



*Member of the FM Global Group*

**Approval Standard  
for  
Adjustable and Fixed  
Sprinkler Fittings  
1/2 Inch through 1 Inch  
Nominal Size**

**Class Number 1631**

**October 2006**

---

# 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

<b>1. INTRODUCTION.....</b>	<b>1</b>
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 .....	3
<b>2. GENERAL INFORMATION .....</b>	<b>4</b>
2.1 Product Information.....	4
2.2 Approval Application Requirements .....	4
2.3 Requirements for Samples for Examination .....	4
<b>3. GENERAL REQUIREMENTS .....</b>	<b>5</b>
3.1 Review of Documentation .....	5
3.2 Physical or Structural Features .....	5
3.3 Materials .....	6
3.4 Markings .....	6
3.5 Manufacturer's Installation and Operation Instructions .....	6
3.6 Calibration .....	6
3.7 Tolerances.....	7
<b>4. PERFORMANCE REQUIREMENTS .....</b>	<b>7</b>
4.1 Examination.....	7
4.2 Thermal Integrity .....	7
4.3 Hydrostatic Integrity .....	8
4.4 Vibration Resistance (Adjustable Sprinkler Fittings Only).....	8
4.5 Mechanical Stop (Adjustable Sprinkler Fittings Only).....	9
4.6 Flow Restriction.....	9
4.7 Additional Tests.....	10
<b>5. OPERATIONS REQUIREMENTS .....</b>	<b>10</b>
5.1 Demonstrated Quality Control Program .....	10
5.2 Facilities and Procedures Audit (F&PA) .....	12
5.3 Manufacturer's Responsibilities .....	12
5.4 Manufacturing and Production Tests .....	12
<b>APPENDIX A: Units of Measurement.....</b>	<b>13</b>
<b>APPENDIX B: FM Approvals Certification Marks .....</b>	<b>14</b>
<b>APPENDIX C: Tolerance.....</b>	<b>16</b>
<b>APPENDIX D: Sample Listing .....</b>	<b>17</b>

## 1. INTRODUCTION

### 1.1 Purpose

- 1.1.1 This standard states FM Approvals criteria for fixed and adjustable sprinkler fittings for use in wet pipe sprinkler systems, with pendent sprinklers.
- 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 encompasses the design and performance requirements for 1/2 in. through 2 inch nominal size fixed and adjustable sprinkler fittings. In cases where metric sized fittings are to be examined for Approval, test criteria comparable to the equivalent or nearest nominal inch size shall be used.
- 1.2.2 Approval Standards are intended to verify that the product described will meet stated conditions of performance, safety and quality useful to the ends of property conservation.

### 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, jurisdictions and/or loss control specialists may also be considered.
- 1.3.2 The requirements of this Standard reflect tests and practices used to examine characteristics of fixed and adjustable sprinkler fittings for the purpose of obtaining Approval. Sprinkler fittings 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, sprinkler fittings 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 initial facilities and procedures audit shall be conducted to evaluate the manufacturer's ability to consistently produce the product that was examined and tested as part of the Approval project. The audit shall review the facility and in-place quality control procedures used in the manufacturing of the product. Typically, areas of review are incoming inspection, work in progress, production testing, final quality control, marking, calibration of equipment, shipping procedures, and document and

drawing control. These examinations are repeated periodically as part of the FM Approvals product follow-up program. (Refer to Section 5.2, Facility and Procedures Audit.).

## 1.5 Basis for Continued Approval

1.5.1 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 Master Agreement;
- Satisfactory re-examination of production samples for continued conformity to requirements; and
- Satisfactory Facilities and Procedures Audits (F&PAs) conducted as part of FM Approvals' Product Follow-up Program.

1.5.2 Also, as a condition of retaining Approval, manufacturers may not change an FM Approved product or service without prior written authorization by FM Approvals. (Refer to Section 5.1.3 for further details regarding changes.)

## 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 forfeit Approval.

The effective date of this standard is **October 31, 2007** 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 Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing and Materials (ASTM) SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*.

## 1.8 Applicable Documents

The latest versions of the following standards, test methods, and practices are referenced in this standard:

ANSI/ASME B1.20.1-1983 (R2001), *Pipe Threads, General Purpose (Inch)*  
ANSI/American Water Works Association (AWWA) C606- 2004, *Joints, Grooved and Shouldered Type*  
FM Global Property Loss Prevention Data Sheet 2-8N, *Installation of Sprinkler Systems*, Feb., 1997  
IEEE/ASTM SI 10, 2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*

## 1.9 Definitions

For purposes of this standard, the following terms apply:

### ***Accepted***

This term refers to installations acceptable to the authority enforcing the applicable installation rules. When the authority is FM Global, such locations are termed “FM Global Accepted.” Acceptance is based upon an overall evaluation of the installation. Factors other than the use of FM Approved equipment impact upon the decision to accept, or not to accept. Acceptance is not a characteristic of a product. A product accepted for one installation may not be acceptable elsewhere. (Contrast with FM Approved.)

### ***Cut Groove***

A groove that is cut into the outside diameter of a pipe or fitting near the end to allow its joining by means of a FM Approved grooved end coupling. For the purposes of this standard, grooves shall comply with the dimensional values shown in AWWA C606, Joints, *Grooved and Shouldered Type*. Grooves made to other standards shall be evaluated on a case-by-case basis. For clarity, the definition used in this Standard is for grooves that start from the outside diameter of the pipe, and project radially inward towards the pipe axis. Not to be confused with shouldered pipe that may be formed on similar equipment.

### ***End Connections***

The means by which components of a sprinkler system are connected to the sprinkler fitting.

### ***FM Approvals Certification Mark***

The FM Approvals Certification Mark is detailed in Appendix B. Its use is mandatory on all units of FM Approved indicating valves. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

### ***FM Approved***

This term refers to products FM Approved by FM Approvals. Such products are listed in the Approval Guide, a publication of FM Approvals, issued annually, or its supplements. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. These forms obligate the manufacturer to allow re-examination of the product and audit of facilities and procedures at FM Approval’s discretion. It further requires the manufacturer not to deviate from the as-FM Approved configuration of the product without review by and agreement of FM Approvals.

### ***Rated Working Pressure***

This is the maximum sustained pressure at or below which the valve shall operate trouble free. This also sets the basis for the testing described in Section 4, Performance Requirements. The minimum pressure rating considered for FM Approval is 175 psi (1205 kPa).

### ***Rolled Groove***

A groove pressed into the surface of a pipe or fitting near the end to allow joining by means of a FM Approved grooved end coupling. For clarity, the definition used in this Standard is for grooves that start from the outside diameter of the pipe, and project radially inward towards the pipe axis. Not to be confused with shouldered pipe that may be formed on similar equipment.

## 2. GENERAL INFORMATION

### 2.1 Product Information

2.1.1 Adjustable sprinkler fittings provide a drop from overhead piping to a suspended ceiling. They are used on wet systems with pendant sprinklers. These devices are adjustable in length so that they may be installed before a suspended ceiling is in place, then set to the proper length for sprinkler installation beneath the ceiling. The adjustable sprinkler fittings are usually composed of four major components: an upper body, a lower body, a stop nut, and a resilient seal, or seal assembly. The fixed fittings are normally one piece.

2.1.2 In order to meet the intent of this standard, adjustable sprinkler fittings must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample sprinkler fittings, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

### 2.2 Approval Application Requirements

2.2.1 To apply for an Approval examination the manufacturer, or an authorized representative, shall submit a request to:

Group Manager - Hydraulics  
FM Approvals  
Hydraulics Laboratory  
743A Reynolds Road  
West Glocester, RI 02814 U.S.A.

2.2.2 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, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures, and
- Number and location of manufacturing facilities making the products submitted for Approval.

2.2.3 All the above referenced documents shall be controlled by the manufacturer's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation, at the time of submittal.

### 2.3 Requirements for Samples for Examination

Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, results of prior testing, and results of the foregoing tests. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. The manufacturer shall provide any special test fixtures, which may be required to evaluate the adjustable sprinkler fitting.

### 3. GENERAL REQUIREMENTS

#### 3.1 Review of Documentation

- 3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.
- 3.1.2 The manufacturer's dimensional specifications and/or dimensional drawings shall fully describe the product. All critical dimensions shall be indicated with the allowed upper and lower tolerance limits clearly shown.
- 3.1.3 All documents pertaining to the product materials, dimensions, processing, and marking shall be controlled by the manufacturer's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

#### 3.2 Physical or Structural Features

- 3.2.1 Sprinkler fittings shall be designed for a minimum rated working pressure of 175 psi (1205 kPa). Fittings with higher rated working pressures will be evaluated on a case-by-case basis.
- 3.2.2 Installation is limited to use with overhead steel sprinkler piping in wet pipe sprinkler systems. FM Global Loss Prevention Data Sheets do not permit pendent sprinklers in dry sprinkler systems.
- 3.2.3 Nominal sizes of sprinkler fitting (outlet) threads shall be 1/2, 3/4, or 1 inch NPS or equal. Threaded connections shall be per ANSI B1.20.1, BS21, ISO 7/1, or other recognized international standard.
- 3.2.4 Typical inlet end connections are cut grooved, roll grooved, or male or female threaded, in accordance with the Standards listed in Section 1.8, or equal.

Approvable combinations include:

<i>Inlet Size</i> <i>in. (Nominal)</i>	<i>Outlet Size</i> <i>in. (Nominal)</i>
1	1/2, 3/4
1-1/4	1/2, 3/4
1-1/2	3/4, 1
2	1

- 3.2.5 Other types and sizes of end connection will be evaluated on a case by case basis, provided such ends are compatible with the requirements of FM Global Loss Prevention Data Sheets.
- 3.2.6 Sprinkler fittings submitted for testing shall be true production samples and shall be free of sharp edges, burrs, or other imperfections which might injure the installer or interfere with proper assembly of the unit.
- 3.2.7 Adjustable sprinkler fittings shall be suitable for use in wet pipe sprinkler systems with 286 °F (141 °C) or lower temperature rated sprinklers in maximum ambient installation temperatures of 225 °F (107 °C).

### 3.3 Materials

All materials used in these fittings shall be suitable for the intended application. Parts exposed to water shall be constructed of corrosion resistant materials. Materials shall be compatible with other sprinkler system components. When unusual materials are used, special tests may be necessary to verify their suitability. All components shall withstand the normal abuse of shipping, handling, and installation.

### 3.4 Markings

3.4.1 All FM Approved adjustable fittings shall bear the FM Approvals Certification Mark (see Appendix B). The FM Approvals Certification Mark shall be displayed visibly and permanently on the product. The manufacturer shall not use this Mark on any other product unless such product is covered by separate agreement with FM Approvals.

3.4.2 Each adjustable and fixed fitting, discussed in this standard, shall be permanently marked with the following information:

- Manufacturer's name or trademark;
- Nominal size(s);
- Model designation;
- The FM Approvals Certification Mark
- A manufacturing Source Code, if necessary

3.4.3 Any additional pertinent marking information required by a national or international standard to which the product is manufactured shall be permanently marked on the outside surface of each assembly.

3.4.4 Each required marking listed in Section 3.4.2 shall be legible and durable and applied in any of, or any combination of die-stamping, forging, roller embossing or eletro-etching.

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

3.4.6 All markings shall be legible and durable throughout the useful life of the product.

### 3.5 Manufacturer's Installation and Operation Instructions

The manufacturer shall provide complete installation instructions with each assembly, including any special dimension requirements. The installation instructions shall outline in detail the field procedures for installing, testing, and repairing the units. The installation instructions shall employ normal tools of the trade. Instructions shall be provided in each shipping container, as appropriate. The manual shall be reviewed for completeness and ease of comprehension.

### 3.6 Calibration

All equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage of the equipment. A copy of the calibration certificate for each piece of test equipment is required for FM Approvals records, indicating that the calibration was performed against working standards whose calibration is certified as traceable to the National Institute of Standards and Technology (NIST) or to other acceptable reference standards and certified by a ISO 17025 calibration laboratory. The test equipment must be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service accreditation certificate as an ISO 17025, "General Requirements for the

Competence of Testing and Calibration Laboratories", calibration laboratory is required for FM Approvals records.

The calibration of recently purchased new equipment is also required. Documentation indicating either the date of purchase or date of shipment, equipment description, model and serial number is required for identification. The period from the time the equipment was put into service to the date of testing must be within an interval that does not require the equipment to be calibrated as determined on the basis of the parameters mentioned above.

### 3.7 Tolerances

Tolerances on units of measure shall be as described in Appendix C, unless otherwise specified.

## 4. PERFORMANCE REQUIREMENTS

### 4.1 Examination

#### 4.1.1 Requirement

The fixed and adjustable sprinkler system fittings shall conform to the manufacturer's drawings and specifications and to FM Approval requirements.

#### 4.1.2 Test/Verification

A sample of each model fitting submitted for Approval shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

### 4.2 Thermal Integrity

#### 4.2.1 Requirements

Fixed and adjustable sprinkler fittings shall be suitable for use in wet pipe sprinkler systems with 286° F (141 °C) or lower temperature rated sprinklers in maximum ambient installation temperatures of 225 °F (107 °C).

#### 4.2.2 Test/Verification

4.2.2.1 Two sample adjustable sprinkler fittings shall be set to their midpoint lengths, filled with water, sealed at both ends, and subjected to a 225 °F (107 °C) air oven environment for 30 days. At the conclusion of that exposure the cooled samples shall exhibit no leakage, nor elongation from their midpoint preset lengths.

4.2.2.2 Two sample fixed sprinkler fittings shall be filled with water, sealed at both ends, and subjected to a 225 °F (107 °C) air oven environment for 30 days. At the conclusion of that exposure the samples shall be cooled to room temperature, they shall exhibit no leakage, deformation, or distortion along the length of the fitting.

**4.3 Hydrostatic Integrity**

4.3.1 Requirement

All sprinkler fittings shall withstand exposure to hydrostatic pressure of four times the rated working pressure of the product. During and at the conclusion of the test, no fracture, permanent distortion, or functional impairment, including leakage, shall occur.

4.3.2 Test/Verification

To demonstrate a factor of safety above the design working pressure, a sample adjustable sprinkler fitting of each size, extended to its maximum length, shall be subjected to a hydrostatic pressure test at 700 psi (4825 kPa) or four times its rated working pressure, whichever is higher, for five minutes. Adjustable sprinkler fittings shall be tested at their maximum length. Afterward, the adjustable sprinkler fittings shall be cycled from the fully opened position to the fully closed position to the fully opened position again. The adjustable sprinkler fittings shall then be tested at a hydrostatic pressure of 175 psi (1205 kPa) or the rated working pressure, whichever is higher, for five minutes. No leakage, fracture, permanent distortion, or functional impairment, shall occur.

**4.4 Vibration Resistance (Adjustable Sprinkler Fittings Only)**

4.4.1 Requirement

Adjustable sprinkler fittings shall withstand expected building and sprinkler piping vibration without damage, variation in length setting, or leakage.

4.4.2 Test/Verification

Compliance shall be verified by vibration testing of a sample adjustable sprinkler fitting, set to its mid-point length. The test sample shall be filled with water, and installed vertically on a vibration test machine. The assembly shall be pressurized to 80 psi (550 kPa) during the entire test and shall be subjected to the vibration sequence of Table 4.4.2; each 5-hour test increment shall be run continuously. No leakage or other failure is allowed during this 25 hour test.

The sample shall meet the required criteria, remaining unchanged in preset length throughout the tests. Subsequently, the hydrostatic test of Section 4.3, Hydrostatic Integrity, shall be repeated after the vibration test of the sample assembly. No leakage or other failure shall be observed at any pressure less than or equal to four times the pressure rating of the adjustable sprinkler fitting.

Table 4.4.2 *Vibration Conditions*

<i>Total Stroke</i>		<i>Frequency</i>	<i>Time</i>
<i>in.</i>	<i>(mm)</i>	<i>Hz</i>	<i>Hours</i>
0.020	(0.51)	28	5
0.040	(1.04)	28	5
0.150	(3.81)	28	5
0.040	(1.04)	18 to 37 (variable)*	5
0.070	(1.78)	18 to 37 (variable)*	5

\* continuously and regularly varied over the 18 to 37 Hertz frequency range at approximately one complete cycle every 25 +/- 5 seconds.

#### 4.5 Mechanical Stop (Adjustable Sprinkler Fittings Only)

##### 4.5.1 Requirement

Mechanical stops shall be provided on adjustable sprinkler fittings to limit absolutely the maximum and minimum length settings. Fittings having mechanical stops which are subject to torsional forces shall withstand a 60 lb•ft (80 N•m) torque without failure. All adjustable fittings, restrained only by the maximum length stop (when possible under the individual design), and by the minimum length stop shall be capable of withstanding four times their rated working pressure with no leakage or permanent damage after application of the torque stated above.

##### 4.5.2 Test/Verification

An attempt shall be made to force a sample adjustable fitting beyond its minimum and maximum length settings by applying a torsional force of 60 lb•ft (80 N•m) to both stops as noted below. The sample will be suitably restrained in order to apply the torsional force.

- a) The minimum length stop
- b) The maximum length stop.

It shall not be possible to force the fitting past the stops.

After these tests, the sample fitting shall be checked to determine that it still turns freely. It shall then be set at its maximum length, and shall be subjected to the hydrostatic pressure test of Section 4.3, Hydrostatic Integrity, with no leakage or loss of adjustability. The fitting shall remain freely adjustable after all tests.

When the design of a given adjustable fitting is such that torsional force cannot be transmitted to the stops, set the assembly at its maximum set length. While the assembly is restrained by the stop, conduct the hydrostatic pressure test. This test shall replace the torsional test.

#### 4.6 Flow Restriction

##### 4.6.1 Requirements

The total head loss through a sprinkler fitting shall be measured and equated to equivalent length of 1 inch nominal sized Schedule 40 pipe or actual inlet size if greater than 1 in. nominal pipe size. The value shall be reported for use in sprinkler system hydraulic calculations.

##### 4.6.2 Tests/Verification

The effect of the fitting on the discharge coefficient of a sprinkler shall be evaluated by means of pressure versus flow measurements of both a sprinkler alone and the sample sprinkler installed on a sample fitting adjusted to, first, its maximum length, and, then, its minimum length, where applicable. The worst case discharge coefficients thus obtained shall be used to calculate the longest theoretical length of 1 inch nominal sized Schedule 40 pipe, or actual inlet size if larger than 1 in. nominal pipe size.

#### 4.7 Additional Tests

Additional tests may be required, depending on design features, results of any tests, material application, or to verify the integrity and reliability of the fixed and adjustable sprinkler fittings, at the discretion of FM Approvals.

Unexplainable failures shall not be permitted. A re-test shall only be acceptable at the discretion of FM Approvals and with adequate technical justification of the conditions and reasons for failure.

## 5. OPERATIONS REQUIREMENTS

A quality control program is required to assure that subsequent sprinkler fittings produced by the manufacturer at an authorized location, shall present the same quality and reliability as the specific sprinkler fittings examined. Design quality, conformance to design, and performance are the areas of primary concern. Design quality is determined during the Approval examination and tests, and is covered in the Approval Report. Conformance to design is verified by control of quality and is covered in the Facilities and Procedures Audit (F&PA). Quality of performance is determined by field performances 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
- Handling and disposition of non-conformance materials.
- In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed, for a minimum period of two years from the date of manufacture.

5.1.2 Documentation/Manual

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

## 5.1.3 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 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.

5.1.3.1 The table below has been included as a guide to manufacturers of what is considered to be a significant change to FM Approvals. As mentioned above, modifications that fit this category shall be documented by means of a letter stating the change, and requesting a quotation for an Approval examination.

<i>Modification</i>	<i>Description/Example</i>
Increase of Pressure Rating:	The product was originally FM Approved for 175 psi (1205 kPa), and now is to be evaluated to 300 psi (2070 kPa).
Addition or Relocation of the Manufacturing Location:	The product was originally FM Approved in location A, and now is desired to be made in locations A and B, or only in location B.
Change in Manufacturing Process:	Change from Threaded Assembly to Electric Resistance Welded
Changes to Critical Dimensions:	Modifications that would depart from the national or international standards that are used in the manufacturing of the product as originally FM Approved.  Modifications that would have an effect on the use of the product with standardized fittings/couplings.  Modifications that would have an effect on the ability of the product to maintain the same performance as the originally Approved product. An example of this would be a significant reduction of wall thickness.

5.1.3.2 The table below has been included as a guide to manufacturers of modifications that are commonly submitted on FM Approvals Form 797.

<i>Modification</i>	<i>Description/Example</i>
Change in Company Contact Information	Name, Title, Phone Number, Fax Number, Email Address, Company Office Address, Company Name
Updating of Drawings	The Form 797 is used to notify FM Approvals in the event of: minor dimensional changes to non-critical features, minor changes in notes, location of title block, re-creation of the same drawing on CAD, etc.
Changes in Markings	Please describe what changes are to be made and include a drawing of the proposed marking.

<i>Modification</i>	<i>Description/Example</i>
Changes in Materials	Where new material is either superior, or comparable to material used in original Approval
Updating of Documentation	Creation of New or Revisions to Sales literature, Installation Instructions, Grooving Dimensions, Quality Manual, etc.

5.1.3.3 For the instances where the modification is difficult to categorize, manufacturers are encouraged to contact FM Approvals to discuss the nature of the change, and inquire about how to send the information to FM Approvals. The examples shown in Sections 5.1.3.1 and 5.1.3.2 are based on common examples of modifications as they relate to the manufacture of the product.

## 5.2 Facilities and Procedures Audit (F&PA)

- 5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality control program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a consistently uniform and reliable product. Initial inspections of facilities already producing similar FM Approved products may be waived at the discretion of FM Approvals.
- 5.2.2 Unannounced follow-up inspections shall be conducted at least annually by FM Approvals, or its designate, to determine continued compliance. More frequent audits may be required by FM Approvals.
- 5.2.3 The manufacturer shall manufacture the product or service only at the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the FM Approvals Certification Mark is not permitted at any other locations without prior written authorization by FM Approvals.

## 5.3 Manufacturer's Responsibilities

- 5.3.1 The manufacturer shall notify FM Approvals of changes in product construction, design, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation of such changes.
- 5.3.2 Where all or part of the quality control has been subcontracted, the manufacturer shall, at a minimum, conduct sufficient oversight audits to verify the continued application of the required controls.

## 5.4 Manufacturing and Production Tests

The manufacturer shall test 100 percent of production fittings for body and joint integrity to 50% of the rated working pressure when tested pneumatically, and to the rated working pressure when tested hydraulically. The pressure shall be held for a minimum of 5 seconds with no evidence of body leakage, cracking or distortion.

**APPENDIX A: Units of Measurement**

<b>FLOW:</b>	gal/min - "gallons per minute"; (L/min - "liter per minute") $L/min = gal/min \times 3.7854$
<b>LENGTH:</b>	in. - "inches"; (mm - "millimeters") $mm = in. \times 25.4$ ft - "feet"; (m - "meters") $m = ft \times 0.3048$
<b>LIQUID:</b>	oz - "ounces"; (mL - "milliliters") $mL = oz \times 29.573$
<b>MASS:</b>	lb - "pounds"; (kg - "kilograms") $kg = lb \times 0.454$
<b>PRESSURE:</b>	psi - "pounds per square inch"; (kPa - "kilopascals") $kPa = psi \times 6.895$
<b>TEMPERATURE:</b>	$^{\circ}F$ - "degrees Fahrenheit"; ( $^{\circ}C$ - "degrees Celsius") $^{\circ}C = (^{\circ}F - 32) \times 0.556$
<b>TORQUE or MOMENT:</b>	lb·ft - "pound-feet"; (N·m - "newton-meter") $N \cdot m = lb \cdot ft \times 1.356$

## 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.

## 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.

## APPENDIX C: Tolerance

Unless otherwise stated, the following tolerances shall apply:

Angle:	$\pm 2^\circ$
Frequency (Hz):	$\pm 5$ percent of value
Length:	$\pm 2$ percent of value
Volume:	$\pm 5$ percent of value
Pressure:	$\pm 5$ psi (35 kPa)
Temperature:	$\pm 4^\circ\text{F}$ ( $2^\circ\text{C}$ )
Time:	+5/-0 seconds +0.1/-0 minutes

Unless stated otherwise, all tests shall be carried out at a room (ambient) temperature of  $68 \pm 9^\circ\text{F}$  ( $20 \pm 5^\circ\text{C}$ ).

## APPENDIX D: Sample Listing

### ADJUSTABLE SPRINKLER FITTINGS

Adjustable fittings are designed for use on wet-pipe pendent-sprinkler drop-pipes. They allow the sprinkler contractor, after the suspended ceiling has been installed, to adjust the drop to the desired length without cutting the pipe.

#### ABC Co., Inc, 4321 E West Ave, Coventry RI 02816

<i>Product Designation</i>	<i>Size in. x in.</i>	<i>Min Length, in., (mm)</i>	<i>Max Length, in., (mm)</i>	<i>Equivalent Length Of Pipe</i>
A1	1 x 1/2	6 (150)	8 (205)	2.8 feet of 1 in.
A2*	1-1/2 x 3/4	4 1/2 (115)	6 (150)	1.7 feet of 1-1/2 in.
B1*	2 x 1	5 1/2 (140)	8 1/2 (215)	1.3 feet of 2 in.

\*Models A1 and B1 have a 250 psi (2070 kPa) rated working pressure.

#### XYZ Fitting Products, PO Box 999, Hollywood, CA 96587

<i>Product Designation</i>	<i>Size in. x in.</i>	<i>Min Length, in., (mm)</i>	<i>Max Length, in., (mm)</i>	<i>Equivalent Length Of Pipe</i>
X46	1 x 1/2	4 1/4 (110)	6 (150)	2.1 feet of 1 in.
Z58*	2 x 1	5 1/2 (140)	8 3/8 (215)	1.6 feet of 1 in.

\*Model Z58 fittings have a 300 psi (1725 kPa) rated working pressure.

### FIXED SPRINKLER FITTINGS

Fixed sprinkler fittings are designed for use on wet-pipe pendent-sprinkler drop-pipes. They allow the sprinkler contractor to cut and re-thread the 1 in. NPT inlet end to length in the field, at installation, with minimum waste.

#### LMNOP Corporation, 27 Allard Highway, East Overshoe, NH 04789

<i>Product Designation</i>	<i>Size in. x in.</i>	<i>Fixed Length, in., (mm)</i>	<i>Equivalent Length of Pipe</i>
432	1 x 1-1/2	6 (150)	0.7 feet of 1 in.
		12 (305)	1.2 feet of 1 in.
		18 (455)	1.6 feet of 1 in.
438	1 x 3/4	18 (455)	1.8 feet of 1 in.
		24 (610)	2.3 feet of 1 in.
		30 (760)	2.6 feet of 1 in.



**FM Approvals**<sup>SM</sup>

*Member of the FM Global Group*