



*Member of the FM Global Group*

# **Approval Standard for Fire Service Meters**

**Class Number 1044**

**August 2012**

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# 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 surveillance 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 criteria for fire service meters for use in automatic fire protection systems. Meters addressed in this standard are used in aboveground installations as well as pits and vaults which maybe below grade.
- 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 surveillance audit program.

### 1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for fire service meters intended for use where full registration metering devices on public water connections are required.
- 1.2.2 Other types and sizes, including metric sizes, of fire service meters may be FM Approved if they meet the requirements and intent of this standard. Fire service meters of unusual design may be subjected to special tests to determine their suitability.

### 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 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. The requirements of this standard reflect tests and practices used to examine characteristics of fire service meters for the purpose of obtaining Approval. Fire service meter 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, fire service meters 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 A first 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 audits are repeated periodically for as long as the product remains FM Approved, as part of FM Approvals' Surveillance Audit program. (Refer to Section 5.2, Surveillance Audit Program.)

## 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 Surveillance Audits conducted as part of FM Approval's product surveillance audit program.

1.5.2 Also, as a condition of retaining Approval, manufacturers may not change an FM Approved product or service without prior 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 **August 30, 2013** 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 Institute of Electrical and Electronics Engineers (IEEE)/ASTM International (ASTM) IEEE/ASTM SI 10-2010, *American National Standard for Metric Practice*. Two units of measurement (Bar and Liter), outside of, but recognized by SI, are commonly used in international fire protection and are used in this standard.

## 1.8 Applicable Documents

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

American Society of Mechanical Engineers (ASME) B1.20.1 - 1983 (R2006), *Pipe Threads, General Purpose, (Inch)*

American Water Works Association (AWWA) C703 - 2011, *Cold-Water Meters -- Fire Service Type*

British Standards Institution European Specifications (BS EN) 10242 - 1995, *Threaded Pipe Fittings in Malleable Cast Iron*

FM Approval Standard 1045, Waterflow Detector Check Valves, August 2005

FM Approval Standard 1140, Quick Opening Valves 1/4 inch through 2 inch Nominal Size, October 1998

FM Approval Standard 5551, Strainers for use with Water Spray Systems, January 1980

FM Global Property Loss Prevention Data Sheets

IEEE/ASTM SI 10-2010, *American National Standard for Metric Practice*

International Organization for Standardization (ISO) 7-1 - 2007, *Pipe Threads Where Pressure-Tight Joints are made on the Threads- Part 1: Dimensions, Tolerances and Designation*

ISO 17025 - 2005, *General Requirements for the Competence of Testing and Calibration Laboratories*

## 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 may be considered when determining whether to accept the product. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere. (Contrast with FM Approved.)

### ***Accuracy***

The extent to which a given measurement agrees with the actual value for that measurement.

### ***Electromagnetic (Mag Meters) Flowmeters***

A volumetric flow meter with no moving parts, based on Faraday’s Law of electromagnetic induction, which states that the voltage induced across any conductor as it moves at right angles through a magnetic field is proportional to the velocity of that conductor.

### ***End Connections***

The term “End Connections” refers to the method of connecting components of a fire protection system. Typical end connections in a fire protection service are grooved, threaded, plain end, flanged and welded end.

### ***Flange Fittings***

The term flanged fittings has been taken to refer to any style of pipe fitting covered in the scope of this Approval Standard with integral flanged end connections.

### ***FM Approvals Certification Marks***

The FM Approvals Certification Marks are detailed in Appendix B. Their use is mandatory on all units of FM Approved products. 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, an on-line resource of FM Approvals. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. This agreement obligates the manufacturer to allow re-examination of the product and surveillance audit of facilities and procedures at FM Approvals 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. Approval is product specific.

### ***Grooved Coupling, Flexible***

A grooved coupling is an assembly that is used to join two similar sized grooved ends together. The flexible grooved coupling is characterized by its ability to allow for angular or rotational differences between the components being joined after assembly. These products may provide greater system reliability in situations involving excessive vibration, difficult alignment, or seismic activity. They may also provide greater system flexibility than historic use of rigid systems of flanged pipe and fittings.

### ***Grooved Coupling, Rigid***

A rigid grooved coupling is an assembly that is used to join two different sized grooved ends together. The rigid grooved coupling is characterized by its prevention of rotation of the joined ends, and reduced tolerances for angular variations after assembly.

### ***Plain End Fittings***

Pipe couplings designed to work with pipe ends that have been cut perpendicular to its axis and incorporating no grooves or threads. The fitting is typically fastened to the pipe by mechanical means, such as a fastener.

**Rangeability**

The ratio of the maximum flow to the minimum flow of the meter.

**Rated Working Pressure**

This is the maximum sustained pressure at or below which the device shall operate trouble free for its entire design life. This value sets the basis for the testing described in Section 4.

**Safe Maximum Operating Capacity**

A specified maximum flow at which the meter is required to function safely.

**Threaded End**

Pipe couplings or fittings which have been furnished with its ends threaded with internal or external pipe threads conforming to national or international standards for pipe threads for the nation of intended use (i.e. ANSI B1.20.1, ISO 7-1).

**Turbine-Type Flowmeters**

A flow meter with turbine blades in the waterway. Water flowing around the blades results in the turbine rotating. The rotational speed of the turbine blades is proportional to the fluid velocity.

**Type 1 Devices- Proportional Fire – Service Meter with Check Valve**

A meter of the proportional type for measuring high flow rates, a bypass meter for measuring low flow rates and a check valve for diverting low flow rates through the bypass meter.

**Type 2 Devices - Compound Fire – Service Meter Assembly and Strainer with Check Valve**

A turbine type meter for measuring high flow rates, a bypass meter for measuring low flow rates, a strainer and a check valve for diverting low flow rates through the bypass meter.

**Type 3 Devices - Turbine Fire – Service Meter and Strainer without Check Valve**

A turbine type meter and strainer without a check valve and by-pass.

**Type 4 Devices**

*Ultrasonic Transit-Time Flowmeters and Electromagnetic (Mag Meters) Flowmeters, (see definitions)*

**Ultrasonic Transit-Time Flowmeters**

A volumetric flow meter with no moving parts, which measures the difference of the transit time of ultrasonic pulses. Ultrasonic transit-time meters requires particulates, bubbles or turbulence in the flow.

**Welded End**

Steel pipe furnished with ends characterized by having the ends cut perpendicular to its axis and finished with a pronounced bevel on each end to allow for butt welding.

## 2. GENERAL INFORMATION

### 2.1 Product Information

- 2.1.1 The products outlined in Section 1.2 of this standard are for use when required by local waterworks as full registration metering devices on public water connections to private fire protection systems. Installations shall be in accordance with FM Global Property Loss Prevention Data Sheets and the manufacturer's installation instructions.
- 2.1.2 In order to meet the intent of this standard, fire service meters shall 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 using identical materials by different manufacturers, or, even by different plants of the same manufacturer, have sometimes been shown to perform differently in testing. Sample fire service meters 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 its authorized representative, shall submit a request to:

Fire Protection Group Manager  
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) (e.g., ASTM A 48, Class 40A, Gray Iron Casting), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures,
  - The number and location(s) of manufacturing facilities.
- 2.2.3 All the above referenced documents shall be controlled by the manufacture's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and/or revision level. All foreign language documents shall be provided with English translation.

### 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 shall 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 fire service meters.

### 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 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 drawings shall be provided with an English translation.

#### 3.2 Physical or Structural Features

- 3.2.1 Fire service meters shall be designed for a minimum rated working pressure of 175 psi (1205 kPa).
- 3.2.2 Nominal sizes of fire service meters are 2, 3, 4, 6, 8, 10 and 12 inch NPS. Other sizes may be evaluated on a case by case basis.
- 3.2.3 Fire service meters discussed in this standard are characterized in three different types as defined below and discussed in AWWA Standard C703 as well as Ultrasonic Transit-Time Flowmeters and Electromagnetic (Mag Meters) Flowmeters. Other types of fire service meters may be evaluated on a case by case basis.
- Type 1 Devices – Proportional Fire – Service Meter with Check Valve
  - Type 2 Devices – Compound Fire – Service Meter Assembly and Strainer with Check Valve
  - Type 3 Devices – Turbine Fire – Service Meter and Strainer without Check Valve
  - Type 4 Devices - Ultrasonic Transit-Time and Electromagnetic (Mag Meters) Flowmeters
- 3.2.4 Fire service meters of the turbine meter type shall be provided with strainers with a 175 psi (1205 kPa) minimum rated working pressure. Strainers may be standalone devices or incorporated into an integral assembly which includes the meter and detector check valve, if applicable. Standalone meters shall be FM Approved. (See FM Approval Standard 5551, Strainers for use with Water Spray Systems, January 1980)
- 3.2.5 Integral strainers must also meet the requirements of FM Approval Standard 5551, Strainers for use with Water Spray Systems, January 1980. Major requirements include that the filter strainer shall be of corrosion resistant material which shall be designed to entrap material 3/8 in. (10 mm) and larger, the strainer shall be designed to permit removal of the filter for replacement or repairs without removing the strainer from the line, and a flushing outlet with shutoff valve shall be provided with each strainer.
- 3.2.6 Detector check valves, if applicable, may be standalone devices or incorporated into an integral assembly which includes the meter and strainer, if applicable. Standalone detector check valves shall be FM Approved. (See FM Approval Standard 1045, Waterflow Detector Check Valves, August 2005)
- 3.2.7 Integral detector check valves also must also meet the requirements of FM Approval Standard 1045, Waterflow Detector Check Valves, August 2005. Major requirements include a clearance examination, spring cycle testing, bonding adequacy and water absorption testing on rubber sealing components as well as a differential cracking pressure examination.
- 3.2.8 End connections shall be male threaded, female threaded, flanged, or grooved end connections, and shall conform to a nationally or internationally recognized standard. Other types of end connections may be evaluated on a case-by-case basis. Fire service meters with threaded end connections shall be provided with a section to serve as a wrench grip.

- 3.2.9 Devices 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.
- 3.2.10 Replaceable internal parts shall be readily accessible by use of normally available hand tools. Parts lists and instruction shall be easily understood by an informed observer.

### 3.3 Materials

All materials used in these devices shall be suitable for the intended application. Device parts exposed to water shall be constructed of corrosion resistant materials. Particular consideration shall be given to turbines, turbine spindles, and main casings. These and any other materials used in fire service meters shall have physical properties necessary to render them suitable for their intended use. When unusual materials are used, special tests may be necessary to verify their suitability.

### 3.4 Markings

- 3.4.1 Each device shall be permanently marked with the following information:
- Manufacturer's name or trademark
  - Product model designation
  - FM Approvals Certification Mark (See Appendix B)
  - Nominal device size
  - Year of manufacture
  - Manufacturing source code, if made at more than one location
  - Rated working pressure
  - Directional flow arrow
- 3.4.2 Markings shall be cast or forged in raised characters or die stamped on the device body.
- 3.4.3 A corrosion resistant metal nameplate bearing the same information as stated above shall be considered acceptable if permanently fastened to the device body.
- 3.4.4 Other methods of applying permanent markings will be evaluated on a case by case basis.
- 3.4.5 Each required marking shall be legible and durable and applied in any of, or combination of, the above methods with the exception of the directional flow arrow which must be applied as stated in Section 3.4.2 or 3.4.3.
- 3.4.6 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as FM Approved. The FM Approvals Certification Mark (see Appendix B) shall be displayed visibly and permanently on the product. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement with FM Approvals.

### 3.5 Manufacturer's Installation and Operation Instructions

- 3.5.1 The installation instructions, including any special dimension requirements shall be furnished by the manufacturer. Instructions shall be provided in each shipping container.
- 3.5.2 The installation instructions identified in Section 3.5.1 shall be made available in multiple languages in support of the regions where the product is intended to be sold.

### 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 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/IEC 17025 calibration laboratory. The test equipment shall 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 the testing must be within an interval that does not require the equipment to be recalibrated.

### 3.7 Tolerances

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

## 4. PERFORMANCE REQUIREMENTS

### 4.1 Examination

#### 4.1.1 Requirements

The fire service meters 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 samples conform to the physical and structural requirements described in Section 3, General Requirements, and the manufacturer’s drawings. The manufacturer’s installation instructions shall be reviewed for completeness and ease of understanding.

### 4.2 Flow Accuracy

#### 4.2.1 Requirements

Prior to conducting the flow accuracy tests described below a fire service meter assembly of each size, shall be subjected to a hydrostatic test pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater, for a duration of five minutes. There shall be no visible leakage as a result of this test.

4.2.1.1 Type 1 Meter Requirements (Proportional Fire – Service Meter with Check Valve)

Meters shall register not less than 97 percent and not more than 103 percent of the water that actually passes through the meter at any flow rate within the normal test flow rate limits shown in Table 4.2.1.1 below, with the exception of changeover between the bypass meter and the main meter, where the accuracy in this flow range shall not be less than 85 percent. The difference in the flow rate from the beginning to the end of the changeover shall not exceed the changeover flow range shown below.

Table 4.2.1.1 Type 1 Meter Operating Requirements

<i>Nominal Device Size</i>		<i>Normal Flow and Test Range Limits</i>		<i>Changeover Flow Range</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	5 - 200	(19 - 755)	30	(115)
3	(80)	5 - 400	(19 - 1515)	40	(150)
4	(100)	5 - 700	(19 - 2650)	60	(225)
6	(150)	8 - 1600	(30 - 6055)	130	(490)
8	(200)	10 - 2800	(38 - 10 600)	210	(795)
10	(250)	15 - 4400	(57 - 16 655)	300	(1135)
12	(305)	20 - 5500	(75 - 20 820)	350	(1325)

4.2.1.2 Type 2 Meter Requirements (Compound Fire – Service Meter Assembly and Strainer with Check Valve)

Meters shall register not less than 98.5 percent and not more than 101.5 percent of the water that actually passes through the meter at any flow rate within the normal test flow rate limits shown in Table 4.2.1.2 below, with the exception of changeover between the bypass meter and the main meter, where the accuracy in this flow range shall not be less than 85 percent. The difference in the flow rate from the beginning to the end of the changeover shall not exceed the changeover flow spreads shown below.

Table 4.2.1.2 Type 2 Meter Operating Requirements

<i>Nominal Device Size</i>		<i>Normal Flow and Test Range Limits</i>		<i>Changeover Flow Range</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	2 - 160	(8 - 605)	15	(55)
3	(80)	2 - 350	(8 - 1325)	30	(115)
4	(100)	4 - 700	(15 - 2650)	40	(150)
6	(150)	5 - 1600	(20 - 6055)	90	(340)
8	(200)	8 - 2800	(30 - 10 600)	150	(565)
10	(250)	8 - 4400	(30 - 16 655)	200	(755)
12	(305)	12 - 5500	(45 - 20 820)	250	(945)

4.2.1.3 Type 3 Meter Requirements (Turbine Fire – Service Meter and Strainer without Check Valve)

Meters shall register not less than 98.5 percent and not more than 101.5 percent of the water that actually passes through the meter at any flow rate within the normal test flow rate limits shown in Table 4.2.1.3 below.

Table 4.2.1.3 Type 3 Meter Operating Requirements

<i>Nominal Device Size</i>		<i>Normal Flow and Test Range Limits</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	5 - 160	(20 - 605)
3	(80)	5 - 350	(20 - 1325)
4	(100)	5 - 700	(20 - 2650)
6	(150)	30 - 1600	(115 - 6055)
8	(200)	35 - 2800	(135 - 10 600)
10	(250)	55 - 4400	(210 - 16 655)
12	(305)	80 - 5500	(305 - 20 820)

4.2.1.4 Type 4 Meter Requirements [Ultrasonic Transit-Time Flowmeters and Electromagnetic (Mag Meters) Flowmeters]

Meters shall register not less than 98.5 percent and not more than 101.5 percent of the water that actually passes through the meter at any flow rate within the normal test flow rate limits shown in Table 4.2.1.4 below.

Table 4.2.1.4 Type 4 Meters Operating Requirements

<i>Nominal Device Size</i>		<i>Normal Flow and Test Range Limits</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	4 - 160	(15 - 605)
3	(80)	5 - 350	(20 - 1325)
4	(100)	5 - 700	(20 - 2650)
6	(150)	20 - 1600	(75 - 6055)
8	(200)	35 - 2800	(130 - 10 600)
10	(250)	55 - 4400	(210 - 16 655)
12	(305)	85 - 5500	(320 - 20 820)

4.2.2 Test/Verification

Sample fire service meter assemblies shall be subjected to a hydrostatic test pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater, for a duration of five minutes, with no visual body or gasket leakage. Each meter shall then be tested for accuracy by comparing the registered flow on the meter to a calibrated standard. If the manufacturer’s stated normal flow rate and/or accuracy exceeds the limits stated above the meter shall be tested for the manufacturers stated accuracy at the manufacturer’s stated minimum and maximum flows rates. A minimum of 4 data points shall be taken for 2, 3 and 4 inch devices and 6 data points for 6, 8, 10 and 12 inch devices.

### 4.3 Durability (24 hr flow test)

#### 4.3.1 Requirements

The fire service meter assemblies shall be flow tested for a total of 24 hours at a flow equal to the Safe Maximum Operating Capacity shown below in Table 4.3 or to the Manufacturer's Safe Maximum Operating Capacity, whichever is greater.

Table 4.3 Durability Flow Requirements

<i>Nominal Device Size</i>		<i>Safe Maximum Operating Capacities</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	160	(605)
3	(80)	350 (Type 2 & 3) 400 (Type 1)	(1325) (1515)
4	(100)	700	(2650)
6	(150)	1600	(6055)
8	(200)	2800	(10 600)
10	(250)	4400	(16 655)
12	(305)	5500	(20 820)

#### 4.3.2 Tests/Verification

Each size meter shall be tested at the flows shown in Table 4.3 or to the Manufacturer's Safe Maximum Operating Capacity, whichever is greater, for a period of 24 hours. Subsequently, each meter shall then be tested for accuracy by comparing the registered flow on the meter to a calibrated standard. A minimum of 4 data points shall be taken for 3 and 4 inch devices and 6 data points for 6, 8, and 10 inch devices. The accuracy of the meter at the conclusion of the 24 hour test shall be  $\pm 3\%$  of actual flow.

### 4.4 Friction Loss

#### 4.4.1 Requirement

Tests shall be conducted to determine the friction loss through each meter size at various flow rates including the Safe Maximum Operating Capacity shown below or to the Manufacturer's Safe Maximum Operating Capacity, whichever is greater. Friction loss through the meter shall not exceed the losses stated in Table 4.4.2.

Table 4.4.1 Friction Loss Flow Requirements

<i>Nominal Device Size</i>		<i>Safe Maximum Operating Capacities</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>
2	(50)	160	(605)
3	(80)	350 (Type 2 & 3) 400 (Type 1)	(1325) (1515)
4	(100)	700	(2650)
6	(150)	1600	(6055)
8	(200)	2800	(10 600)
10	(250)	4400	(16 655)
12	(305)	5500	(20 820)

4.4.2 Test/Verification

A sample fire service meter shall be installed between two Schedule 40 test pipes of the same nominal diameter as the fire service meter and equipped with piezometer rings. The pressure loss between the piezometer rings shall be measured at a minimum of five flow rates including those listed in Table 4.4.1 to determine the total friction loss of the fire service meter assembly and test piping. The friction loss of the test piping, without the fire service meter assembly installed, shall then be measured at the same flow rates and deducted from the total friction loss with the device installed in the flow line previously measured. The net friction loss across the fire service meter shall not exceed the losses stated in Table 4.4.2.

Table 4.4.2 Friction Loss Requirements

<i>Meter Type</i>	<i>Friction Loss</i>	
	<i>psi</i>	<i>(kPa)</i>
Type 1 Meter - Proportional Fire - Service Meter with Check Valve	4	(30)
Type 2 Meter - Compound Fire - Service Meter Assembly and Strainer with Check Valve	12	(85)
Type 3 Meter - Turbine Fire – Service Meter and Strainer without Check Valve	11	(75)
Type 4 Meter - Ultrasonic Transit-Time Flowmeters and Electromagnetic (Mag Meters) Flowmeters	4	(30)

4.5 Hydrostatic Strength

4.5.1 Requirements

Fire service assemblies shall withstand a hydrostatic pressure of four times the rated working pressure without rupture, cracking or permanent distortion.

4.5.2 Test/Verification

Fire service meter assemblies of each size shall be subjected to a hydrostatic test pressure of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, for a duration of five minutes. There shall be no visible rupture, cracking, or permanent distortion to the fire service meter assemblies as a result of this test.

4.6 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 fire service meters, 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 shall be required to assure that subsequent fire service meters produced by the manufacturer at an authorized location, shall demonstrate the same quality and reliability as the specific fire service meters 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 Surveillance Audit Program. 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 discrepant materials.
- In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed, and their results, for a minimum period of two years from the date of manufacture of the fire service meter.

5.1.2 Documentation/Manual

There shall be an authoritative collection of procedures and policies. It 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 not allow unauthorized changes to the product. Revisions 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 reporting proposed revisions to FM Approved products to FM Approvals before implementation. In situations involving significant modifications to an Approved product, the notification shall be in the form of a formal request for an Approval examination. For modifications of a more common nature, the manufacturer shall provide notification to FM Approvals by means of FM Approvals Form 797, *FM Approved Product/Specification-Tested Revision Request Form*. 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. The table is not all-inclusive. As mentioned above, modifications that fit this category should 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 of Product Sizes	The product was originally FM Approved for 4 and 6 inch NPS, and now Approval of 8 and 10 inch NPS sizes is desired.
Additional or Relocation of the Manufacturing Location	The product was originally FM Approved as manufactured in location A, and now is desired to be made in locations A and B, or only in location B.
Addition of Alternate Suppliers for Purchased Items	Meter Bodies, Standalone Strainers or Detector Check Valves
Major Changes to Critical Dimensions, or Components	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 may affect the results of earlier satisfactory testing of the fire service meters such as: A reduction of body wall thickness in the pressure retaining areas or significant changes in the measuring/metering portion of the meter.

5.1.3.2 The listing 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:	Company Name, Company Contact and Title, Phone Number, Fax Number, Email Address, Company Office Address
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.
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 In instances where the modification is difficult to categorize, manufacturers are encouraged to contact FM Approvals to discuss the nature of the change, and to 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 fire service meters.

**5.2 Surveillance Audit Program**

5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality control program. Its purpose is to ensure that the manufacturer’s equipment, procedures, and quality program are maintained to produce 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 Surveillance audits shall be conducted periodically but at least annually by FM Approvals or its representatives or more frequently depending on jurisdictional requirements. At issue of this standard the Occupational and Safety Health Administration (OSHA) of the United States Department of Labor requires audits of manufacturing sites producing products for use in hazardous locations during each quarter the product is manufactured.
- 5.2.3 The client shall manufacture the FM Approved 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.
- 5.2.4 In the event that all or part of the quality inspection is subcontracted, the manufacturer shall provide FM Approvals with documentation outlining the nature of the inspection, frequency, test details, and pass / fail criteria that was provided to the subcontracted company, and documentation that they have received and implemented these procedures.

### 5.3 Manufacturer's Responsibilities

The manufacturer shall notify FM Approvals of proposed 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 - *Body Leakage*

The manufacturer shall test 100 percent of production meters for body leakage to twice the rated working pressure. The pressure shall be held for a minimum of 30 seconds with no evidence of body leakage or distortion.

#### 5.4.2 Test Requirement No. 1 - *Accuracy*

The manufacturer shall test 100 percent of production meters for accuracy, insuring that they meet the accuracy requirements of this standard, before shipment.

## APPENDIX A: Units of Measurement

<b>FLOW:</b>	gal/min - "gallons per minute"; (L/min - "liters per minute") L/min = gal/min x 3.7854
<b>FORCE:</b>	lb - "pounds"; (N - "Newtons") N = lb x 4.4482
<b>DISCHARGE COEFFICIENT (K-FACTOR):</b>	gal/min/(psi) <sup>1/2</sup> - "gallons per minute per square root of pounds per square inch" (L/min/(bar) <sup>1/2</sup> - "liters per minute per square root of bar") L/min/(bar) <sup>1/2</sup> = gal/min/(psi) <sup>1/2</sup> x 14.414
<b>LENGTH:</b>	in. - "inches"; (mm - "millimeters") mm = in. x 25.4  ft - "feet"; (m - "meters") m = ft x 0.3048
<b>PRESSURE:</b>	psi - "pounds per square inch"; (kPa - "kilopascals") kPa = psi x 6.895  bar - "bar"; (kPa - "kilopascals") bar = kPa x 0.01 bar = psi x 0.06895
<b>VELOCITY:</b>	ft/s - "feet per second"; (m/s - "meters/second") m/s = ft/s x 0.3048
<b>VOLUME:</b>	gal - "gallons"; (L - "liter") L = gal x 3.785  L - "liter"; (dm <sup>3</sup> - "cubic decimeters") L = 1 dm <sup>3</sup>

## APPENDIX B: FM Approvals Certification Marks

FM Approvals certifications marks are to be used only in conjunction with products or services that have been FM 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.



**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.



**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.

*Downloadable art and other FM Approvals resources are available by visiting our Web site at [www.fmaprovals.com](http://www.fmaprovals.com)*

## FM Approvals Certification Marks

### Usage Guidelines

- All FM Approvals certification marks are the sole property of FM Approvals LLC (“FM Approvals”) and are registered or the subject of applications for registration in the United States and many other countries. They are for use only according to these guidelines.
- FM Approvals certification marks may be used only on FM Approved products and related product packaging, in advertising material, catalogs and news releases. Use of FM Approvals certification marks on such material is not a substitute for use of the complete FM Approvals certification mark on FM Approved products and/or product packaging.
- No FM Approvals certification mark or aspect thereof may be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. This includes both design aspects (the FM Approvals “diamond,” etc.) and word aspects (“FM,” “Approved,” etc.). The use of any FM Approvals certification mark as a trademark is strictly prohibited.
- The Approval Standard number or class number may not be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. For example, a company may not say “ABC Company’s 4100 Fire Door is FM Approved”; the proper terminology is, “ABC Company’s Fire Door is FM Approved per Approval Standard 4100.”
- FM Approvals certification marks, except for the FM Approvals Quality System Registration mark, may not be used on business stationery/cards/signage because this could mischaracterize the relationship with FM Approvals. Additionally, these items should not reference any FM Approvals certification mark.
- Products or services may not be marketed under any mark or name similar to “FM Global,” “FM Approvals” or any of the FM Approvals certification marks. Further, products or services may not be marketed to imply a relationship beyond the scope of any Approval made by FM Approvals.
- When an FM Approvals certification mark is used in advertising material or on product packaging, all material must reflect the specific circumstances under which the product was FM Approved. The material must clearly differentiate between products that are FM Approved and those that are not, and may not, in any way, imply a more substantial relationship with FM Approvals.
- A company may not reference the intent to submit a product for Approval or the expectation that a company will have a certain product FM Approved in the future. For example, a company may not state, “Approval by FM Approvals pending” or “Approval by FM Approvals applied for.”
- FM Approvals certification marks should not be preceded or followed by a qualifier that indicates a degree of certification or acceptability. For example, “exceeds,” “first” or “only” may not be used to qualify any FM Approvals certification mark.
- Only original artwork issued by FM Approvals should be used. The FM Approvals certification marks should not be altered in any way other than to resize the artwork proportionately. Unacceptable uses of the marks include, but are not limited to, adding/deleting wording or artwork, reducing the artwork to an illegible size, animation or distortion.
- The text of the FM Approvals certification marks may not be translated into any language other than English.
- FM Approvals certification marks must appear in a size and location that is readily identifiable, but less prominent than the name of the owner of the certification or the manufacturer/seller/distributor of the certified products.

## APPENDIX C: Sample Listings

### Fire Service Meters

Where local waterworks authorities require the installation of full registration metering devices on public water connections to private fire protection systems, meters especially designed for fire protection service should be used. Unless otherwise noted in the listing, these meters have a 175 psi (1205 kPa) rated working pressure.

**TPH Mfg Inc, 743 Reynolds Rd, Chepachet, RI 02814**

<i>Model Number</i>	<i>Nominal Pipe Size, in.</i>	<i>By-Pass Size, in.</i>	<i>Max. Working Pressure, psi (kPa)</i>	<i>Remarks</i>
TPH-2	3	3/4	175 (1205)	a
	4	1	175 (1205)	a
	6, 8, 10	2	175 (1205)	a
TPH-3	3	n/a	175 (1205)	b
	4	n/a	175 (1205)	b
	6, 8, 10	n/a	175 (1205)	b

Remarks

- a. Approved as a Type 2 Fire Service Meter (with Waterflow Detector Check Valve)
- b. Approved as a Type 3 Fire Service Meter (without Waterflow Detector Check Valve)

## APPENDIX D: 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

*Volume Per Unit Area:*  $\pm 5$  percent of value

*Pressure:* + 5 percent of value  
- 0 percent of value

*Temperature:*  $\pm 4^\circ\text{F}$  ( $2^\circ\text{C}$ )

*Flow*  $\pm 2$  percent of value

*Time:* + 5/-0 seconds  
+0.1/-0 minutes

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