shall be disposed of by the FTF in accordance with written instructions on file as agreed to by the purchaser and manufacturer.

7.6.2 **Site Receipt Inspection Rejected Filters :** Rejected filters shall be disposed of by the purchaser in accordance with written instructions on file as agreed to by the purchaser and manufacturer.

CONCLUDING MATERIAL

Review Activity:

HQ Offices

NA

EE

EH

EM

ME

NE

SC

Field Offices

Albuquerque Service Center

Chicago Operations Office

Idaho Operations Office

Nevada Operations Office

Oakland Operations Office

Oak Ridge Operations Office

Office of River Protection

Rocky Flats Office

Richland Operations Office

Preparing Activity:

DOE-EH-31

Project Number:

44600007

National Laboratories

Brookhaven National Laboratory

Los Alamos National Laboratory

Lawrence Livermore National Laboratory

Oak Ridge National Laboratory

Sandia National Laboratory

Savannah River National Laboratory