



# **Approval Standard for Ignitable Liquid Drainage Floor Assemblies**

**Class Number 6090**

**May 2017**

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# 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 ignitable liquid drainage floor assemblies. Ignitable liquid drainage floor assemblies are one component of an ignitable liquid drainage system where the intended purpose of the overall system is to collect, direct and transfer any ignitable liquid that has been spilled into a specific area or areas where it can be pumped to a remote storage location. Such a system must be capable of functioning whether or not the liquid has ignited.
- 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 Surveillance Audits.

## 1.2 Scope

- 1.2.1 This standard applies to flooring assemblies that are part of an overall drainage system designed to prevent or minimize the consequences of an ignitable liquid pool fire or hazardous liquid spill in commercial and/or industrial applications.
- 1.2.2 The purpose of a the system is to minimize the spill area and reduce the overall fire size until the flow of liquid is stopped or fire fighting measured can be initiated. This is generally accomplished by removing and transporting the ignitable liquid to a remote location.
- 1.2.3 The purpose of this standard is to:
- determine the maximum spill flow rate that the floor assembly can handle;
  - ensure that the floor assembly is leak proof;
  - that the floor assembly will function whether or not the liquid has been ignited, and;
  - that the floor assembly can withstand the anticipated dead and live loads to which it will be subjected.
- 1.2.4 The test methods, criteria and products evaluated in this standard shall not be used to provide the following:
- The type, amount or class of ignitable liquids that can be used with or stored in the area that the drainage system will service;
  - Proper storage guidelines, storage arrangements or ignitable liquid container types, sizes and quantities of ignitable liquids being used;
  - The proper type or level of automatic sprinkler protection or other protection systems required for the amount of ignitable liquids present;
  - The design, quantity, type, size, location or reliability of the ancillary devices used to form the entire system for the complete detection and evacuation of the ignitable liquids to a remote holding area;
  - The size, shape, construction, location and protection systems, if any, required to provide a safe and secure remote holding area for the liquid that has been evacuated from the spill or fire area;
  - The installation, physical arrangement or recommended maintenance of the ancillary devices provided with the product being Approved.

### 1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing. The advice of manufacturers, scientists 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 ignitable liquid drainage floor assemblies for the purpose of obtaining Approval. Ignitable liquid drainage floor assemblies 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, ignitable liquid drainage floor assemblies 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 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

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 the date of issue for compliance with all requirements.

## 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 10-2010, American National Standard for Metric Practice.

## 1.8 Applicable Documents

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

### FM Approvals Test Procedures

Drainage Flow Rate Test Procedure

Survivability Test Procedure

### FM Global Property Loss Prevention Data Sheets

7-29, Ignitable Liquid Storage in Portable Containers

7-32, Ignitable Liquid Operations

### Department of Transportation (DOT)

Title 49, Code of Federal Regulations, Parts 100 through 199IBC

## 1.9 Definitions

For purposes of this standard, the following terms apply:

**Ancillary Devices** – devices that are not part of the floor assembly but are needed to have a complete system. This includes, but is not limited to items such as detection devices, pumps, hoses, piping, fittings, control valves and control stations.

**Drainage System** – the complete assembly of devices and components which in their entirety, make up the system that detects and transports the ignitable liquids to the remote holding area. The system may be comprised of, but not limited to a floor assembly, liquid detection devices, pumps for removing the liquid, piping for conveying the pumped liquid, control valves and control station.

**Floor Assembly** – the part of the drainage system that consists of a specially designed noncombustible structure or platform serving as the base of a room on which one walks, drives or uses as a storage surface. The floor assembly consists of all components required to provide initial containment of a spilled liquid including manifolds, seals and gaskets.

**Flush Flow** – the volume of water per unit of time that can be added automatically or manually to flush and clean the system of any ignitable liquid or debris that is present in the system.

**Holding Area** – the sump, tank or container to which the spilled or ignited liquid will be pumped.

**Ignitable Liquid** - any liquid or liquid mixture that will burn. A liquid is defined as having the ability to burn if it has a measurable fire point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids or any other term for a liquid that will burn.

**Intermediate Bulk Container (IBC)** – any closed vessel intended for storing and transporting liquids, as defined in Title 49, Code of Federal Regulations, Parts 100 through 199 or in Part 6 of the United Nations Recommendations on the Transport of Dangerous Goods, Ninth Edition, Chapter 16. For purposes of this standard, Approval will be limited to containers that have a maximum capacity of 330 gallons (1250 L).

**Maximum Flow Rate** – the largest steady volume of liquid per unit of time to which the drainage system has been successfully evaluated. It consists of the total volume of liquid being collected and transported by the drainage system. It consists of the liquid that has been spilled, is discharging from a storage container, the volume of sprinkler water being discharged and any flush flow, if present.

**Spill Rate** – the volume of liquid per unit of time that can be expected to be present as a result of a hazardous liquid spill or accidental release of the contents of an ignitable liquid portable container.

**Sprinkler Discharge** – the volume of water per unit of time per defined area that can be collected by the flooring assembly due to the activation of automatic sprinklers.

## 2 GENERAL INFORMATION

### 2.1 Product Information

Ignitable liquid drainage systems are a potential solution to eliminate or minimize the effects of ignitable liquid pool fires and/or hazardous liquid spills in commercial and industrial applications. The systems are intended to allow liquids to flow into a flooring section where the liquid is removed and transported to a remote location, ideally before ignition can occur. If the liquid has been ignited, the system will minimize the spill area and reduce the overall size of the fire until the flow of liquid is stopped or extinguished.

### 2.2 Approval Application Requirements

To apply for an Approval examination the manufacturer, or its authorized representative, should submit a request to [information@fmapprovals.com](mailto:information@fmapprovals.com).

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

- 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, piping and electrical schematics, nameplate format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures as applicable;
- 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 as determined by FM Approvals following a review of the preliminary information.
- 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 discretion of FM Approvals.
- 2.3.4 The manufacturer shall submit detailed schematics showing the type, size and location of the ancillary devices needed to comprise a complete drainage system.

## **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 Physical or Structural Features**

- 3.2.1 All ignitable liquid drainage floor assemblies shall meet the following criteria:
  - be of non-combustible construction;
  - be of sufficient strength to carry the anticipated live and dead loads to which the floor assembly shall be subjected;
  - have the capability of cleaning or removing spills or ponding of ignitable liquid in non-fire situations without having to disassemble the flooring assembly. This can be achieved through the use of an internal flushing system.
- 3.2.2 The ignitable liquid drainage floor system Approval shall not include any of the ancillary devices used to comprise a complete system, including but not limited to:
  - detection devices
  - pumps
  - hoses, piping and fittings
  - control valves or control stations
  - items needed to provide a safe and secure remote holding area

### 3.3 Markings

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

- Company name and address (city and state [and country where applicable] 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.

When hazard warnings are needed, the markings should be universally recognizable.

3.3.2 The model or type identification shall correspond with the 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.

3.3.3 The Approval Mark shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the FM Approvals Certification Mark Usage Guidelines. The manufacturer shall not use this Mark on any other product unless such product is covered by a separate report.

3.3.4 All markings shall be legible and durable.

3.3.5 When labels are adhered to the product, the adhesive shall be compatible with the proposed substrates such that any attempts to remove it shall result in at least a partial destruction of the label.

### 3.4 Manufacturer's Installation and Operation Instructions

The manufacturer shall provide the user with:

- 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.

### 3.5 Calibration

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

## 4 PERFORMANCE REQUIREMENTS

### 4.1 Drainage Flow Rate Test

#### 4.1.1 Requirement

All ignitable liquid drainage floor assemblies shall be evaluated in order to determine the maximum drainage flow rate of a single floor assembly when subjected to the Drainage Flow Rate Test Procedure.

#### 4.1.2 Test/Verification

- A) The test shall be considered successful if the floor assembly is able to capture all of the liquid prior to any liquid overflowing off the edge or perimeter of the floor assembly.
- B) Upon completion of the evaluation, the assembly will be assigned a total maximum flow rate based on the test results using a simulated spill occurring towards the pump sensors. Maximum flow rates with the simulated spill flowing perpendicular to the sensors and with the simulated spill flowing away from the sensors shall also be reported. Flow rates shall be reported in multiples of 10 gpm (38 lpm).

### 4.2 Survivability Test

#### 4.2.1 Requirement

All ignitable liquid drainage floor assemblies shall be evaluated in order to determine that the assembly can withstand a simulated ignitable liquid fire. Two separate tests shall be conducted using heptane as the ignition source. One test shall be conducted at a flow rate of 2 gpm (7.6 lpm) and the second test conducted at a flow rate of 40 gpm (151 lpm). Each test shall be conducted for a period of twenty (20) minutes. Additional tests shall be permitted to be conducted using higher heptane flow rates, in multiples of 10 gpm (38 lpm) increments, if the system demonstrates acceptable performance at the 2 gpm (7.6 lpm) and 40 gpm (The ceiling height for all tests shall be 30 ft  $\pm$  0.375 in (9.1 m  $\pm$  9 mm).

#### 4.2.2 Tests/Verification

- A) The test shall be considered successful if the floor assembly is able to capture all of the liquid prior to any liquid overflowing off the edge or perimeter of the floor assembly.
- B) Upon completion of the test, there shall be negligible evidence of any leakage from any part, joint or seam of the assembly. All gaskets and other items used to keep the assembly liquid tight shall be examined to ensure that they have maintained their integrity. All liquid pathways shall be fully open and not clogged with any debris. The total cumulative amount of liquid that leaks from assembly shall not be more than 0.1% of the total amount of liquid that flowed through the assembly during the test.

### 4.3 Structural Analysis

#### 4.3.1 Requirement

All drainage floor assemblies shall be subjected to an analysis to determine that the assembly will not fail when subject to a total dead load + live load = 125 lbs/in<sup>2</sup> (0.86 MPa).

#### 4.3.2 Tests/Verification

Hand calculations shall be submitted to demonstrate that the stresses under normal usage conditions of a minimum of 125 lbs/in<sup>2</sup> (0.86 MPa) does not result in buckling, overstress or yielding of the material. As an alternative at the sole discretion of FM Approvals, a finite element analysis shall be permitted to be required.

## 5 OPERATIONS REQUIREMENTS

A quality assurance program is required to assure that subsequent ignitable liquid drainage floor assemblies produced by the manufacturer shall present the same quality and reliability as the specific floor 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 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 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 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 the FM Approved Products/Specification Tested Revision Request Form.
- 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 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 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 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the 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
	ft - "feet"; (m - "meters") m = ft x 0.3048
AREA:	in <sup>2</sup> - "square inches"; (mm <sup>2</sup> - "square millimeters") mm <sup>2</sup> = in <sup>2</sup> x 6.4516 x 10 <sup>2</sup>
	ft <sup>2</sup> - "square feet"; (m <sup>2</sup> - "square meters") m <sup>2</sup> = ft <sup>2</sup> 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 <sup>3</sup>
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 <sup>3</sup> - "cubic decimeters") L = dm <sup>3</sup>
FLOW RATE:	gal/min - "gallon per minute"; (L/min - "liters per minute") L/min = gal/min x 3.785