



Member of the FM Global Group

Approval Standard for Fire Pump Flowmeter Systems

Class Number 1046

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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 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

I. INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Basis for FM Approval	1
1.4 Basis for Continued Approval	1
1.5 Requirements	1
1.6 Effective Date	2
1.7 System of Units	2
II. GENERAL INFORMATION	2
2.1 Product Information	2
III. GLOSSARY	2
IV. GENERAL REQUIREMENTS (OTHER THAN PERFORMANCE REQUIREMENTS)	3
4.1 Minimum Meter Size	3
4.2 Flow Measurement Device	4
4.3 Markings	4
4.4 Instructions	4
4.5 Physical or Structural Features	4
4.6 Drawings/Plans/Specifications Required	4
4.7 Other Requirements	5
V. PERFORMANCE REQUIREMENTS	5
5.1 Operation and Accuracy	5
5.2 Hydrostatic Strength	5
5.3 Friction Loss Determination	6
VI. MANUFACTURING AND FIELD INSTALLATION REQUIREMENTS	6
6.1 Demonstrated Quality Control Program	6
6.2 Facilities and Procedures Audit (F&PA)	7
APPENDIX A: APPROVAL MARKS	8
APPENDIX B: UNITS OF MEASUREMENT	9

I. INTRODUCTION

1.1 Purpose

This standard states FM Approval requirements for fire pump flowmeter systems used to determine the discharge of a fire pump.

1.2 Scope

There are many devices and methods for measuring the flow of liquids through a pipeline. The devices examined to the requirements of this standard shall be specifically Approved for use on fire pump systems, and a particular model or models shall be specified for a particular pump size.

1.3 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.3.1 Examination and tests on production samples shall be performed to evaluate

- the suitability of the product; and
- the proper operation and performance of the product as specified by the manufacturer and required by FM Approvals.

1.3.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product which is 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.

1.4 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality control procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement; and
- re-examination of production samples for continued conformity to requirements.

1.5 Requirements

1.5.1 The requirements of this standard are based on experience, research and testing and/or the standards of other national and international organizations. The advice of manufacturers, users, trade associations and loss control specialists was also considered.

1.5.2 Meeting these requirements qualifies a product as an Approved fire pump flowmeter system.

1.5.3 The requirements of this standard reflect tests and practices used to examine characteristics of fire pump flowmeter systems for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Fire pump flowmeter systems 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, flowmeters which do meet all 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.

1.6 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 else forfeit Approval. The effective date shall apply to the entire Approval standard, or, where so indicated, only to specific paragraphs of the standard.

1.7 System of Units

Units of measurement are English System standard units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. Appendix B lists the selected units for quantities dealt with in testing these products; conversions to SI units are included. Conversion of U.S. customary units is in accordance with ASTM E380.

II. GENERAL INFORMATION

2.1 Product Information

Fire pump flowmeter systems are used to measure the flow output of fire pumps during testing; when installed they perform the same function as a system of 2½ inch fire hose and playpipes. The system is permanently installed in a pipeline which connects the discharge of the pump to the suction supply of the pump or to drain facilities. The system is isolated from the pump discharge during pump operations other than flow testing.

III. GLOSSARY

For purposes of this standard, the following terms apply:

Flow Element — The flow element is that part of the system which is permanently installed in the meter line. The device generates a signal (i.e., a secondary flow, a pressure differential, an electrical signal, or other) which is proportional to the flow of water discharging from the pump and which is sent to the flow measurement device. The flow element may be a venturi tube, orifice plate, magnetic meter, pilot tube, or other device, and may be made up of a combination of these devices.

Flow Measurement Device — The flow measurement device is that part of the system which displays the signal produced by the flow element as a flow rate. This instrument may be portable or permanently installed. The flow measuring instrument may be a manometer, a differential meter with linear or square root scale, a rotameter, an electrical meter, or other readout device.

IV. GENERAL REQUIREMENTS (OTHER THAN PERFORMANCE REQUIREMENTS)

4.1 Minimum Meter Size

- a) The following minimum meter sizes (nominal pipe size of the meter line) shall be observed:

<i>Pump Rating</i>		<i>Meter Line Size</i>	
<i>gal/min</i>	<i>(dm³/min)</i>	<i>inches</i>	<i>mm</i>
200	(760)	3	(76)
250	(950)	3.5	(89)
300	(1140)	3.5	(89)
450	(1710)	4	(102)
500	(1890)	5	(127)
750	(2830)	5	(127)
1000	(3790)	6	(152)
1250	(4730)	6	(152)
1500	(5675)	8	(203)
2000	(7570)	8	(203)
2500	(9460)	8	(203)
3000	(11340)	8	(203)
3500	(13250)	10	(254)
4000	(15140)	10	(254)
4500	(17030)	10	(254)
5000	(18925)	12	(305)

- b) These values are based on an expected maximum head loss through the meter line (including pipe, fittings, valves, elevation and the meter) of less than or equal to 100 feet (30.5 m) of straight pipe (Schedule 40), based on the Hazen & Williams formula with C equal to 120.
- c) Some pump installations may have head losses through the meter line of greater than 100 equivalent feet. In these situations, a larger meter and associated piping would be required. It is permissible for the manufacturer to anticipate this situation, and to have a larger than minimum size (see Paragraph 4.1 a) flowmeter system Approved for a particular pump. For example, a 6 inch (152 mm) meter, the minimum size for a 1000 or 1250 gal/min (3785 or 4730 dm³/min) pump, could be equipped with an additional scale for use with a 500 or 750 gal/min (1895 or 2840 dm³/min) pump. These additional combinations would be subjected to the same examination as the rest of the systems in the manufacturer's line.

4.2 Flow Measurement Device

- 4.2.1 The scale of the device shall read in units of volume per unit of time. Dual scales are permitted, and systems marketed in the United States shall read in gallons per minute (gal/min).
- 4.2.2 The range of the device shall be at least 200 percent of the rated capacity of the pump for which it will be used.

4.3 Markings

Each component of the system shall be permanently marked with the manufacturer's trademark; applicable operating characteristics such as rated working pressure, range and size, model or type number, year of manufacture; and the FM Approval mark.

4.4 Instructions

The manufacturer shall provide installation/operation procedures and maintenance instructions with each system. Details of recommended upstream and downstream piping configurations shall be included.

4.5 Physical or Structural Features

- 4.5.1 *Sizes* — System sizes shall be compatible with pump ratings (see Paragraph 4.1a).
- 4.5.2 *Rated Working Pressure* — All system components that come in contact with system water shall have a minimum rated working pressure of 175 psi (1.2 Mpa).
- 4.5.3 *Materials* —
- a) All flow element components shall be constructed of materials suitable to resist the ambient conditions common to fire pump installations. If the build-up of corrosion and corrosion products will have a detrimental effect on system performance, those parts that come in contact with moisture shall be made from corrosion resistant materials.
 - b) Rubber or rubber-like materials contained in system components may be subjected to a detailed investigation, including evaluation of water absorption, hardness, aging and adhesion.
- 4.5.4 *Operation and Failure Mode* — Fire pump flowmeter systems are used on an infrequent basis and must remain idle for long periods. When they are used, they must perform accurately and reliably. If there is a system malfunction which could cause inaccurate flow readings, this condition shall be readily apparent to the operator.
- 4.5.5 *End Connections* — End connections for the in-line portion of the system shall be compatible with fire pump piping connections. These may be flanged ends, wafer-type elements to fit between flanged connections, or other configurations.

4.6 Drawings/Plans/Specifications Required

The manufacturer shall provide general assembly drawings, piping and electrical schematics, materials lists, nameplate format, brochures, sales literature, specification sheets, etc.

4.7 Other Requirements

Fire pump flowmeter systems are composed of flow elements and flow measuring devices which are specifically designated for a particular pump rating. No attempt should be made to use any of the component parts for purposes other than that intended by the manufacturer. This precaution shall be clearly stated by the manufacturer.

V. PERFORMANCE REQUIREMENTS

Representative samples of a line of fire pump flowmeters shall be tested, typically two or three sizes. Depending on the circumstances of the project, this testing shall be performed at FM Approvals, or at flow testing facilities provided by the manufacturer. Additional flow data for the remaining sizes shall be provided and shall be evaluated during the system examination.

5.1 Operation and Accuracy

5.1.1 Requirement

The system shall display an accuracy of ± 2 percent full scale deflection, for the range of flows from 50 percent to 200 percent of the rated capacity of the pump for which it will be used.

For example, a device used on a 1000 gal/min (3785 dm³/min) pump shall be accurate within ± 40 gal/min (150 dm³/min) for all flow rates in the range from 500 gal/min to 2000 gal/min (1895 to 7570 dm³/min).

5.1.2 Test/Verification

Sufficient flow tests shall be performed on the samples selected to ensure that the system meets the above requirements. Flow measurements shall be easy to read within minimal fluctuation or oscillation of the readings.

5.2 Hydrostatic Strength

5.2.1 Requirement

The flow element of the "in-line" portion of the system and the meter portion of the system shall resist rupture or permanent deformation when subjected to hydrostatic pressure as indicated below.

5.2.2 Test/Verification

- a) The flow element of the "in-line" portion of the system shall be hydrostatically tested to 700 psi (4.8 MPa) or 400 percent of the rated working pressure (whichever is greater) for 5 minutes. No rupture or permanent deformation shall result.
- b) The meter portion of the system, including the signal lines, shall be hydrostatically tested to 350 psi (2.4 Mpa) or 200 percent of the rated working pressure (whichever is greater) for 5 minutes. No rupture or permanent deformation shall result.

5.3 Friction Loss Determination

5.3.1 Requirement

There is no specification for this loss, although systems with excessively high friction loss shall be evaluated on a case-by-case basis.

5.3.2 Test/Verification

Friction loss through the meter shall be determined during the system evaluation.

VI. MANUFACTURING AND FIELD INSTALLATION REQUIREMENTS

6.1 Demonstrated Quality Control Program

6.1.1 A quality control program is required to assure that each subsequent fire pump flowmeter system produced by the manufacturer shall present the same quality and reliability as the specific samples examined. Design quality, conformance to design, and performance are the areas of primary concern.

Design quality is determined during the examination and tests, and is covered in the Approval report.

Conformance to design is verified by control of quality in the following areas:

- existence of corporate quality control guidelines
- incoming inspection and test
- in-process inspection and test
- final inspection and test
- equipment calibration
- drawing and change control
- packaging and shipping

Quality of performance is determined by field performance and by re-examination and test.

6.1.2 The manufacturer shall establish a system of product configuration control to prevent unauthorized changes, including, as appropriate:

- engineering drawings
- engineering change requests
- engineering orders
- change notices

These shall be executed in conformance with a written policy and detailed procedures. Records of all revisions to all Approved products shall be kept.

- 6.1.3 The manufacturer shall assign an appropriate person or group to be responsible for keeping FM Approvals informed of all pending changes applicable to Approved products. FM Approvals Form 797, "Approved Product Revision Report or Address/Contact Change Notice", is provided to notify FM Approvals of pending changes.

6.2 Facilities and Procedures Audit (F&PA)

6.2.1 At Manufacturing Plant

- a) An inspection of the product manufacturing facility shall be part of the Approval investigation. Its purpose shall be to determine that equipment, procedures, and the manufacturer's controls are properly maintained to produce a product of the same quality as initially tested.
- b) Unannounced follow-up inspections shall be conducted to assure continued quality control and product uniformity.

APPENDIX A

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 B

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”; (MPa – “megapascals”) kPa = psi × 0.0068948
FLOW:	gal/min = gallons per minute (dm ³ /min = cubic decimeters per minute) dm ³ /min = gal/min × 3.7854