

INSTRUCTIONS FOR USE OF HPS-151-M  
STANDARD SPECIFICATION FOR HIGH  
EFFICIENCY PARTICULATE AIR FILTERS

1. This specification covers four types of high efficiency particulate air filters: (1) Type "A" fire-resistant and moisture-resistant, (2) Type "B" HF (hydrogen fluoride fume-air mixture) resistive, (3) Type "C" fire-resistant and moisture-resistant and chemical-resistant, and (4) Type "D" fire-resistant and moisture-resistant and high temperature applications. Only a small number of Type "B" HF resistive filters are presently used in hood and laboratory service. The materials normally used in Type "A" filters are satisfactory for use in many chemical fume applications other than HF. The Type "C" or "D" filters are used in mildly corrosive exhaust systems.
2. Each purchase requisition must contain the following information:
  - a. Size and type of filter required.
  - b. Filter frame material selection.
    - (1) May be wood or metal.
    - (2) Shall be wood.
    - (3) Shall be metal.
      - (a) When applicable indicate type of material selected (Stainless, Zinc-coated, or Chromium-Clad).
  - c. Selected Filter Assembly Separator Option
    - (1) May be furnished with or without separators
    - (2) Shall be furnished with separators
    - (3) Shall be furnished without separators, with a minimum initial flow rate and/or pressure drop limit other than values specified in paragraphs 1.2 and 4.2.b (1).
  - d. Specify gasket requirements, if other than those noted in paragraph 4.4.
3. The following paragraph should be included in filter purchase requisitions for use by Purchasing:

ACCEPTANCE

Filters will not be accepted by the Buyer until the Buyer has tested and inspected each filter for conformance to this specification. Filters that do not meet the Buyer's independent test will be either returned to the Seller or his consignee at the Seller's expense, or disposed of per Seller's and Buyer's agreement. Unacceptable filters will be tagged by the Buyer with a "REJECT" slip noting the reason for the rejection. The Seller shall provide replacement filters until the stipulated quantity of filters has been found acceptable in the Buyer's tests. The Buyer will accept any filter which successfully passes the tests outlined in Sections 6.0 of Specification HPS-151-M Standard Specification for HIGH EFFICIENCY PARTICULATE AIR FILTERS.

DESCRIPTION OF REVISION		<b>HANFORD PLANT STANDARDS</b>		NUMBER
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APPROVED	ERDA			1
<i>R. G. Jagot</i>				

4. All fire resistant type filters, as noted in Item 1 above, shall meet the requirements of the "Heated Air Test" as stated in UL 586 unless otherwise specified.
5. ALL HIGH EFFICIENCY FILTERS USED AT HANFORD ARE TESTED AT THE ERDA QUALITY ASSURANCE TESTING STATION, BUILDING 747. Details of this testing service are described in the AEC\* Accident and Fire Prevention Bulletin No. 114, dated June 17, 1965. Information can be obtained from Environmental Health Sciences, Hanford Environmental Health Foundation, Building 747, 700 Area.
6. Orders for small lots of filters (a dozen or less) will not require a sample filter from the lot for destructive testing, unless otherwise specified. The destructive testing will be performed by the Buyer. It shall be standard practice to call for one filter for a lot up to 50 filters, and second sample filter for the next lot up to 50 filters, etc.
7. The 24" x 24" x 5-7/8" (500 cfm) size is no longer listed as a standard size for new construction. But it is still recognized as a replacement filter for existing installations requiring this size. The purchase order (Invitation for Bids) should reference HPS-151-M and state the exception that the size shall be as indicated on the purchase order.
8. The Sellers are normally not set up to run the tests indicated in Section 5.3.b of the specification. Care should be exercised in requesting the Seller to have this test run by an independent laboratory.
9. The Filter Quality Assurance Station at Richland, Washington, recommends that shipping instructions in the Purchase Order specify palletizing the filters to reduce intransit damage causing rejections for puncture and dropping damage.

\*The referenced document shall be used with the understanding that the words "...The Atomic Energy Commission," "...The Commission," or "...The AEC" shall be interpreted to mean "...The Energy Research and Development Administration," "...The Administration," or "...The ERDA" respectively.

HPS-151-M

STANDARD SPECIFICATION

FOR

HIGH EFFICIENCY PARTICULATE AIR FILTERS

This Specification consists  
of 10 pages.

DESCRIPTION OF REVISION General Revisions Change Title		<b>HANFORD PLANT STANDARDS</b> ERDA - RICHLAND, WASHINGTON	NUMBER
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STANDARD SPECIFICATION FOR  
HIGH EFFICIENCY PARTICULATE AIR FILTERS

1.0 SCOPE

This specification covers the requirements for four types and four sizes of high efficiency particulate air filters, assembled with or without separators and gaskets.

1.1 TYPES

- Type "A" Fire Resistant and Moisture Resistant
- Type "B" Hydrogen Fluoride Fume (HF) Resistant
- Type "C" Fire Resistant and Moisture Resistant and Chemical Resistant
- Type "D" Fire Resistant and Moisture Resistant, High Temperature and High Humidity

1.2 SIZES

The sizes of standard air filters are as follows:

<u>Outside Frame Dimensions*-Inches</u>	<u>Minimum Initial Rated Flow - CFM**</u>
8" x 8" x 3-1/16"	25
8" x 8" x 5-7/8"	50
12" x 12" x 5-7/8"	125
24" x 24" x 11-1/2"	1000
24" x 24" x 11-1/2" (Separatorless)	1400

\* Exclusive of gasket

\*\* At the pressure drop limits set forth under paragraph 5.1

1.3 OPERATING CONDITIONS

- (a) Normal operating conditions for Type "A", "B" or "C" filters are defined as air at 70 to 120 F temperature with a relative humidity from 40 to 90 percent, unless otherwise specified.
- (b) Operating conditions for Type "D" filters are defined as up to 250° F continuous duty or 100% relative humidity with free water in the form of mists or droplets.

2.0 REFERENCE STANDARDS AND SPECIFICATIONS

The standards and specifications designated below are a part of this Standard Specification to the extent specified herein.

2.1 AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

- a) ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- b) ASTM A263 Standard Specification for Corrosion-Resisting Chromium Steel Clad Plate, Sheet, and Strip

- c) ASTM A527 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality
  - d) ASTM D903 Tests for Peel or Stripping Strength of Adhesive Bonds
  - e) ASTM D1056 Specification for Sponge and Expanded Cellular Rubber Products
  - f) ASTM E84 Test for Surface Burning Characteristics of Building Materials (cross reference ANSI A2.5)
- 2.2 UNDERWRITERS' LABORATORIES, INC. (UL)
- a) UL-586 High Efficiency, Particulate, Air Filter-Units
  - b) UL-723 Tests for Surface Burning Characteristics of Building Materials
- 2.3 U.S. DEPARTMENT OF COMMERCE STANDARDS
- a) PS 1 Softwood Plywood, Construction and Industrial
  - b) CS 236 Mat-Formed Wood Particleboard
- 2.4 U.S. DEPARTMENT OF DEFENSE
- a) DLD 76-2-639 Instruction Manual for the Installation, Operation, and Maintenance of Penetrometer, Filter Testing, (Edgewood Arsenal) DOP, Q107 No. 136-300-175A.
  - b) DLB 125-8-1 Water Repellency Indicator, Q101 (Edgewood Arsenal)
- 3.0 MATERIALS
- 3.1 FILTER FRAMES
- a) Wood filter frames may be provided for Type "A", "B", or "C" filters when specified in the purchase requisition.
    - (1) Wood filter frames shall be constructed of either of the materials specified below.
      - (a) Group 1 plywood, 5 ply, exterior type, A-B Grade, sanded two sides to 3/4 inch thickness in accordance with the requirements of PS 1.
      - (b) Mat-formed wood particleboard, Type 2, Grade B, Class 2 for exterior service, having a minimum density of 45 pounds per cubic foot, in accordance with the requirements of CS 236, and filled on both faces.

- (2) The plywood shall be impregnated by a pressure process to reduce combustibility of both faces to a flame spread classification rating of 25 or less, in accordance with the test method for fire hazard classification of building materials of UL 723.
  - (3) The particleboard shall have the chips batch-treated for fire retardance before they are placed in the mix.
- b) Metal filter frames may be provided for Type "A", "C" or "D" filters when specified in the purchase requisition.
- (1) Metal filter frames for Type "A" and "D" filters shall have a 16 gauge minimum wall thickness and shall be corrosion resistant in a moist environment. The filter frame material may be any of those specified below unless otherwise noted in the purchase requisition.
    - (a) Stainless steel sheet in accordance with ASTM A167, or equivalent.
    - (b) Zinc-coated (galvanized) carbon steel sheet in accordance with ASTM A527, coating designation G60, or equivalent.
    - (c) Chromium-clad (chromized) carbon steel with cladding on both sides of the sheet metal, in accordance with ASTM A263, or equivalent.
  - (2) Metal filter frames for Type "C" filters shall be any 300 series stainless steel with a 16 gauge minimum wall thickness when stainless steel is specified.

### 3.2 FILTER MEDIUM

- a) Filter medium for Type "A", "C" and "D" filters shall be a glass-fiber paper, a glass-asbestos paper, or any other inorganic-fiber paper with a maximum of 5% combustible matter.
- b) Filter medium for Type "B" filter shall be non-combustible and capable of handling HF fumes without damage.
- c) For all types, water shall not penetrate the filter medium under a head of no less than 10 inches of water when tested for water repellancy in accordance with DLB 125-8-1, Water Repellancy Indicator, Q101.

### 3.3 SEPARATORS

When filters are specified to be assembled with separators, the separators shall comply with the following requirements.

- a) All separator material shall be capable of withstanding continuous service at normal operating conditions (subsection 1.3 of this specification) without swelling, sagging, melting, or distortion.
- b) All separator material shall be noncombustible.
- c) Separator material for Type "A" filters shall be aluminum or aluminum alloy.
- d) Separator material for Type "B" filters shall be nonmetallic and at least as resistive to hydrogen fluoride fume attack as the fiber medium used in Type "B" filters.
- e) Separator material for Type "C" and "D" filters shall be nonmetallic.

#### 3.4 ADHESIVES

- a) The adhesive used to seal the filter pack to the frame shall, after curing, be water resistant, and when exposed to 200 F for eight hours shall not show evidence of hardening, cracking, "alligatoring," or other visible damage. If capable of ignition under exposure to flame, the adhesive shall be self-extinguishing when the flame is removed. The adhesive shall be compatible with the intended service, the filter media and the frame.
- b) The adhesive used to fasten the gasket to the frame shall be a rubber-base adhesive compatible with the gasket material. When the adhesive is cured, the gasket shall be firmly attached to the frame. It shall have a peeling strength of at least sixteen pounds per inch of width when tested in accordance with ASTM D903.
- c) The adhesive used in splicing two pieces of filter media together shall be compatible with the media and the specified service conditions of the filter.
- d) The adhesive used in the filter frame joints shall be moisture and heat resistant and shall provide bonding strength and impermeability to air flow equal to that provided by the adhesive used to fasten the filter media to the frame, and shall satisfy the frame integrity requirements of Sections 5.2 and 6.2 of this specification.

#### 3.5 GASKETS

When filters are specified to be assembled with gaskets, the gasket material shall be ozone resistant, closed-cell rubber, or rubber-like material conforming to ASTM D1056, Grade SCE 43. Compression deflection, 25 percent deflection, (limits) psi, shall be  $11 \pm 2$ . Both faces of gasket shall be cut surfaces (without natural skin).

### 3.6 AUXILIARIES

The use of 4 x 4 mesh wire cloth with a 70 percent minimum open area, for backing braces (face guards), is required on both sides of the 24" x 24" x 11-1/2" size (1000 cfm) Types "A", "C" and "D" filters. The wire cloth shall not extend beyond the face of the filter frame (less gaskets). The wire cloth material shall be any 300 Series stainless steel or galvanized steel (after weaving). Wire cloth (or backing braces) shall not be provided for Type "B" filters.

### 4.0 FABRICATION

#### 4.1 GENERAL

The filters shall be carefully assembled and shall be free from obvious flaws and imperfections that can be detected by simple visual examination. Minor imperfections such as scratches and nicks in the frame shall be acceptable provided:

- a) that such minor imperfections shall not abridge the functional performance of the filter;
- b) that minor imperfections are random in type in any lot of filters. Consistent imperfections from filter to filter, exceeding 20% of the filters indicating lack of quality control, shall be cause for rejection of the entire lot.

#### 4.2 FILTER FRAMES

##### a) Wood Filter Frames

- (1) Filter frames shall be assembled with Grade A side of the plywood surface on the inside (next to the media).
- (2) Frame joints shall be rabbeted, glued, double nailed with coated nails and shall be impermeable to air when a pressure equal to 10" W.G. is imposed across the filter media.
- (3) The entire gasket surface of the assembled frame shall be flat within 1/16" and free of spinters, lamination separations, and voids.

##### b) Metal Filter Frames

- (1) Frame joints shall be sealed to prevent particulate leakage at rated air flow or when a pressure equal to 10" W.G. is imposed across the filter media.
- (2) The entire gasket surface of the assembled frame shall be flat within 1/16".

- (3) The assembled filter frame shall be free of indentations greater than 1/16" deep due to external forces imposed on the filter assembly.
- c) Outside dimensions of frame shall be within  $\pm 1/16$ " of the nominal dimensions.
- d) Assembled frames shall be square and within  $\pm 1/8$ " between diagonal measurements.

#### 4.3 FILTER PACK

- a) Filter assemblies with a filter pack that utilizes separators shall comply with the following fabrication requirements.
  - (1) The filter medium shall not extend beyond the exposed ends of the separators.
  - (2) The separators shall not extend beyond the ends of the frame.
  - (3) There shall be no kinked separators or filter medium.
  - (4) The filter pack shall be rigid within the frame and the separators shall be perpendicular to the frame (centerline).
  - (5) Separators shall not vary more than 1/4" from a straight line connecting the fixed ends and abrupt deviations will not be acceptable.
- b) The entire inside surface of the frame shall be coated with the adhesive before the filter pack is installed. The pack shall be firmly bonded to the frame at all contact surfaces.
- c) The filter medium shall have no holes, cracks, splits, or other harmful imperfections. Patching of the medium is not permitted. Only one splice per filter is permitted and the splice shall not be located on a fold (see Subsection 3.4 of this specification). Splice must have 1-1/2 inch minimum overlap, and adhesive applied.

#### 4.4 GASKETS

Unless otherwise specified, filter gaskets shall conform to the following requirements.

- a) One end (the downstream end) of the Type "A" filter shall be fitted with a smooth, continuous gasket 1/4" thick by 5/8" wide.
- b) Both ends of the Type "B" filter shall be fitted with a smooth, continuous gasket 1/4" thick by 5/8" wide.

- c) Both ends of the Type "C" and "D" filter shall be fitted with a smooth continuous gasket 1/4" thick by 5/8" wide.
- d) On all types, the gaskets shall be sealed to the filter frame over the entire contact area.
- e) The edge of the gasket shall not project beyond the outside edge of the frame.
- f) If joints in gasket material occur, they shall be located at the filter frame corners and mating surfaces shall be cemented. Joints shall be notched or rabbeted in a manner that assures no air leakage as determined by test specified in subsection 6.2 of this specification. There shall be no more than four gasket joints per gasket.

## 5.0 FUNCTIONAL REQUIREMENTS

### 5.1 FILTER EFFICIENCY (PENETRATION) AND FLOW RESISTANCE

- a) All Type "A", "C" and "D" filters (in all sizes) shall have a minimum efficiency of 99.97% at rated flow; i.e., the penetration of 0.3 micron diameter, homogeneous particles of dioctyl phthalate (DOP) shall not exceed 0.03% as determined by test specified in subsection 6.1 of this specification. All Type "B" filters (in all sizes) shall have a minimum efficiency of 99.95% at rated flow; i.e., the penetration of 0.3 micron diameter, homogeneous particles of dioctyl phthalate (DOP) shall not exceed 0.05% as determined by test specified in subsection 6.1 of this specification.
- b) The initial pressure drop for Type "A", "C" and "D" filters (in all sizes) shall not exceed 1.0 inches w.g. at rated flow. (See subsection 1.2 of this specification.) The initial pressure drop for Type "B" filters (in all sizes) shall not exceed 1.20 inches of w.g. at rated flow. (See subsection 1.2 of this specification.)
- c) All Type "A", "C" and "D" filters, size 24" x 24" x 11-1/2" shall also have a minimum efficiency of 99.97% at 20% rated flow.
- d) All Type "B" filters size 24" x 24" x 11-1/2" shall also have a minimum efficiency of 99.95% at 20% of rated flow.

### 5.2 FIRE RESISTANCE

Type "A", "C" and "D" filters shall meet the "Heated Air Test" and the "Spot Flame Test" requirements of UL-586.

### 5.3 MOISTURE RESISTANCE

#### a) Static Moist Air Resistance

All Type "A", "C" and Type "D" filters shall meet the requirements of the "moist air test" of UL-586.

#### b) Dynamic Moist Air Resistance

All Type "A", "C" and "D" filters shall be capable of passing a minimum of 80% of rated flow of air at  $90 \pm 5\%$  relative humidity, 200 F, and pressure differential of 2.5 inches w.g. for two hours. Upon return to normal operating conditions (subsection 1.3 of this specification) there shall be no loss below the filtering efficiency specified in paragraph 5.1.a. of this specification, and the resistance to flow shall not have changed more than 10% from the initial value.

### 5.4 FILTER DIMENSIONAL CHANGES

No dimensional changes or distortion shall result from any nondestructive humidity, pressure or temperature tests required by this specification. The basis of dimensional comparison shall be the original size of the filter (before any tests) and the filter size when the filter has returned to ambient conditions.

### 6.0 TEST REQUIREMENTS

#### 6.1 FILTER EFFICIENCY (PENETRATION) AND FLOW RESISTANCE TEST

Penetration and pressure drop of each completed filter (all types in all sizes), as determined by the efficiency test methods specified in DLD 76-2-639, Instruction Manual Q107 No. 136-300-175A, shall not exceed the limits established in paragraphs 5.1.a. or b. of this specification. In addition, all Types in size 24" x 24" x 11-1/2" shall meet the requirements of paragraphs 5.1.c. and 5.1.d. of this specification.

#### 6.2 FILTER FRAME INTEGRITY TEST

In conjunction with the penetration test of subsection 6.1 of this specification, each completed filter (size 24" x 24" x 11-1/2") shall be subjected to DOP particles at the rated flow of the filter in the manner specified in DLD 76-2-639, Instruction Manual Q107 No. 136-300-175A. The overall penetration of the filter unit (frame, frame joints, gaskets, and media) shall not exceed the penetration allowed in paragraphs 5.1.a. thru 5.1.d. of this specification.

#### 6.3 FIRE RESISTANCE TEST

a) Each Type "A", "C" and Type "D" filter shall bear an authorized UL label.

- b) In lieu of UL label, and unless otherwise stated in the purchase order, the Seller shall test at least one representative filter in each group of 200 filters or less of the same type in accordance with UL-586.

#### 6.4 MOISTURE RESISTANCE TEST

Each Type "A", "C" and "D" filter shall bear an authorized UL label to satisfy the functional requirement 5.3.a. for moisture resistance (static moisture test). In lieu of UL label the Seller shall test at least one representative filter per lot of 50 or less of the same type of filter. The test shall be performed in accordance with the "moist air test" of UL-586.

#### 7.0 TEST CERTIFICATION

7.1 Test certification requirements are as follows:

- a) Fire resistance for Type "A", "C" and "D" per subsection 6.3 of this specification by an independent laboratory if filter does not carry UL Label.
- b) Static moist air test for Type "A", "C" and "D" per paragraph 6.4 of this specification by an independent laboratory if filter does not carry UL Label.

7.2 Copies of test certification shall be supplied to the Buyer at the time of shipment.

#### 8.0 BUYER INSPECTION AND TESTING

8.1 All material received by the Buyer's facility will be inspected and tested as shown below to verify that the requirements of this specification have been met.

- a) Independent tests will be performed for the Buyer as follows:
  - (1) Efficiency (penetration) and airflow resistance tests, including frame integrity, in accordance with subsections 6.1 and 6.2 of this specification.
  - (2) Visual check of each filter (Section 4.0 of this specification).
- b) Representative sample filters may be tested as follows:
  - (1) Dynamic moist air test on Type "A", "C" and "D" filters (paragraph 5.3.b of this specification).

(2) Dimensional check of the filter (subsection 4.2 of this specification).

(3) Adhesive tests (paragraph 3.4 of this specification).

#### 9.0 MARKING

9.1 Each completed filter shall be marked indelibly and legibly on top of the frame with the following information:

a) Manufacturer's name, Model No., and Serial No.

b) This specification No. (HPS-151-M).

c) Airflow direction designated by arrow and the words "Airflow Direction: in letters 1" high.

d) Type of filter, i.e., Type "A", Type "B", Type "C", or Type "D" with separators or without separators.

e) UL label per subsections 6.3 and 6.4 of this specification.

9.2 The shipping container shall be prominently marked "Fragile" and "This Side Up" and arrows to show filter placement in the container with the separators or the media pleats in the vertical position.

9.3 The shipping container shall be marked with the purchase order number and the type of filter.