



Approval Standard for Vane-Type Waterflow Alarm Indicators

Class Number 1042

May 2016

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 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 requirements for vane-type waterflow alarm indicators for installations in automatic sprinkler systems. Other applications shall be evaluated on a case-by-case basis.
- 1.1.2 Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements of vane-type waterflow alarm indicators for use in aboveground automatic sprinkler systems designed and installed in accordance with FM Global Property Loss Prevention Data Sheets.
- 1.2.2 This Approval Standard encompasses Nominal Pipe Size (NPS) 1, 1-1/4, 1-1/2, and 2 inch vane-type waterflow alarm indicator that are installed in piping via threaded connection.
- 1.2.3 This Approval Standard encompasses NPS 2, 2-1/2, 3, 4, 5, 6, and 8 inch vane-type waterflow alarm indicators that are installed in piping via a pre-cut hole in system piping with a U-bolt connection.
- 1.2.4 The minimum rated working pressure for vane-type waterflow alarm indicators evaluated using this standard is 175 psi (1205 kPa).
- 1.2.5 This standard is intended to verify that the product described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of vane-type waterflow alarm indicators for the purpose of obtaining Approval. Vane-type waterflow alarm indicators having characteristics not anticipated by this standard may be FM Approved if performance equal, or superior, to that required by this Standard is demonstrated, or if the intent of the standard is met. Alternatively, vane-type waterflow alarm indicators which meet all of the requirements identified in this Standard may not be FM Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for Approval

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

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
 - the suitability of the product;
 - the performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures is made 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. These examinations may be repeated as part of FM Approvals' Surveillance Audit program.

1.5 Basis for Continued Approval

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 Approval report;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Surveillance Audits conducted as part of FM Approvals' product surveillance audit program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval.

The effective date of this Standard is December 31, 2016 for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-2010, "American National Standard for Metric Practice."

1.8 Applicable Documents

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

FM Global Property Loss Prevention Data Sheets

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

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 impact upon the decision to accept, or not to accept. 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.)

Corrosion Resistant

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

FM Approvals Certification Mark

The FM Approvals Certification Mark. Its 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, issued annually, or its supplements. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. These forms obligate the manufacturer to allow re-examination of the product and surveillance audits at FM Approval’s discretion. It further requires the manufacturer not to deviate from the as-FM Approved configuration of the product without review by and agreement of FM Approvals.

Retard

The time delay between paddle response to waterflow and the switch output. This delay is typically controlled by a pneumatic or electronic delay assembly.

Rated Working Pressure

The maximum sustained pressure in pounds per square inch - psi (kilopascals -kPa) at or below which the vane-type waterflow alarm indicator shall operate trouble free. This value sets the basis for the testing described in Section 4.

2 GENERAL INFORMATION

2.1 Product Information

- 2.1.1 In order to meet the intent of this standard, vane-type waterflow alarm indicators must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample devices, selected in conformance to this criterion, shall satisfy all of the requirements of this Standard.
- 2.1.2 Vane-type waterflow indicators discussed in this Approval standard are for use in wet sprinkler systems.

2.2 Approval Application Requirements

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

Manager of Fire Protection
FM Approvals Hydraulics Laboratory
743A Reynolds Road
West Glocester, RI 02814
U.S.A.

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

- A complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration;
- product assembly drawings including: General assembly drawings, complete set of manufacturing drawings, materials list(s) and physical property specifications, anticipated marking format;
- copy of the installation/operation manual;
- copy of the sales literature/brochures;
- 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 foreign language documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Sample requirements are to be determined by FM Approvals following review of the preliminary information used in the preparation of the examination proposal. Sample requirements may vary depending on size range of the product under consideration, design features, or results of prior testing. Following the authorization of the examination proposal, the manufacturer shall submit samples for examination and testing using the shipping guidance information included with the proposal letter.
- 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. Any decision to use data generated using prototypes is at the discretion of FM Approvals.
- 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 vane-type waterflow alarm indicators.
- 2.3.5 If there are failures encountered during the examination testing, FM Approvals will provide the manufacturer with information regarding what testing will need to be repeated and any additional 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 Approval investigation shall define the limits of the Approval.
- 3.1.2 The manufacturer's dimensional specification and/or dimensional drawings shall fully describe the product. All critical dimensions shall be identified with the allowed upper and lower tolerance levels clearly shown.

3.2 Physical or Structural Features

- 3.2.1 Vane-type waterflow alarm indicators shall be designed for a minimum rated working pressure of 175 psi (1205 kPa).
- 3.2.2 Vane-type waterflow alarm indicators covered by this Standard are for installations in Schedule 10 and Schedule 40 steel pipe in nominal sizes of 1 inch (25 mm) through 8 inch (200 mm). Other sizes of vane-type waterflow alarm indicators shall be evaluated on a case-by-case basis.
- 3.2.3 The vane-type waterflow alarm indicators shall be fitted with a mechanical or electronic retard assembly which will permit the adjustment of an alarm delay from an instantaneous alarm up to a maximum 120 seconds retard. This retard adjustment shall be such that the user can select predefined delay points within this range.

- 3.2.4 The retard assembly design shall completely reset when waterflow ceases before the retard time has elapsed. After resetting the complete predetermined retard time must elapse after a successive waterflow condition in order for the switch output to take place.
- 3.2.5 An enclosure that is adequate for the service conditions shall be provided to protect the retard assembly and electrical components.
- 3.2.6 Vane-type waterflow alarm indicators shall be provided with two electrical switches which provide output at the same time. Electrical switch design shall permit wiring normally open or normally closed.
- 3.2.7 Vane-type waterflow alarm indicators shall be designed so that they can be installed in either horizontal or vertical directions and that after proper initial factory setting they will provide the following:
- Provide a switch output at a minimum flow rate between 4 and 20 gpm (15 and 75 L/min) at any service pressure between 20 psi (140 kPa) and the rated working pressure;
 - return to the original switch position immediately after water flow ceases;
 - transmit successive switch outputs without manual resetting.
- 3.2.8 Samples 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.
- 3.2.9 Waterflow detectors shall be evaluated for their electrical performance. The test requirements listed below define the minimum requirements for FM Approval. In order to establish the electrical test program, the manufacturer is required to submit documentation outlining the location of intended use, enclosure, design features, wiring diagrams, and detail drawings for review. After review, FM Approvals will advise the required test program.
- 3.2.10 Vane-type waterflow alarm indicators shall provide a leak free seal to the pipe they are installed on.

3.3 Markings

- 3.3.1 Marking on the product or, if not possible due to size, on its packaging or label accompanying the product, shall include the following information:
- name and address of the manufacturer or marking traceable to the manufacturer;
 - date of manufacture or code traceable to date of manufacture or lot identification;
 - model number, nominal size, rated working pressure, direction of flow.

When hazard warnings are needed, the markings should be universally recognizable. The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as FM Approved. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

- 3.3.2 The Approval Mark shall be displayed visibly and permanently on the product and/or packaging as appropriate. The manufacturer shall not use this Mark on any other product unless such product is covered by a separate report.
- 3.3.3 All markings shall be legible and durable.
- 3.3.4 Wiring instructions shall be permanently attached to the inside cover.

3.4 Manufacturer's Installation and Operation Instructions

The manufacturer shall provide the user with

- instructions for the installation, maintenance, and operation of the product. Instructions shall be provided with each shipping container.
- facilities for repair of the product and supply replacement parts.

3.5 Calibration

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

3.6 Tolerances

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

4 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirements

The vane-type waterflow alarm indicator shall conform to the manufacturer's drawings and specifications and to FM Approvals requirements.

4.1.2 Test/Verification

A sample shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.2 Gasket Leakage

4.2.1 Requirement

The vane type waterflow alarm indicator when hydrostatically tested at a pressure equal to two times the rated working pressure for duration of five minutes shall not leak.

4.2.2 Test/Verification

A sample of each size device submitted for Approval shall be installed in accordance with the manufacturer's installation instructions in a short section of appropriately sized pipe (approximately 3-4 ft. in length) such that the sample can be subjected to a hydrostatic pressure equal to two times the rated working pressure for a duration of five minutes. There shall be no leakage of the test sample as a result of this test.

4.3 Hydrostatic Strength

4.3.1 Requirement

The vane type waterflow alarm indicator shall have sufficient strength to withstand a hydrostatic pressure equal to four times the rated working pressure for duration of five minutes.

4.3.2 Test/Verification

A sample of each size device submitted for Approval shall be tested. The test will consist of installing the sample in accordance with the manufacturer's installation instructions in a short section of appropriately sized pipe such that the sample can be subjected to a hydrostatic pressure equal to four times the rated working pressure for a duration of five minutes. There shall be no rupture, cracking, or permanent distortion of the test sample as a result of this test.

4.4 Operational

4.4.1 Requirements

The vane-type alarm waterflow indicators mechanical or electronic retard assembly shall permit the adjustment of an alarm delay from an instantaneous alarm up to a maximum 120 seconds retard. This adjust shall be such that the user can select predefined delay points within this range.

4.4.2 Tests/Verification

One or more representative samples of the product line will be used for this test. The test consists of forcing the paddle to its forward flow position and measuring the reaction time of the switches at each retard setting. This test will be conducted three times for each retard setting and for each switch. A retard value in excess of 120 seconds is not permitted.

4.5 Sensitivity

4.5.1 Requirements

Vane-type waterflow alarm indicators shall be designed so that they can be installed in either horizontal or vertical installations and that after proper initial factory setting they will provide a switch output at a minimum flow rate between 4 and 20 gpm (15 and 75 L/min) at any service pressure between 20 psi (140 kPa) and the rated working pressure, return to the original switch position immediately after waterflow ceases, and transmit successive switch outputs without manual resetting.

4.5.2 Test/Verification

A vane-type waterflow alarm indicator of each size submitted shall be tested in horizontal and vertical installations. After installation of the vane-type waterflow alarm indicator in a section of

appropriately sized pipe, the minimum flow-rate necessary to produce a switch output shall be determined. This flow-rate shall be determined by using a device to determine the switch status while waterflow is gradually increased. The flow will be recorded at the point of switch actuation. This flow-rate shall be between 4 and 20 gpm (15 and 75 L/min) and the switch output must occur on both switches simultaneously. Once the flow-rate has been determined, the water flow shall be lowered while the system pressure is maintained. Each switch must return to its normal position and the retard assembly must reset completely. This test shall be repeated two additional times at the same system pressure. Subsequently, the system pressure shall be increased and the three tests will be conducted again. This series of tests shall be repeated a minimum of seven times between 20 psi (140 kPa) and the rated working pressure.

4.6 Fatigue

4.6.1 Requirement

In order to determine the vane-type waterflow alarm indicator's ability to withstand flows created by fluctuating water pressures, systems tests and operation of sprinklers one or more representative sample(s) shall be subjected to 100,000 cycles of repeated flexing at a rate of 15 to 20 cycles/min. There shall be no deterioration of the performance characteristics as a result of this test. Following the cycling test the test sample shall comply with the sensitivity requirements of Section 4.5 (Sensitivity).

4.6.2 Test/Verification

One or more representative sample(s), selected as representative samples, shall be subjected to 100,000 cycles. A single cycle is defined as flexing the vane in the forward direction through an angle of 45° from the "normal" (zero flow) position and then permitting it to return to the "normal" position. The rate of the cycling shall be between 15-20 cycles per minute.

A rubber faced roller (approximately O.D. of 3 in.) connected to the end of an air powered oscillating rod will be arranged to translate the vane at its center when it is in the "normal" position. The roller moves at all times in a direction perpendicular to the plane of the vane when in its "normal" position.

There shall no failure or significant change in performance characteristics as a result of this test. Following the cycling test, the sample shall be tested to verify compliance with the sensitivity requirements in Section 4.5 (Sensitivity).

4.7 Friction Loss

4.7.1 Requirements

The construction of the vane-type waterflow alarm indicators shall be such that the loss in pressure across the device shall not exceed 5.0 psi (34 kPa) at a flow producing a velocity of 20 ft/sec (6 m/s).

4.7.2 Test/Verification

A sample vane-type waterflow alarm indicator of each size shall be tested to verify that the friction loss through the vane-type waterflow alarm indicator does not exceed 5.0 psi (34 kPa) at a flow producing a velocity of 20 ft/sec (6 m/s). A minimum of three data points shall be obtained including the value at 20 ft/sec (6 m/s) plus at least one point above and below this value. This test or a portion thereof may be waived at the option of the examining engineer if a drawing and calculation review are satisfactory, or a review of manufacturer's supplied friction loss data is deemed satisfactory.

4.8 Durability

4.8.1 Requirements

The construction of the vane-type waterflow alarm indicators shall be such that device can withstand high flow rates in both the forward and reverse flow directions.

4.8.2 Test/Verification

One or more vane-type waterflow alarm indicator(s), selected as representative samples, shall undergo testing in which the indicator is subjected to a flow rate which will produce 20 ft/sec (6 m/s) for thirty minutes in both the forward and reverse directions. There shall be no failure or significant change in performance characteristics as a result of this test. Following the durability test, the sample shall be tested to verify compliance with the sensitivity requirements in Section 4.5 (Sensitivity).

4.9 Supervisory Switches - Dielectric

4.9.1 Requirement

The switch shall withstand, for a time period one minute, high potential applied between the switch contacts and the valve enclosure (body), and between the switch contacts and the switch enclosure. During this test there shall be no signs of arcing or breakdown.

4.9.2 Test/Verification

The voltage, based on the switch rating, as shown in Table 4.9.2, shall be applied between the switch contacts and the vane-type waterflow alarm indicator enclosure and between the switch contacts and the switch enclosure. This voltage shall be applied in each test for a duration of 1 minute. During the dielectric test there shall be no signs of arcing or breakdown.

Table 4.9.2 Dielectric Test

<i>Switch Ratings</i>	<i>Test Parameters</i>
24 Volt	500 Volts
60 Volt, or higher	1000 Volts + 2 * (AC Voltage if over 60 Volts)

4.10 Supervisory Switches - Bonding Resistance

4.10.1 Requirement

The resistance measured between the grounding screw and/or terminal and various locations shall be less than 1 ohm.

4.10.2 Test/Verification

Using an ohmmeter, the resistance measured between the grounding screw and/or terminal and various locations on the vane-type waterflow alarm indicator housing and enclosure shall be measured.

4.11 Additional Tests

Additional tests may be required, at the discretion of FM Approvals, depending on design features, results of any foregoing tests or to further verify the integrity and reliability of the vane-type waterflow alarm indicators.

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

5 OPERATIONS REQUIREMENTS

A quality assurance program is required to assure that subsequent vane-type waterflow alarm indicators produced by the manufacturer shall present the same quality and reliability as the specific vane-type waterflow alarm indicators 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 documented in the Approval Report.
- Continued conformance to this Standard is verified by the Surveillance Audits.
- Quality of performance is determined by field performance 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; and
- handling and disposition of non-conforming materials.

5.1.2 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.

5.1.3 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.

5.1.4 Drawing and Change Control

The manufacturer shall establish a system of product configuration control that does 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 619, *FM Approved Product/Specification-Tested Revision Request Form*. Records of all revisions to all FM Approved products shall be maintained.

5.1.4.1 The table below has been included as a guide to manufacturers of FM Approvals considers to be a significant change. 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 500 gallon capacity, and now Approval at a capacity of 750 gallons 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.
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 vane-type waterflow alarm indicators such as a change in the wall thickness of the housing or material of the vane.

5.1.4.2 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 Office Address, Company Contact and Title, Phone Number, Fax Number, Email Address.
Updating of Drawings:	Form 619 is used to notify FM Approvals in the event of: minor dimensional changes to non-critical features, minor changes in notes, relocation of title block, re-creation of the same drawing on CAD, etc.
Changes in Markings:	Proposed changes should 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 existing, sales literature, Installation Instructions, Quality Manual, etc.

- 5.1.4.3 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 for further review. The examples shown in Sections 5.1.4.1 and 5.1.4.2 are based on common examples of modifications as they relate to the manufacture of vane-type waterflow alarm indicators.

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 assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and FM Approved.
- 5.2.2 These audits shall be conducted periodically but at least annually by FM Approvals or its representatives.
- 5.2.3 FM Approved products or services shall be produced or provided at or from the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the discretion of FM Approvals.

5.4 Manufacturer's Responsibilities

The manufacturer shall notify FM Approvals of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

5.5 Manufacturing and Production Tests

5.5.1 Test Requirement No. 1 – Hydrostatic Test

The manufacturer shall perform hydrostatic pressure testing on a sample basis for production units bearing the FM Approvals certification mark. Testing shall be conducted to twice the rated working pressure for a minimum of 15 seconds with no body leakage. The manufacturer shall have a controlled procedure on file for conducting this test.

5.5.2 Test Requirement No. 2 – Retard Adjustment

The manufacturer shall perform a retard adjustment test on a sample basis for production units bearing the FM Approvals certification mark. Samples shall be adjusted to a common retard delay, and the vane moved in the direction of waterflow and held until the switch is observed to activate. The vane will be returned to the original position and the retard will automatically reset. The manufacturer shall have a controlled procedure on file for conducting this test.

APPENDIX A: UNITS OF MEASUREMENT

LENGTH:	in. - "inches"; (mm - "millimeters") $\text{mm} = \text{in.} \times 25.4$
	ft - "feet"; (m - "meters") $\text{m} = \text{ft} \times 0.3048$
PRESSURE:	psi - "pounds per square inch"; (bar - "bar") $\text{kPa} = \text{psi} \times 6.895$
	bar - "bar"; (kPa - "kilopascals") $\text{bar} = \text{kPa} \times 0.01$ $\text{bar} = \text{psi} \times 0.06895$
FLOW RATE:	gal/min - "gallon per minute"; (L/min - "liters per minute") $\text{L/min} = \text{gal/min} \times 3.785$
VOLUME:	gal - "gallons"; (L - "liter") $\text{L} = \text{gal} \times 3.785$
VELOCITY:	ft/s - "feet per second"; (m/s - "meters/second") $\text{m/s} = \text{ft/s} \times 0.3048$

APPENDIX B: TOLERANCES

Unless otherwise stated, the following tolerances shall apply:

Flow: ± 2 percent of value

Length: ± 2 percent of value

Volume: ± 5 percent of value

Resistance ± 0.25 percent of value

Pressure: within $+5/-0$ psi of value

Temperature: ± 4 °F (2 °C)

Time: $+ 5.0/-0$ seconds
 $+0.1/-0$ minutes

Volts ± 5 Volts

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

APPENDIX C: SAMPLE LISTING

Waterflow Detectors, Vane Type

Waterflow detectors installed in sprinkler systems provide an electrical alarm when a flow of water from the system equals or exceeds that of a single sprinkler. They can be used with either open or closed signaling circuits.

They may consist of a flexible vane which projects into the waterway or a pressure-sensing device. For the flexible vane type, water movement deflects the vane, and the motion is transmitted to an alarm-actuating switch after a predetermined time delay. The time delay is accomplished by the use of an instantly recycling retard.

Waterflow detectors should not be specified for those systems where the time duration of a pressure fluctuation is greater than the retard time. Instantly recycling retards will not transmit an electrical alarm until the time duration of the pressure fluctuation or waterflow past the vane of the flow detector has exceeded the predetermined time setting. Unless otherwise noted in the listing, these detectors have 175 psi (1205 kPa) rated working pressure.

Model ASB

Model ASB-XX. 2 through 8 in. NPS as indicated in Table below. 2 through 4 in. NPS have a 300 psi (3105 kPa) rated working pressure. 6 and 8 in. NPS have a 175 psi (1205 kPa) rated working pressure.

All sizes rated for Schedule 10 and 40 pipe.

<i>Model No.</i>	<i>Nominal Pipe Size, in.</i>
ASB-2	2
ASB-2.5	2 1/2
ASB-3	3
ASB-3.5	3 1/2
ASB-4	4
ASB-5	5
ASB-6	6
ASB-8	8