Approval Standard for Water Pressure Relief Valves

Class Number 1361

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Foreword

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

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

For examining equipment, materials and services, Approval Standards:

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

b) must be readily identifiable.

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

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

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I. INTRODUCTION

1.1 Purpose

This Standard states FM Approval requirements for water pressure relief valves which relieve excess pressures in a water supply system, or which are used in the discharge line of a fire pump to limit the pressure developed by the pump. Smaller sizes are used with electric motor-driven pumps.

1.2 Scope

This standard is used to evaluate water pressure relief valves for their intended application of rapid response to excess pressure. Relief valves must remain functional after long periods of inactivity. ''Water pressure relief valve'' as used in this standard includes any trim and/or associated device necessary for satisfactory and reliable operation of the assembly. Both direct acting and pilot-operated devices are within the scope of this standard.

1.3 Basis for FM Approval

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

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

- the suitability of the product;
- the proper operation and 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.

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

1.4 Basis For Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality control procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement; and
- re-examination of production samples for continued conformity to requirements.

1.5 Requirements

1.5.1 The requirements of this standard are based on experience, research and testing and/or the standards of other national and international organizations. The advice of manufacturers, users, trade associations and loss control specialists has also been considered.

1.5.2 The requirements of this standard reflect tests and practices used to examine characteristics of water pressure relief valves for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Valves having characteristics not anticipated by this standard may be Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, valves which do meet all the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.6 Effective Date

The effective date of an Approval Standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval. The effective date shall apply to the entire Approval Standard, or, where so indicated, only to specific paragraphs of the standard.

The effective date of this standard is July 1, 1994, for full compliance with all requirements.

1.7 System of Units

Units of Measurement are U.S. customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. Appendix A lists the selected units for quantities dealt with in testing these products; conversions to SI units are included. Conversion of U.S. customary units is in accordance with ASTM E380.

II. GENERAL INFORMATION

2.1 Product Information

2.1.1 Sizes

Present standard nominal sizes of valves for water pressure relief are:

In.	*In.*	*In.*
¾	2	4
1¼	2½	6
1½	3	8

Either globe or angle body styles are acceptable.

2.1.2 End Connections

Valves having the following types of end connection are suitable. Other types of end connection shall be evaluated on a case-by-case basis.

- screwed
- flanged
- cut groove

2.1.3 Range Adjustment

The adjustable range of the relief valves shall be between 60 and 180 psi (415 and 1240 kPa).

III. GENERAL REQUIREMENTS

3.1 Markings

3.1.1 The following data shall be cast in raised characters on the valve body or cover, or both:

- manufacturer's name or trademark
- valve size
- year of manufacture
- rated working pressure
- model designation
- factory set pressure
- set pressure range
- flow directional arrow or ''INLET'' marking
- FM Approval Mark (See Appendix B).

3.1.2 A corrosion-resistant metal nameplate bearing the same information shall be considered acceptable if permanently fastened to the valve body.

3.1.3 Direct acting valves shall have a handwheel marked with the word ''OPEN'' and a directional arrow.

3.2 Instructions

Each shipment shall be packaged with complete installation instructions, including any special dimension requirements.

3.3 Physical or Structural Features

3.3.1 Rated Working Pressure

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

3.3.2 Materials

All materials used in these valves shall be suitable for the intended application. Valve parts exposed to water shall be constructed of corrosion-resistant materials. Particular consideration shall be given to the plug or disc, the stem, seat ring, bushings and guides.

3.3.3 Parts Removal

The valve shall be designed so that all interior parts are accessible and replaceable while the valve is installed in the line. The components of the pressure relief valves and those of associated devices shall be designed so as to preclude mis-assembly.

3.4 Valve Operation

Direct acting valves shall be designed so that the operating handwheel is turned counter-clockwise to decrease spring load. The operating handwheel shall furnish a ready hand grip and have sufficient mechanical strength to endure normal, expected abuse during shipment and after installation.

3.5 Screen

A screen shall be provided to protect orifices or ports which are ¼ in. (6.4 mm) in diameter or less. The diameter of the holes in the screen shall be at least 1⁄16 in. (1.6 mm) less than the diameter of the smallest orifice to be protected. The total area of the openings in the screen shall be at least 20 times greater than the area of the orifice the screen is designed to protect.

3.6 Pressure Setting

Means shall be provided with a jam nut or other device to lock or seal the valve stem, or the adjusting screw of a pilot valve, once the adjusted pressure setting has been established.

3.7 Position Indicator (Optional)

A position indicator may be provided to give visual indication of every position of the disc assembly, or equivalent component, from open to closed. The words ‘‘OPEN’’ and ‘‘CLOSED’’ (or ‘‘SHUT’’) shall be cast or stamped in the proximity of the position indicator. The indicator shall point to these words when the valve is fully open or closed.

3.8 Flow Indicator (Optional)

A sight glass or other similar type of flow indicator may be provided in the side of the valve, downstream of the valve plug and seat. A paddlewheel or other visible indicator is required as part of the sight glass assembly to give positive indication of flow in the line.

3.9 Drawings/Plans/Specifications Required

Valves submitted for testing shall be true production samples and shall be free of sharp edges, burrs or other imperfections liable to injure the installer or interfere with proper assembly of the unit.

In addition to the production samples, the manufacturer shall provide complete detail and assembly drawings, and material specifications.

3.10 Manufacturer's Responsibilities

All valves shall be tested for seat and body leakage before leaving the factory to at least twice the rated working pressure. The pressure shall be held for a minimum of 1 minute without noticeable seat or body leakage. All valves shall be opened through their full travel range.

IV. PERFORMANCE REQUIREMENTS

4.1 General

The tests discussed below shall be utilized, as deemed necessary by FM Approvals, to demonstrate conformity to these requirements. Other tests, indicated by examination or mathematical calculations, may also be necessary to demonstrate suitability for Approval. The number and size of sample valves required for testing shall be at the discretion of FM Approvals.

4.2 Hydrostatic Strength

4.2.1 Requirement

Valve bodies shall withstand hydrostatic strength testing without suffering cracking or permanent distortion. This will include flow indicators or other accessories included in the valve shell.

4.2.2 Test/Verification

Valve bodies shall be subjected to a hydrostatic test of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, for 5 minutes. No cracking or permanent distortion shall result. Diaphragms may be replaced with a gasket during this test.

4.3 Relief Valve Capacity

4.3.1 Requirement

The minimum relief valve size shall be as follows:

Pump Capacity		*Relief Valve Size*
gal/min	*(dm^3/min)*	*in.*
Up to 250	(945)	2
300	(1135)	2½
400-500	(1515-1895)	3
750-1000	(2840-3785)	4
1250-2500	(4730-9465)	6
3000-4000	(11355-17035)	8

4.3.2 Test/Verification

With the relief valves set at 100 psi (690 kPa), the relief valves shall discharge the full rated capacity of the pump with which it is used without the inlet pressure rising above 125 psi (860 kPa).

4.4 Disc Assembly, or Equivalent Component/Disc Strength

4.4.1 Requirement

The disc assembly or equivalent component shall withstand strength testing without suffering cracking or permanent distortion.

4.4.2 Test/Verification

With the inlet open to atmosphere, a hydrostatic pressure of two times the rated working pressure shall be applied to the outlet of the pressure relief valve. This pressure shall be maintained for 5 minutes. During and at the conclusion of this test, no leakage, fracture, permanent distortion, or functional impairment shall occur.

4.5 Diaphragm Strength

4.5.1 Requirement

Any diaphragm supplied shall withstand a strength test without tear, rupture, or other failure.

4.5.2 Test/Verification

Diaphragms in either the pressure relief valve or the associated devices shall be subjected to a hydrostatic pressure of two times (350 psi [2445 kPa] minimum) the rated working pressure for 5 minutes. During and at the conclusion of this test, there shall be no evidence of leakage or functional impairment.

4.6 Seat Leakage

4.6.1 Requirement

Valve seats shall be leak tight when tested as described below.

4.6.2 Test/Verification

When pressurized at rated working pressure (175 psi [1210 kPa] minimum) for 5 minutes, there shall be no leakage across the seat.

4.7 Durability

4.7.1 Requirement

The pressure relief valve shall not undergo appreciably altered performance after being operated 2000 times under flow conditions.

4.7.2 Test/Verification

The pressure relief valve and associated devices shall be opened and closed 2000 times under representative pressures and flows. The valve shall continue to operate properly without appreciably altered performance after this test, and shall still be leak tight when retested according to Paragraph 4.6.

4.8 Operational Characteristics

4.8.1 Requirement

After a valve has been pressurized to the set pressure of 100 psi (690 kPa) and has opened, it shall reseat itself leak tight at no less than 90 percent of the operating set pressure.

4.8.2 Test/Verification

The pressure at which the seat/disc opens shall be observed. The inlet pressure shall be increased to at least 102 percent to ensure a clear operation. The pressure shall be reduced slowly until the valve reseats and seals. The reseating pressure shall be no less than 90 percent of the opening pressure.

4.9 Flow Indicator

4.9.1 Requirement

A valve with a flow indicator as described in Paragraph 3.8 shall be placed in a flow line and performance of the indicator shall be witnessed at several flow velocities between 1 and 20 ft/sec (0.3 and 6.1 m/sec) in Schedule 40 pipe of the same nominal size as the valve.

4.9.2 Flow tests shall be performed to verify the operation of the flow indicator, as described above.

4.10 Accessory Examination

4.10.1 Requirement

Pilot-operated valves shall be examined for their ability to retain water above the valve operating diaphragm. This is necessary so that they will function with vertical lift pumps.

Trapping of air above the diaphragm causes failure to perform in this application.

4.10.2 Test/Verification

The manufacturer's piping schematic drawing shall be examined to determine whether potential for trapping air above the diaphragm exists. Based on this examination, operational tests may be necessary to determine the ability of the assembly to avoid this ''choking'' condition.

4.11 Additional Tests

Additional tests may be required depending on design features and results of the foregoing tests.

V. OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A Quality Control Program is required to assure that each subsequent valve produced by the manufacturer shall present the same quality and reliability as the specific valve samples examined. Design quality, conformance to design, and performance are the areas of primary concern.

Design quality is determined during the examination and tests.

Conformance to design is verified by control of quality in the following areas:

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

Quality of performance is determined by field performance and by re-examination and test.

5.1.2 The manufacturer shall establish a system of product configuration control to prevent unauthorized changes, including, as appropriate:

- engineering drawings
- engineering change requests
- engineering orders
- change notices

These shall be executed in conformance with a written policy and detailed procedures. Records of all revisions to all Approved products shall be kept.

5.1.3 The manufacturer shall assign an appropriate person or group to be responsible for obtaining FM Approvals' authorization of all changes applicable to Approved Products. FM Approvals' Form 797, ''Approved Product Revision Report or Address/Contact Change Notice'', is provided to notify FM Approvals of pending changes.

5.2 Facilities and Procedures Audit (F&PA)

5.2.1 An inspection of the product manufacturing facility shall be part of the Approval investigation. Its purpose shall be to determine that equipment, procedures, and the manufacturer's controls are properly maintained to produce a product of the same quality as initially tested.

5.2.2 Unannounced follow-up inspections shall be conducted to assure continued quality control and product uniformity.

APPENDIX A:

UNITS OF MEASUREMENT

LENGTH:

in. – ''inches''
(mm – ''millimeters'')

mm = in. × 25.4

ft – ''feet''
(m – ''meters'')

m = ft × 0.3048

PRESSURE:

psi – ''pounds per square inch'';
(kPa – ''kilopascals'')

kPa = psi × 6.8948

TEMPERATURE:

°F – ''degrees Fahrenheit''
(°C – ''degrees Celsius'')

°C = (°F - 32) × 5/9

FLOW:

gal/min = ''gallons per minute''
(dm^3/min = ''cubic decimeters per minute'')

dm^3/min = gal/min × 3.7854

MASS WEIGHT:

lb = ''pounds''
(kg = ''kilograms'')

kg = lb × 0.4535

TORQUE or MOMENT:

lb•ft = ''pound-feet''
(N•m = ''newton-meters'')

N × m = lb•ft × 1.356

LIQUID:

oz = ''ounces''
(cm^3 = ''cubic centimeters'')

$cm^3 = oz \times 3.382 \times 10^{-2}$

APPENDIX B:

APPROVAL MARKS

REPRODUCTION ART: FM Approval Marks

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

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

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

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

For Cast-On Marks

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

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

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