Approval Standard for Pressure Reducing Valves

Class Number 1362

January 2020

Foreword

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

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

For examining equipment, materials and services, Approval Standards:

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

b) must be readily identifiable.

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

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

Table of Contents

1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states Approval requirements for pressure reducing valves.

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 sets performance requirements for pressure reducing valves used in fire protection sprinkler systems. Pressure reducing valves are typically installed on a fire pump discharge line or as zone control valves within a sprinkler system.

1.2.2 Pressure reducing valves are used to control the water pressure in a fire protection system to downstream devices. They may be either direct-acting or pilot-operated type valves.

1.2.3 This standard covers the examination and Approval of pressure reducing functionality in deluge and preaction valves that are equipped with a pressure control option. To be considered for FM Approval, those valves must meet the requirements of this standard as well as all applicable requirements of Approval Standards 1020 and 1011/1012/1013.

1.2.4 Examination and Approval of pressure reducing valves includes the entire valve assembly (main control valve, valve trim components and/or associated devices) necessary for the satisfactory and reliable operation of the pressure reducing valve.

1.2.5 Valves without automatic operation are not covered in the scope of this Approval.

1.2.6 The requirements of this standard shall be used to measure and describe the performance of pressure reducing valves in response to exposure from flow, pressure, etc., under controlled laboratory conditions. The results of these controlled exposures shall not be used to describe or appraise actual exposure conditions since such conditions will vary widely.

1.3 Basis for Requirements

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

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of pressure reducing valves for the purpose of obtaining Approval. Pressure reducing 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, pressure reducing 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 examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. These examinations may be repeated as part of FM Approvals' product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

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

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

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products 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 January 31, 2021 for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units (with the exception of heat flux). 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. 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, *American National Standard for Metric Practic*e.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies:

FM Approvals, Approval Standard Class 1011/1012/1013, *Deluge and Preaction Sprinkler Systems*
FM Approvals, Approval Standard Class 1020, *Automatic Water Control Valves*
ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*
International Organization for Standardization, ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.
ASTM D471, *Standard Test Method for Rubber Property – Effect of Liquids*
ASTM D572, *Standard Test Method for Rubber – Deterioration by Heat and Oxygen*

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.)

End Connections

Refers to the method of connecting components to a piping system. Typical end connections are flanged, grooved and threaded.

FM Approvals Certification Marks

Product markings, applied by the manufacturer, that identify a product as FM Approved. Their use is mandatory on all units of FM Approved products. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

FM Approved

This term refers to products FM Approved by FM Approvals. Such products are listed in the Approval Guide, an on-line resource of FM Approvals. 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 surveillance audits 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. See Appendix A for a sample Approval Guide listing.

Rated Working Pressure

Also referred to as the Maximum Allowable Working Pressure, it is the specified maximum internal pressure at which the weakest point of the pressure reducing valve can operate trouble free within the operating temperature range when the valve is in normal operation.

Specified

The value of a design parameter set by the manufacturer.

Pressure Reducing Valve

A type of automatic water control valve used in fire protection sprinkler systems to control the water pressure to downstream devices. Pressure reducing valves are typically installed on a fire pump discharge line or as zone control valves within a sprinkler system.

Pressure Reducing Valve, Direct-Acting Type

Typically used as zone control valves within a sprinkler system, direct-acting type pressure reducing valves utilize an internal spring that exerts force directly against the valve seat assembly. Pressure reducing control is achieved via an internal control chamber which senses outlet pressure and applies a force to the valve seat assembly opposite the internal spring. The outlet pressure is adjusted by increasing or decreasing the spring compression. Direct-acting type pressure reducing valves are typically equipped with a handwheel type manual close feature that bypasses the spring and control chamber to close the valve.

Pressure Reducing Valve, Pilot-Operated Type

Typically installed on a fire pump discharge line, pilot-operated pressure reducing valves utilize a diaphragm type automatic control valve equipped with an adjustable trim pilot valve. Water flows into the diaphragm control chamber from an inlet sensing port with exit flow through the outlet sensing port controlled by the trim pilot valve. The outlet pressure is adjusted by increasing or decreasing the spring compression within the pilot valve via adjusting screw.

Pressure Relief Valve

Valves containing a spring or other means of holding a valve seat closed until a preset upstream pressure is reached. Once the preset pressure is reached, the valve opens and relieves the pressure build-up downstream. Once the pressure decreases to the set pressure, the relief valve closes.

2 GENERAL INFORMATION

2.1 Approval Application Requirements

To apply for an Approval examination the manufacturer, or its authorized representative, should submit a request to information@fmapprovals.com.

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 being submitted for Approval consideration;
- Assembly drawings, component drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures;
- The number and location of manufacturing facilities;
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level; and
- All documents shall be provided with English translation.

2.2 Requirements for Samples for Examination

2.2.1 Following authorization of an Approval examination, the manufacturer shall submit samples for examination and testing based on a determination by FM Approvals following review of the preliminary information.

2.2.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.2.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of FM Approvals.

2.2.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the samples.

2.2.5 If there are failures encountered during the examination testing, FM Approvals will provide the manufacturer with information regarding what testing will need to be repeated and any additional sample requirements.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The Approval investigation shall define the limits of the Approval.

3.1.2 The manufacturer’s dimensional specification and/or dimensional drawings shall fully describe the product. All critical dimensions shall be identified with the allowed upper and lower tolerance levels clearly shown.

3.2 Physical or Structural Features

3.2.1 A pressure reducing valve shall only be considered for Approval as a complete and identifiable assembly. It shall perform in all respects to the manufacturer’s specifications.

3.2.2 The standard pressure reducing valve sizes associated with fire protection service are the following: 1-1/2, 2, 2-1/2, 3, 4, 6, 8, 10, 12, 14 and 16 inch NPS (40, 50, 65, 75, 100, 150, 200, 250, 300, 350 and 400 mm NPS). Others may be considered on a case-by-case basis

3.2.3 Pressure reducing valves shall be provided with nationally recognized end connections.

3.2.4 A 1⁄2 in. (15 mm) or larger pressure relief valve must be supplied for installation with every pressure reducing valve. Pressure relief valves must be FM Approved or meet the performance requirements of Approval Standard 1359 or 1361.

3.2.5 Pressure reducing valves and associated devices shall have a minimum rated working pressure of 175 psi (1210 kPa).

3.2.6 All materials shall be suitable for the intended application. Internal components of the pressure reducing valves and those of associated devices which, if corroded, would render the pressure reducing valve inoperative or reduce the performance to an unsatisfactory level shall be constructed of corrosion resistant materials.

3.2.7 Clearances shall be provided between working parts and working and stationary parts so that corrosion or deposits of foreign matter within the assembly will not render the valve inoperative or reduce its performance to an unsatisfactory level. For valves size 3 inch NPS and larger, a minimum clearance shall be maintained between the seat assembly and valve body in every position from open to closed. The minimum clearance is 3⁄8 in. (9.5 mm) for bronze bodied valves and 3⁄4 in. (19.0 mm) for cast and ductile iron valves.

3.2.8 A strainer shall be included in the inlet sensing line of all pilot-operated pressure reducing valves to protect orifices or ports which are 1⁄4 in. (6.4 mm) in diameter or less. The strainer shall be accessible by maintenance personnel when servicing the valve.

3.2.9 When in operation, a pressure reducing valve shall maintain a fully open position at all flow conditions when the inlet pressure is below the set outlet pressure.

3.2.10 Pressure reducing valves shall be designed in such a way that failure of the pressure reducing components results in the valve reverting to the full open position.

3.2.11 Needle valves utilized in pilot-operated pressure reducing valve trim shall be rendered non-adjustable by the manufacturer.

3.2.12 Means shall be provided to lock or seal the pressure reducing valve at the adjusted pressure setting.

3.2.13 A position indicator, or inlet and outlet pressure gauges, shall be provided to give visual indication of the disc assembly position, or equivalent component, from open to closed.

3.2.14 A manual closing feature (local or remote) may be incorporated in the design of a pressure reducing valve to operate the valve closed. If such a feature is provided, the means shall be also be provided to lock it in the fully open position. On pilot-operated type pressure reducing valves, the manual close feature shall be an FM Approved component or examined under the applicable FM Approval Standard.

3.2.15 The pressure reducing valves shall be fully serviceable in the field without the use of special tools and the components of the pressure reducing valves and those of associated devices shall be designed to preclude mis-assembly.

3.3 Markings

3.3.1 The following information shall be permanently marked on all FM Approved pressure reducing valves:

- Manufacturer’s name or trade name
- Valve size
- Year of manufacture
- Model designation
- Direction of flow
- Rated working pressure

- Set outlet pressure range
- FM Approvals Certification Mark

3.3.2 All markings shall be legible and durable and are typically cast into the valve body or presented on a securely attached, corrosion-resistant label or nameplate.

3.3.3 All products tested and Approved to this standard shall bear an FM Approvals Certification Mark. The location, material, and application method will be by mutual agreement between FM Approvals and the manufacturer.

3.3.4 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.

3.3.5 The FM Approvals Certification Mark shall be displayed visibly and permanently on the product and packaging as appropriate. The manufacturer shall not use this Mark on any other product unless such product is covered by a separate report.

3.4 Manufacturer's Installation, Operation and Maintenance Manual

3.4.1 The manufacturer shall provide each user with a manual that includes Installation, Operation and Maintenance instructions.

3.4.2 Installation and Operation

The manual shall include step-by-step instructions, diagrams, etc. to illustrate the proper installation and operation of the pressure reducing valve and associated devices. It shall also include the technical specifications and performance data of the product, including (but not limited to):

- Set outlet pressure range
- Minimum and maximum allowable pressure drop across the valve for proper operation
- Minimum and maximum allowable flow rate per valve size
- Friction loss data for the valve in its fully open position
- Data indicating the anticipated hydraulic performance for the full operational range of the valve

3.4.3 Maintenance

The manual shall provide the user with facilities for repair of the product and/or supply replacement parts as well as services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.5 Calibration

3.5.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of its stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment shall be submitted to FM Approvals for its records. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified as traceable to the National Institute of Standards and Technology (NIST) or traceable to

other acceptable reference standards and certified by an ISO 17025 "*General Requirements for the Competence of Testing and Calibration Laboratories*" calibration laboratory. The test equipment shall 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 calibration laboratory is required for FM Approvals' records.

3.5.2 The calibration of 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 new test equipment shall be clearly identified by label or sticker showing the date of initial calibration and the next due date.

3.5.3 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of the equipment.

3.6 Tolerances

Tolerances on measurements shall be as described in Appendix B, unless otherwise specified.

4 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

Pressure reducing valves shall conform to the manufacturer's drawings and specifications and to FM Approvals requirements. The manufacturer's Installation, Operation and Maintenance Manual shall contain the required information described in Section 3.4.

4.1.2 Test/Verification

Sample pressure reducing valve assemblies shall be examined and compared to drawings and specifications. It shall be verified that the samples conform to the physical and structural requirements described in Section 3, General Requirements.

The manufacturer's Installation, Operation and Maintenance Manual shall be provided and reviewed prior to conducting performance testing in Sections 4.2 to 4.14.

4.2 Operation

4.2.1 Requirement

The pressure reducing valve shall perform as specified through the full set outlet pressure range at all allowable inlet pressures and flows. Pressure reducing valves shall close within 15 minutes at zero-flow conditions.

4.2.2 Test/Verification

A sample pressure reducing valve of each size shall be tested at the minimum and maximum set outlet pressure and several set pressures in between. At each set pressure, the valve shall be set at initial conditions that meet manufacturer's specifications then subjected to the minimum and maximum allowable flow and several flows in between. At all data points throughout the operation test, the inlet pressure shall be maintained between the minimum and maximum allowable per manufacturer's specifications.

The operation test data shall be compared to manufacturer's anticipated hydraulic performance data to evaluate accuracy and consistency between data sets.

At the maximum set outlet pressure, a zero-flow test shall be performed on a representative size valve with the pressure relief valve installed downstream and set per manufacturer's specifications. The flow shall be reduced to zero by closing a valve downstream of the pressure reducing valve under test. The pressure reducing valve shall close within 15 minutes.

4.3 Friction Loss

4.3.1 Requirement

Friction loss of pressure reducing valves shall be determined in the fully open position at a flow rate producing a velocity of 17 ft/sec (5 m/sec) in Schedule 40 steel pipe of the same nominal diameter as the valve. See flow rates shown in Table 4.3.1.

Table 4.3.1 – *Friction Loss Flow Rates*

Valve Size		***Flow***	
in.	***(mm)***	***gal/min***	***(L/min)***
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	(200)	2650	(10 030)
10	(250)	4180	(15 820)
12	(300)	5930	(22 445)
14	(350)	7100	(26 875)
16	(400)	9300	(35 200)

4.3.2 Test/Verification

A sample valve of each size 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.

Diaphragm style valves may require a minimum inlet pressure to achieve a full open position. The inlet pressure required to fully open a diaphragm style valve shall be recorded and included in the Approval Guide listing and shall not exceed 75 psi (520 kPa) at the required flow.

4.4 Leakage Test

4.4.1 Requirement

At static conditions, pressure reducing valves shall be able to withstand an inlet pressure equal to 50 psi (345 kPa) above the rated working pressure for 2 hours without external leakage or leakage through the seat.

4.4.2 Test/Verification

With the outlet open to atmosphere, the inlet side of the pressure reducing valve shall be subjected to a hydrostatic pressure of 50 psi (345 kPa) above the rated working pressure. Diaphragm style valves may require that test pressure be applied to both the inlet and control chamber. The applied hydrostatic test pressure shall be maintained for 2 hours. There shall be no external leakage or leakage past the seat of the valve during this test.

4.5 Seat Assembly Strength

4.5.1 Requirement

The valve seat assembly (or equivalent component) shall be able to withstand exposure to hydrostatic pressure of two times the rated working pressure for five minutes without functional impairment. For diaphragm type valves, refer to the requirements in Section 4.6.

4.5.2 Test/Verification

With the outlet open to atmosphere, the inlet side of the pressure reducing valve shall be subjected to a hydrostatic pressure of two times the rated working pressure. The applied hydrostatic test pressure shall be maintained for 5 minutes. After this test, the valve shall be fully operable and shall comply with the leakage requirements in Section 4.4.

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 two times the rated working pressure without diaphragm damage or functional impairment.

4.6.2 Test/Verification

Diaphragms of each size shall be subjected to a differential test pressure of two times the rated working pressure. For diaphragms that are exposed to hydraulic pressure on two sides when in operation (for example, when utilized as a control chamber), the differential pressure shall be applied across the diaphragm in the direction which normally applies the closing force in the valve. The test duration shall be five minutes. Examination shall demonstrate that there is no diaphragm damage or functional impairment as a result of this test.

4.7 Valve Stem Strength

4.7.1 Requirement

The valve stem of direct-acting type pressure reducing valves with a manual close feature shall be able to resist the effects of over-tightening. The manual close feature of each valve size shall be subjected to the torque values contained in Table 4.7.1 below applied to the valve stem in the direction to further close the valve without failure or permanent distortion of parts.

Table 4.7.1 – *Stem Torque Values*

Nominal Valve Size		***Torque***	
in.	***(mm)***	***Lb-ft***	***(N-m)***
1-1/2	(40)	60	(80)
2	(50)	75	(100)
2-1/2	(65)	125	(170)
3	(80)	150	(200)
4	(100)	250	(350)
6	(150)	300	(400)
8	(200)	400	(550)
10	(250)	600	(800)
12	(300)	800	(1085)
14	(350)	900	(1220)
16	(400)	1025	(1390)

4.7.2 Test/Verification

Representative samples of each size of direct-acting type pressure reducing valve with a manual close feature under consideration shall be subjected to valve stem strength testing. At the start of the test, the valve shall be manually closed, and then subjected to the applicable torque values shown in Table 4.7.1 above applied to the valve stem of the manual close feature in the direction to further close the valve. Once the specified torque value has been applied, the valve can be opened so that the it can be examined for signs of permanent distortion or failure which would be regarded as not meeting this requirement.

4.8 Body Hydrostatic Strength

4.8.1 Requirement

The valve body assembly shall withstand a hydrostatic pressure of four times the rated working pressure without rupture, cracking or permanent distortion.

4.8.2 Test/Verification

With the seat assembly (or equivalent component) in the partially open position, valve bodies of each valve size and end connection style shall be subjected to a hydrostatic test pressure of four times the rated working pressure for a duration of five minutes. For the diaphragm type valves, the hydrostatic pressure must be applied to the valve inlet, outlet and control chamber. There shall be no visible rupture, cracking, or permanent distortion to the valve body as a result of this test.

4.9 Cycle Test

4.9.1 Requirement

Pressure reducing valves shall be capable of 1000 cycles from open to close under representative pressures and flows without functional impairment or excessive wear, damage or failure of any valve component.

4.9.2 Test/Verification

A sample pressure reducing valve of representative size shall be initially set to an outlet pressure within the specified outlet pressure range at a flow rate within the specified allowable flow range. Once set, the flow rate shall be increased to the maximum allowable flow and the inlet pressure maintained between the specified minimum and maximum allowable inlet pressure.

While maintaining the maximum allowable flow as described above, the pressure reducing valve shall then be cycled 1000 times from open to closed at a rate that allows the valve to maintain a consistent outlet pressure when open.

When equipped, cycling shall be conduct by operating the manual close feature. For pressure reducing valves without a manual close feature, a butterfly valve shall be installed downstream of the sample valve at a distance of at least 10 times the nominal valve diameter. The butterfly valve shall then be cycled from open to close. The pressure reducing valve without a manual close feature does not need to achieve full close during cycling.

After cycling, the valve shall remain in the open position and the outlet pressure shall be consistent with that measured prior to cycling.

4.10 Durability Test

4.10.1 Requirement

Pressure reducing valves shall be fully operable and without any functional impairment after a 90 minute exposure to both high flow / low pressure drop and low flow / high pressure drop conditions within manufacturer's specifications.

4.10.2 Test/Verification

A sample pressure reducing valve of representative size shall be installed and set at the specified minimum outlet pressure with inlet pressure and flow conditions that meet manufacturer's specifications. The flow shall be increased to the specified maximum allowable flow with the inlet pressure maintained at a level resulting in the specified minimum allowable pressure drop across the valve. This high flow / low pressure drop condition shall be maintained for 90 minutes.

After 90 minutes, the flow shall be decreased to the specified minimum allowable flow with the inlet pressure increased near the rated working pressure of the valve. This low flow / high pressure drop condition shall be maintained for 90 minutes.

At the conclusion of the two 90 minute tests described above, the flow and inlet pressure conditions of the sample valve shall be returned to the initial set conditions. The outlet pressure shall be consistent with that measured prior to exposure to both the high flow / low pressure drop and low flow / high pressure drop conditions.

4.11 Water Absorption

4.11.1 Requirement

For elastomeric components in pressure reducing valves (including o-rings, diaphragms, valve facings, etc.), water absorption of these components shall not result in an increase greater than 1.5 percent of the original thickness or weight.

4.11.2 Test/Verification

A specimen of the valve elastomeric component, approximately 1 x 3 inches (25 x 75 mm) by 1/8 in. (3 mm) thick, 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.

4.12 Aging

4.12.1 Requirement

For elastomeric components in pressure reducing valves (including o-rings, diaphragms, valve facings, etc.), aging shall not promote cracking of these components.

4.12.2 Test/Verification

A specimen of the valve elastomeric component, approximately 1 x 3 inches (25 x 75 mm) by 1/8 in. (3 mm) thick, supplied by the 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°).

4.13 Corrosion Protection Coating

4.13.1 Requirement

All materials used as corrosion resistant coatings that are required to ensure effectiveness of the valve seal shall resist separation from the corrosion protected material. No evidence of separation of the coating material from the base material, such as blistering, peeling, flaking, or delaminating shall result.

4.13.2 Test/Verification

Four test coupons, of the same material as the valve body, supplied by the valve manufacturer, prepared from cylindrical tubes measuring 6 inches (152 mm) in diameter by 4 inches (102 mm) long and split lengthwise shall be coated. On each sample an ‘‘X’’ of at least 2 in. (51 mm) length on each leg shall be scribed with a sharp instrument through the coating material to the metal substrate on both the inside and outside surfaces. The scribed test coupons shall then be immersed in a non-reactive container of deionized water at a temperature of 38˚F (3˚C) for 30 days. The samples shall be arranged so that they do not come in contact with the container or other samples.

Following this test, the water temperature shall be raised to 150˚F (66˚C) and the same test coupons shall remain immersed for an additional 30 days. At the conclusion of this testing the

coupon shall then be visually examined to determine if blistering, peeling, flaking or delaminating has occurred.

4.14 Additional Requirements

Additional tests may be required, at the discretion of FM Approvals, depending on design features and results of any foregoing tests.

A re-test following a failure shall be acceptable only at the discretion of FM Approvals and with a technical justification of the conditions or reasons for failure.

5 OPERATIONS REQUIREMENTS

A quality assurance program is required to assure that all subsequent pressure reducing valve(s) produced by the manufacturer shall present the same quality and reliability as the specific pressure reducing valve(s) examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests, and is documented in the Approval Report.
- Continued conformance to this standard is verified by the Surveillance Audits.
- Quality of performance is determined by field performance and as necessary by periodic re-examination and testing.

5.1 Demonstrated Quality Control Program

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

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.2 Documentation/Manual

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

5.1.3 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.4 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation for production.
- The manufacturer shall assign an appropriate person or group to be responsible for, and require that, proposed changes to FM Approved or Listed products be reported 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 an FM Approvals' Revision Request Form.
- Records of all revisions to all FM Approved products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and FM Approved.

5.2.2 These audits shall be conducted periodically but at least annually by FM Approvals or its representatives.

5.2.3 FM Approved products or services shall be produced or provided at or from the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 Installation Inspections

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

5.4 Manufacturer's Responsibilities

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

5.5 Manufacturing and Production Tests

The manufacturer shall provide documentation noting all test procedures and performance criteria related to the final inspection and testing of pressure reducing valves. Manufacturer's documentation shall be reviewed as part of the Approval process. At a minimum, the tests in Sections 5.5.1, 5.5.2 and 5.5.3 must be performed unless otherwise noted in the Approval Report.

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

The manufacturer shall test 100 percent of production pressure reducing 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. No evidence of leakage past the seat shall be permitted.

5.5.2 *Test Requirement No. 2 – Hydrostatic Test*

The manufacturer shall hydrostatically test 100 percent of production pressure reducing valves for body leakage at twice the rated working pressure. The pressure shall be held for a minimum of 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 pressure reducing valves following the above seat leakage and hydrostatic test. All valves shall be operated and demonstrate expected pressure reducing functionality without evidence of sticking or binding.

APPENDIX A: SAMPLE LISTING

Fire Protection / Fire Pump Installation Systems / Water Pressure Reducing Valves

A water pressure reducing valve is designed to limit system outlet pressure in a fire protection system. These valves are used in standpipe systems to actively regulate outlet pressures in both static and flowing conditions. Water pressure reducing valves employ an active mechanism that compensates for variations in inlet pressures by balancing water pressure in an internal chamber or chambers.

Approval specifications require that a pressure relief valve must be supplied for installation with every water pressure reducing valve. FM Approved pressure reducing valves should only be used in accordance with the requirements of FM Global Property Loss Prevention Data Sheet 3-11 for installation, testing and maintenance.

Model JML

Model JML is a pilot-operated type pressure reducing valve.

Nominal Size (in.)	***End Connections***	***Pressure Rating, psi (kPa)***	***Flow gpm (m^3/hr)***	***Outlet Pressure, psi (kPa)***	***Friction Loss, psi***	***Remarks***
3	Grooved	300 (2070)	20-360 (4-82)	30-175 (210-1210)	3.5 at 391 gpm (at 1480 L/min)	a, b, c
4	Grooved	300 (2070)	20-640 (4-145)	30-175 (210-1210)	4.0 at 675 gpm (at 2555 L/min)	a, b, c
6	Grooved	300 (2070)	20-1450 (4-330)	30-175 (210-1210)	3.1 at 1530 gpm (at 5790 L/min)	a, b, c

Remarks:

a. Must be installed with an FM Approved pressure relief valve size 1⁄2 inch or larger
b. Requires a 20 psi (140 kPa) or greater differential between inlet pressure and outlet set pressure

APPENDIX B: TOLERANCES

Unless otherwise stated, the following tolerances shall apply:

Length:	± 5 percent of value
Volume:	± 5 percent of value
Pressure:	± 5 percent of value
Flow:	± 5 percent of value
Temperature:	± 5 percent of value
Time:	+ 5/- 0 seconds + 0.1/- 0 minutes + 0.1/- 0 hours + 0.25/- 0 days

Unless stated otherwise, all tests shall be carried out at an ambient and fluid temperature of 68°F ± 18°F (20°C ± 10°C).