



Approval Standard for Filters Used in Clean Room Facilities

Class Number 4920

June 2013

Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

Table of Contents

1. INTRODUCTION	1
1.1 Purpose.....	1
1.2 Scope.....	1
1.3 Basis for Requirements	1
1.4 Basis for Approval	1
1.5 Basis for Continued Approval	2
1.6 Effective Date	2
1.7 System of Units.....	2
1.8 Applicable Documents.....	2
1.9 Definitions	2
1.10 References.....	3
2. GENERAL INFORMATION.....	3
2.1 Product Information.....	3
2.2 Approval Application Requirements	3
2.3 Requirements for Samples for Examination	4
3. GENERAL REQUIREMENTS.....	4
3.1 Review of Documentation	4
3.2 Physical or Structural Features	4
3.3 Markings	5
3.4 Manufacturer's Installation and Operation Instructions	5
3.5 Calibration	5
3.6 Test Sample Production	5
4. PERFORMANCE REQUIREMENTS.....	6
4.1 Fire Exposure (for horizontal, vertical, wall filters or prefilters).....	6
5. OPERATIONS REQUIREMENTS	7
5.1 Demonstrated Quality Control Program	7
5.2 Surveillance Audit	8
5.3 Installation Inspections	8
5.4 Manufacturer's Responsibilities	8
APPENDIX A: UNITS OF MEASUREMENT	9
APPENDIX B: FM APPROVALS CERTIFICATION MARKS.....	10

1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval requirements for filter assemblies used in clean room facilities.
- 1.1.2 Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard applies to filters assemblies for use in clean room facilities. The filter assembly typically consists of frames, filter media, gaskets, sealing gel material and potting compounds.
- 1.2.2 This standard covers Approval of final stage wall filters, ceiling filters and prefiltration units.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing and/or the standards of other organizations. The advice of manufacturers, users, trade associations and loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of clean room filters and pre-filters for the purpose of obtaining FM Approval. Clean room filters and pre-filters having characteristics not anticipated by this standard may be FM Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, clean room filters and pre-filters which meet all of the requirements identified in this standard may not be FM Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for Approval

Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate
 - the suitability of the product;
 - the performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested and the marking procedures used to identify the product. These examinations may be repeated as part of FM Approvals' product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently FM Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval report;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Surveillanc Audits conducted as part of FM Approvals' product audit program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior written authorization by FM Approvals.

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval.

The effective date of this Standard is April 1, 2014.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10, "Standard for Use of the International System of Units (SI): The Modern Metric System."

1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard:

Test Procedure, Clean Room Materials Flammability Test Method for the Parallel Panel Test, Class 4910

FM Global Property Loss Prevention Data Sheet 1-56, Cleanrooms

1.9 Definitions

For purposes of this standard, the following terms apply:

Efficiency Value – the ratio of the number of particles captured by the filter to the number of the particles challenging the filter.

HEPA Filter – High Efficiency Particulate Air filter having an efficiency value 99.97% and able to remove airborne particles with a size of 0.3 microns or greater in size.

ULPA Filter – Ultra Low Penetration Air filter having an efficiency value of 99.9995% and able to remove airborne particles with a size of 0.12 microns or greater in size.

Pack Height- The height of the filter media housed in the filter frame

1.10 References

2. FM Global Research Division Technical Report #3036082, Development of a Fire Performance test for Clean Room Air Filters, FM Approvals Standard 4920.
3. FM Global Property Loss Prevention Data Sheet 1-56, "Cleanrooms"

2. GENERAL INFORMATION

2.1 Product Information

The clean room filter assemblies are typically constructed from pleated fiberglass or polytetrafluorethylene (PTFE) media and housed within a frame. The filter media is secured and sealed to the frame with an adhesive. The folded portion of the media is typically held in position at the apex of the fold maintaining the pleat spacing by adhesive. The finished filter assembly can be used in the clean room in either a horizontal (ceiling) or vertical (wall) position. In either position, the filter assembly is held in position using a grid system. The filter is sealed against the grid system with either a gasket or silicone gel material. The filters are supplied in a variety of pack heights and widths to fit the application and room size.

Pre-filters assemblies are used upstream of the finished clean room filters and are positioned within the duct work. Normally, there are two stages of pre-filtration. The first stages of pre-filters are constructed with a low cost filter media assembled in pressed cardboard. These filters are positioned at the intake of the air stream. The second stage pre-filters use a micro fiberglass media and is secured in a plastic box frame. The second stage filters are located downstream of the first stage filters.

2.2 Approval Application Requirements

To apply for an FM Approval examination, the manufacturer, or its authorized representative, should submit a request to

Materials- Director
FM Approvals
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
U.S.A.

The manufacturer shall provide the following preliminary information with any request for FM Approval consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration;
- complete set of assembly drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, spec. sheets, installation procedures
- the number and location of manufacturing facilities.
- all documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Following authorization of an FM Approval examination, the manufacturer shall submit samples for examination and testing based on the following:
 - 2.3.1.1 Sample requirements to be determined by FM Approvals following review of the customer's preliminary information.
 - 2.3.1.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.
 - 2.3.1.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the sole discretion of FM Approvals.
 - 2.3.1.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the filter assembly with a ceiling or wall grid system.
 - 2.3.1.5 For all filter assemblies, the manufacturer must supply details, or a method of securement, to the FM Approvals test configuration.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

- 3.1.1 During the initial investigation, and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The FM Approval investigation shall define the limits of the FM Approval.

3.2 Physical or Structural Features

- 3.2.1 The sides and ends of the filter media pack shall be secured to the filter frame in accordance with the manufacturer's written instructions.
- 3.2.2 Each filter assembly shall be supplied with its maximum filter pack media height.
- 3.2.3 A complete grid system with all the necessary gaskets or sealant gel materials shall be supplied for each filter type (style) being tested for FM Approval.
- 3.2.4 If the manufacturer is seeking FM Approval of a filter assembly that uses a sealant gel, the Material Safety Data Sheet (MSDS) must be submitted prior to shipping the product to FM Approvals.
- 3.2.5 Instructions for mixing the sealant gel, and required tooling to combine the ingredients of the sealant gel, must be submitted prior to assembling the material sample.

3.3 Markings

Marking on the product or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, size, rating, capacity, etc., as appropriate.
- Approval Mark of FM Approvals

3.4 Manufacturer's Installation and Operation Instructions

The manufacturer shall provide the user with:

- written instructions for the proper installation, maintenance and operation of the product;
- services to ensure proper installation, inspection or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection or maintenance.

3.5 Calibration

All examinations and tests performed in evaluation to this standard shall use calibrated measuring instruments traceable and certified to acceptable national standards.

3.6 Test Sample Production

All products submitted for testing shall be representative of production material. The need to monitor the manufacture of the test specimen shall be at the sole discretion of FM Approvals. Any decision to use data generated using prototypes is at the discretion of FM Approvals.

4. PERFORMANCE REQUIREMENTS

- tests of alternate constructions may be waived if considered less hazardous than those previously tested.
- confirming tests may be required, at the sole discretion of FM Approvals, depending on design features and results of any foregoing tests.
- following a test failure, a re-test of an identical or similar assembly shall be at the sole discretion of FM Approvals and with a technical justification of the conditions or reasons for the failure. When a test specimen fails to meet the Approval acceptance criteria for a given classification/rating, two successful test specimens of the same or similar construction must meet the Approval acceptance criteria to qualify for the given classification/rating.
- prior to testing, assemblies shall be permitted to cure for a maximum period of 28 days.

4.1 Fire Exposure (for horizontal, vertical, wall filters or prefilters)

4.1.1 Requirement

The test sample is a field installed horizontal, vertical (wall) filter or pre-filter assembly consisting of finished filter units placed in the FM Approvals vertical parallel panel test arrangement fixture. Four 4 ft. (1.2 m) high by 2 ft. (0.6 m) wide filter assemblies are secured to the fixture with the vertical surfaces facing each other spaced 1 ft. (0.3 m) apart. The parallel panels are subjected to a 57 BTU/s (60 kW) propane sand burner placed at the base of the panels. The filters will be tested with their maximum filter pack height and associated grid suspension (if applicable) system with gaskets or sealant gel (if appropriate).

4.1.2 Test/Verification

The fire exposure test is conducted to determine if the sample filters meet the acceptance conditions as stated in section 4.1.3. Testing of the filter assembly shall be in accordance with *FM Approvals Clean Room Materials Flammability Test Method for the Parallel Panel Test, Class 4910, FM Approvals, LLC*

4.1.3 Conditions of Acceptance of the Fire Exposure Test

- 1) The visual flame height shall not exceed 6 feet (1.83 m).
- 2) The heat release rate, measured 2 minutes after the burner is shut off is to be at or below 25% of the maximum heat release rate observed up to 10 seconds before the burner is shut down.
- 3) The cumulative smoke generated shall be less than or equal to 0.13 lb (60 g).
- 4) The smoke generation rate shall be less than or equal to 0.0005 lb/s (0.23 g/s).
- 5) The smoke generation rate at 12 minutes shall be less than or equal to 0.0002 lb/s (0.07 g/s).

5. OPERATIONS REQUIREMENTS

A quality assurance program is required to assure that subsequent filter assemblies produced by the manufacturer shall present the same quality and reliability as the specific filter assemblies examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests, and is documented in the FM Approval Report.
- Continued conformance to this standard is verified by the FM Approvals Surveillance Audit.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1 Demonstrated Quality Control Program

5.1.1 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.2 Documentation/Manual

There must be an authoritative collection of procedures/policies. It must provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system must require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.3 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.4 Drawing and Change Control

- the manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the FM Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation for production.
- the manufacturer shall assign an appropriate person or group to be responsible for, and require that, proposed changes to FM Approved or Listed products be reported to FM Approvals before implementation. The manufacturer shall notify FM Approvals of changes in the product or of persons responsible for keeping FM Approvals advised by means of FM Approvals' Form 797, FM Approved Product/Specification-Tested Revision Report or Address/Main Contact Change Report.

- records of all revisions to all FM Approved products shall be maintained.

5.2 Surveillance Audit

- 5.2.1 An audit of the manufacturing facility is part of the FM Approval investigation to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and FM Approved.
- 5.2.2 These audits shall be conducted periodically, but at least annually, by FM Approvals or its representatives.
- 5.2.3 FM Approved products or services shall be produced, or provided, at, or from, the location(s) audited by FM Approvals and as specified in the FM Approval Report. Manufacture of products bearing the FM Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of installation, and conformance to written installation and operating specifications. When more than one installation technique is used, one, or all, may be inspected at the sole discretion of FM Approvals.

5.4 Manufacturer's Responsibilities

The manufacturer shall notify FM Approvals of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

APPENDIX A: UNITS OF MEASUREMENT

LENGTH:	in. - "inches"; (mm - "millimeters") mm = in. x 25.4
AREA:	ft - "feet"; (m - "meters") m = ft x 0.3048 in ² - "square inches"; (mm ² - "square millimeters") mm ² = in ² x 6.4516 x 10 ²
MASS:	ft ² - "square feet"; (m ² - "square meters") m ² = ft ² x 0.0929 lb - "pounds"; (kg - "kilograms") kg = lb x 0.454
PRESSURE:	psi - "pounds per square inch"; (bar - "bar") kPa = psi x 6.895 bar - "bar"; (kPa - "kilopascals") bar = kPa x 0.01 bar = psi x 0.06895
HEAT:	Btu - "British thermal units"; (J - "joules") J = Btu x 1.0551 x 10 ³
HEAT RELEASE RATE:	Btu/min - "British thermal units per minute"; (kW - "kilowatts") kW = Btu/min x 0.0176
TEMPERATURE:	°F - "degrees Fahrenheit"; (°C - "degrees Celsius") °C = (°F - 32) x 0.556
LIQUID:	gal - "gallons"; (L - "liter") L = gal x 3.785 L - "liter"; (dm ³ - "cubic decimeters") L = dm ³
FLOW RATE:	gal/min - "gallon per minute"; (L/min - "liters per minute") L/min = gal/min x 3.785

APPENDIX B: FM APPROVALS CERTIFICATION MARKS

FM Approvals certifications marks are to be used only in conjunction with products or services that have been Approved by FM Approvals and in adherence with usage guidelines.



FM APPROVED mark:

Authorized by FM Approvals as a certification mark for any product that has been FM Approved. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.



Cast-On FM Approvals marks:

Where reproduction of the FM Approved mark described above is impossible because of production restrictions, use these modified versions of the FM Approved mark. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable.



FM Approved Mark with “C” only:

Authorized by FM Approvals as a certification mark for any product that has been evaluated by FM Approvals in accordance with Canadian codes and standards. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.



FM Approved mark with “C” and “US”:

Authorized by FM Approvals as a certification mark for any product that has been evaluated by FM Approvals in accordance with US and Canadian codes and standards. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.

FM Approvals Certification Marks

USAGE GUIDELINES

All FM Approvals certification marks are the sole property of FM Approvals LLC (“FM Approvals”) and are registered or the subject of applications for registration in the United States and many other countries. They are for use only according to these guidelines.

FM Approvals certification marks may be used only on FM Approved products and related product packaging, in advertising material, catalogs and news releases. Use of FM Approvals certification marks on such material is not a substitute for use of the complete FM Approvals certification mark on FM Approved products and/or product packaging.

No FM Approvals certification mark or aspect thereof may be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. This includes both design aspects (the FM Approvals “diamond,” etc.) and word aspects (“FM,” “Approved,” etc.). The use of any FM Approvals certification mark as a trademark is strictly prohibited.

The Approval Standard number or class number may not be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. For example, a company may not say “ABC Company’s 4100 Fire Door is FM Approved”; the proper terminology is, “ABC Company’s Fire Door is FM Approved per Approval Standard 4100.”

FM Approvals certification marks, except for the FM Approvals Quality System Registration mark, may not be used on business stationery/cards/signage because this could mischaracterize the relationship with FM Approvals. Additionally, these items should not reference any FM Approvals certification mark.

Products or services may not be marketed under any mark or name similar to “FM Global,” “FM Approvals” or any of the FM Approvals certification marks. Further, products or services may not be marketed to imply a relationship beyond the scope of any Approval made by FM Approvals.

When an FM Approvals certification mark is used in advertising material or on product packaging, all material must reflect the specific circumstances under which the product was FM Approved. The material must clearly differentiate between products that are FM Approved and those that are not, and may not, in any way, imply a more substantial relationship with FM Approvals.

A company may not reference the intent to submit a product for Approval or the expectation that a company will have a certain product FM Approved in the future. For example, a company may not state, “Approval by FM Approvals pending” or “Approval by FM Approvals applied for.”

FM Approvals certification marks should not be preceded or followed by a qualifier that indicates a degree of certification or acceptability. For example, “exceeds,” “first” or “only” may not be used to qualify any FM Approvals certification mark.

Only original artwork issued by FM Approvals should be used. The FM Approvals certification marks should not be altered in any way other than to resize the artwork proportionately. Unacceptable uses of the marks include, but are not limited to, adding/deleting wording or artwork, reducing the artwork to an illegible size, animation or distortion.

The text of the FM Approvals certification marks may not be translated into any language other than English.

FM Approvals certification marks must appear in a size and location that is readily identifiable, but less prominent than the name of the owner of the certification or the manufacturer/seller/distributor of the certified products.