

CLASS NUMBER 1046

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# Examination Standard for Flow Test Equipment for Fire Protection Systems

## Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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## 1. INTRODUCTION

### 1.1. PURPOSE

- 1.1.1. This standard states testing and certification requirements for flow testing equipment for fire protection systems used to determine the flowrate of systems.
- 1.1.2. Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

### 1.2. SCOPE

- 1.2.1. 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 certified for use on fire pump systems, standpipe systems and fire hydrants, as specified by the manufacturer. These devices may be permanently or temporarily installed for the purpose of measuring the liquid flow of these fire protection systems. The flow test equipment will be certified for a particular flow range.

### 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 flow testing equipment for fire protection systems for the purpose of obtaining certification.

### 1.4. BASIS FOR CERTIFICATION

Certification 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 for certification,
  - the durability and reliability of the product.
- 1.4.2. An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

### 1.5. BASIS FOR CONTINUED CERTIFICATION

The basis for continual certification may include the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

### 1.6. EFFECTIVE DATE

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard 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. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this standard.

1.8. NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

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

1.9. TERMS AND DEFINITIONS

Accepted	This term refers to installations acceptable to the authority enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.
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.
Flow Element	The flow element is the part of the system which is installed in the discharge 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 fire protection system and which is sent to the flow measurement device. The flow element may be a venturi tube, orifice plate, magnetic meter, pitot 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 a linear or square root scale, a rotameter, an electrical meter, or another readout device.
Nozzle Discharge Systems	Like a playpipe, the pressure is measured and used to calculate the flow using the known k-factor of the device.
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.
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.

**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.

**Venturi Type Flowmeters**

A differential pressure flow meter with no moving parts, which measures the difference of the pressure at the inlet and outlet of a venturi tube. The differential pressure is converted to the actual flow on some type of read-out device.

## 2. GENERAL INFORMATION

### 2.1. PRODUCT INFORMATION

- 2.1.1. Flow test equipment for fire protection systems discussed in this standard are composed of flow elements and flow measurement devices designed to measure the flow output of fire pumps, standpipes, and/or fire hydrants during flow testing.
- 2.1.2. Flow test equipment for fire protection systems are specifically designed for particular pump ratings or a certain flow range. They are not considered certified if used outside of the flow range or for a different pump rating.
- 2.1.3. The in-line flow test system is any flowmeter that is permanently installed into the pipeline which connects the discharge of the fire protection system to the suction supply or to drain facilities. The system is isolated from the pump discharge during pump operations other than flow testing. Meter types and designs may vary between manufacturers.
- 2.1.4. Nozzle discharge flow test systems are setup only for the flow tests and are not permanent fixtures in the fire protection system. A typical nozzle discharge test assembly can include nozzles, fire hose assemblies, pressure or pitot gauges, test valves and discharge diffusers. Component types and designs may vary between manufacturers.
- 2.1.5. 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.

### 2.2. CERTIFICATION APPLICATION REQUIREMENTS

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

- a complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration.
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures.
- the number and location of manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

### 2.3. REQUIREMENTS FOR SAMPLES FOR EXAMINATION

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

- 2.3.1. Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:
  - Sample requirements to be determined by the certification agency.
- 2.3.2. Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.
- 2.3.3. The manufacturer shall submit samples representative of production.
- 2.3.4. It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the flow test equipment .
- 2.3.5. If there are failures encountered during the examination testing, the certification agency will provide the manufacturer with information regarding what testing will need to be repeated and any additional test sample requirements.

### **3. GENERAL REQUIREMENTS**

#### **3.1. REVIEW OF DOCUMENTATION**

- 3.1.1. During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.
- 3.1.2. The manufacturer's dimensional specifications and/or dimensional drawings shall fully describe the product. All critical dimensions shall be indicated with the allowed upper and lower tolerance limits clearly shown.

#### **3.2. PHYSICAL OR STRUCTURAL FEATURES**

- 3.2.1. Fire pump flow test system sizes shall be compatible with certified fire pump flow rates and line size. Other flow test equipment for other fire protection systems shall be tested and certified to the ratings required in that system.
- 3.2.2. All materials used in the flow test equipment shall be suitable for its intended applications. The material strength of the components shall be sufficiently strong and may be subjected to a detailed investigation.
- 3.2.3. All in-line flow test system components that come in contact with system water shall have a minimum rated working pressure of 175 psi (1205 kPa).
- 3.2.4. 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).
- 3.2.5. When installed in fire pump systems, the range of the in-line flow test system shall be at least 200 percent of the rated capacity of the pump for which it will be used. All flow test equipment shall be rated for the flow rate that is being measured.
- 3.2.6. In-line fire protection flow test equipment is installed on a separate pipeline than the sprinkler system and nozzle discharge flow test systems are only installed during testing; therefore, the friction loss across the product does not need to be considered for hydraulic calculations.
- 3.2.7. All flow element components shall be constructed of materials suitable to resist the ambient conditions common to fire protection system 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.
- 3.2.8. 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.
- 3.2.9. In-line flow test systems for fire protection 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.
- 3.2.10. End connections for the in-line portion of the system shall be compatible with fire protection system piping connections. These may be flanged ends, wafer-type elements to fit between flanged connections, or other suitable configurations.

### 3.3. MARKINGS

3.3.1. Each device shall be permanently marked with the following information:

- Manufacturer's name or trademark;
- Product model designation;
- Certification mark;
- Nominal device size;
- Date of manufacture, code traceable to date of manufacture or lot identification;
- Manufacturing source code, if made at more than one location;
- Directional flow arrow;
- Flow rating or capacity as appropriate;
- Rated working pressure as appropriate.

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

3.3.2. All markings shall be legible and durable.

3.3.3. The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.3.4. The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

### 3.4. MANUFACTURER'S INSTALLATION AND OPERATION INSTRUCTIONS

3.4.1. The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the product;
- provide installation/operation procedures and maintenance instructions with each system—details of recommended upstream and downstream piping configurations shall be included;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for the product where it is not reasonable to expect the average user to be able to provide the installation, inspection, or maintenance.

### 3.5. CALIBRATION

3.5.1. Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to the National Institute of Standards and Technology (NIST) or to other acceptable reference standards and certified by an ISO/IEC 17025 accredited 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 provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.5.2. When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

### 3.6. TOLERANCES

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

## 4. PERFORMANCE REQUIREMENTS

### 4.1. OPERATION AND ACCURACY

#### 4.1.1. Requirement

The flow testing equipment shall be tested for accuracy by comparing the registered flow to a calibrated standard. The flow testing equipment rated range of flows shall display an accuracy of  $\pm 2$  percent of the full scale.

#### 4.1.2. Test/Verification

Sufficient flow tests shall be performed on each size sample to ensure that the flow testing equipment meets the above requirements. The flow testing equipment shall display an accuracy of  $\pm 2$  percent of the full scale for the range of flows. Flow measurements shall be easy to read within minimal fluctuation or oscillation of the readings.

### 4.2. HYDROSTATIC STRENGTH

#### 4.2.1. Requirement

The flow element and the measurement portion of the in-line flow test system shall resist rupture or permanent deformation when subjected to hydrostatic pressure as indicated below. Nozzle discharge devices, that only flow and discharge water, will not be subjected to this test unless deemed necessary by the certification agency.

#### 4.2.2. Test/Verification

- A. The flow element 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.

### 4.3. ROUGH USAGE TEST

#### 4.3.1. Requirement

Flow test equipment that is not permanently installed in a flow loop and is subjected to constant installation and removal shall operate and show no significant deformation, blistering, or fracture following rough usage. All functions of the flow test equipment shall operate as intended.

After completion of the rough usage test, if deemed necessary by visual inspection, deterioration of the performance characteristics shall be evaluated by testing the Operation and Accuracy test (Section 4.1) again.

#### 4.3.2. Test/Verification

A sample will be dropped a minimum of ten times from 4 feet elevation onto a concrete floor. Initial position of the sample will vary from vertical to horizontal. There shall be no deformations which will interfere with the flow accuracy or operation.

Following the drop tests, the nozzle shall be examined for signs of significant deformation, blistering, or fracture. If deemed necessary by visual inspection, deterioration of the performance characteristics shall be evaluated by testing the operation and accuracy test (Section 4.1) again.

### 4.4. VIBRATION RESISTANCE

#### 4.4.1. Requirement

A new test sample shall withstand the effects of vibration without cracking, rupture, leakage, or movement from its originally installed location. Following the vibration test detailed in Section 4.4.2 the connection between the pipe and the test sample shall not leak when tested in accordance with the requirements of Section 4.2, Hydrostatic Strength.

#### 4.4.2. Test/Verification

Compliance shall be verified by tests of representative samples of flow test equipment for fire protection systems. The assembly shall be pressurized to 80 psi (550 kPa) during the entire test and shall be subjected to the vibration sequence of Table 4.4.2; each 5 hour test increment shall be run continuously. The plane of vibration shall be vertical. No joint leakage or other failure is allowed during this 25 hour test. Subsequently, the hydrostatic test of Section 4.2 shall be repeated after the vibration test. No leakage or other failure shall be observed during the hydrostatic test.

Table 4.4.2 Vibration Conditions

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

## 5. MANUFACTURING REQUIREMENTS

### 5.1. DEMONSTRATED QUALITY CONTROL PROGRAM

- 5.1.1. A quality assurance program is required to assure that subsequent flow test equipment for fire protection systems produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.
- Design quality is determined during the examination and tests and may be documented in the certification report.
  - Continued conformance to this standard is verified by the certifier's surveillance program.
  - Quality of performance is determined by field performance and by periodic re examination and testing.
- 5.1.2. The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:
- existence of corporate quality assurance guidelines;
  - incoming quality assurance, including testing;
  - in process quality assurance, including testing;
  - final inspection and tests;
  - equipment calibration;
  - drawing and change control;
  - packaging and shipping; and
  - handling and disposition of non-conforming materials.
- 5.1.3. Documentation/Manual
- There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.
- 5.1.4. Records
- To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.
- 5.1.5. 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 certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
  - Records of all revisions to all certified products shall be maintained.

### 5.2. SURVEILLANCE AUDIT

- 5.2.1. An audit of the manufacturing facility may be part of the certification agencies surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.
- 5.2.2. Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

### 5.3. PRODUCT MODIFICATIONS

- 5.3.1. The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

## **5.4. MANUFACTURING AND PRODUCTION TESTS**

- 5.4.1. Test Requirement No. 1 – Body Leakage
- 5.4.2. The manufacturer shall test a minimum of 1 production flow test equipment for fire protection systems 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.
- 5.4.3. Test Requirement No. 2 – Accuracy
- 5.4.4. The manufacturer shall test a minimum of 1 production flow test equipment for fire protection systems per day for accuracy, ensuring that they meet the accuracy requirements of this standard, before shipment.

## 6. BIBLIOGRAPHY

ISO/IEC 17025, the international standard for testing and calibration laboratories.

## APPENDIX A: 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  $68 \pm 9^{\circ}\text{F}$  ( $20 \pm 5^{\circ}\text{C}$ ).