



Member of the FM Global Group

Approval Standard for Automatic Water Control Valves

Class Number 1020

April 2007

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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1.0 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval criteria for Automatic Water Control Valves.
- 1.1.2 Approval criteria may include, but are not limited to: performance requirements, marking requirements, examination of manufacturing facilities, audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 Automatic water control valves are most commonly used to control the flow of water to various fire protection sprinkler systems. They are used in sprinkler systems such as deluge, preaction, refrigerated area, and on-off multicycle sprinkler systems. Therefore, valves used for these applications must meet the requirements of this standard, as well as, at minimum, one of the following Approval Standards:

<i>Sprinkler System</i>	<i>Approval Standard Class</i>
Deluge	1011
Praction	1012
Refrigerated Area	1013
On-Off Multicycle	1016

Although not addressed in this standard, automatic water control valves may be configured to control the flow to water spray systems, open and closed head foam water sprinkler systems and other special purpose systems. Certain designs of automatic water control valves are also utilized on the discharge of fire pumps for pressure relief, pressure reducing, and pump suction pressure regulating purposes.

- 1.2.2 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 the design of automatic water control valves for the purpose of obtaining Approval. Automatic water control 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, automatic water control 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 that was examined and tested as part of the Approval project. The audit shall 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 document and drawing control. These examinations are repeated periodically as part of the FM Approvals product follow-up program. (Refer to Section 5.2, Facility and Procedures Audit.)

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;
- Compliance with the terms stipulated in the Master Agreement;
- Satisfactory re-examination of production samples for continued conformity to requirements;
- Satisfactory Facilities and Procedures Audits (F&PAs) conducted as part of FM Approvals' product follow-up program; and
- Satisfactory field experience.

1.5.2 Satisfactory field experience is the final test of Approval. Unsatisfactory field experience because of FM Approved equipment malfunction may necessitate withdrawal of Approval.

1.5.3 Also, as a condition of retaining Approval, manufacturers may not change an FM Approved product or service without prior written authorization by FM Approvals. (Refer to Section 5.1.3 for further details regarding changes.)

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after that date shall satisfy the requirements of the 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 **February 29, 2008** 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 Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing and Materials (ASTM) SI 10-2002, "*American National Standard for Use of the International System of Units (SI): The Modern Metric System.*" The units of measurement for pressure discussed in this standard are gage pressures unless otherwise noted in the text.

1.8 Applicable Documents

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

American National Standards Institute (ANSI)/ American Water Works Association (AWWA) C606-06,
AWWA Standard for Grooved and Shouldered Joints
American Society of Mechanical Engineers (ASME) B16.5 - 2003, *Pipe Flanges and Flanged Fittings: NPS
1/2 through 24*
ASTM D 471 - 2006, *Standard Test Method for Rubber Property - Effect of Liquids*
ASTM D 572 - 2004, *Standard Test Method for Rubber - Deterioration by Heat and Oxygen*
FM Global Property Loss Prevention Data Sheets
IEEE/ASTM SI 10 - 2002, *American National Standard for Use of the International System of Units (SI): The
Modern Metric System*
International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 17025 - 2005,
General Requirements for the Competence of Testing and Calibration Laboratories
National Fire Protection Association (NFPA) 13 - 2007, *Standard for the Installation of Sprinkler Systems*
NFPA 15 - 2001, *Standard for Water Spray Fixed Systems for Fire Protection*
NFPA 16 - 2007, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*

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 this 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. A product accepted for one installation may not be acceptable elsewhere. (Contrast with FM Approved.)

Deluge System

A deluge system is a sprinkler system employing open sprinklers installed in the piping system. The system is connected to a water supply through an automatic water control valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

Deluge sprinkler systems have open sprinklers and are used where it is desirable to discharge water through all of the system's sprinklers simultaneously. Prior to discharge there is no water in the sprinkler piping. The water supply is held back by a automatic water control valve which is operated manually or automatically by the actuation of a fire detection system. The fire detection system is required to be one of the following types: wet pilot sprinkler line, dry pilot sprinkler line, hydraulic rate-of-rise, pneumatic rate-of-rise or electric.

FM Approvals Certification Marks

The FM Approvals Certification Marks are detailed in Appendix B. Their use is mandatory on all units of FM Approved Deluge and Preaction Valves and Control Panels. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to specific systems and components.

FM Approved

This term refers to products FM Approved by FM Approvals. Such products are listed in the Approval Guide, issued annually, or its supplements. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. These forms obligate the manufacturer to allow re-examination of the product and the audit of its facilities and procedures at FM Approval's discretion. It further prohibits the manufacturer from deviating from the as-FM Approved configuration of the product without prior review by and agreement of FM Approvals.

Preaction System

A sprinkler system employing automatic sprinklers attached to a piping system containing air that may or may not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers. Actuation of the detection system opens an automatic water control valve that permits water to flow into the sprinkler piping system and to be discharged from any sprinklers that open.

Preaction systems are equipped with automatic sprinklers and are used where it is important to prevent the accidental discharge of water. These systems may also be used where an alarm is desired in advance of sprinkler operation or where it is desired to minimize the water delivery delay inherent in a standard dry-pipe system.

Rated Working Pressure

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

Refrigerated Area System

A hybrid preaction system that requires both a sprinkler and a heat-actuated device to operate before the water control valve opens and admits water into the sprinkler piping. It is intended for use in freezers with extremely low temperatures.

A refrigerated area sprinkler system affords fire protection in refrigerated rooms or buildings and includes special safeguards against accidental filling with water and subsequent freezing of the system. A fire detection system must actuate and one or more automatic sprinklers in the piping must operate before water will enter the sprinkler system. An alarm sounds if the detection system only is actuated while pneumatic pressure is maintained in the sprinkler piping. An alarm also sounds if the pneumatic pressure in the sprinkler piping is not properly maintained. In either case, water does not enter the system piping.

On-Off Multicycle Sprinkler Systems

Multicycle sprinkler systems are FM Approved automatic sprinklers and hydraulic controls capable of repeated on-off cycles appropriate to control the possible redevelopment of fire in the protected area. The cycling occurs as the result of fire detector operation which, acting as an electrical interlock, causes the main automatic water control valve to open and close. Fire detector actuation precedes sprinkler operation so water is discharged as from a conventional water system. Should the fire rekindle after its initial control, water again flows from the opened sprinklers. Manual control valve operation, in the event of detector impairment, is a required system capability. Sprinkler replacement after a fire does not cause impairment of protection.

2.0 GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Nominal sizes of automatic water control valves for fire protection service addressed in this standard are: nominal pipe sizes (NPS) 1-1/2, 2, 2½, 3, 4, 6 and 8 inches with a minimum rated working pressure of 175 psig (1215 kPa). Other pressure ratings and sizes, including metric sizes, shall be evaluated on a case-by-case basis.
- 2.1.2 In order to meet the intent of this standard, automatic water control valves must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is required because identical designs, fabricated using identical materials by different manufacturers, or even by different plants of the same manufacturer, have been shown to perform differently in testing. Sample automatic water control valves selected in conformance to this criterion shall satisfy all of the requirements of this standard.

2.2 Types

Current automatic water control valves are of two general designs:

2.2.1 Clapper Type

The clapper type valve utilizes a swing type clapper that is held closed on its seat by a mechanical latch which is held in the closed position by the force from a piston. The clapper type valve is illustrated in Figure C-1. Figure C-1 shows the valve in its ready or set position. Also illustrated are the sequence and the mechanisms for valve trip: the piston chamber water pressure is reduced by operation of a releasing device (a solenoid valve is shown in Figure C-1), the piston retracts, the clapper is unlatched and opens, and water flows to the sprinklers. The piston retracts because of a reduction in water pressure in the piston chamber. This pressure reduction results from the action of heat detectors and/or activated sprinklers opening trim release devices in the piston charge line. Figure C-1 shows an energized open solenoid valve (normally closed) which vents the pressure in the piston charge line. This solenoid valve release shown is one of many automatic control valve release mechanisms. A complete description of all the various release systems is detailed in the Approval Standards listed in Section 1.2.1 of this Standard. Figure C-1 shows a restrictor orifice between the water supply and the piston chamber. This is a common feature which ensures that the piston chamber pressure is fully vented by the release device(s), because the orifice limits the flow into the chamber to be less than the flow out of it.

2.2.2 Diaphragm Type

The diaphragm type utilizes an elastomeric flat or cylindrical (sleeve type) diaphragm that is held closed on the valve seat by the water supply pressure acting on the top of the flat diaphragm or on the outside of the sleeve type diaphragm. The flat diaphragm is illustrated in Figure C-2. The sleeve type diaphragm type is illustrated in Figure C-3. Figures C-2 and C-3 shows the valves in their ready or set position. Also illustrated are the sequence and the mechanisms for valve trip: diaphragm chamber water pressure is reduced by operation of a releasing device (a solenoid valve is shown in Figures C-2 and C-3), the diaphragm retracts, and water flows to the sprinklers. The diaphragm retracts because of a reduction in water pressure in the diaphragm chamber. This pressure reduction results from the action of heat detectors and/or activated sprinklers, which open trim components in the diaphragm charge line. Figures C-2 and C-3 show an energized open solenoid valve (normally closed) which vents the pressure in the diaphragm charge line. This solenoid valve release shown is one of many automatic control valve release systems. A complete description of all the various release systems is detailed in the Approval Standards listed in Section 1.2.1 of this Standard. Figures C-2 and C-3 also show a restrictor orifice between the water supply and the diaphragm chamber. This ensures that the diaphragm chamber pressure is fully vented, because the orifice limits the flow into the chamber to be less than the flow out of it.

2.2.3 Summary

In summary, the common designs of automatic water control valves trip when the water pressure in the piston or diaphragm chamber is reduced. This reduction of chamber pressure is controlled by the releasing mechanisms of the trim assemblies. These releasing mechanisms may be pneumatic, hydraulic, electrical or a combination of these releasing mechanisms. These releasing mechanisms and detailed operational testing requirements are contained in the Deluge, Preaction and Refrigerated Area Standard Class 1011/1012/1013, and the On-Off Multicycle Standard Class 1016.

2.3 Approval Application Requirements

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

Group Manager - Hydraulics
FM Approvals
Hydraulics Laboratory
743A Reynolds Road
West Glocester, R.I. 02814, USA

2.3.2 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, and installation, operation and maintenance procedures; and,
- Number and location of manufacturing facilities making the products submitted for Approval.

2.3.3 All foreign language documents shall be provided with an English translation.

2.4 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 determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, and results of prior testing. 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 automatic water control valves. Testing may be performed at FM Approvals, at the manufacturer's test facility, or at a third-party location, as mutually agreed.

3.0 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 by FM Approvals 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 dimensional drawings shall fully describe the product. All critical dimensions shall be indicated with the 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.
- 3.1.4 All foreign language documents shall be provided with an English translation.

3.2 Physical or Structural Features

- 3.2.1 Common sizes for deluge, preaction, refrigerated area, and on-off multicycle valves are: 1-1/2, 2, 2-1/2, 3, 4, 6 and 8 inches nominal pipe size (NPS).
- 3.2.2 All automatic water control valves shall have a minimum rated working pressure of 175 psi (1215 kPa).
- 3.2.3 Valve bodies of 3 in. (76.2 mm) and larger shall have flanged ends conforming to a recognized national or international standard for flanges and flanged fittings, such as ASME B16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 through 24*. Flanged by grooved ends, or grooved by grooved ends are also acceptable in sizes 3 inches and larger. Smaller valves may have flanged, threaded, or grooved ends conforming to a recognized national or international standard such as ANSI/AWWA C606-06, AWWA Standard for Grooved and Shouldered Joints. Other end connections may be FM Approved if there is a demonstrated need for them, and these will be examined on a case-by-case basis.
- 3.2.4 Valves manufactured or for use outside North America may be FM Approved with end connections conforming to recognized national or international standards.

3.3 Design Requirements

- 3.3.1 Water control valves may remain inactive for long periods of time, yet they must be ready and able to operate positively and reliably at any moment. Overall design should be uncomplicated and construction should be simple and rugged with appropriately generous dimensions and clearances. An example of this design approach is the piston or plunger assembly in a clapper type valve, frequently a fabric reinforced rolling rubber diaphragm, which is shown in Figure C-1. The generous clearance on the piston periphery and the rolling low friction movement of the diaphragm is far superior in these applications than the piston with the radial seal also shown in Figure C-1. Radial Seals shall not be considered for Approval. The rolling rubber diaphragm is a good example of the desired seal. However, each seal design submitted for Approval is examined on a case-by-case basis.
- 3.3.2 Water control valves and releasing devices shall be designed so that all movements of lever systems, diaphragms, valves and switches are positive and repeatable. The releasing device shall be capable of providing the energy necessary to trip the valve under all conditions of system water pressure up to the rated working pressure.

- 3.3.3 Valves may be designed for manual or automatic resetting. Automatic resetting, if provided, is accomplished by mechanical or hydraulic means external to the main valve, without removing the cover faceplate, if provided. Valves without faceplates will be evaluated on a case-by-case basis.

3.4 Operation

- 3.4.1 Water control valves shall be designed to operate at all water supply pressures, from a minimum of 20 psi (140 kPa) to the maximum rated working pressure of the valve.
- 3.4.2 Water control valves which are operated by a reduction in water supply pressure in the piston or diaphragm chamber, shall operate (trip) at a positive gauge pressure greater than 5 psi (35 kPa). A check valve shall be installed in the water supply pressure line leading to the chamber in order to prevent accidental valve trip if the water supply pressure momentarily drops below the trip point pressure.
- 3.4.3 All water control valves shall have means incorporated in their design for manual tripping of the valve at the valve location, such as a manual pull station.

3.5 Markings

The following shall be cast onto the valve body in raised letters:

- The manufacturers' name or logo;
- The valve model number;
- Nominal valve size (inches/millimeters);
- A arrow indicating the direction of flow;
- The foundry and casting date code; and,
- Rated working pressure, psi (kPa)

Alternatively, a corrosion resistant nameplate, positively fastened to the valve body or faceplate cover, for example with drive screws, may contain the same information. A combination of both may be used. If the valves are manufactured at more than one location, each valve shall be uniquely marked to indicate place of origin.

Additionally, a metal nameplate, attached to the body or hand hole cover with drive screws, must also be attached to the trimmed valve to indicate the systems as following:

- The manufacturers' logo;
- Model Number and "Deluge or Preaction", "Single or Double Interlock" Valve;
- The FM Approvals Certification Mark;

Valve users should be advised in the manufacturer's installation instructions if horizontal installation is required. The installation instructions (shipped with the valve) shall contain detailed descriptions of the valve installation and operation in the horizontal orientation.

For specific marking information, refer to the various release systems as detailed in the other relevant Approval Standards listed in Section 1.2.1 of this Standard.

3.6 Materials and Construction

All materials used in automatic water control valves shall be suitable for the intended purpose. Valve parts which could affect the operation of the valve if they became corroded or are subject to tuberculation shall be constructed of corrosion resistant materials. This includes such parts as clapper arm and latch hinge pins and their bushings. The mating sealing components, such as metal seat rings in contact with rubber sealing surfaces

and diaphragms, shall be constructed of materials which will not adhere to each other over time. Adhesion testing involving long term contact under pressure between the seal and seat in various environments may be necessary. Refer to the Deluge, Preaction and Refrigerated Area Standard Class 1011/1012/1013, and the On-Off Multicycle Standard 1016. Certain designs involving dynamic seals are not considered for Approval. A radial O-ring seal design in the piston of a clapper type valve shall not be considered for Approval. Valve body coatings may be tested for durability, particularly if the coatings are subjected to mechanical wear or water erosion.

3.7 Environment

The automatic water control valves shall be designed to operate in a temperature environment of between 40 °F to 125 °F (4 °C to 52 °C). The manufacturer's Installation, Maintenance, and Operation Instructions shall include wording to the effect: "The valves must be located in an indoor environment above 40 °F (4 °C), which is not subject to weather, freezing temperatures, or physical damage".

3.8 Serviceability and Parts Removal

- 3.8.1 Automatic water control valves shall be designed so that all parts are uniquely oriented to minimize the possibility of improper assembly. All internal parts shall be easily removable for inspection, cleaning, repair or replacement without removing the valve from the system piping. Certain water control valves may be FM Approved even when required to be removed from the system piping for maintenance if the intent of the Standard is met. Specifically, if the valve assembly has design features which facilitate ease of removal, and this is verified by testing, it may be FM Approved.
- 3.8.2 The valve shall be constructed so that it can be reset after valve trip by a single person using standard tools.
- 3.8.3 All valve installation and maintenance manuals must contain safety warnings requiring depressurization and draining of all piping before any maintenance is attempted.
- 3.8.4 An integral drain shall be provided below the valve seat such that the sprinkler system, after valve trip, is able to be drained *completely* of water without opening the faceplate cover, if so equipped. This is intended to eliminate any pool of water above the valve seat which may evaporate and form ice plugs in a refrigerated area, and may also contribute to corrosion.

3.9 Instructions and Trim Equipment

- 3.9.1 The manufacturer shall provide complete installation, maintenance, operating and troubleshooting instructions for the automatic water control valve and all its component parts. Valve resetting procedures and verification of such shall be completely detailed.
- 3.9.2 The manufacturer shall provide all necessary trim, including equipment, fittings, and piping, to perform the following:
- Automatically drain to atmosphere any water leakage past the water seat. After valve operation, the automatic drain mechanism may either close or constantly drain through an orifice.
 - Automatically operate an electric or hydraulic alarm, or both, when the valve operates.
 - Allow checking of the water supply flow after the valve operates.
 - Permit manual drainage of the system after the valve operates.

The drain line shall be located on the supply side of the clapper and shall be sized as follows:

<i>Nominal Valve Size, in.</i>	<i>Drain Size</i>	
	<i>in.</i>	<i>(mm)</i>
1-1/2	3/4	(20)
2	3/4	(20)
2-1/2	1-1/4	(32)
3	1-1/4	(32)
4	2	(50)
6	2	(50)
8	2	(50)

- Permit manual isolation of the alarms after operation or for repairs, and manual testing of the alarm(s) without tripping the valve.
- Give a visual indication of the water supply pressure.

3.9.3 FM Approved equipment (such as pressure gauges, valves, and pressure switches) shall be used as trim components wherever applicable.

3.10 Clearances

3.10.1 Ample clearances shall be provided between all moving and stationary parts so that corrosion or deposits such as tuberculation will not interfere with proper operation of the valve.

3.10.2 To assure ample clearance, the following minimum dimensions shall be maintained (refer to Figure C-4):

- 3/4 in. (20 mm) between valve body and clapper assembly in all positions from closed to wide open.
- 1/2 in. (13 mm) between valve body and clapper hub or hubs of any intermediate levers.
- 1/16 in. (1.6 mm) minimum play between clapper hinge pin bearings or bushings and the clapper arm dimension.
- 1/8 in. (3 mm) minimum projection of hinge pin bushings or clapper arm bushings beyond the supporting material.

3.10.3 The above clearances may differ for valves which use special materials, coatings or finishes. Examination of these valves will be on a case-by-case basis.

3.11 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 an 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/IEC 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 recalibrated.

3.12 Tolerances

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

4.0 PERFORMANCE REQUIREMENTS

This section of the Approval Standard describes the required test procedures. The valve manufacturer shall determine the sequence of testing.

4.1 Examination

4.1.1 Requirement

The automatic water control 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 requirements described in Section 3, General Requirements.

4.2 Operational Tests

4.2.1 Requirements

Automatic water control valve systems shall be tripped by operating all of the relevant releasing means at various water supply pressures from 20 psi (140 kPa) to the rated working pressure of the valve. The valves shall operate smoothly, consistently, and repeatedly. For detailed operational testing requirements refer to Deluge, Preaction and Refrigerated Area Standard Class 1011/1012/1013, and On-Off Multicycle Standard 1016.

Special emphasis will be given to the installation and operating instructions provided by the manufacturer. The possibilities of malfunction due to maladjustment of parts or improper installation will be investigated.

Special tests will be developed, as necessary, to evaluate the operation of automatic water control valves having special or unusual releasing mechanisms.

4.2.2 Test/Verification

Automatic water control valve systems shall be set up by following the installation instructions provided by the manufacturer. The automatic water control valve shall be tripped by operating all of the relevant releasing means at various water supply pressures from 20 psi (140 kPa) to the rated

working pressure of the valve. The valves shall operate smoothly, consistently, and repeatedly. Each operational test shall be repeated 3 times at each water supply pressure in order to demonstrate consistent operation.

Detailed operational testing requirements are contained in the Deluge, Preaction and Refrigerated Area Standard Class 1011/1012/1013, and On-Off Multicycle Standard 1016.

Automatic water control valves used in sprinkler systems such as deluge, preaction, refrigerated area, and on-off multi-cycle sprinkler systems must meet the requirements of this Standard, and also the following Approval Standards:

<i>Sprinkler System</i>	<i>Approval Standard Class</i>
Deluge	1011
Preaction	1012
Refrigerated Area	1013
On-Off Multicycle	1016

4.3 Friction Loss

4.3.1 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 diaphragm in the full open position, the loss in water pressure through the valve shall not exceed 5.0 psi (35 kPa) at a flow producing a velocity of 17 ft/sec (5 m/sec) in Schedule 40 steel pipe of the same nominal diameter as the valve, as shown in Table 4.3.

Table 4.3. - Friction Loss Flows, 17 ft/sec (5 m/sec)

<i>Valve Size</i>		<i>Flow</i>	
<i>in.</i>	<i>(mm)</i>	<i>gal/min</i>	<i>(L/min)</i>
1-1/2	(40)	106	(400)
2	(50)	179	(680)
2-1/2	(65)	255	(965)
3	(80)	391	(1480)
4	(100)	675	(2555)
6	(150)	1530	(5790)
8	(205)	2650	(10 030)

4.3.2 Tests/Verification

A sample valve shall be installed between two Schedule 40 test pipes of the same nominal diameter as the valve and equipped with piezometer rings. The pressure loss between the piezometer rings shall be measured for the corresponding flow rates listed in Table 4.3 to determine the total friction loss of the valve and test piping. The friction loss in the test piping, without the valve installed, is then measured at the same flow rates and deducted from the total friction loss previously measured. The net friction loss across the valve shall not exceed 5.0 psi (35 kPa).

4.4 Body Hydrostatic Strength

4.4.1 Requirement

The valve body assembly shall withstand a hydrostatic pressure of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, without rupture, cracking or permanent distortion.

4.4.2 Test/Verification

With the clapper or diaphragm 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. For the clapper type valves, the clapper shall be open, off the seat in order to subject the entire body assembly to the hydrostatic pressure. For the diaphragm type valves, the hydrostatic pressure must be applied to the top and bottom of the diaphragm. There shall be no visible rupture, cracking, or permanent distortion to the valve body as a result of this test.

4.5 Clapper Strength

4.5.1 Requirement

For the clapper type valves, the outlet side of the clapper shall withstand a hydrostatic pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater, without damage or functional impairment.

4.5.2 Test/Verification

With the clapper closed, on the seat and the valve inlet open to atmosphere, the clapper of each valve size shall be subjected to a hydrostatic test pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater, applied to the outlet side of the clapper for a duration of five minutes. Examination shall demonstrate that there is no damage or functional impairment as a result of this test.

4.6 Diaphragm Strength

4.6.1 Requirement

All diaphragm type valves, as well as all actuators and trim components which utilize diaphragms, shall withstand a differential pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater, without diaphragm damage or functional impairment.

4.6.2 Test/Verification

Diaphragms of each size shall be subjected to a differential test pressure of 350 psi (2415 kPa) or two times the rated working pressure, whichever is greater. The differential pressure shall be applied across the diaphragm in the direction which normally applies the closing force in the device. The test duration shall be five minutes. For example, referring to Figure C-2, two times the rated working pressure would be applied to the top of the diaphragm with the valve inlet open to atmosphere. As another example, referring to Figure C-1, the pressure would be applied to the piston chamber with the opposite side of the piston not pressurized, but with the piston rod restrained against the latch. Examination shall demonstrate that there is no diaphragm damage or functional impairment as a result of this test.

4.7 Bonding Adequacy

4.7.1 Requirement

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

4.7.2 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. The test duration shall be 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 4.7.2 - Bonding Adequacy Flows

Nominal Valve Size, in.	Flow, gal/min (L/min) at Velocity of 30 ft/sec (9 m/sec)	
1-1/2	190	(720)
2	315	(1190)
2-1/2	450	(1705)
3	690	(2610)
4	1190	(4505)
6	2700	(10 220)
8	4680	(17 715)

4.8 Water Absorption

4.8.1 Requirement

For resilient seated valves, water absorption of the rubber facings shall not result in an increase greater than 1.5 percent of the original thickness or weight.

4.8.2 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 the 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, an increase in the thickness or weight of the sample shall not be greater than 1.5 percent of the original thickness or weight.

4.9 Aging

4.9.1 Requirement

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

4.9.2 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. bent 180°).

4.10 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. This may include various tests to evaluate the effects of chemical and galvanic corrosion on valve parts, and tests to evaluate the effects of environmental factors such as dust, dirt, airborne chemicals, vibration, or temperature. Durability testing which subjects a mechanism or device under representative pressures and flows for numerous cycles may also be conducted.

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.

5.0 OPERATIONS REQUIREMENTS

A quality control program is required to assure that subsequent automatic water control 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 documented 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 performance and by periodic re-examination and testing.

5.1 Demonstrated Quality Control Program

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

- Existence of corporate quality assurance guidelines;
- Incoming quality assurance, including testing;
- In-process quality assurance, including testing;
- Final inspection and tests;
- Equipment calibration;
- Drawings, Operating Manuals, and specific Test Procedure 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, and their results, for a minimum period of two years after the date of a valve's manufacture.

5.1.2 Documentation/Manual

The manufacturer shall provide FM Approvals with an authoritative collection of procedures and policies. Such documentation shall provide an accurate description of the quality management system, while also 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 to verify operation of the quality system.

5.1.3 Drawing Specification, and Document Change Control

The manufacturer shall establish a system of product configuration control that shall not allow unauthorized changes to the product. Revisions to critical documents, identified in the Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation in production. The manufacturer shall assign an appropriate person or group to be responsible for reporting proposed revisions to FM Approved products to FM Approvals. In situations involving significant modifications to an FM Approved product, the notification shall be in the form of a formal request for an Approval examination. For modifications of a more common nature, the manufacturer shall provide notification to FM Approvals by means of FM Approvals Form 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. Copies of Form 797 are provided to the manufacturer by FM Approvals.

In summary, when a manufacturer revises a drawing, specification, or document which is listed in the controlled document list of the Approval Report, the manufacturer’s representative must submit a completed Form 797 to FM Approvals by mail or electronically. The following information must be included: the revised drawing which clearly specifies the change and reason for the change; the product model and size(s) affected; the original FM Approvals Project ID(s); and the FM Approvals representative who should be one of the two signatories of the original Approval Report.

5.1.3.1 The table below has been included as a guide to manufacturers of what is considered to be a significant change to FM Approvals. As mentioned above, modifications that fit this category shall be documented by means of a letter stating the change, and requesting an Approval examination.

<i>Modification</i>	<i>Description/Example</i>
Increase of Pressure Rating	The valve 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 system was originally FM Approved for 1-1/2 through 4 inch NPS, and now Approval of 6 and 8 inch NPS is desired.
Addition to or Relocation of the Manufacturing Location	The product was originally FM Approved in location A, and now is desired to be made in locations A and B, or only in location B.
Change in Manufacturing Process	Change of a pressure-containing component from machined bar stock to a sand casting.
Changes to Critical Design, Dimensions, Materials, Hydraulic and Electrical Components	Pressure-containing component wall thickness change. Clapper or diaphragm redesign. Component shape and/or material used change.

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

<i>Modification</i>	<i>Description/Example</i>
Change in Company Contact Information	Company Name, Contact Name, Title, Phone Number, Fax Number, Email Address, Company Office Address.
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	Describe what changes are to be made and include a drawing of the proposed marking.

<i>Modification</i>	<i>Description/Example</i>
Updating of Documentation	Creation of New or Revisions to Sales literature, Installation Instructions, Quality Manual, etc.
Changes in Materials	Where new material is either comparable, or superior, to material used in original Approval. NOTE: What may appear to be a comparable or even superior material may in fact not perform as well as the existing material in service. FM Approvals should be contacted by the manufacturer very early in the planning process if a material change is being contemplated.

5.1.3.3 In instances where the modification is difficult to categorize, manufacturers are encouraged to contact FM Approvals to discuss the nature of the change, and to inquire about how to send the information to FM Approvals. Sections 5.1.3.1 and 5.1.3.2 contain common examples of modifications as they relate to the manufacture of automatic water control valves.

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 ensure that the manufacturer's equipment, procedures, and quality program are maintained to produce a consistently uniform and reliable product. Initial inspections of facilities already producing similar FM Approved 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 manufacturer 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 Approvals Certification Mark is not permitted at any other locations without prior written authorization by FM Approvals.

5.3 Installation Inspections

FM Approvals engineers frequently inspect deluge, preaction, refrigerated area, and on-off multicycle sprinkler system installations with automatic water control valves in FM Global insured facilities. The inspections are conducted because major malfunctions in these systems often result in loss of automatic fire protection, notification of the Authority Having Jurisdiction, establishment of fire patrols in the affected zone(s), significant production downtime, furloughed employees, product and facility equipment loss, high maintenance costs, and expensive follow-up system modifications. These inspections are conducted to evaluate: (1) the performance of the manufacturers' FM Approved automatic water control valves; (2) the installation relative to the manufacturers' Installation, Maintenance, Operation and Testing Manuals; and (3) the installation relative to FM Global Property Loss Prevention Data Sheets, NFPA Standards, and this Approval Standard. The results of these evaluations are disseminated to FM Global field engineers and to FM Approvals, particularly if the observed installation anomalies are reoccurring and can be anticipated in other similar insured locations. Of course, the system manufacturers are also notified if their equipment performance is deficient so that appropriate corrective action can be taken. Additionally, if chronic problems relative to system installation are observed, the manufacturer may be asked to revise their Installation, Maintenance, Operation and Testing Manuals.

5.4 Manufacturer's Responsibilities

- 5.4.1 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.
- 5.4.2 Where all or part of the quality control has been subcontracted, the manufacturer shall, at a minimum, conduct sufficient oversight audits to verify the continued application of the required controls.

5.5 Manufacturing and Production Tests

5.5.1 *Test Requirement No. 1 - Seat Leakage Test*

The manufacturer shall test 100 percent of production automatic water control valves at the rated working pressure for seat leakage. The test pressure shall be applied on the seat of a closed valve for a minimum of 15 seconds. Leakage shall not exceed 0.017 oz. (0.5 cm³) for metal-seated valves; zero leakage is required for resilient-seated valves.

5.5.2 *Test Requirement No. 2 - Hydrostatic Test*

The manufacturer shall hydrostatically test 100 percent of production automatic water control valves for body leakage at twice the rated working pressure. The pressure shall be held for a minimum of 1 minute. No evidence of body leakage or distortion shall be permitted.

5.5.3 *Test Requirement No. 3 - Operation Test*

The manufacturer shall perform an operation test on 100 percent of production automatic water control valves following the above seat leakage and hydrostatic test. All valves shall be operated without evidence of sticking or binding.

APPENDIX A: Units of Measurement

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

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”)
 $L = \text{gal} \times 3.785$

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: FM Approvals Certification Marks



FM APPROVED mark:

Authorized by FM Approvals as a certification mark for any product that has been FM Approved. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.



Cast-On FM Approvals marks:

Where reproduction of the FM Approved mark described above is impossible because of production restrictions, use these modified versions of the FM Approved mark. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable.



FM APPROVED mark With "C" only:

Authorized by FM Approvals as a certification mark for any product that has been evaluated by FM Approvals in accordance with Canadian codes and standards. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.



FM APPROVED mark with "C" and "US":

Authorized by FM Approvals as a certification mark for any product that has been evaluated by FM Approvals in accordance with US and Canadian codes and standards. There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in black on a light background, or in reverse on a dark background.

USAGE GUIDELINES

All FM Approvals certification marks are the sole property of FM Approvals LLC (“FM Approvals”) and are registered or the subject of applications for registration in the United States and many other countries. They are for use only according to these guidelines.

FM Approvals certification marks may be used only on FM Approved products and related product packaging, in advertising material, catalogs and news releases. Use of FM Approvals certification marks on such material is not a substitute for use of the complete FM Approvals certification mark on FM Approved products and/or product packaging.

No FM Approvals certification mark or aspect thereof may be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. This includes both design aspects (the FM Approvals “diamond,” etc.) and word aspects (“FM,” “Approved,” etc.). The use of any FM Approvals certification mark as a trademark is strictly prohibited.

The Approval Standard number or class number may not be incorporated as part of a business name, Internet domain name, or brand name/trademark for products/product lines. For example, a company may not say “ABC Company’s 4100 Fire Door is FM Approved”; the proper terminology is, “ABC Company’s Fire Door is FM Approved per Approval Standard 4100.”

FM Approvals certification marks, except for the FM Approvals Quality System Registration mark, may not be used on business stationery/cards/signage because this could mischaracterize the relationship with FM Approvals. Additionally, these items should not reference any FM Approvals certification mark.

Products or services may not be marketed under any mark or name similar to “FM Global,” “FM Approvals” or any of the FM Approvals certification marks. Further, products or services may not be marketed to imply a relationship beyond the scope of any Approval made by FM Approvals.

When an FM Approvals certification mark is used in advertising material or on product packaging, all material must reflect the specific circumstances under which the product was FM Approved. The material must clearly differentiate between products that are FM Approved and those that are not, and may not, in any way, imply a more substantial relationship with FM Approvals.

A company may not reference the intent to submit a product for Approval or the expectation that a company will have a certain product FM Approved in the future. For example, a company may not state, “Approval by FM Approvals pending” or “Approval by FM Approvals applied for.”

FM Approvals certification marks should not be preceded or followed by a qualifier that indicates a degree of certification or acceptability. For example, “exceeds,” “first” or “only” may not be used to qualify any FM Approvals certification mark.

Only original artwork issued by FM Approvals should be used. The FM Approvals certification marks should not be altered in any way other than to resize the artwork proportionately. Unacceptable uses of the marks include, but are not limited to, adding/deleting wording or artwork, reducing the artwork to an illegible size, animation or distortion.

The text of the FM Approvals certification marks may not be translated into any language other than English.

FM Approvals certification marks must appear in a size and location that is readily identifiable, but less prominent than the name of the owner of the certification or the manufacturer/seller/distributor of the certified products.

APPENDIX C: Figures

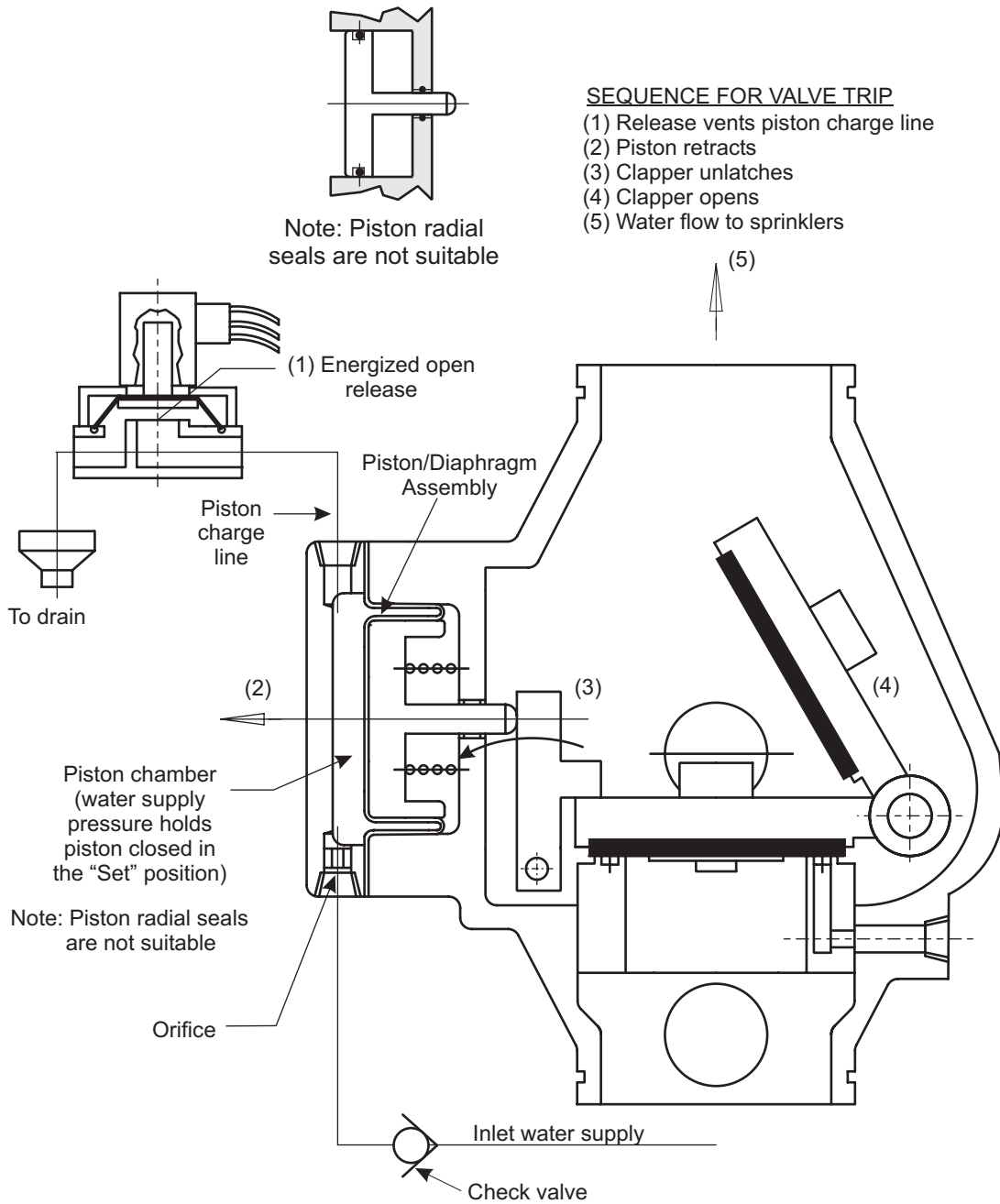


Figure C-1: Clapper Type Valve Assembly

SEQUENCE FOR VALVE TRIP

- (1) Release vents diaphragm charge line
- (2) Diaphragm retracts
- (3) Disc opens off seat
- (4) Water flows to sprinklers

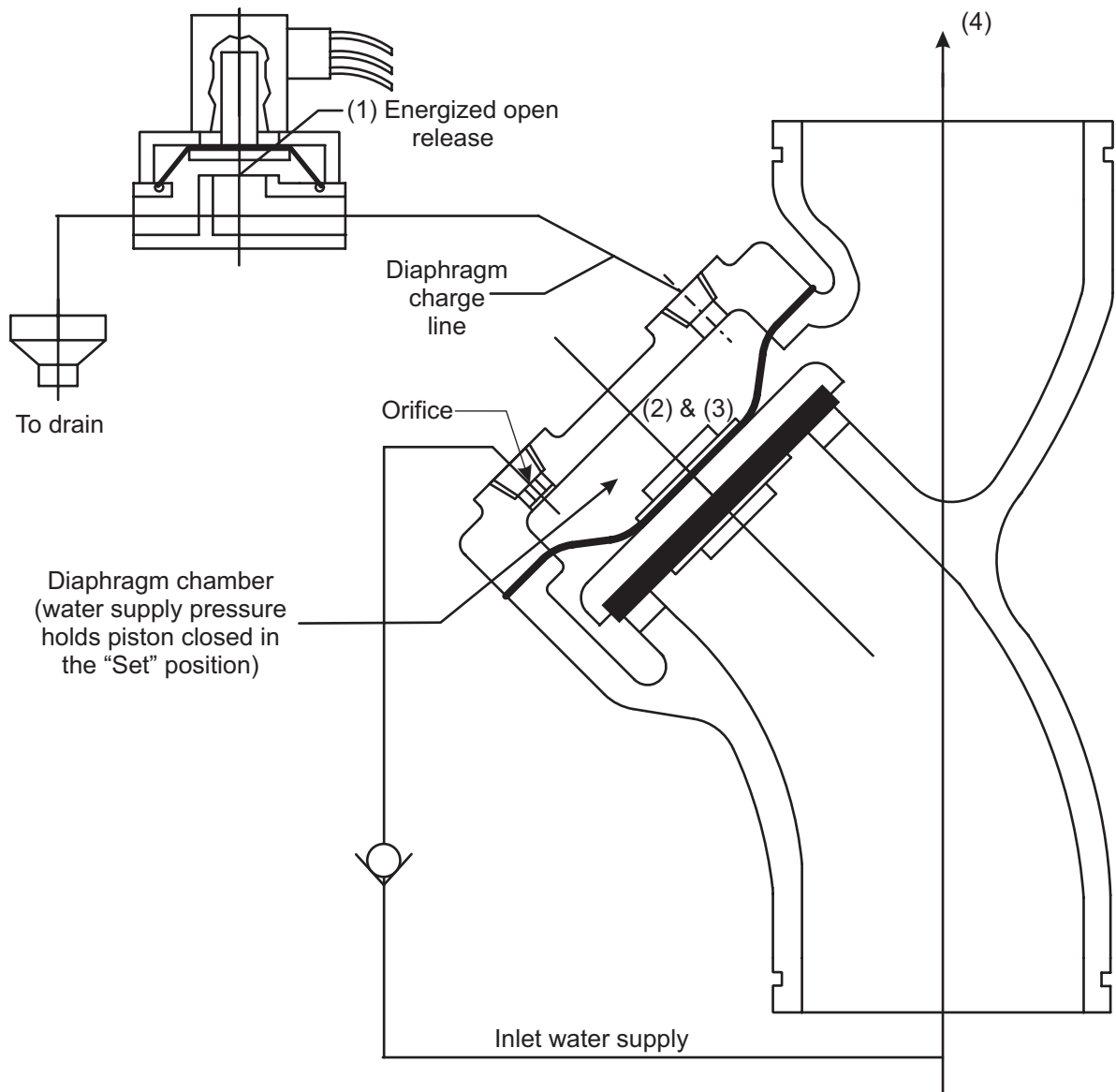


Figure C-2: Diaphragm Type Valve Assembly

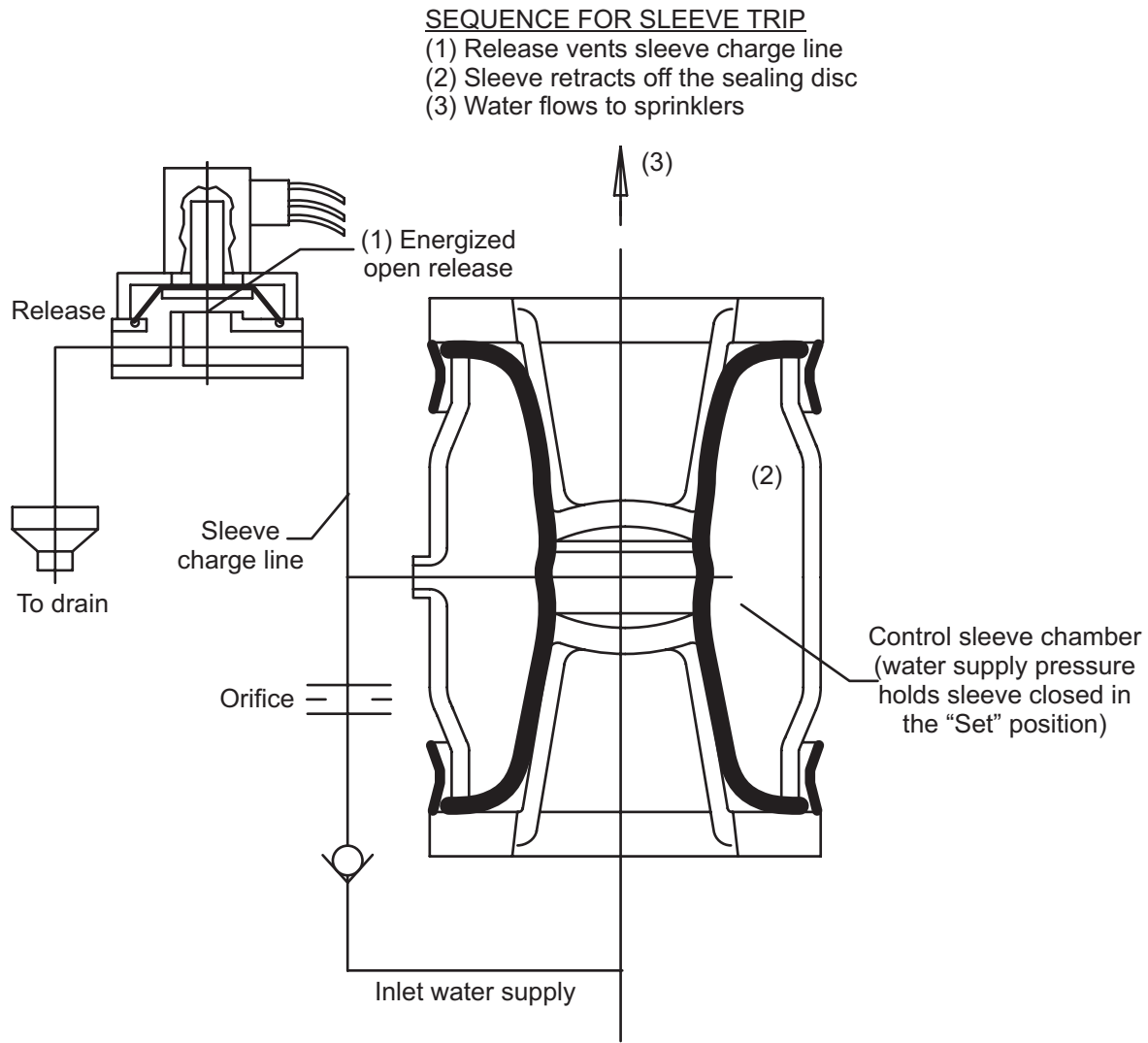


Figure C-3: Sleeve Type Valve Assembly

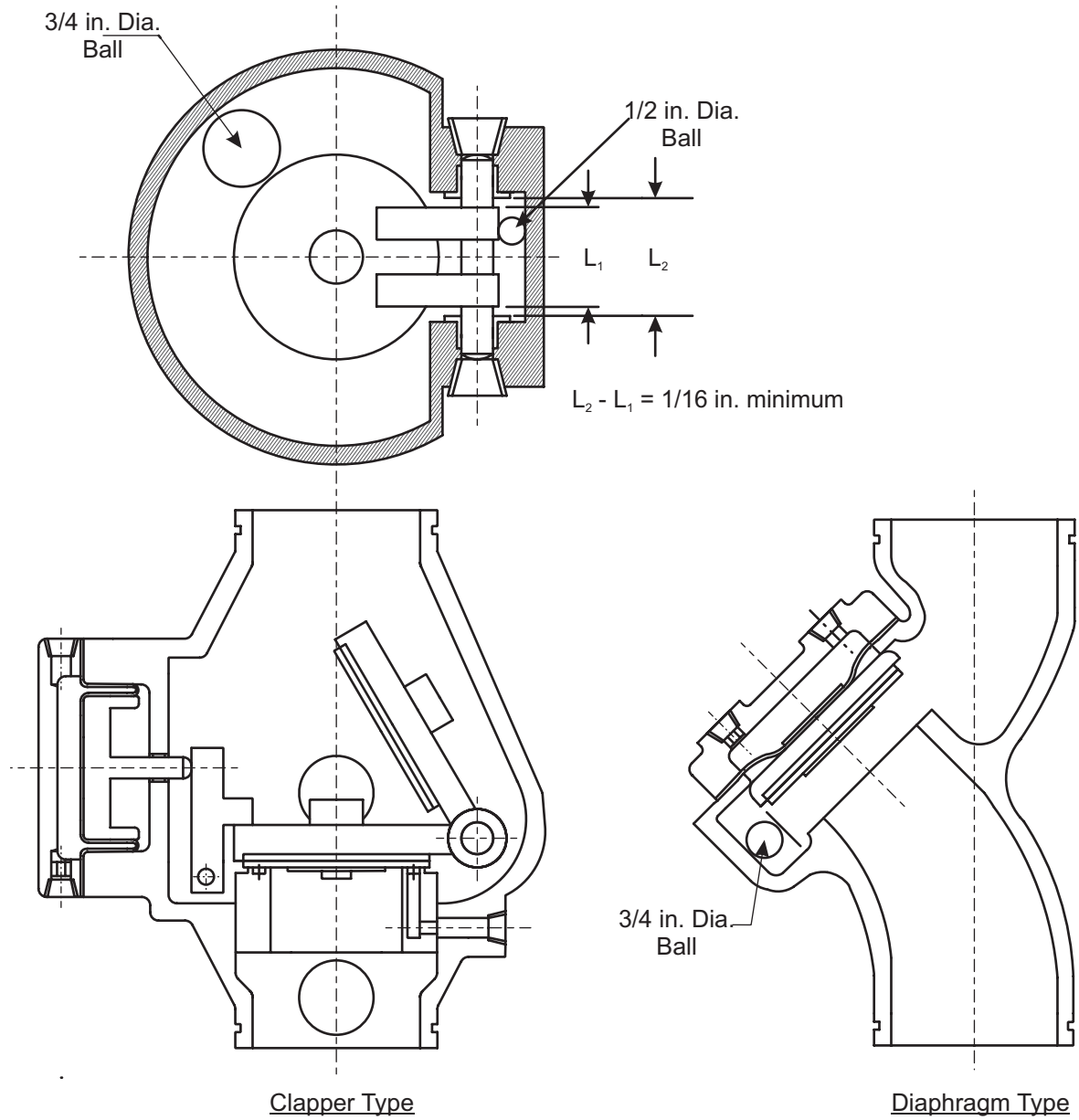


Figure C-4: Clearance Illustrations

APPENDIX D: Tolerance

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 percent of value
Temperature:	$\pm 4^\circ\text{F}$ (2°C)
Time:	+ 5/-0 seconds +0.1/-0 minutes

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



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