Approval Standard for Alarm Check Valves

Class Number 1041

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Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and

b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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1. INTRODUCTION

1.1 Purpose

1.1.1 This standard states FM Approvals criteria for alarm check valves that hydraulically activate a mechanical and/or electrical alarm when one or more sprinklers activate.

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 differential and pilot valve type alarm check valves. These valves are installed in wet sprinkler systems in either the vertical or horizontal orientation.

1.2.2 This standard was developed for alarm check valves in sizes: 1-1/2, 2, 2-1/2, 3, 4, 5, 6, and 8 in. nominal pipe size. Sizes refer to the nominal diameter of the pipeline to which the valve will be connected. In cases where metric sized alarm check valves are to be examined for Approval, test criteria comparable to the equivalent or nearest nominal inch size shall be used.

1.2.3 Alarm check valves covered in this Approval standard are supplied with either flanged, grooved, or flange x grooved inlet and outlet end connections.

1.2.4 Alarm check valves discussed in this Approval standard may also be supplied with a retard chamber in order to minimize false alarms due to surges and fluctuations in water supply pressure.

1.2.5 Alarm check valves discussed in this Approval standard are FM Approved for a 175 psi (1205 kPa) minimum rated working pressure.

1.2.6 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. Alarm check valves of unusual design may be subjected to special tests to determine their suitability.

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 alarm check valves for the purpose of obtaining Approval. Alarm 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, alarm 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. (Refer to Section 5.1.3 Drawing and Change Control.)

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 **September 1, 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."*

1.8 Applicable Documents

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 AMSE/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 D 572 - 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
International Standards Organization (ISO) 17025 – 1999, *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.)

Alarm Device
This term refers to the device that activates as a result of the opening of the alarm check valve. Alarm devices include electrical pressure switches that send signals to the control panel, and mechanical devices such as water motor gongs.

Alarm Line
This term refers to the valve trim piping from the alarm check valve to the alarm device. The alarm line piping is fed from water from the alarm port and may pass through the retard chamber.

Alarm Port
This term refers to the passageway through the alarm check valve body from the seat ring to the alarm line.

Bypass Line
This term refers to the trim piping that channels water from the water supply to the downstream side of the alarm check valve.

Constant Pressure Service
This term refers to installations where the alarm check valve is fed from a static water supply such as a water tank.

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.

Drain Orifice
This term refers to the designed restriction in the valve trim piping used to regulate the draining of water from the alarm line. The drain orifice may be located prior to, or at the bottom of the retard chamber.

Drain Valve

This term refers to the auxiliary valve located adjacent to the alarm check valve used to drain all water from the sprinkler system for valve maintenance, or system repair.

End Connections

This term refers to the method of connecting components of a pipe system to the ends of the valve. Typical end connections for alarm check valves discussed in this Approval Standard are flanged and grooved ends.

Flanged End Valves

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 Mark

The FM Approved 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.

FM Approved

This term refers to products FM Approved 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 the manufacturer not to deviate from the as-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.

Horizontal Orientation

This term refers to installations where the alarm check valve is installed so that the clapper is in a near vertical position when closed. When installed in the horizontal orientation, the clapper shall be observed to fall towards the closed position when the waterflow stops.

Rated Working Pressure

The maximum sustained pressure at or below which the valve shall operate trouble free. This also sets the basis for the testing described in Section 4, Performance Requirements.

Retard Chamber

A retard chamber is a pressure vessel that is fed from water flowing through the alarm port of the alarm check valve. The vessel is sized to minimize false alarms due to surges and fluctuations in water supply pressures found in variable pressure service.

Retard Orifice

This term refers to a designed restriction in the waterway feeding the retard chamber with water. The retard orifice shall be sized to allow the retard chamber to provide a 5 to 60 second delay before signaling the alarm. The retard orifice may or may not be part of the retard chamber itself.

Variable Pressure Service

This term refers to installations where the alarm check valve is supplied water from a water supply with varying water supply pressure. An example of variable pressure service installations are when the alarm check valve is fed off the municipal water main.

Vertical Orientation

This term refers to installations where the alarm check valve is installed so that the clapper is in a near horizontal position when closed. When installed in the vertical orientation, the clapper shall be observed to fall towards the closed position when the waterflow stops.

2. GENERAL INFORMATION

2.1 Product Information

2.1.1 Alarm check valves typically consist of an assembly of the following components: body, spring, disc/clapper, seat ring, seal facing, lifting lug, hand hole cover, clapper spring, and hinge pin.

2.1.2 Alarm check valves are supplied with trim piping that create the alarm, bypass, and drain lines that provide for proper operation of the valve. The trim piping typically consists of pipe fittings and nipples, retard chamber, retard orifice, drain orifice, drain valve, inlet and outlet pressure gauges, and pressure switch (for electrical alarm signaling).

2.1.3 Alarm check valves discussed in this Approval standard are for use in wet sprinkler systems.

2.1.4 In order to meet the intent of this standard, alarm 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, Member of the FM Global Group
Hydraulics Laboratory
743A Reynolds Road
West Glocester, RI 02814
U.S.A.

2.2.2 The manufacturer shall provide, at a minimum, 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 be controlled by the manufacturer's Quality Assurance procedures and 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 alarm check valves.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 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.

3.1.2 The manufacturer's dimensional specifications and / or design drawings shall fully describe the product. All critical dimensions shall be indicated with allowed upper and lower tolerance limits clearly shown.

3.1.3 All documents pertaining to the product materials, dimensions, processing, and marking shall be controlled by the manufacturer's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language drawings shall be provided with an English translation.

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, grooved, or flanged x 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 Alarm check valves shall be supplied with a hand hole large enough to permit the removal of all internal working parts without removal of the valve body from the sprinkler system.

3.2.4 The interior of the valve body shall preferably have a straight waterway. The area of the waterway at any point within the valve body shall not be less than 60 percent of the nominal area of the pipe to which the valve is connected.

3.2.5 The valve body shall have a drain connection so that it will serve to drain all water from the system piping with the alarm valve installed in either the horizontal or vertical orientation. The drain size for valves less than 4inch NPS shall be 1-1/4 inch NPS. For alarm check valves 4 inch NPS and larger, the drain size shall be 2 inch NPS.

3.2.6 Placement of a test and drain valve in lieu of the typically supplied style of drain valve does not replace the need for an inspector's test connection at the most remote location of the sprinkler system. The test and drain valve shall not be used in lieu of the inspector's test connection for the testing of the entire wet piping system. The test and drain valve shall only be used to exercise the clapper and check the mechanical alarm (water motor gong). All alarm check valves with this option shall have a note in their Installation, Operation, and Maintenance Instructions and a note in the listing in the Approval Guide, a publication of FM Approvals, regarding use.

3.2.7 The alarm check valve body shall be supplied with two 1/4 inch NPS pipe connections for pressure gauges. There shall be one pipe connection below, and one above the clapper.

3.2.8 The clapper with arm shall be designed so that it will close when no water is flowing through the valve.

3.2.9 The clapper and arm shall be designed so that they cannot separate in use. Clearance allowances for the clapper and arm have been shown in Appendix C.

3.2.10 If the clapper arm is made of iron, bushings shall be provided in the hub of the clapper arm where the hinge pin passes through it.

3.2.11 The face of the body seat ring shall be at least 1/8 inch (3.2 mm) higher than the surrounding metal into which it is placed. The seat ring shall be a minimum of 1/4 inch (6.3 mm) in width.

3.2.12 Metal clapper facings (finished seating surface) shall have a minimum width of 1/4 inch (6.3 mm).

3.2.13 Rubber clapper facings shall be clamped at least 1/2 inch (12.7 mm) from the inner edge of the seat ring. The rubber clapper facing shall extend a minimum of 1/8 inch (3.2 mm) over the outside of the seat ring and shall be backed up across the full width by a finished surface on the clapper. The clamping ring shall come to a stop against a shoulder on the clapper to prevent distortion of the rubber.

3.2.14 Valves having a single hinge pin side plug shall provide hinge pins which have tapped holes at each end for ease of removal.

3.2.15 Clapper parts shall be assembled in such a manner that they will not separate in reasonable cycling pressure service.

3.2.16 Valves that 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.

3.2.17 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. Any decision to use data generated using prototypes is at the discretion of FM Approvals.

3.2.18 Where screens are provided at the inlet to the retard chamber, the diameter of the holes in the screen shall be 1/16 inch (1.6 mm) less than the diameter of the smallest orifice to be protected by the screen. The total area of the openings in the screen should be a minimum of 20 times the cross sectional area of the orifice that the screen is designed to protect.

3.2.19 The retard chamber shall have suitable supports for mounting. The piping ordinarily used in retard chamber connections must not be used as the sole means of support for the retard chamber.

3.2.20 The retard chamber shall be supplied with 3/4 inch NPS piping connections to the alarm devices.

A manually operated control valve shall be installed in the line between the alarm valve and the retard chamber. The valve, when wide open, shall have a waterway at least equal to the nominal waterway area of the pipe to which it is connected. The valve position shall be readily apparent by visual examination (open or closed).

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 C-1 in Appendix C.

- 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 C-2 in Appendix C.

- The width of the hub on the clapper arm shall be at least 1/8 inch (3 mm) less than the minimum distance between the hinge pin bearings. See Figure C-3 in Appendix C.

- 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 C-3 in Appendix C.

- There shall be a minimum 1/8 inch (3 mm) projection of hinge pin bushings beyond the supporting material. See Figure C-3 in Appendix C.

- No allowance or reductions in tolerances are allowed for coatings applied to valve body or 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 FM Approved Mark (Appendix B).

3.5.2 Markings shall be cast or forged in raised characters or die stamped on the valve body. All letters and symbols shall be large enough to be read by a person with normal vision 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 FM Approved 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 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.

The calibration of recently purchased new equipment is also required. Documentation indicating either the date of purchase or date of shipment, equipment description, model and serial number is required for identification. The period from the time the equipment was put into service to the date of testing must be within an interval that does not require the equipment to be calibrated as determined on the basis of the parameters mentioned above.

4. PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The alarm 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 either 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 hydrostatic test pressures applied to the outlet side of the valve ranging from 30 psi (205 kPa) to the rated working pressure.

4.3.2 Test/Verification

With the inlet side open to atmosphere, the outlet 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 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 outlet 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 – Alarm Check Valve

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 or disc in the partially open position, 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 to the valve body as a result of this test.

4.6 Hydrostatic Strength – Trim Piping

4.6.1 Requirement

Alarm check valve trim piping shall withstand a hydrostatic pressure of twice times the rated working pressure without rupture, cracking or permanent distortion.

4.6.2 Test/Verification

This test may be conducted including the alarm check valve body or just using the trim piping. In either case, the items under test shall be filled with water making sure to remove all internal air. The component shall then be subjected to a hydrostatic test pressure of twice the rated working pressure for a duration of five minutes. The minimum test pressure for this test shall be 350 psi (2415 kPa). There shall be no visible rupture, cracking, or permanent distortion to any component of the trim piping as a result of this test.

4.7 Friction Loss Determination

4.7.1 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 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.

4.7.2 Tests/Verification

Tests shall be conducted to show 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 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

Nominal Valve Size in.	***Flow, at Velocity of 20 ft/sec (6.1 m/sec)***	
	gal/min	***(L/min)***
1-1/2	125	(475)
2	210	(795)
2-1/2	300	(1135)
3	460	(1740)
4	795	(3010)
5	1245	(4715)
6	1800	(6815)
8	3120	(11 810)

4.8 Cycle Test

4.8.1 Requirements

Alarm 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 examining engineer if design and calculation reviews 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 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. 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

Nominal Valve Size	***Flow, at Velocity of 30 ft/sec (9 m/sec)***	
in.	***gal/min***	***(L/min)***
1-1/2	190	(720)
2	315	(1190)
2-1/2	450	(1695)
3	690	(2615)
4	1190	(4505)
5	1870	(7080)
6	2700	(10 225)
8	4680	(17 705)

4.10 Water Absorption

4.10.1 Requirement

For resilient seated valves, water absorption of the rubber facings shall not 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. The comparative ability of rubber to withstand the effect of water shall be evaluated 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 180º).

4.12 Minimum Operational Flow Test

4.12.1 Requirement

Samples of each size of alarm check valve under evaluation shall be installed into a piping system in order to determine the minimum flow rate required to cause alarm signaling. This test shall be performed for supply pressures ranging from 20 psi (135 kPa) through the rated working pressure.

Under no circumstances shall the operational flow be less than 4 gpm (15 L/min). This test shall be performed for vertical and horizontal orientations as applicable.

4.12.2 Test/Verification

Samples of each size of alarm check valve under evaluation shall be installed into a piping system in order to determine the minimum flow rate required to cause alarm signaling. Upstream of the alarm check valve shall be a control valve that can isolate the valve under test from the water supply. The outlet of the alarm check valve shall discharge flow through a throttling and shut-off valve continuing on to a calibrated flow meter. The alarm line shall be fitted with a mechanical and/or electrical alarm device for verification of alarm signal. The alarm check valve may be supplied with a retard chamber at the manufacturer's option.

The test piping shall be filled with water making sure to remove all trapped air from the system. The throttling valve adjacent to the flow meter and the main drain valve adjacent to the alarm check valve shall be in the closed position. The water supply control valve shall be opened slowly causing the seating of the clapper of the alarm check valve. The manual control valve between the alarm check valve and the retard chamber shall be in the open position. The test piping shall be visually inspected for leakage in any of the piping connections; any leaks shall be stopped prior to testing. To perform the test, the throttling valve located upstream of the flow meter shall be opened slowly causing water to flow through the alarm valve via the bypass line. Flow shall be increased until the flow meter is reading slightly less than 4 gpm (15 L/min) and start a timing device. If at the end of 180 seconds the alarm valve has not operated, the test may be stopped. If the valve is observed to operate at a flow rate under 4 gpm (15 L/min) the valve has not met the requirement. (Refer to Appendix D for an example of the test arrangement.)

4.13 Sensitivity Test

4.13.1 Requirement

Samples of each size of alarm check valve under evaluation shall be installed into a piping system in order to determine the minimum flow rate required to cause repeatable alarm signaling. This test shall be performed for supply pressures ranging from 20 psi (135 kPa) through the rated working pressure. Under no circumstances shall the operational flow be under 4 gpm (15 L/min) nor over 20 gpm (75 L/min) throughout the range of water supply pressure. This test shall be performed for vertical and horizontal orientations as applicable.

4.13.1 Test/Verification

Samples of each size of alarm check valve under evaluation shall be installed into a piping system in order to determine the minimum flow rate required to cause repeatable alarm signaling. This test shall be conducted using the same test piping as described in Section 4.11.2, Minimum Operational Flow Test. The following test shall be performed for supply pressures ranging from 20 psi (135 kPa) through the rated working pressure.

The test piping shall be filled with water making sure to remove all trapped air from the system. The throttling valve adjacent to the flow meter and the main drain valve adjacent to the alarm check valve shall be in the closed position. The water supply control valve shall be opened slowly causing the seating of the clapper of the alarm check valve. The manual control valve between the alarm check valve and the retard chamber shall be in the open position. The test piping shall be visually inspected for leakage in any of the piping connections; any leaks shall be stopped prior to testing. To perform the test, the throttling valve located upstream of the flow meter shall be opened slowly causing water to flow through the alarm valve via the bypass line. Flow shall be increased until the alarm valve is observed to open causing the mechanical and/or electrical alarm device to signal. The flow rate shall be recorded.

The manual control valve between the alarm check valve and the retard chamber, and the water supply valve shall be closed, and the retard chamber shall be allowed to drain completely. Once the retard chamber has drained, the water supply valve can be slowly opened. The alarm check valve should reset automatically into the closed position. The test system shall be allowed to settle prior to the next step.

Simultaneously, the manual control valve between the alarm check valve and the retard chamber shall be opened, and a timing device shall be started. The time to activation for the alarm device shall be recorded. The recorded activation time shall fall between 5 and 60 seconds. The intent of this test is to determine the minimum flow rate that will result in repeatable activation of the alarm device within the allowed response time limits. It may be necessary to adjust the throttling valve between tests. This test shall be repeated for a total of three recordings per increment of water supply pressure. (Refer to Appendix D for an example of the test arrangement.)

4.14 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.

Modification	***Description / Example***
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.

Modification	***Description / Example***
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 alarm 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 FM Approved Mark is not permitted at any other locations without prior written authorization by FM Approvals.

5.3 Manufacturer's Responsibilities

The manufacturer shall notify and receive authorization from FM Approvals for 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) the valve is considered to have failed the test. Resilient-seated valves of any sizes 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”)
L/min = gal/min x 3.785

LENGTH: in. - “inches”; (mm - “millimeters”)
mm = in. x 25.4

ft - “feet”; (m - “meters”)
m = ft x 0.3048

LIQUID: gal - “gallons”; (L - “liter”)
L = gal x 3.785

MASS: lb - “pounds”; (kg - “kilograms”)
kg = lb x 0.454

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

APPENDIX B: FM APPROVED 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: DRAWINGS

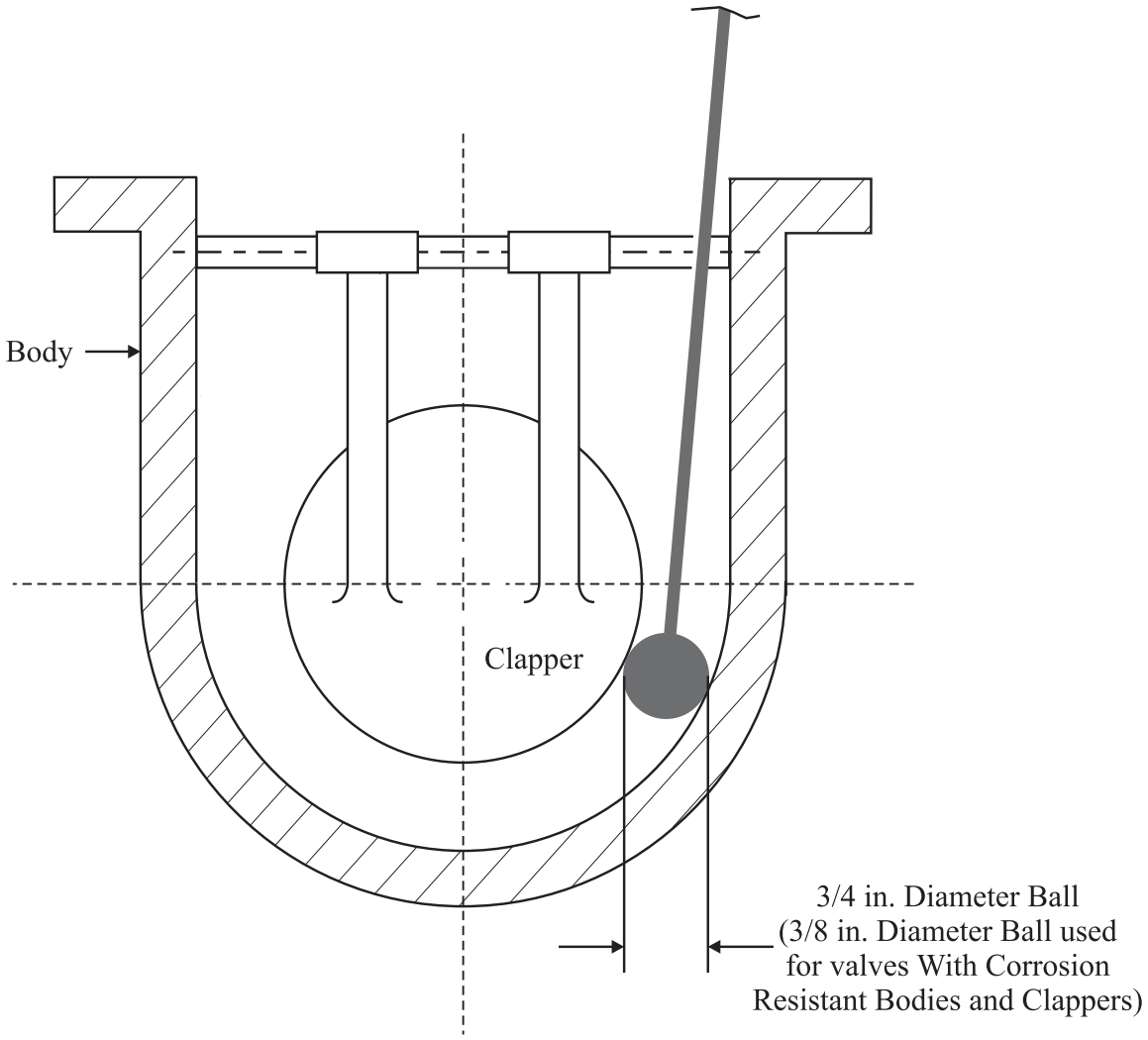


Figure C-1. Periphery of the Clapper and the Inside of the Body Clearances

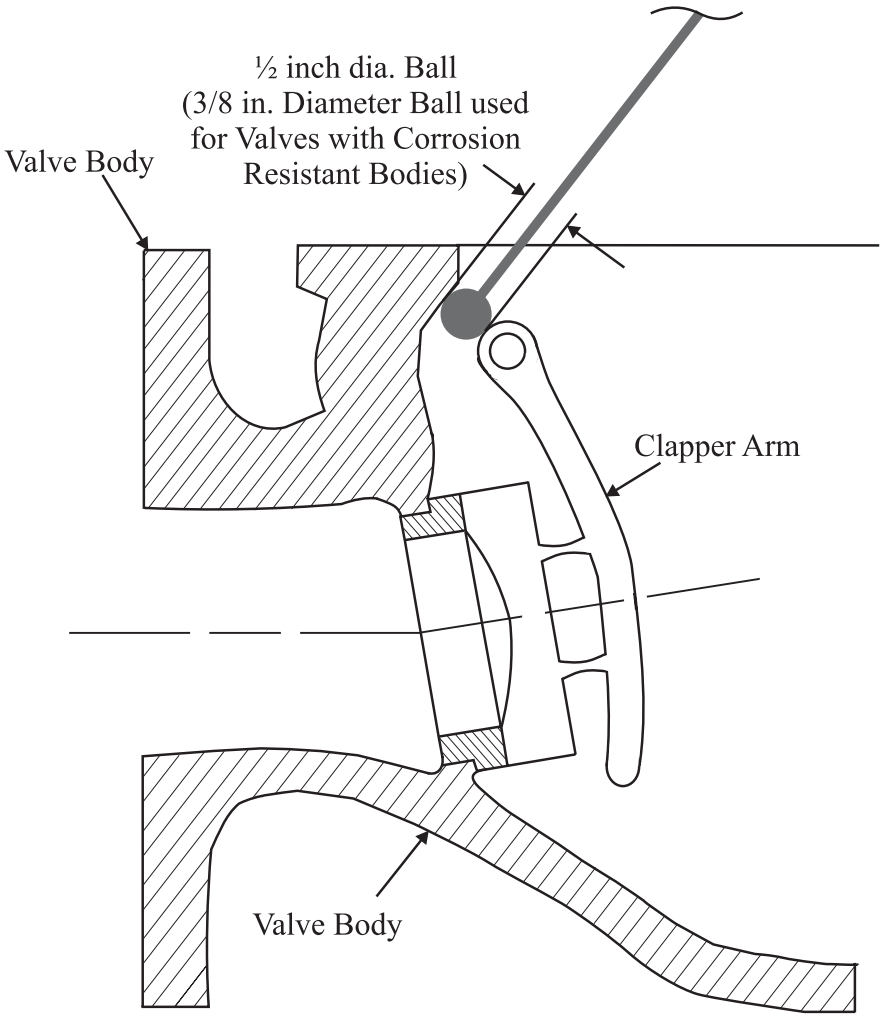


Figure C-2. Hub of the Clapper Arm and Inside of the Body Clearances

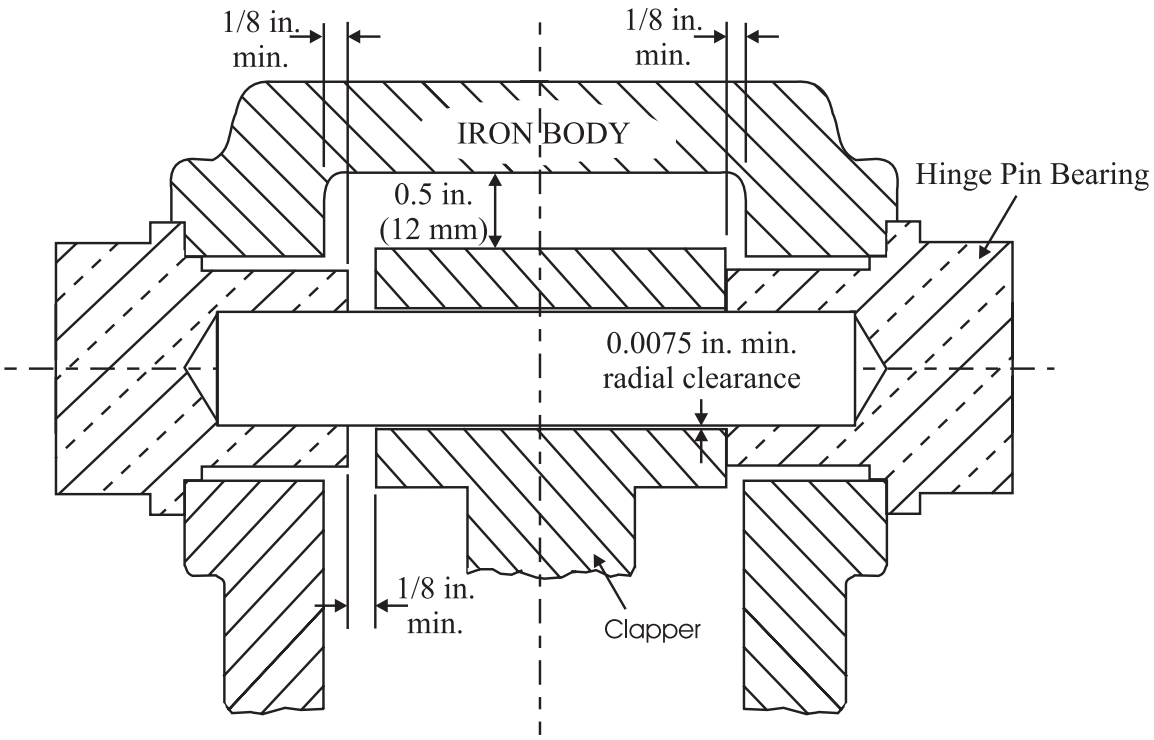
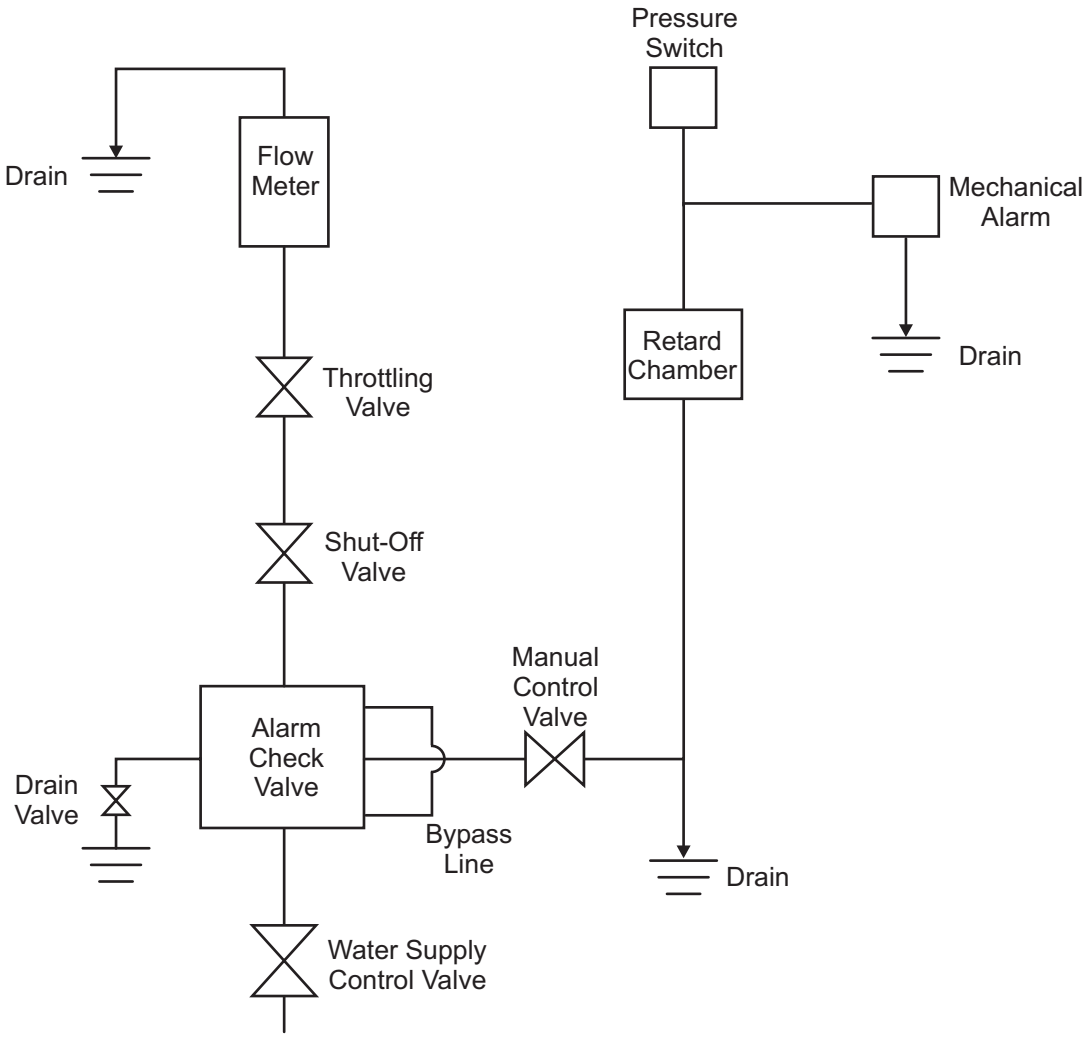


Figure C-3. Hinge Pin Clearances

APPENDIX D: TEST SET-UP DIAGRAM



APPENDIX E: SAMPLE LISTING

All new and current listings in the Approval Guide, a publication of FM approvals, will be reformatted to resemble the following sample.

ABC Inc 123 Approvals Dr, Any City, Anywhere

Product Description	***End Connections Inlet x Outlet***	***Nominal Pip Size, in.***	***Max. Rated Working Pressure, psi (kPa)***	***Remarks***
Model ABC	Flange x Flange	4, 6, 8	175 (1205)	a
	Flange x Groove	4, 6	175 (1205)	a, b
	Groove x Groove	4, 6, 8	300 (2070)	a

Remarks:

a. For use with FM Approved Retard Chamber Model XYZ.
b. For vertical installations only.

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