



Member of the FM Global Group

Approval Standard for Pipe and Duct Insulation

Class Number 4924

January 2013

Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet 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.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval requirements for materials which may be used as insulation on the exterior of noncombustible pipes or ducts. If such a material is sufficiently combustible, it may cause a spreading fire along the route of the pipe or duct which it insulates. Mechanical piping systems such as those in heating, ventilating, air conditioning, or refrigeration sometimes need to be insulated for maximum operational efficiency. This standard sets the performance requirements to accurately assess the ability of a material to resist this fire.
- 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 sets the fire performance requirements for pipe and duct insulation including pre-insulated pipe and evaluates the potential for a horizontal spreading fire in parallel runs of insulated pipes or ducts within a pipe chase or plenum. To qualify for FM Approval as a product of low fire hazard, not requiring automatic sprinkler protection of itself, the insulation material must perform satisfactorily in all tests as outlined in this standard. This standard is not intended to address Approval of pre-insulated ducts, or Fume and Smoke Exhaust Ducts that have been Approved in accordance with Approval Standard 4922.
- 1.2.1.1 Pipe and duct insulation that meet the fire performance requirements of paragraph 1.2.1 above, and are categorized for use in pharmaceutical manufacturing and storage area, food preparation and storage areas and similar occupancies or other occupancies that are highly susceptible to smoke damage shall also meet the requirements as outlined in paragraph 4.5 (Duct Insulation) or paragraph 4.6 (Pipe Insulation) of this standard. Pipe and duct insulation in this category produce somewhat higher levels of smoke (when compared to those materials which are evaluated for cleanrooms) but produce less smoke than materials evaluated for fire performance only.
- 1.2.1.2 Pipe and duct insulation that meet the fire performance requirements of paragraph 1.2.1 above, and are intended for use in cleanroom occupancies shall also meet the requirements of FM 4910-Cleanroom Materials Flammability Test Protocol. This test protocol evaluates the materials' fire propagation behavior and potential for smoke contamination using two indices: Fire Propagation Index (FPI) and Smoke Development Index (SDI).
- 1.2.2 This standard is intended to evaluate only those hazards investigated, and is not intended to determine suitability for end use of a product.
- 1.2.3 The results of tests conducted under the controlled conditions required by this standard shall not be used to describe or appraise performance under actual fire conditions. Actual fire conditions may vary widely.

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 national and international organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of pipe and duct insulation for the purpose of becoming FM Approved. These requirements are intended primarily as guides, strict conformity is not always mandatory. Pipe and duct insulation 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, pipe and duct insulation 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 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' Facilities and Procedures Audit 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 Surveillance Audits conducted as part of FM Approvals' product follow-up program.

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

1.6 Effective Date

- 1.6.1 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 shall apply to the entire Approval Standard, or, where so indicated, only to specific paragraphs of the standard.
- 1.6.2 The effective date for this standard is January 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 BSR/IEEE/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, practices, books and technical papers were either used to develop this standard or are referenced in this standard:

ASTM E2058, Standard Test Methods for Measurement of Synthetic Polymer Material Flammability Using a Fire Propagation Apparatus (FPA).

ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

BSR/IEEE/ASTM SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System*.

Ditch, Benjamin. "Development of a Fire Performance Test for Pipe and Duct Insulation, Approval Standard Class Number 4924", FM Global Technical Report, Project ID 0003033423, May 2011.

International Standards Organization (ISO) 9705, International Standard, "Fire Tests-Full Scale Room Test for Surface Products".

International Standards Organization (ISO/IEC) 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories, International Standards Organization, Geneva, Switzerland, 2005 Edition.

FM Approvals Test Procedure Class Number 4924: FM Approvals Pipe Chase Test.

FM Approvals 4910-Cleanroom Materials Flammability Test Protocol.

FM Approvals 4922-Approval Standard for Fume Exhaust Ducts or Fume and Smoke Exhaust Ducts.

Tewarson, A. "Generation of Heat and Chemical Compounds in Fires," The SFPE Handbook of Fire Protections Engineering, 3rd Edition, Section 3 Chapter 4, pp. 3-82 to 3-161, 2002.

Test Procedure Uniform Building Code (UBC) Standard 26-3, Room Fire Test Standard for Interior of Foam Plastics.

1.9 Definitions

For purposes of this standard, the following terms apply:

Critical Heat Flux (CHF): the maximum heat flux at or below which there is no ignition.

Duct Insulation: thermal insulation applied to the exterior of non-combustible ducts that are used in heating, ventilation, and air conditioning (HVAC) systems.

Fire Propagation Index (FPI): ratio of the one-third power of the radiative fraction of the chemical heat release rate per unit width of a sample to the ignition resistance of the sample, defined as the Thermal Response Parameter (TRP). It is an indicator of the propensity of the material to support fire propagation.

FSP_c- convective flame spread parameter: $FSP_c = (Q_c/TRP \cdot A)$ where Q_c is the 5 second average peak convective heat release rate, TRP is the thermal response parameter determined from ignition tests per ASTM E2058, and A is the area of the combustion sample used to determine Q_c .

Pipe Insulation: thermal insulation applied to the exterior of non-combustible pipes

Pre-Insulated Pipe: Pre-insulated pipe systems normally include a carrier pipe, an outer jacket, and an insulation material between the pipe and jacket.

Smoke Development Index (SDI): Smoke Yield (y_s) multiplied by Fire Propagation Index (FPI). It is an indicator of the potential for smoke contamination during fire propagation.

Smoke Yield (y_s): ratio of the total mass of smoke released to the total mass of the material vaporized

Thermal Response Parameter (TRP): indicator of the ignition resistance or the thermal inertia of a material.

Thermocouple: A thermoelectric device used to make accurate measurements of temperatures, especially high temperatures.

Thermoplastic: polymer that becomes pliable or moldable above a specific temperature, and returns to a solid state upon cooling.

Thermosetting Polymer: also known as a thermoset, is a polymer material that irreversibly cures. The cure may be done through heat, through a chemical reaction or irradiation. Once hardened, a thermoset resin cannot be reheated and melted back to a liquid form.

2 GENERAL INFORMATION

2.1 Product Information

- 2.1.1 The requirements of this standard shall be used to measure and describe the performance of pipe and duct insulation in response to exposure from fire under controlled laboratory conditions. The results of these controlled exposures shall not be used to describe or appraise actual exposure conditions, since such conditions may vary widely. The Approval examination includes fire tests as noted. Inspection of the product manufacturing facility shall be conducted to assure conformance with the required tests and specifications.
- 2.1.2 Pipe and duct insulation comes in many forms including, but not limited to Flexible elastomeric foams (nitrile butadiene rubber [NBR] or ethylene propylene diene monomer (M-class) rubber [EPDM]), rigid foams (phenolic, polyurethane [PUR] or polyisocyanurate [PIR]), polyolefin foams, mineral wool and fiberglass. In addition these insulators may or may not be jacketed with metal foil and paper combinations or some other material. The type of jacket, if any, is dependent upon the specific application, the insulation manufacturer or both. In some cases pre-insulated pipe systems are used which normally include a carrier pipe, an outer jacket, and an insulation material between the pipe and jacket.
- 2.1.3 Testing of tubular pipe insulations will be conducted in accordance with FM Approvals Pipe Chase Test Procedure. Testing will be performed on the maximum insulation wall thickness, most critical facer (if applicable), maximum internal diameter and most critical system components (adhesives, tapes and accessories) at the density for which FM Approval is sought. Overall outside diameter shall not exceed 18 in. (457 mm). Upon successful completion Approval will be extended to include thinner wall thicknesses and smaller internal diameters at the same density tested.
- 2.1.3.1 For Approval of tubular pipe insulation exceeding an overall outside diameter of 18 in. (457 mm) the following is required:
- successful completion of testing as described in 2.1.3 above for tubular pipe insulation having less than overall outside diameter of 18 in (457 mm) and
 - successful completion of testing as a flat sheet as described in 2.1.4 below.
- 2.1.4 Testing of flat sheet insulations will be conducted in accordance with UBC Standard No. 26-3 or ISO 9705 room test. Testing will be performed on the maximum insulation wall thickness, most critical facer (if applicable) and most critical system components (adhesives, tapes and accessories) at the density for which FM Approval is sought. Upon successful completion Approval will be extended to include thinner wall thicknesses at the same density tested.

2.2 Approval Application Requirements

To apply for an 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 Approval consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration;
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, brochures, sales literature, specification sheets and installation; and
- 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 Approval examination, the manufacturer shall submit samples for examination and testing based on the following:
- sample requirements will be determined by FM Approvals following review of the preliminary information;
 - a representative of FM Approvals shall inspect the manufacturing facility for, witness the production of, and place their mark on, each sample pipe or duct insulation to be evaluated.
- 2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.
- 2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the sole discretion of FM Approvals.
- 2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures or special tools, such as those which may be required to evaluate the products for Approval.

2.4 Recognition

Pipe and duct insulation meeting the requirements of this standard shall receive a listing in the Approval Guide, *an online resource of* FM Approvals.

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 Approval investigation shall define the limits of the Approval.

3.2 Markings

- 3.2.1 Marking on 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, model type, size and/or product trade name as appropriate.

- 3.2.2 The model or type identification shall correspond with the Approval Guide, manufacturer's catalog designation and shall uniquely identify the product as FM Approved. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

- 3.2.3 The Approval Mark (see Appendix B) must be displayed visibly and permanently on the product and may also be displayed on the packaging. The manufacturer shall not use this Mark on any other product unless such product is covered by a separate FM Approvals Approval Report. Each section of insulation shall carry permanently the FM Approval symbol. One (1) FM Approval symbol is required for sections less than or equal to 6.5 ft (2.0 m). For sections longer than 6.5 ft (2.0 m) these symbols must be placed at intervals of not more than 6.5 ft (2.0 m). Insulation supplied as flat sheets and field shaped shall carry the FM Approval symbol at the intervals stated above and placed not less than 1-1/2 in. (40 mm) from the edge of the sheet.

- 3.2.4 All markings shall be legible and durable.

3.3 Manufacturer's Installation Instructions

The manufacturer shall provide the user with:

- printed instructions for the installation, maintenance, and operation of the product;
- facilities for repair of the product and supply replacement parts; and
- 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.

3.4 Calibration

All examinations and tests performed in evaluation to this Standard shall use calibrated measuring instruments traceable and certified to ISO/IEC 17025:2005 or other acceptable national standards.

3.5 Observation of Test Sample Production

A representative of FM Approvals shall inspect the manufacturing facility, witness the production of, and place an identification mark on, each pipe and duct insulation product to be evaluated.

3.6 Formulation Changes

- 3.6.1 Approval of formulation changes involving a single major ingredient (polymeric ingredients, flame retardant, fillers, plastisizers, blowing agents, etc.) of a previously FM Approved pipe or duct insulation shall be based on a favorable comparison of the flammability characterization of the component produced from the modified formulation with the flammability characterization of the originally Approved component.
- 3.6.2 Approval of formulation changes involving more than one major ingredient or a single major ingredient where flammability characterization of the modified formulation and previously Approved components do not compare favorably shall be based on all the requirements of this standard.

4 PERFORMANCE REQUIREMENTS

In order to qualify for Approval, the candidate product shall satisfy the following test requirements as described in paragraphs 4.1 thru 4.5 below. An optional smoke-sensitive occupancy rating may be attained as described in paragraphs 4.6 and 4.7 below.

4.1 Room Test

4.1.1 Requirement:

Duct insulation (sheets) covered by this standard shall be subjected to a: 1) UBC Standard No. 26-3 or ISO 9705¹ room test. When tested in accordance with UBC Standard No. 26-3, the sheet insulation shall: 1) be installed on the walls only; 2) not burn on the floor of the test enclosure for more than 10 seconds and 3) meet the conditions of acceptance of UBC Standard No. 26-3. When conducted in accordance with ISO 9705, the sheet insulation shall 1) be installed on the walls only; 2) not generate an instantaneous total heat flux greater than 106 BTU/ft²/min (20 kW/m²) as measured on a heat flux gage located on the center of the floor; 3) not burn on the floor of the test enclosure for more than 10 seconds and 4) not support a self-propagating fire which extends to the outer extremities of the test area or exit the enclosure door within the 20 minute test.

4.1.1.1 For both UBC Standard No. 26-3 and ISO 9705 the extent of flame spread along the insulation is assessed as a:

- 0.25 in. (6.4 mm) char depth for Thermosetting Polymer material measured at least 1 ft (0.3 m) below the enclosure ceiling. For products with a thickness of less than 0.25 in. (6.4 mm), the char depth must be less than the material thickness.
- 0.50 in. (13 mm) melt depth for Thermoplastic material measured at least 1 ft (0.3 m) below the enclosure ceiling. For products with a thickness of less than 0.50 in. (13 mm), the melt depth must be less than the material thickness.

Note 1: If testing is conducted in accordance with ISO 9705 Room test an optional smoke-sensitive occupancy rating may also be attained. (See paragraph 4.6)

4.1.2 Test/Verification

Test Procedure Uniform Building Code (UBC) Standard 26-3, Room Fire Test Standard for Interior of Foam Plastics or International Standards Organization (ISO) 9705, International Standard, "Fire Tests-Full Scale Room Test for Surface Products".

4.2 Pipe Chase Test

4.2.1 Requirement:

Pipe insulation (tubes) and pre-insulated pipe covered by this standard shall be subjected to a: 1) Test Procedure Class Number 4924: FM Approvals Pipe Chase Test. When tested in accordance with Test Procedure Class Number 4924, the tube insulation shall (1) not support a self-propagating fire to the end of the 24 ft (7.3 m) horizontal segment of the insulated pipe within 10 minutes of ignition. This can be qualitatively assessed from visual observation during the fire test or as a ¼ in. (6.35 mm) char depth measured for at least 30% of the insulations outer diameter; (2) not exceed a temperature of 572°F (300°C) as measured by the thermocouple located along the centerline of the pipe chase, 0.5 in (13 mm) below the ceiling and adjacent to the open end of the Pipe Chase (TC 5); and (3) be considered acceptable if all flaming and glowing material, that has fallen from the horizontal segment of the test pipes during the 10 minute fire exposure, has extinguished within 10 seconds of hitting the floor.

Test/Verification:

Test Procedure Class Number 4924: FM Approvals Pipe Chase Test

4.3 Surface Burning Characteristics of Pipe and Duct Insulation

4.3.1 Requirement:

For pipe and duct insulation, the flame spread and smoke developed shall be reported for the bare insulating core at a thickness of 4 in. (100 mm) or the maximum insulating core thickness, whichever is less. A minimum of 3 tests shall be conducted².

Test/Verification:

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

Note 2: These tests are optional and conducted to satisfy building code requirements or for identification purposes. FM Approvals place no limits on the values obtained

4.4 Density of Insulating Core

4.4.1 Requirement:

For pipe and duct insulation, the density of the un-faced insulation shall be determined and reported³.

Test/Verification:

ASTM C167, Standard Test Methods for Thickness and Density of Blanket or Preformed Block or Broad-Type Thermal Insulation or ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.

Note 3: These tests are conducted for identification purposes including confirmation of test sample product density. FM Approvals place no limits on the values obtained

4.5 Flammability Characterization

4.5.1 Requirement:

For plastic or other combustible components of pipe and duct insulation covered by this standard, the chemical heat of combustion, kJ/g (ΔH_{ch}), critical heat flux for ignition, kW/m² (q''_c), thermal

response parameter, $\text{kW/m}^2\text{s}^{-1/2}$ (TRP) and convective flame spread parameter, $\text{s}^{-1/2}$ (FSPc) shall be determined⁴.

Note 4: These tests are conducted to establish a base from which requests for formulation revisions are evaluated. With respect to this Standard FM Approvals place no limits on the values obtained.

4.5.2 Test/Verification

Flammability Characterization using an FM Approvals Fire Propagation Apparatus per ASTM E2058.

4.6 Optional Smoke-Sensitive Occupancy Rating (Duct Insulation)

4.6.1 Requirement:

Duct insulation (sheets) covered by this standard which are categorized for use in pharmaceutical manufacturing and storage areas, food preparation and storage areas and similar occupancies or other occupancies which are susceptible to smoke damage shall (1) meet the Approval requirement as outlined in paragraphs 4.1, 4.3, 4.4 & 4.5 and (2)⁵ not generate smoke in excess of 575 g (1.30 lb) during the 20 minute exposure fire plus an additional 2 minutes.

Note 5: Smoke generation rates as measured during ISO 9705 Room test.

4.6.2 Test/Verification:

Instrumentation installed to quantify the smoke generation rate in the gas flow exiting the apparatus during the International Standards Organization (ISO) 9705, International Standard, "Fire Tests-Full Scale Room Test for Surface Products".

4.7 Optional Smoke-Sensitive Occupancy Rating (Pipe Insulation)

4.7.1 Requirement:

Pipe insulation (tubes) covered by this standard which are categorized for use in pharmaceutical manufacturing and storage areas, food preparation and storage areas and similar occupancies or other occupancies which are susceptible to smoke damage shall (1) meet the Approval requirement as outlined in paragraphs 4.2, 4.3, 4.4 & 4.5 and (2) not generate smoke in excess of 110 g (0.24 lb) during the 10 minute exposure fire plus an additional 2 minutes.

4.7.2 Test/Verification:

Instrumentation installed to quantify the smoke generation rate in the gas flow exiting the apparatus during the FM Approvals Pipe Chase Test.

5 OPERATIONS REQUIREMENTS

A quality assurance program is required to assure that subsequent pipe and duct insulation produced by the manufacturer shall present the same quality and reliability as the specific samples 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 Approval Report.
- Continued conformance to this Standard is verified by the 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 should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should 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 FM Approved products or to critical documents, identified in the 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 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 Program

- 5.2.1 An audit of the manufacturing facility is part of the 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 surveillance 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 Approval Report. Manufacture of products bearing the Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 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 ft - "feet"; (m - "meters") m = ft x 0.3048
AREA:	in ² - "square inches"; (mm ² - "square millimeters") mm ² = in ² x 6.4516 x 10 ² ft ² - "square feet"; (m ² - "square meters") m ² = ft ² x 0.0929
MASS:	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 VOLUME:	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
FORCE:	lbf - "pound force" (N - "newton") N = lbf x 4.448

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.

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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.”

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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.