



Member of the FM Global Group

Approval Standard for Waterflow Detector Check Valves

Class Number 1045

August 2005

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. INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Basis for Requirements	1
1.4 Basis for Approval	2
1.5 Basis for Continued Approval	2
1.6 Effective Date	2
1.7 System of Units	2
1.8 Applicable Documents	3
1.9 Definitions	3
2. GENERAL INFORMATION	4
2.1 Product Information	4
2.2 Approval Application Requirements	4
2.3 Requirements for Samples for Examination	5
3. GENERAL REQUIREMENTS	5
3.1 Review of Documentation	5
3.2 Physical or Structural Features	5
3.3 Clearances	6
3.4 Materials	7
3.5 Markings	7
3.6 Manufacturer's Installation and Operation Instructions	7
3.7 Calibration	7
4. PERFORMANCE REQUIREMENTS	8
4.1 Examination	8
4.2 Clapper Strength	8
4.3 Resilient Seat (Reverse Flow) Leakage	8
4.4 Metal-To-Metal (Reverse Flow) Seat Leakage	8
4.5 Hydrostatic Strength	9
4.6 Friction Loss Determination	9
4.7 Differential Cracking Pressure	10
4.8 Cycle Test	10
4.9 Bonding Adequacy	11
4.10 Water Absorption	11
4.11 Aging	12
4.12 Additional Tests	12
5. OPERATIONS REQUIREMENTS	12
5.1 Demonstrated Quality Control Program	12
5.2 Facilities and Procedures Audit (F&PA)	14
5.3 Manufacturer's Responsibilities	14
5.4 Manufacturing and Production Tests	15
APPENDIX A: Units Of Measurement	16
APPENDIX B: Approval Marks	17
APPENDIX C: Tolerances	18
APPENDIX D: Drawings	19
APPENDIX E: Sample Listing	22

1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states FM Approvals criteria for waterflow detector check valves. These devices are required by waterworks authorities to supervise private fire service lines in order to detect loss of water through leakage or misuse. Detector check valves permit the flow of water in one direction and prevent flow in the opposite direction. Additionally, these valves direct small flows through a by-pass line that contains a water meter. Large flows for fire protection lift the clapper within the waterflow detector check valve and pass without being metered. When used as part of a Compound Fire Service Meter Assembly the mainline flow is metered by an upstream mainline meter.
- 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 for 2, 2-1/2, 3, 3-1/2, 4, 5, 6, 8, 10 and 12 in. nominal size waterflow detector check valves for their intended application of permitting flow of water in one direction and preventing flow in the opposite direction while permitting the supervision of private fire service lines in order to detect loss of water through leakage or misuse. Sizes refer to the nominal diameter of the pipeline to which the valve will be connected. Sizes outside the range shown above shall be evaluated on a case-by-case basis. In cases where metric sized waterflow detector check valves are to be examined for Approval, test criteria comparable to the equivalent or nearest nominal inch size shall be used.
- 1.2.2 This standard defines the requirements for waterflow detector check valves. Waterflow detector check valves covered in this Approval Standard are supplied with either flanged or grooved end connections, and are provided with hand hold covers. Other types of waterflow detector check valves may be FM Approved if they meet the requirements and intent of this standard. Waterflow detector check valves of unusual design may be subjected to special tests to determine their suitability.
- 1.2.3 Approval Standards are intended to verify that the product described will meet stated conditions of performance, safety and quality useful to the ends of property conservation.

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 waterflow detector check valves for the purpose of obtaining Approval. Waterflow detector check valves 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, waterflow detector check valves 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 initial facilities and procedures audit shall be conducted to evaluate the manufacturer's ability to consistently produce the product which was examined and tested as part of the Approval project. The audit will review the facility and in-place quality control procedures used in the manufacturing of the product. Typically areas of review are: incoming inspection, work in progress, production testing, final quality control, marking, calibration of equipment, shipping procedures and drawing control. These examinations are repeated periodically as part of the FM Approvals' product follow-up program, (Refer to Section 5.2, Facilities and Procedures Audits).

1.5 Basis for Continued Approval

1.5.1 Continued Approval is based upon:

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

1.5.2 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 forfeit Approval.

The effective date of this standard is **July 31, 2006** 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 10-97, *"Standard for Use of the International System of Units (SI): The Modern Metric System."*

2 FM APPROVALS

1.8 Applicable Documents

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

ANSI/American Society of Mechanical Engineers (ASME) B1.20.1-2001, *Pipe Threads, General Purpose (Inch) and Redesignation of ASME/ANSI B2.1 - 1968 (R2001)*
ANSI/ASME B16.5 - 1988, *Pipe Flanges and Flanged Fittings*
ANSI/IEEE/ASTM SI 10-1997, *Standard for Use of the International System of Units (SI): The Modern Metric System*
ASTM D471 - 1998e1, *Standard Test Method for Rubber Property - Effect of Liquids*
ASTM D572 - 1999, *Standard Test Method for Rubber - Deterioration by Heat and Oxygen*
American Water Works Association (AWWA) C606-1997, *Joints, Grooved and Shouldered Type*
FM Global Property Loss Prevention Data Sheets

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.)

Approval Mark

The Approval Mark is detailed in Appendix B. Its use is mandatory on all units of FM Approved valves. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

Corrosion resistant

Having resistance to corrosion equal to or exceeding that of a bronze alloy having a minimum copper content of 80 percent, or constructed of 300 or 400 Series Stainless Steel.

End Connections

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

Flanged End Valve

Valves having mating flanged ends per the dimensional values shown in ANSI/ASME B16.5. Flanges to other national or international standards shall be evaluated on a case-by-case basis.

FM Approved

This term refers to products that have received Approval by FM Approvals. Such products are listed in the Approval Guide, a publication of FM Approvals, issued annually, or one of the 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. This form obligates the manufacturer to allow re-examination of the product and audit of facilities and procedures at FM Approvals’ discretion. It further requires that the manufacturer not deviate from the FM Approved configuration of the product without review by and agreement of FM Approvals. Approval is product specific.

Grooved End Valves

A grooved end valve is characterized by having grooved ends on the inlet and outlet ends of the valve body such that the valve may be installed in the sprinkler system piping using FM Approved grooved end couplings. For the purpose of this standard, grooves shall comply to the dimensional values shown in AWWA C606. Grooves to dimensions of other standards will be reviewed on a case-by-case basis.

Hand Hole Cover

A removable cover, which when removed, allows replacement of internal parts without having to remove the valve from the pipe line.

Rated Working Pressure

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

Waterflow Detector Check Valve

A valve with an inherent design characteristic that permits flow of water in one direction and prevents flow in the opposite direction under cyclic pressure conditions. Additionally, these valves direct small flows through a by-pass line that contains a water meter. Large flows for fire protection lift the clapper of the detector check valve and pass without being metered. When used as part of a Compound Fire Service Meter Assembly the mainline flow is metered by an upstream mainline meter.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 These valves typically consists of an assembly of the following components: body, spring, disc/clapper, seat ring, seal facing, lifting lug, hand hold cover, hinge pin and by-pass including water meter and check valve.
- 2.1.2 In order to meet the intent of this standard, waterflow detector check 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

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

Hydraulics Group Manager
FM Approvals - Hydraulics Laboratory
Member of the FM Global Group
743A Reynolds Road
West Glocester, RI 02814
U.S.A.

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

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

2.2.3 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 waterflow detector check valves.

3. 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 End connections shall be flanged or grooved and shall conform to a nationally or internationally recognized standard. Other types of end connections shall be evaluated on a case-by-case basis.
- 3.2.3 Replaceable internal parts shall be removable through an opening in the body without having to remove the valve from the pipe line. A suitable gasketed hand hole cover shall be provided for the opening.
- 3.2.4 Valves having a single hinge pin side plug shall provide hinge pins which have tapped holes at each end for ease of removal.
- 3.2.5 Clapper parts shall be assembled in such a manner that they will not separate in reasonable cycling pressure service.

- 3.2.6 Valves incorporating clapper weights shall be designed such that the clapper weight is located inside the valve body.
- 3.2.7 Valves which employ springs to aid in closing the valve shall be capable of 50,000 cycles of full travel without damage to or failure of the spring or any other valve component.
- 3.2.8 The pressure drop across the clapper required to lift it off its seat shall be not less than 1.5 psi (10 kPa) and not more than 3.0 psi (21 kPa).
- 3.2.9 The body shall be provided with two ports on each side in order to permit the installation of either a right or left hand by-pass line. These ports shall be furnished with 2 inch maximum threaded pipe outlets.
- 3.2.10 There shall be a manually operated control valve upstream of the by-pass meter and a swing check valve or manually operated control valve in the by-pass line downstream of the by-pass meter in order to isolate the by-pass meter to allow removal for repairs without impairment of the fire protection system.
- 3.2.11 The by-pass meter sizes commonly used are: 1, 1-1/2 or 2 inch NPS. The size shall be determined by the requirements of the authority having jurisdiction.
- 3.2.12 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.

3.3 Clearances

- 3.3.1 Ample clearances shall be provided between all moving and stationary components so that corrosion or deposits such as tuberculation will not interfere with proper operation of the valve.
- 3.3.2 To assure ample clearance, the following minimum dimensions shall be maintained:
 - The clearances between the periphery of the clapper and the inside of the body in every position of the clapper from “closed” to “full open” shall be at least 3/4 inch (19 mm). For valves incorporating corrosion resistant clappers and bodies, the clearance requirement shall be 3/8 inch (10 mm). See Figure D-1 in Appendix D.
 - There shall be a clearance of at least 1/2 inch (13 mm) between the hub of the clapper arm and the inside of the body. For valves incorporating corrosion resistant clappers and bodies, the clearance requirements shall be 3/8 inch (10 mm). See Figure D-2 in Appendix D.
 - The width of the hub of the clapper arm shall be at least 1/8 inch (3 mm) less than the minimum distance between the hinge pin bearings. See Figure D-3 in Appendix D.
 - There shall be a diametrical clearance of at least 0.015 in. (0.4 mm) between the outside diameter of the hinge pin and the inside diameter of the hole in the hinge pin bearing. See Figure D-3 in Appendix D.
 - There shall be a minimum 1/8 inch (3 mm) projection of hinge pin bushings beyond the supporting material.
 - No allowance or reduction in tolerances are allowed for coatings applied to iron components.

3.4 Materials

All materials used in these valves shall be suitable for the intended application. Particular consideration shall be given to the corrosion resistance of the materials used as contact surfaces between rotating or moving and stationary parts. When unusual materials are used, special tests may be necessary to verify their suitability.

3.5 Markings

3.5.1 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; and,
- the Approval Mark (Appendix B).

3.5.2 Markings shall be cast or forged in raised characters or die stamped on the valve body or cover or both. All letters and symbols shall be large enough to be read by a person with normal vision (20/20 corrected) standing 3 ft. (0.9 m) away.

3.5.2.1 A corrosion resistant metal nameplate bearing the same information as stated above shall be considered acceptable if permanently fastened to the valve body or cover.

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

3.5.3 Each required marking listed in Section 3.5.1 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 3.5.2.

3.5.4 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.

3.5.5 The 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.

3.6 Manufacturer's Installation and Operation Instructions

Installation instructions, including any special dimensional or access requirements, shall be furnished by the manufacturer. Instructions and spare parts lists shall be provided in each shipping container.

3.7 Calibration

All examinations and tests performed in evaluation to this standard shall use calibrated measuring instruments traceable and certified to national standards or international standards. All measurement instruments shall be within the allowed calibration time intervals, or shall be compared to a controlled and traceable master instrument before and after the tests are conducted. For tests conducted at locations other than FM Approvals, copies of the calibration certificates or verification data shall be provided to the FM Approvals Representative at the time of testing.

4. PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The waterflow detector check 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 Clapper Strength

4.2.1 Requirements

The valve clapper 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 4.3 (Resilient Seat Leakage) or Section 4.4 (Metal-To-Metal Seat Leakage), as applicable.

4.2.2 Tests/Verification

A hydrostatic pressure of two times the rated working pressure shall be applied to the outlet side of the valve with the inlet of the valve open to atmosphere. The test pressure shall be held for five minutes. During and at the conclusion of the test, no fracture, permanent distortion or functional impairment shall occur. Full compliance with Section 4.3 (Resilient Seat Leakage) or Section 4.4 (Metal-To-Metal Seat Leakage) is required after the clapper strength test.

4.3 Resilient Seat (Reverse Flow) Leakage

4.3.1 Requirement

Resilient seated valves shall be leak tight when subjected to downstream hydrostatic test pressures ranging from 30 psi (205 kPa) to the rated working pressure.

4.3.2 Test/Verification

With the inlet side open to atmosphere, the downstream side of each size valve shall be subjected to hydrostatic pressures of 30, 100 and 175 psi (205, 690 and 1205 kPa) and at the rated working pressure if in excess of 175 psi (1205 kPa). The test pressures shall each be held for five minutes, with no leakage allowed.

4.4 Metal-To-Metal (Reverse Flow) Seat Leakage

4.4.1 Requirement

Metal-to-metal seated valve leakage shall not exceed 1 fluid ounce/hr (30 ml/hr) per inch of nominal valve size when subjected to downstream hydrostatic test pressures ranging from 30 psi (205 kPa) to the rated working pressure.

4.4.2 Test/Verification

With the inlet side open to atmosphere, the downstream side of each valve shall be subjected to hydrostatic pressures of 30, 100 and 175 psi (205, 690 and 1205 kPa) and at the rated working pressure if in excess of 175 psi (1205 kPa). The test pressures shall each be held for five minutes. Slight leakage, not in excess of 1 fluid ounce/hr (30 ml/hr) per inch of nominal valve size, is allowed.

4.5 Hydrostatic Strength

4.5.1 Requirement

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

4.5.2 Test/Verification

With the clapper removed or blocked off its seat, valve bodies of each valve size and end connection style, shall be subjected to a hydrostatic test pressure of 700 psi (4825 kPa), or four times the rated working pressure, whichever is greater, for a duration of five minutes. There shall be no visible rupture, cracking or permanent distortion of the valve body.

4.6 Friction Loss Determination

4.6.1 Requirement

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

4.6.2 Tests/Verification

Tests shall be conducted to verify that the friction loss through each nominal size valve does not exceed 5.0 psi (35 kPa) at the flow rates shown in Table 4.6.2. These flows have been calculated based on a fluid velocity of 20 ft/sec (6.1 m/s) in Schedule 40 steel sprinkler pipe. This test may be waived at the examining engineer's option if drawing and calculation reviews of manufacturer's flow data are satisfactory (Note: For valves larger than 12 in. nominal size, it shall be the responsibility of the manufacturer to submit friction loss data or calculations showing compliance.) For valves corresponding to metric sizes, the manufacturer shall indicate the metric pipe to be used in the evaluation.

Table 4.6.2. - Friction Loss Flows

<i>Nominal Valve Size, in.</i>	<i>Flow at Velocity of 20 ft/sec (6.1 m/sec),</i>	
	<i>gal/min</i>	<i>(L/min)</i>
2	210	(795)
2-1/2	300	(1135)
3	460	(1740)
3-1/2	615	(2330)
4	795	(3010)
5	1245	(4715)
6	1800	(6815)

<i>Nominal Valve Size, in.</i>	<i>Flow at Velocity of 20 ft/sec (6.1 m/sec), gal/min (L/min)</i>	
8	3120	(11 810)
10	4915	(18 605)
12	7050	(26 685)
14	8450	(31 985)
16	11,000	(41 640)
18	14,000	(52 995)
20	17,500	(66 245)
24	25,000	(94 635)

4.7 Differential Cracking Pressure

4.7.1 Requirements

The pressure differential across the clapper needed to lift the clapper from its seat shall be not less than 1.5 psi (10 kPa) and not more than 3.0 psi (21 kPa).

4.7.2 Tests/Verification

One sample of each size valve shall be placed in a level horizontal position. Both the inlet and outlet ends shall be capped with shut off valves. Transparent sight glasses, open to atmosphere and approximately 8 feet (2.4 m) long, shall be installed vertically to both upstream and downstream chambers of the valve seat. With the outlet shut off valve closed, the valve shall be purged of all entrapped air by flowing water through the inlet shut off valve. The inlet shall be pressurized until the upstream sight glass reaches a height of 83 inches (211 cm) of water higher than the water level in the downstream site glass. The inlet shut off valve shall then be closed. The decrease in water level in the inlet site glass shall be monitored until no further fall of water is observed. The difference in water levels between the upstream and downstream site glasses shall be recorded. The distance between the two water levels must be greater than 41.5 inches (106 cm) and less than 83.1 inches (211 cm).

4.8 Cycle Test

4.8.1 Requirements

Waterflow detector check valves which employ springs on the clapper shall be capable of 50,000 cycles of normal operation without excessive wear, damage or failure of any valve component.

4.8.2 Tests/Verification

A sample valve of each size shall be cycled 50,000 times, at a rate not exceeding 6 cycles per minute, through its full range of travel in a static air environment. This test shall be conducted at atmospheric (0 psi, 0 kPa) conditions. After the completion of the cycling test, the valve shall be disassembled. Parts shall be visibly examined for signs of excessive wear, damage or failure. This test, or a portion thereof, may be waived at the option of the FM Approvals examining engineer if a design and calculation review are satisfactory.

4.9 Bonding Adequacy

4.9.1 Requirement

For resilient seated valves, rubber facings shall remain securely bonded or fastened to the disc/clapper base material.

4.9.2 Test/Verification

A representative size valve shall be subjected to a flow rate producing a velocity of 30 ft/sec (9 m/sec) in Schedule 40 steel pipe of the same nominal diameter as the valve for 90 minutes. These flow rates are shown in Table 4.9.2. Following this test, there shall be no apparent separation of the rubber from the base material or substrate or any other type of failure, such as blistering, peeling, flaking, delaminating, or evidence of loosening from the base material or of any hardware used to secure the rubber facing.

Table 4.9.2 - Bonding Adequacy Flows

<i>Nominal Valve Size, in.</i>	<i>Flow at Velocity of 30 ft/sec (9 m/sec),</i>	
	<i>gal/min</i>	<i>(L/min)</i>
2	315	(1190)
2-1/2	450	(1695)
3	690	(2615)
3-1/2	925	(3500)
4	1190	(4505)
5	1870	(7080)
6	2700	(10 225)
8	4680	(17 705)
10	7375	(27 910)
12	10 465	(39 620)
14	12 650	(47 880)
16	16 525	(62 550)
18	20 915	(79 170)
20	25 990	(98 380)
24	37 590	(142 290)

4.10 Water Absorption

4.10.1 Requirement

For resilient seated valves, water absorption of the rubber facings shall not result in changes that exceed 1.5 percent of the original thickness or weight.

4.10.2 Test/Verification

A specimen of the valve rubber facing supplied by the manufacturer shall be maintained in water at a temperature of 212 °F (100 °C) for 6 hours to measure the comparative ability of rubber to withstand the effect of water in accordance with ASTM D 471, "Standard Test Method for Rubber Property - Effect of Liquids." At the end of this period, a change in the thickness or weight of the sample shall not exceed 1.5 percent of the original thickness or weight.

4.11 Aging

4.11.1 Requirement

For resilient seated valves, aging shall not promote cracking of the rubber facings.

4.11.2 Test/Verification

A specimen of the valve rubber facing, approximately 1 x 3 inches (25 x 75 mm) by 1/8 in. (3 mm) thick, supplied by the valve manufacturer shall be subjected to an accelerated aging test in accordance with ASTM D 572, "Standard Test Method for Rubber - Deterioration by Heat and Oxygen." The test duration shall be 96 hours. After the test, the specimen shall be examined for resilience. No cracking shall occur when the sample is bent double, (i.e. bend radius of 180°).

4.12 Additional Tests

Additional tests may be required, at the discretion of FM Approvals, depending on design features and results of any foregoing tests, or to verify the integrity and reliability of the valves.

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

5. 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 not allow 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 in production. The manufacturer shall assign an appropriate person or group to be responsible for reporting proposed changes to FM Approved 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/ Specification-Tested Revision Report or Address/Main Contact Change Report". Records of all revisions to all FM Approved products shall be maintained.

- 5.1.3.1 The listing below has been included as a guide to manufacturers of what is considered to be a significant change to FM Approvals. To facilitate the Approval of significant changes, 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 2 – 4 inch NPS, and now Approval of 6 and 8 inch NPS is desired.
Addition 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 effect the Valve such as: A reduction of body wall thickness in the pressure retaining areas, change in sealing arrangement (i.e. revision of the clapper facing material), significant changes in the waterway diameter, clapper/disc thickness, material changes to valve body, hinge pin, clapper or disc, etc.

- 5.1.3.2. The listing below has been included as a guide to manufacturers of modifications that are commonly submitted on FM Approvals Form 797.

<i>Modification</i>	<i>Description / Example</i>
Change in Company Contact Information	Name, Title, Phone Number, Fax Number, Email Address, Company Address, Company Name
Updating of Drawings	The Form 797 is used to notify FM Approvals in the event of: minor dimensional changes to non-critical features, minor changes in notes, location of title block, re-creation of the same drawing on CAD, etc.
Changes in Markings	Please describe what changes are to be made and include a drawing of the proposed marking.
Changes in Materials	Where new material is either of greater strength than, or comparable to material used in original Approval
Updating of Documentation	Creation of New or Revisions to Sales literature, Installation Instructions, Grooving Dimensions, Quality Manual, etc.

- 5.1.3.3 For the instances where the modification is difficult to categorize, manufacturers are encouraged to contact FM Approvals to discuss the nature of the change, and how to send the information to FM Approvals. The examples shown in Sections 5.1.3.1 and 5.1.3.2 are based on common examples of modifications as they relate to the manufacture of waterflow detector check valves.

- 5.1.3.4 FM Approvals, at its sole discretion, shall determine when additional testing is necessary to validate proposed changes.

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 Approval Mark is not permitted at any other locations 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 to the rated working pressure. The pressure shall be held for a minimum of 15 seconds. If there is no visible leakage after 15 seconds, then the test may be considered acceptable. For metal seated valves, only, if there is leakage visible during the 15 second test, then the test duration shall be extended to a minimum of 1 minute so that the leakage rate can be determined. If the metal seated valve is observed to have leakage in excess of 1 fluid ounce/hr (30 ml/hr) for each inch of valve size, the valve is considered to have failed the test. Resilient-seated valves of any size shall have no visible leakage.

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 1 minute with no evidence of body leakage or distortion.

APPENDIX A: Units Of Measurement

FLOW RATE: gal/min - “gallon per minute”; (L/min - “liters per minute”)
 $\text{L/min} = \text{gal/min} \times 3.785$

LENGTH: in. - “inches”; (mm - “millimeters”)
 $\text{mm} = \text{in.} \times 25.4$

ft - “feet”; (m - “meters”)
 $\text{m} = \text{ft} \times 0.3048$

LIQUID: gal - “gallons”; (L - “liter”)
 $\text{L} = \text{gal} \times 3.785$

MASS: lb - “pounds”; (kg - “kilograms”)
 $\text{kg} = \text{lb} \times 0.454$

PRESSURE: psi - “pounds per square inch”; (kPa - “kilopascals”)
 $\text{kPa} = \text{psi} \times 6.895$

bar - “bar”; (kPa - “kilopascals”)
 $\text{bar} = \text{kPa} \times 0.01$
 $\text{bar} = \text{psi} \times 0.06895$

TEMPERATURE: °F - “degrees Fahrenheit”; (°C - “degrees Celsius”)
 $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 0.556$

APPENDIX B: 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 Approval mark 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 Approval marks should never be used in any manner (including advertising, sales or promotional purposes) that could suggest or imply 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
USA

APPENDIX C: Tolerances

Unless otherwise stated, the following tolerances shall apply:

Angle	$\pm 2^\circ$
Frequency (Hz)	± 5 percent of value
Length	± 2 percent of value
Volume	± 5 percent of value
Volume Per Unit Area	± 5 percent of value
Pressure	± 5 psi (35 kPa)
Temperature	$\pm 4^\circ\text{F}$ ($\pm 2^\circ\text{C}$)
Time	+5/ -0 seconds +0.1/ -0 minutes

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

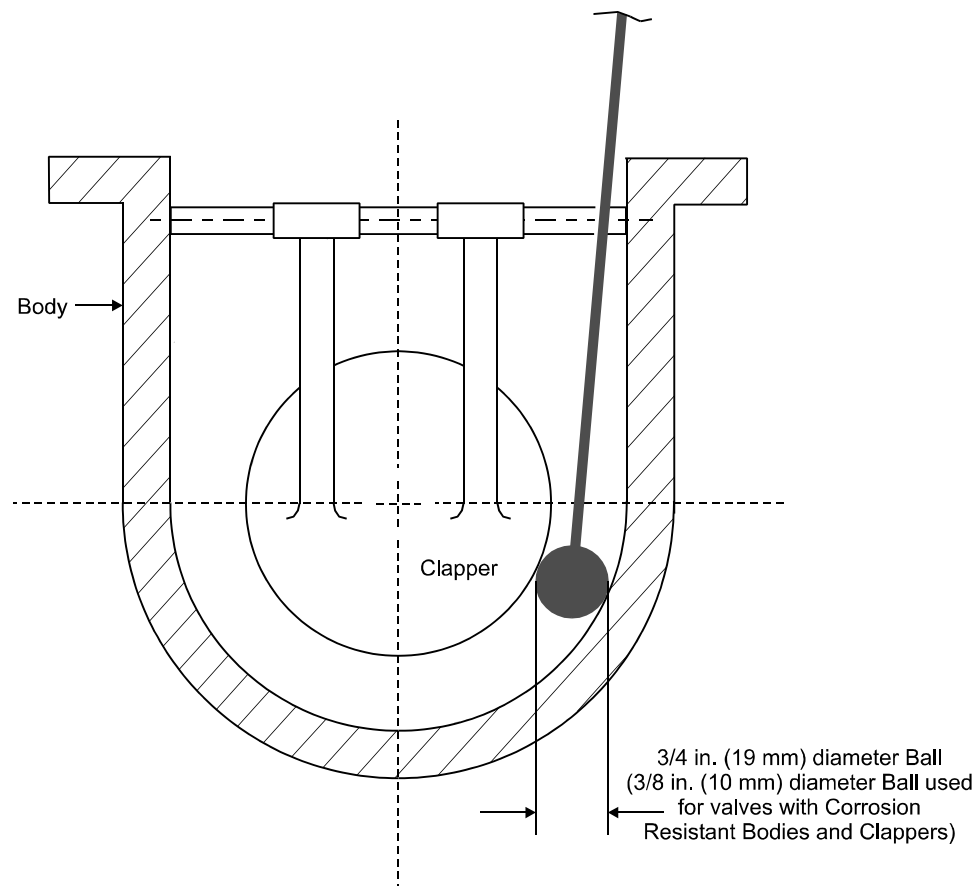
APPENDIX D: Drawings

Figure D-1: Clearances

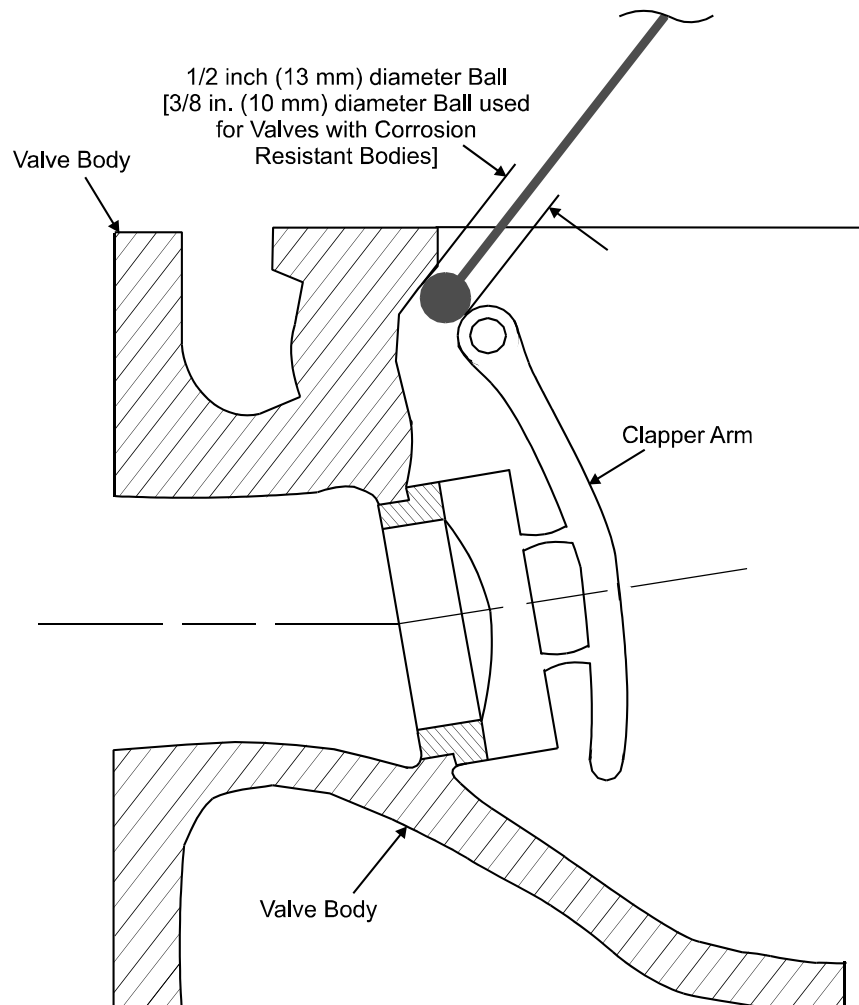


Figure D-2: Clearances

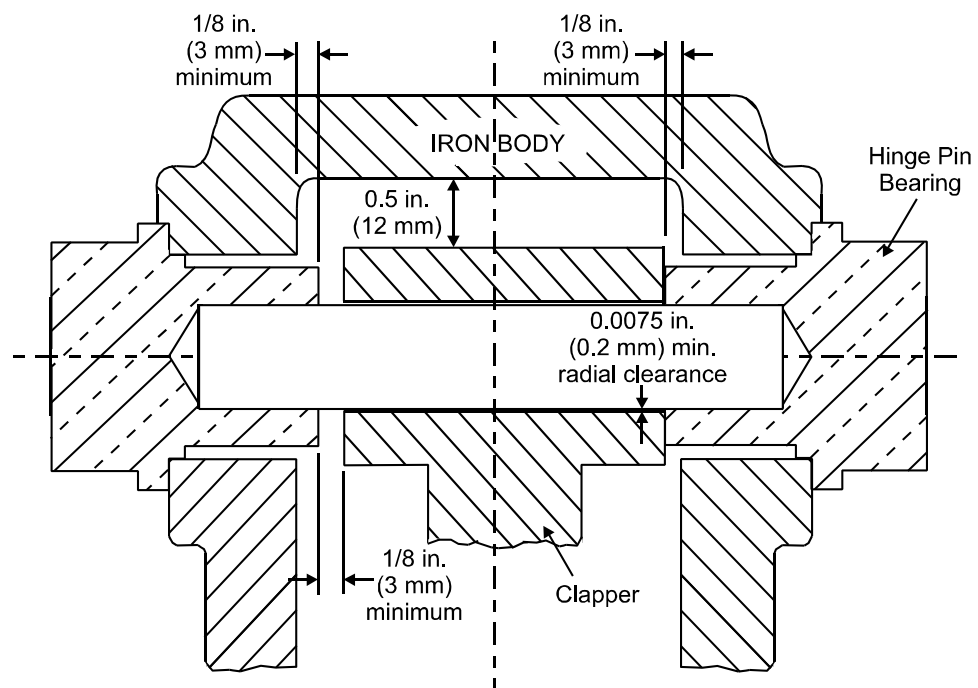


Figure D-3: Clearances

APPENDIX E: Sample Listing

Company Name and Address			
<i>Product Designation</i>	<i>Valve Size, in.</i>	<i>Flow Rate gal/min (dm³/min)</i>	<i>Friction Loss, psi (kPa)</i>
XYZ	4	500	2.5
		(1895)	(17.0)
		750	2.8
		(2840)	(19.5)
		1000	3.2
	6	(3785)	(22.0)
		1000	1.8
		(3785)	(12.5)
		1500	2.4
		(5680)	(16.5)
	8	2000	3.0
		(7570)	(20.7)
		2000	3.1
		(7570)	(21.5)
		3000	3.9
	10	(11 355)	(27.0)
		4000	4.5
		(15 140)	(31.0)
		2250	1.9
		(8515)	(13.0)
		4500	1.9
		(17 035)	(13.0)
		6000	1.8
		(22 710)	(12.5)



Member of the FM Global Group

Printed in USA