



Member of the FM Global Group

Approval Standard for Backflow Preventers (Reduced Pressure Principle and Double Check Valve Types)

Class Number 1221

February 1987

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 backflow preventers of the reduced pressure principle or double check valve types.

1.2 Scope

1.2.1 This standard sets performance requirements for backflow preventers which can be used in connections between public water supplies and fire protection systems to prevent reverse flow. Local health authorities usually recommend these devices to prevent contaminated water from entering public water supplies.

1.2.2 There are two varieties of backflow preventers, the reduced pressure principle type and the double check valve type. From a fire protection viewpoint, both have the same performance requirements as the standard check valves they would replace.

1.2.3 This standard does not attempt to prescribe performance requirements which will ensure the public health. This is best handled by recognized national agencies established for this purpose.

1.2.4 FM Approvals will consider for Approval only those backflow preventers which have been accepted by one of the following agencies:

- ASSE (American Society of Sanitary Engineering)
- AWWA (American Water Works Association)
- USCF-MCCC (University of Southern California Foundation – Manual of Cross Connection Control)

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 which is 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 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 was also considered.

1.5.2 The requirements of this standard reflect tests and practices used to examine characteristics of backflow preventers for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Backflow preventers 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, backflow preventors 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.

1.7 System of Units

Units of measurement are English System standard 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 E 380.

II. GENERAL INFORMATION

2.1 Product Information

2.1.1 Components

Backflow preventers of the reduced pressure principle type consist of two independently acting check valves which are internally loaded to a normally closed position. The check valves are separated by an intermediate chamber or zone with an automatic relief valve for venting to atmosphere. To facilitate field testing, two tightly closing valves are provided as standard equipment.

The double check valve assembly does not have a relief valve in the intermediate chamber.

2.1.2 Operation

a) Reduced Pressure Principle Type

Under Normal Conditions – The first check valve is internally loaded to create the required pressure differential across the first check and intermediate chamber. Hydraulic force from this differential keeps the relief valve closed. The second check valve functions as a standard check valve.

Under Backflow Conditions – A backflow condition exists when outlet pressure exceeds inlet pressure. The second check outlet closes to prevent backflow through the device. However, if the second check should become fouled or damaged, backflowing water will enter the intermediate chamber and decrease the pressure differential across the first check. When the differential pressure reaches a minimum predetermined value, the relief valve opens and vents the intermediate chamber to atmosphere.

b) Double Check Type

The prevention of backflow depends solely on the proper operation of at least one of the independently acting check valves.

2.2 Sizes

The following table lists standard check valve sizes recognized for fire protection service:

<i>Inches</i>	<i>(mm)</i>
2	(51)
2½	(64)
3	(76)
3½	(89)
4	(102)
5	(127)
6	(152)
8	(203)
10	(254)
12	(305)
14	(356)
16	(406)
18	(457)
20	(508)
24	(610)

III GENERAL REQUIREMENTS (Other than Performance Requirements)

3.1 Preliminary Information

Prior to testing, the manufacturer shall provide the following information for review:

- One copy of the ASSE, AWWA and/or USCF-MCCC Test Report(s) and a letter from the certifying agency.
- Detail and assembly drawings
- Performance characteristics, if available
- Material specifications (ASTM designations, when applicable)
- Maintenance, operation and installation instructions.

3.2 End Connections

Backflow preventers shall be provided with nationally recognized end connections.

3.3 Clearances

3.3.1 To reduce the possibility of foreign material from lodging between the periphery of the clapper, or equivalent component, and the inside of the valve body, a clearance of $\frac{3}{8}$ in. (9.5 mm) and $\frac{3}{4}$ in. (19.0 mm) shall be maintained in every position from open to closed for bronze and cast iron bodied valves, respectively.

3.3.2 If a clapper design is incorporated, the following minimum clearances shall be provided:

- $\frac{1}{2}$ in. (12.7 mm) between the hub of the clapper arm and the inside of iron bodied valves. If the materials of the body and clapper are corrosion resistant, the clearance may be reduced to $\frac{1}{4}$ in. (6.5 mm).
- The clearances between the clapper bearing and the body bearing faces shall not adversely affect the performance of the device. Past experience indicates that a $\frac{1}{8}$ in. (3.2 mm) clearance has shown satisfactory long term performance.

3.4 Friction Loss

Although requirements are not specified, the friction loss of Approved devices, at the following flows, shall be determined and listed in the Approval Guide:

Valve Size		Flow	
in.	(mm)	gal/min	(dm ³ /min)
2	(51)	200	(757)
2½	(64)	300	(1136)
3	(76)	400	(1514)
3½	(89)	550	(2082)
4	(102)	750	(2839)
5	(127)	1000	(3785)
6	(152)	1500	(5678)
8	(203)	3000	(11,356)
10	(254)	4900	(18,570)
12	(305)	7000	(26,500)
14	(356)	9500	(35,900)
16	(406)	12,500	(47,300)
18	(457)	16,000	(60,500)
20	(508)	19,500	(73,700)
24	(610)	28,000	(105,800)

Note: For valves larger than 8 in. (203.2 mm) it shall be the responsibility of the manufacturer to submit friction loss data points.

3.5 Materials

Materials used in the construction of the device shall be suitable for the intended application.

3.6 Markings

The device shall be permanently marked with the following information which may be cast into the valve body or inscribed on a securely attached nameplate:

- Manufacturer's name and address
- Model or type designation
- Maximum rated working pressure
- Date of manufacture
- Serial number
- Size of inlet and outlet connections
- Direction of water flow
- FM Approval Mark (see Appendix B).

See Appendix B for acceptable Approval Mark formats.

IV PERFORMANCE REQUIREMENTS

4.1 Clapper Strength

4.1.1 Requirement

The valve clapper shall withstand exposure to hydrostatic pressure in excess of its rated working pressure.

4.1.2 Test/Verification

A hydrostatic pressure of two times the rated working pressure shall be applied to the outlet side of each check with the inlet exposed to atmosphere. During and at the conclusion of the test, no leakage, fracture, permanent distortion or functional impairment shall occur.

4.2 Body Strength

4.2.1 Requirement

The valve body shall withstand exposure to hydrostatic pressure in excess of its rated working pressure.

4.2.2 Test/Verification

The valve body shall be subjected to four times the rated working pressure for a period of 5 minutes without evidence of physical damage.

4.3 Diaphragm Strength

4.3.1 Requirement

Diaphragms shall withstand exposure to hydrostatic pressure in excess of the rated working pressure.

4.3.2 Test/Verification

Diaphragms shall be subjected to twice the rated working pressure for 5 minutes. At the conclusion of the test there shall be no evidence of leakage or functional impairment.

4.4 Friction Loss

4.4.1 Requirement

Friction loss shall be determined for various flows and sizes of valve. See Paragraph 3.4.

4.4.2 Test/Verification

If friction loss curves have already been generated, sample valves shall be used to check submitted data for compliance.

4.5 Other Tests

Other tests may be conducted at the discretion of FM Approvals to further evaluate the adequacy and reliability of valve performance.

V MANUFACTURING AND FIELD INSTALLATION REQUIREMENTS

5.1 Demonstrated QC Program

5.1.1 A Quality Control Program is required to assure that each subsequent backflow preventer produced by the manufacturer shall present the same quality and reliability as the specific 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 inspection and test
- In-Process inspection and test
- Final inspection and test
- Equipment calibration
- Drawing and change control
- Packaging and shipping

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 keeping FM Approvals informed of all pending changes applicable to Approved products. FM Approval 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 At Manufacturing Plant

a) 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.

b) 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”)

$$\text{mm} = \text{in.} \times 25.4 \text{ in.}$$

PRESSURE: psi – “pounds per square inch”
(kPa – “kilopascals”)

$$\text{kPa} = \text{psi} \times 6.8948$$

FLOW: gal/min – “gallons per minute”
(dm³/min – “cubic decimeters per minute”)

$$\text{dm}^3/\text{min} = \text{gal}/\text{min} \times 3.7854$$

APPENDIX B

APPROVAL MARKS

REPRODUCTION ART: FM Approval Marks

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



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