Approval Standard
for
Quick Opening Valves
1/4 Inch Through 2 Inch Nominal Size

Class Number 1140

October 1998

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

1.0 INTRODUCTION

1.1 Purpose

1.1.1 This standard states FM Approval criteria for manually operated quick opening valves that control the water supply to accessories in a fire protection system or to small open-head extinguishing systems.

1.1.2 FM Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

1.2.1 This standard encompasses the design and performance requirements for ¼ in. through 2 in. nominal size quick opening valves for their intended application of controlling water to small open-head extinguishing systems, or in the trim of various types of valves including waterflow alarm valves, dry pipe valves, or automatic water control valves. Approval is limited to quick opening valves no larger than 2 in. nominal size due to water hammer concerns. In cases where metric sized quick opening valves are to be examined for Approval, test criteria comparable to the equivalent or nearest nominal inch size shall be used.

1.2.2 Other types of quick opening valves may be Approved if they meet the requirements and intent of this standard. Valves of unusual design may be subjected to special tests to determine their suitability.

1.2.3 FM Approvals Standards are intended to verify that the product described will meet stated conditions of performance, safety and quality useful to the ends of property conservation.

1.3 Basis for Requirements

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

1.3.2 The requirements of this Standard reflect tests and practices used to examine characteristics of quick opening valves for the purpose of obtaining FM Approval. Quick opening valves 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, quick opening valves which meet all of the requirements identified in this Standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this Standard is not met.

1.4 Basis for FM Approval

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

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required by FM Approvals; and, as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facility(ies) and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product as examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Facilities and Procedures Audits (F&PAs) conducted as part of FM Approvals' product follow-up program.

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

1.6 Effective Date

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

The effective date of this Standard is **April 30, 2000** for full compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-97, *"Standard for Use of the International System of Units (SI): The Modern Metric System."*

1.8 Applicable Documents

The latest versions of the following standards, test methods, and practices are referenced in this standard:

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

FM Global Property Loss Prevention Data Sheets.

1.9 Definitions

For purposes of this standard, the following terms apply:

End Connections
The method of connecting components of a pipe system to the valve.

Quarter Turn Valve
A valve with the same characteristics as a quick opening valve. Actuation is achieved by rotating a lever or handle ¼ of a full turn (90° rotation).

Quick Opening Valve
A valve with an inherent design characteristic that provides a maximum flow with minimal lever or handle movement.

Rated Working Pressure
The maximum sustained pressure at or below which the valve shall operate trouble free.

2.0 GENERAL INFORMATION

2.1 Product Information

2.1.1 The present standard nominal sizes of quick opening valves for fire protection service are: ¼, ⅜, ½, ¾, 1, 1¼, 1½, and 2 inches. For valves which employ gear actuators or larger size valves, refer to FM Approval Standard 1112, Indicating Valves (Butterfly or Ball).

2.1.2 In order to meet the intent of this Standard, quick opening valves 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 valves, selected in conformance to this criterion, shall satisfy all of the requirements of this Standard.

2.2 Approval Application Requirements

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

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

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

- a complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration;
- general assembly drawings, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures; and
- 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

Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, results of prior testing, and results of the foregoing tests. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. The manufacturer shall provide any special test fixtures, which may be required to evaluate the quick opening valves.

3.0 GENERAL REQUIREMENTS

3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.

3.2 Physical or Structural Features

3.2.1 Valves shall be designed for a minimum rated working pressure of 175 psi (1205 kPa).

3.2.2 Nominal sizes of quick opening valves shall be ¼, ⅜, ½, ¾, 1, 1¼, 1½, and 2 inches. For larger size valves, refer to FM Approval Standard 1112.

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

3.2.4 Valves 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.

3.2.5 The valve shall have a stem seal designed to prevent water within the body from escaping to atmosphere at the point where the stem passes through the body.

3.2.6 When tested in accordance with Section 4.2 (Seat Leakage), the valve shall not leak in either direction of flow, or in the direction of flow if the valve is unidirectional.

3.3 Materials

All materials used in these valves shall be suitable for the intended application. Valve parts exposed to water shall be constructed of corrosion resistant materials. Particular consideration shall be given to the ball or disc, the stem, seats, bushings and packing glands. These and any other materials used in quick opening valves 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 valve shall be permanently marked with the following information:

- manufacturer's name or trademark;
- nominal valve size;
- year of manufacture;
- rated working pressure;
- model designation;
- directional flow arrow (unidirectional valves only); and
- the FM Approval Mark.

3.4.2 Markings shall be cast or forged in raised characters or die stamped on the valve 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 valve body.

3.4.4 Markings may also be shown on the valve handle.

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

3.4.6 Each required marking listed in Section 3.4.1 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.

3.4.7 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as Approved. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

3.4.8 The FM Approval Mark (see Appendix B) shall be displayed visibly and permanently on the product. The manufacturer shall not use this Mark on any other product unless such product is covered by separate agreement with FM Approvals.

3.5 Manufacturer's Installation and Operation Instructions

Installation instructions, including any special dimension requirements, shall be furnished by the manufacturer. Instructions shall be provided in each shipping container.

3.6 Calibration

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

4.0 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The quick opening valves 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 Seat Leakage

4.2.1 Requirement

Quick opening valves shall not leak at or below the rated working pressure, when tested accordance with Section 4.2.2.

4.2.2 Test/Verification

With one side open to atmosphere, the other side of each size valve shall be hydrostatically tested at 30, 100 and 175 psi (205, 690 and 1205 kPa) and at the rated working pressure if in excess of 175 psi (1205 kPa) to prove the sealing ability from each direction of flow, unless the valve is unidirectional. The test pressures shall each be held for five minutes in each direction.

4.3 Ball or Disc Strength

4.3.1 Requirements

The valve ball, disc or other sealing mechanism shall withstand exposure to hydrostatic pressure of two times the rated working pressure. During and at the conclusion of the test, no fracture, permanent distortion, or functional impairment shall occur. After this test the valve shall be fully operable and shall comply with the leakage requirements in Section 4.2 (Seat Leakage).

4.3.2 Tests/Verification

A sample valve of each size shall be closed. With one side open to atmosphere, the other side shall be hydrostatically pressurized to two times the rated working pressure. The test pressure shall be held for five minutes. For this strength test, special provisions may be made to prevent leakage past the seat. This test shall be repeated for both directions of flow.

4.4 Hydrostatic Strength

4.4.1 Requirement

Valve bodies shall withstand a hydrostatic pressure of four times the rated working pressure without rupture, cracking or permanent distortion.

4.4.2 Test/Verification

With the ball or disc in the open position, valve bodies of each valve size shall be subjected to a hydrostatic test of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, for five minutes.

4.5 Stem Seal

4.5.1 Requirement

Stem seals shall not leak when subjected to a hydrostatic pressure equal to the rated working pressure.

4.5.2 Tests/Verification

A sample valve of each size with the ball, disc or other sealing mechanism in a partially open position shall be subjected to its rated working pressure for five minutes with no visible stem leakage. Cycling of the ball, disc or other sealing mechanism twelve times during this time span shall not cause leakage past the stem seal.

4.6 Operating Force Test

4.6.1 Requirements

The force to open the valve shall be measured. An internal hydrostatic pressure of 90 psi (620 kPa) shall be applied to the valve for various time periods. The force required to open the valve at the end of each time period shall not exceed 50 lb force (220 N) applied to the outermost end of the valve handle. No damage to any internal components of the valve shall result.

4.6.2 Tests/Verification

Sample valves shall be subjected to 90 psi (620 kPa) water pressure for consecutive periods of one week, two weeks, and one month. Initially and at the end of each specified period, the force to open the valve shall be measured. The force required to open the valve at the end of each period shall not exceed 50 lb force (220 N), measured at the outermost end of the valve handle.

4.7 Durability Test

4.7.1 Requirement

At the conclusion of a 1000 cycle operational test on a representative size valve, excessive wear shall not occur.

4.7.2. Tests/Verification

Prior to the start of the durability test, a sample valve shall be hydrostatically pressurized to the rated working pressure for five minutes to verify that there is no seat or stem leakage. The sample valve shall then be cycled 1000 times through its full angular stem travel. The pressure upstream of the test valve in the closed position shall be 110 psi (760 kPa) for the duration of this test. The pressure downstream of the test valve in the closed position shall be atmospheric (0 psi, 0 kPa). During the test the speed of rotation shall be five to ten cycles per minute. After the completion of the cycling test, the valve shall be re-pressurized to the rated working pressure for five minutes and shall comply with the seat leakage requirements in Section 4.2 (Seat Leakage) and the stem seal requirements in Section 4.5 (Stem Seal). The valve shall then be disassembled and moving parts shall be visibly examined for signs of excessive wear or damage.

4.8 Friction Loss Determination

4.8.1 Requirement

The construction of the valve shall be such that obstruction to the passage of water through the valve body is minimal. With the ball or disc in the full open position, the loss in pressure through the valve shall not exceed 5.0 psi (35 kPa) at a flow producing a velocity of 20 ft/s (6.1 m/s) in Schedule 40 steel pipe of the same nominal diameter as the valve.

4.8.2 Tests/Verification

Tests shall be conducted to show that the friction loss through any valve does not exceed 5.0 psi (35 kPa) at a flow producing a velocity of 20 ft/s (6.1 m/s) in Schedule 40 steel pipe of the same nominal diameter as the valve as stated in Section 3.2.2. This test may be waived at the examining engineer's option if drawing and calculation reviews of manufacturer's flow data are satisfactory.

4.9 Stability Test — Disc Type Valves Only

4.9.1 Requirement

With the parts loosened to a point approaching body and/or stem leakage, a sample valve shall be subjected to flow at a velocity of 50 ft/s (15 m/s) for fifteen minutes. The valve shall remain in the fully open position.

4.9.2 Tests/Verification

Tests shall be conducted to show that the disc type valve remains open as required above.

4.10 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 valves, 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.

5.0 OPERATIONS REQUIREMENTS

A quality control program is required to assure that subsequent valves produced by the manufacturer at an authorized location, shall present the same quality and reliability as the specific valves examined. Design quality, conformance to design, and performance are the areas of primary concern. Design quality is determined during the Approval examination and tests, and is covered in the Approval Report. Conformance to design is verified by control of quality and is covered in the Facilities and Procedures Audit (F&PA). Quality of performance is determined by field performances and by periodic re-examination and testing.

5.1 Demonstrated Quality Control Program

5.1.1 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines
- incoming quality assurance, including testing
- in-process quality assurance, including testing
- final inspection and tests
- equipment calibration
- drawing and change control
- packaging and shipping
- handling and disposition of non-conformance materials
- in order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed for a minimum period of two years from the date of manufacture.

5.1.2 Documentation/Manual

There shall exist an authoritative collection of procedures and policies. Such documentation shall provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system shall require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.3 Drawing and Change Control

The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation for production. The manufacturer shall assign an appropriate person or group to be responsible for reporting proposed changes to Approved or Listed products to FM Approvals before implementation. The manufacturer shall notify FM Approvals of changes in the product or of persons responsible for keeping FM Approvals advised by means of FM Approvals Form 797, *Approved Product Revision Report or Address/ Contact Change Notice*. Records of all revisions to all Approved products shall be maintained.

5.2 Facilities and Procedures Audit (F&PA)

5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality control program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a consistently uniform and reliable product. Initial inspections of facilities already producing similar products may be waived at the discretion of FM Approvals.

5.2.2 Unannounced follow-up inspections shall be conducted at least annually by FM Approvals, or its designate, to determine continued compliance. More frequent audits may be required by FM Approvals.

5.2.3 The client shall manufacture the product or service only at the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the FM Approval mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 Manufacturer's Responsibilities

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

5.4 Manufacturing and Production Tests

5.4.1 *Test Requirement No. 1 — Seat leakage*

The manufacturer shall test 100 percent of production valves for seat leakage at the rated working pressure. The test pressure shall be applied on the seat of a closed valve for a minimum of 15 seconds with no leakage allowed.

Following the seat leakage test, all valves shall be opened through their full range with no evidence of sticking or binding.

5.4.2 *Test Requirement No. 2 — Body Leakage*

The manufacturer shall test 100 percent of production valves 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.

APPENDIX A

UNITS OF MEASUREMENT

LENGTH:	in. – “inches”; (mm – “millimeters”) mm = in. x 25.4
	ft – “feet”; (m – “meters”) m = ft x 0.3048
FORCE:	lb force – “pounds force”; (N – “newtons”) N = lb force x 4.448
VELOCITY:	ft/s – “feet per second”; (m/s – “meters/second”) m/s = ft/s x 0.3048
PRESSURE:	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
TEMPERATURE:	°F – “degrees Fahrenheit”; (°C – “degrees Celsius”) °C = (°F – 32) x 0.556
LIQUID:	gal – “gallons”; (L – “liter”) L = gal x 3.785
	L – “liter”; (dm^3 – “cubic decimeters”) L = 1 dm^3

APPENDIX B

APPROVAL MARKS

REPRODUCTION ART: FM Approval Marks

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

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

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

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

For Cast-On Marks

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

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

Additional reproduction art is available through

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