FM Approvals®

Member of the FM Global Group

Approval Standard for Telescoping Sprinkler Assemblies for Use in Fire Protection Systems for Anechoic Chambers

Class Number 1632

April 2003

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.

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1. INTRODUCTION

1.1 Purpose

1.1.1 This standard states FM Approvals criteria for telescoping sprinkler assemblies for use in fire protection systems for anechoic chambers.

1.1.2 FM 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 telescoping sprinkler assemblies for use in fire protection systems for anechoic chambers. In cases where metric sized telescoping sprinkler assemblies are to be examined for Approval, test criteria comparable to the equivalent nominal inch size shall be used.

1.2.2 Other types of telescoping sprinkler assemblies for use in fire protection systems for anechoic chambers may be Approved if they meet the requirements and intent of this standard. Telescoping sprinkler assemblies of unusual design may be subjected to special tests to determine their suitability.

1.2.3 FM 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 was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of telescoping sprinkler assemblies for the purpose of obtaining FM Approval. Telescoping sprinkler assemblies having characteristics not anticipated by this standard may be Approved if performance equal, or superior to, that required by this standard is demonstrated or if the intent of the standard is met. Alternatively, telescoping sprinkler assemblies which meet all of the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for FM Approval

FM 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 shall be made to evaluate the manufacturer's ability to consistently produce the product which was examined and tested, and the marking procedures used to identify the product. These examinations are 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 Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval 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.

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 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 **June 1, 2003** 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 10-97, *"Standard for Use of the International System of Units (SI): The Modern Metric System."*

1.8 Applicable Documents

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

ANSI/IEEE/ASTM SI 10-97, Standard for Use of the International System of Units (SI): The Modern Metric System.

FM Global Property Loss Prevention Data Sheets.

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 the 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 Approved equipment impact upon the decision to accept, or not to accept, the product. Acceptance is not a characteristic of a product. It is installation and site specific. A product accepted for one installation may not be acceptable elsewhere. (Contrast with Approved.)

Approval Mark

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

Approved

This term refers to products Approved by FM Approvals. Such products are listed in the Approval Guide, a publication of FM Approvals, issued annually, or one of the supplements. All products so listed have been successfully examined by FM Approvals and their manufacturers have signed and returned a Master Agreement or an Approval Agreement (Form L-15) to FM Approvals. This form obligates the manufacturer to allow re-examination of the product and audit of facilities and procedures at FM Approvals discretion. It further requires the manufacturer not to deviate from the as-Approved configuration of the product without review by and agreement of FM Approvals. Approval is product specific.

Anechoic Chambers

Enclosures designed to provide test regions that simulate free space for a variety of measurements including antenna pattern, radar backscatter tests, soundproof measurements, etc. The chambers may also be shielded to provide RF isolation from undesirable external signals as well as to prevent internally generated RF energy from radiating outside the enclosure.

Assembly

A complete unit which can be installed in an anechoic chamber fire protection system and has the ability to extend an appropriate distance into the chamber. These devices have the following: an inlet mounting assembly for attachment to the sprinkler system; an outer tube and an inner tube which gives the assembly "stroke"; and an upright sprinkler at the outlet end of the device.

Corrosion Resistant

Having resistance to corrosion equal to or exceeding that of bronze alloy having a minimum copper content of 80 percent, or constructed of Series 300 Stainless Steel.

End Connections

The method of connecting components of a pipe system to the telescoping sprinkler assemblies.

Extension

See Stroke

Operating Pressure

The pressure required to move the piston tube from the fully retracted to the fully extended position in the intended installation position.

Rated Working Pressure

The maximum sustained pressure at, or below, which the telescoping sprinkler assemblies shall reliably operate.

Stroke

Total length of travel from fully retracted to fully extended position.

2. GENERAL INFORMATION

2.1 Product Information

2.1.1 Sprinklers used in the telescoping sprinkler assembly are evaluated as part of this Approval for use with the telescoping sprinkler assembly. Sprinklers for use in these assemblies must be FM Approved in addition to being FM Approved for this application.

2.1.2 In order to meet the intent of this standard, telescoping sprinkler assemblies for use in fire protection systems for anechoic chambers 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 telescoping sprinkler assemblies, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

2.2 Approval Application Requirements

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

Hydraulics Group Manager
FM Approvals — Hydraulics Laboratory
743A Reynolds Road
West Glocester, RI 02814
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, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures;
- the number and location of manufacturing facilities;
- the make, model, style and manufacturer of the sprinkler to be used in the assemblies; and,
- the manufacturer of the telescoping sprinkler assembly, if not also the manufacturer of the Approved sprinkler, must have written authorization, from the sprinkler manufacturer, to use a specific Approved sprinkler in the telescoping sprinkler assembly. A copy of this written authorization must be supplied to FM Approvals prior to an Approval examination or re-examination.

All documents 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.

2.3 Requirements for Samples for Examination

Following initiation 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 telescoping sprinkler assemblies.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

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.

3.2 Physical or Structural Features

3.2.1 Telescoping sprinkler assemblies shall be designed for a maximum rated working pressure of 175 psi (1205 kPa) and a minimum water discharge density of 0.6 gal/min/ft^2 (24.4 mm/min).

3.2.2 End connections shall be male threaded, female threaded, soldered tube end, or grooved end connections, and shall conform to a nationally or internationally recognized standard. Other types of end connections shall be evaluated on a case-by-case basis. Telescoping sprinkler assemblies with threaded end connections shall be provided with a section to serve as a wrench grip.

3.2.3 Telescoping sprinkler assemblies submitted for testing shall be production samples and shall be free of sharp edges, burrs, or other imperfections that might injure the installer, interfere with proper assembly of the unit, or affect the seals.

3.2.4 Telescoping sprinkler assemblies can be Approved for use in the vertical and/or horizontal position. Testing will be conducted in each respective position.

3.2.5 Approved sprinklers (refer to FM Approval Standard 2000, Automatic Sprinklers for Fire Protection) shall be used in telescoping sprinkler assemblies. Telescoping sprinkler assemblies shall be limited to use with the Approved automatic sprinklers that have been evaluated for use with that particular telescoping sprinkler assembly.

3.2.6 Telescoping sprinkler assemblies submitted for possible Approval shall have a minimum nominal discharge coefficient of 5.6 gal/min/(psi)^{½} [8.1 L/min/(kPa)^{½}].

3.3 Materials

All materials used in telescoping sprinkler assemblies shall be suitable for the intended application.

3.4 Markings

3.4.1 Each telescoping sprinkler assembly shall be permanently marked with the following information:

- manufacturer's name or trademark;
- model number;
- serial number;
- rated working pressure, and;
- the FM Approval Mark.

3.4.2 Telescoping sprinkler assemblies that are produced at more than one location shall be identified as a product of a particular location.

3.4.3 A corrosion resistant metal nameplate bearing the information as stated above shall be considered acceptable if permanently fastened to the telescoping assembly. The nameplate can be riveted, screwed or tack welded. Adhesive is not permitted as a means of securing the nameplate.

3.4.4 Other methods of applying permanent markings will be evaluated on a case by case basis.

3.4.5 Each required marking listed in Section 3.4.1 shall be legible and durable.

3.4.6 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 Approval Report.

3.4.7 The FM Approval Mark (see Appendix B) 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.

3.5 Manufacturer's Installation and Operation Instructions

Installation and maintenance instructions, including any special dimensional requirements, shall be furnished by the manufacturer. Maintenance instructions shall include a statement that automatic sprinklers used in telescoping sprinkler assemblies shall be replaced after each operation (actual or accidental) at full pressure. Installation of the telescoping sprinkler assemblies shall conform to FM Global Property Loss Prevention Data Sheets. Instructions shall be provided in each shipping container.

3.6 Calibration

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

4. PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The telescoping sprinkler assembly shall conform to the manufacturer's drawings and specifications and to FM Approvals requirements.

4.1.2 Test/Verification

A sample 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 Friction Loss (Equivalent Length of Pipe)

4.2.1 Requirement

To determine the effect of the telescoping assembly on the discharge coefficient of the sprinkler, the average friction loss through the telescoping sprinkler assembly shall be equated to the theoretical length of nominal 1 in. diameter schedule 40 sprinkler pipe which would produce the same amount of friction loss. The results shall be listed in the FM Approval Guide and in manufacturer's published literature.

4.2.2 Test/Verification

Samples of each length shall be tested using the test apparatus for determining discharge coefficient (K-factor) shown in Figure C-1 at increasing and decreasing pressures over the complete operating range, 15 through 175 psi (105 through 1205 kPa) in 10 psi (70 kPa) increments. Measurements shall be taken using an open upright sprinkler alone (see Figure C-1), and with the sprinkler mounted to a previously untested telescoping sprinkler assembly (see Figure C-2). The telescoping sprinkler assembly with the sprinkler attached, shall be tested in the fully extended position. The average friction loss through the assembly shall be equated to the theoretical length of nominal 1 inch diameter schedule 40 sprinkler pipe using a flow of 30 gal/min (115 L/min) that would produce the equivalent reduction in the sprinkler discharge coefficient, using the following equations:

$$P = \frac{Q^2}{K_1^2} - \frac{Q^2}{K_2^2} \qquad L = \frac{P}{F_c}$$

Where:

P = Pressure in psi

Q = Flow in gal/min (30 gal/min)

K_1 = Discharge coefficient of the flexible sprinkler hose with fitting assembly and sprinkler in gal/min/(psi)^{½}

K_2 = Discharge coefficient of sprinkler only in gal/min/(psi)^{½}

L = Equivalent length of 1 in. pipe in feet

F_c = Friction loss in 1 in. pipe with a Hazen-William C = 100 (F_c = 0.386 psi for 30 gal/min)

4.3 Minimum Operating Pressure

4.3.1 Requirement

The minimum water pressure required to move the piston tube from the fully retracted to the fully extended position shall not exceed a maximum pressure of 25 psi (170 kPa).

4.3.2 Test/Verification

Six telescoping sprinkler assemblies shall be tested to determine the minimum water pressure required to fully extend the devices. Three sample assemblies shall be tested using a plug, and three assemblies shall be tested using an open upright sprinkler. Each assembly shall be tested five times. The operating pressure shall be determined, and shall not exceed a maximum pressure of 25 psi (170 kPa), to move the piston tube to its fully extended position. Testing must be conducted in each position requested, (vertical and/or horizontal).

4.4 Leakage

4.4.1 Requirement

There shall be no visual leakage past the seal while the piston tube is moving or after it has come to rest at the fully extended position.

4.4.2 Test/Verification

A representative sample of a telescoping sprinkler assembly shall be pressurized to 25 psi (170 kPa) with water until fully extended. After the piston tube has come to a rest, the system pressure will be increased to 175 psi (1205 kPa) and held for 5 minutes. There shall be no leakage.

4.5 Hydrostatic

4.5.1 Requirements

The telescoping sprinkler assembly in the fully extended position shall be able to withstand a hydrostatic pressure of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, for 5 minutes. During and at the conclusion of the test, no fracture, permanent distortion, or functional impairment shall occur. After this test the telescoping sprinkler assembly shall be fully operable and shall comply with the operating pressure requirements in Section 4.3 (Minimum Operating Pressure).

4.5.2 Tests/Verification

Two telescoping sprinkler assemblies shall be pressurized in the fully extended position with water to 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater. The test pressure shall be held for five minutes. The assemblies shall then be subjected to the Minimum Operating Pressure test as described in Section 4.3.

4.6 High Pressure Operating (Strength)

4.6.1 Requirement

With the piston tube fully retracted, a flow of water at 225 psi (1550 kPa) will be introduced, through a quick opening valve. There shall be no rupture or signs of permanent deformation as a result of this test.

4.6.2 Test/Verification

Three telescoping sprinkler assemblies with an upright sprinkler shall be individually subjected to a sudden water pressure of 225 psi (1550 kPa), a total of 5 times each. After each operation, there shall be no leakage or permanent damage. The samples shall then be visually examined, and there shall be no rupture or signs of permanent deformation as a result of this test. After each operation, the sample shall be put in its fully retracted position without performing maintenance, with the exception of replacing an "O" ring, shock absorber, or sprinkler. The test shall be repeated for a total of 5 times per sample.

4.7 Humidity

4.7.1 Requirement

Telescoping sprinkler assemblies exposed to a high temperature-humidity atmosphere consisting of 98 ± 2 percent humidity and 203 ± 2°F (95 ± 1°C) temperature for 90 days shall still comply with the operating pressure requirements in Section 4.3 (Minimum Operating Pressure).

4.7.2 Tests/Verification

Three previously untested telescoping sprinkler assemblies shall be tested in accordance with Section 4.3 (Minimum Operating Pressure) and then subjected to a high temperature-humidity atmosphere consisting of 98 ± 2 percent humidity and 203 ± 2°F (95 ± 1°C) temperature for a period of 90 days. The samples shall be plugged and not pressurized during exposure. Following this exposure the Minimum Operating Pressure test (Section 4.3) shall be repeated using an open upright sprinkler head. Testing shall be conducted with each of the three assembles, in each position (vertical and/or horizontal) requested by the manufacturer for Approval.

4.8 Exposure To Maximum Installation Temperature

4.8.1 Requirements

Telescoping sprinkler assemblies shall be exposed to a 150°F (66°C) environment for a period of 90 days. The Minimum Operating Pressure test (Section 4.3) shall be performed prior to the high temperature exposure, after 30 days and after 90 days. Following this test the telescoping sprinkler assemblies shall still meet the requirements of the Minimum Operating Pressure test (Section 4.3). There shall be no leakage as a result of this exposure.

4.8.2 Tests/Verification

Three previously untested telescoping sprinkler assemblies**,** with the outlet plugged**,** shall be tested to the requirements of Section 4.3 (Minimum Operating Pressure). The minimum operating pressure to move the piston tube to its fully extended position shall be determined. Following this test the three samples shall be placed in an 150°F (66°C) environment for a period of 30 days. Following this exposure the Minimum Operating Pressure test (Section 4.3) shall be repeated using a plug in the outlet. The samples shall then be placed back in the 150°F (66°C) environment for a period of 60 days. Following this second exposure the Minimum Operating Pressure test (Section 4.3) shall be repeated using a plug in the outlet. Testing shall be conducted with the three exposed samples in each position, vertical or horizontal, as requested by the manufacturer for Approval.

4.9 Friction Fit (Vertical Position Only)

4.9.1 Requirement

The telescoping sprinkler assembly shall be so designed to prevent the piston tube from extending from its own weight.

4.9.2 Tests/Verification

Two telescoping sprinkler assemblies shall be individually placed in a vertical down position with an open upright sprinkler. The assemblies shall be tested so the piston tube operates to its fully extended position. The assembly shall be slowly retracted by hand pushing the piston tube up to its fully retracted position, with no maintenance performed. When fully retracted, each piston tube shall be capable of remaining in the retracted up position for 5 minutes, without sliding back out of the assembly. Extension by more than 1 inch (25.4 mm) during the 5 minutes shall be considered a failure.

4.10 Additional Tests

Additional tests may be required, depending on design features, test results, or material application to verify the integrity and reliability of the telescoping sprinkler assemblies, 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 telescoping sprinkler assemblies produced by the manufacturer at an authorized location shall present the same quality and reliability as the specific telescoping sprinkler assemblies 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 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, Approved Product Revision Report or Address/Contact Change Notice. Records of all revisions to all Approved products shall be maintained.

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 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 client 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 Approval Mark is not permitted at any other locations without prior written authorization by FM Approvals.

5.3 Manufacturer's Responsibilities

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.

5.4 Manufacturing and Production Tests

5.4.1 *Test Requirement No. 1 — Minimum Operating Pressure*

The manufacturer shall test 100 percent of production telescoping sprinkler assemblies for minimum operating pressure. The minimum operating water pressure shall not exceed 25 psi (170 kPa) to move the piston tube to its fully extended position. The outlet shall be plugged for this test.

APPENDIX A

UNITS OF MEASUREMENT

LENGTH: in. – ‘‘inches’’; (mm – ‘‘millimeters’’)

mm = in. × 25.4

ft – ‘‘feet’’; (m – ‘‘meters’’)

m = ft × 0.3048

PRESSURE: psi – ‘‘pounds per square inch’’; (kPa – ‘‘kilopascals’’)

kPa = psi × 6.895

bar – ‘‘bar’’; (kPa – ‘‘kilopascals’’)

bar = kPa × 0.01

bar = psi × 0.06895

TEMPERATURE: °F – ‘‘degrees Fahrenheit’’; (°C – ‘‘degrees Celsius’’)

°C = (°F – 32) × 0.556

APPENDIX B
APPROVAL MARKS

REPRODUCTION ART: FM Approval Marks

For use on nameplates, in literature, advertisements, packaging and other graphics.

1) The FM Approvals diamond mark is acceptable to FM Approvals as an Approval mark when used with the word ‘‘Approved.’’

2) The FM Approval logomark has no minimum size requirement, but should always be large enough to be readily identifiable.

3) Color should be black on a light background or a reverse may be used on a dark background.

For Cast-On Marks

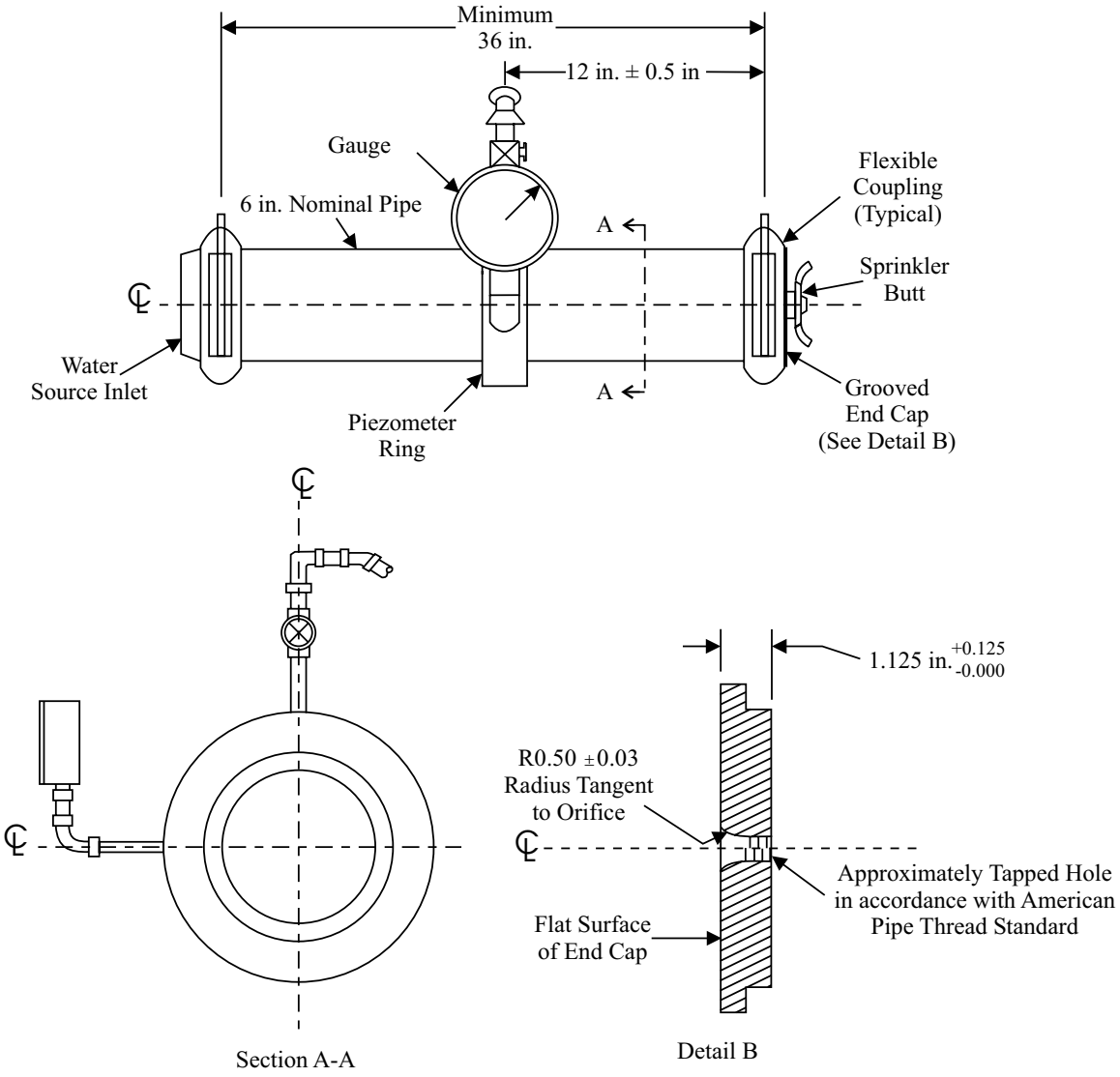
4) Where reproduction of the mark described above is impossible because of production restrictions, a modified version of the diamond is suggested. Minimum size specifications are the same as for printed marks. Use of the word ‘‘Approved’’ with this mark is optional.

NOTE: These Approval marks are to be used only in conjunction with products or services that have been FM Approved. The FM Approval marks should never be used in any manner (including advertising, sales or promotional purposes) that could suggest or imply FM Approval or endorsement of a specific manufacturer or distributor. Nor should it be implied that Approval extends to a product or service not covered by written agreement with FM Approvals. The Approval marks signify that products or services have met certain requirements as reported by FM Approvals.

Additional reproduction art is available through

FM Approvals
P.O. Box 9102,
Norwood, Massachusetts 02062
U.S.A.

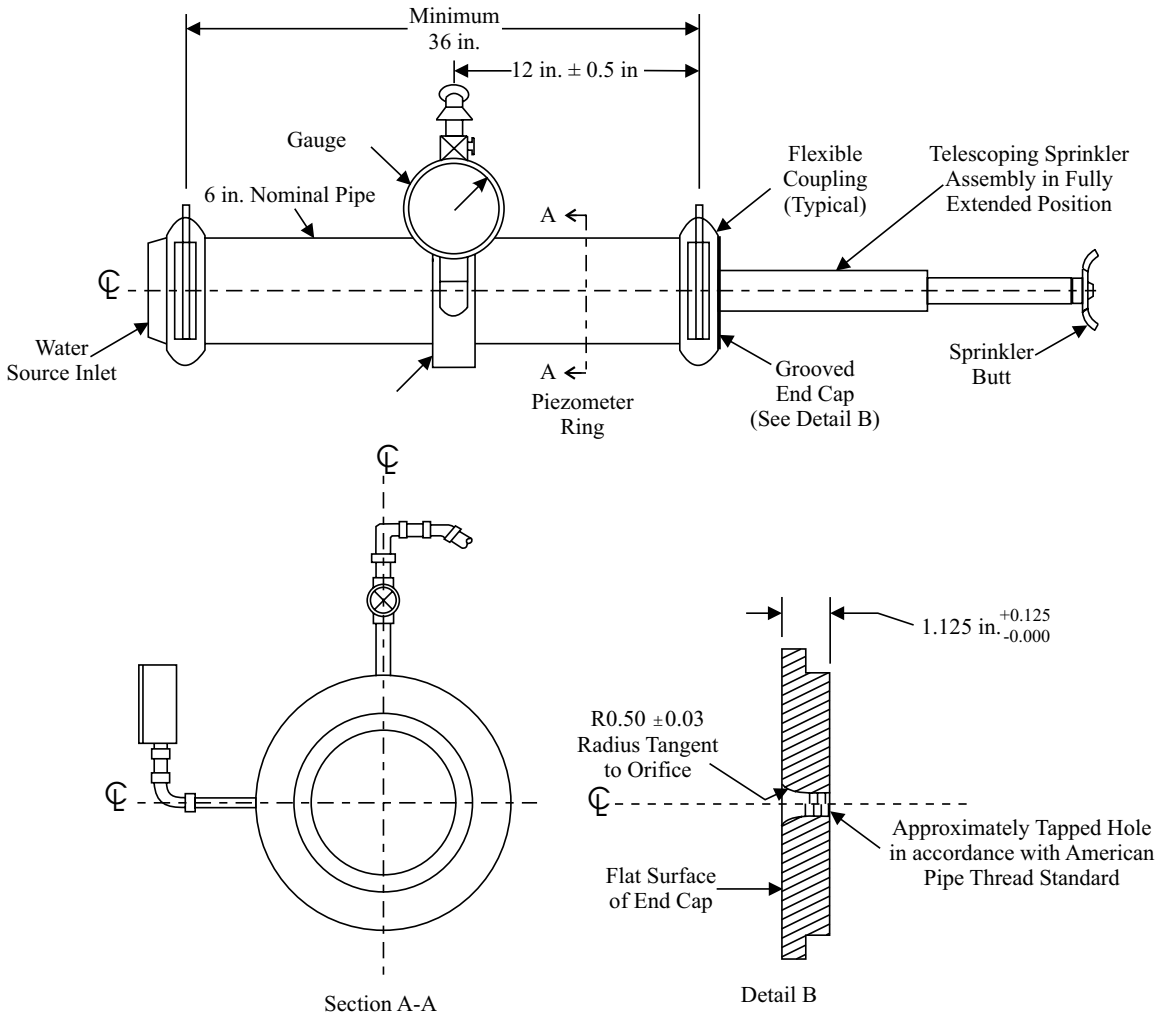
APPENDIX C
DRAWINGS



Note: All dimensions are nominal size, unless specified otherwise. Radius on tapped holes equal to, or greater then, 1 in. NPT maybe truncated on the internal face.

Figure C-1. Test Apparatus for Measuring Nominal K-Factors.

APPENDIX C
DRAWINGS



Note: All dimensions are nominal size, unless specified otherwise. Radius on tapped holes equal to, or greater then, 1 in. NPT maybe truncated on the internal face.

Figure C-2. Test Apparatus with Telescoping Sprinkler Assembly for Measuring Friction Loss (Equivalent Length of Pipe) with the Assembly in a Fully Extended Position.

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