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Examination Standard for Dry Pipe Valves

Class Number 1021

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Foreword

This standard 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 this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1. INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for dry pipe valves.

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance audit program.

1.2 Scope

A dry pipe valve is installed in the water supply line to a dry pipe sprinkler system. The sprinkler piping downstream of the dry pipe valve contains air under pressure instead of water as in a wet system. When one or more sprinklers operate, air escapes, the dry pipe valve trips and water is admitted to the system.

1.3 Basis for Requirements

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

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of indicating valves for the purpose of obtaining certification. Indicating valves having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following 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 for certification; 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 shall be made to evaluate the manufacturer's ability to consistently produce the product which was examined and tested. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

1.5.1 The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- Production or availability of the product as currently certified;
- The continued use of acceptable quality assurance procedures;
- Satisfactory field experience;
- Compliance with the terms stipulated in the certification;

- Satisfactory re-examination of production samples for continued conformity to requirements; and,
- Satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard 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. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

One unit of measurement (liters), outside of, but recognized by SI, is commonly used in international fire protection and is used in this standard.

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.

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*
ISO/IEC 17025 - 2005, *General Requirements for the Competence of Testing and Calibration Laboratories*
NFPA 13 - 2007, *Standard for the Installation of Sprinkler Systems*

1.9 Terms and 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. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. A product accepted for one installation may not be acceptable elsewhere.

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.

2. GENERAL INFORMATION

2.1 Product Information

2.1.1 The differential type dry pipe valve has either one or two hinged discs or clappers within a valve body. In the two-clapper design, one is the water clapper, the other is the air clapper with a linkage assembly between them. The one clapper design utilizes one side of the clapper to contain the water supply while the other side contains pressurized air in the sprinkler piping. In both designs the ratio between the areas or lever arms of the air clapper and water clapper is about 6 to 1 so that the water supply can be contained by a relatively smaller air pressure. The space formed between the air and water clappers, or between the two seat rings in the single clapper design, is called the intermediate chamber. This chamber is vented to atmosphere through an automatic drain valve when the valve is in its normally shut or ''set'' position. This chamber allows any water or air leakage by the clapper(s) to be detected. When the valve operates or ''trips'', water enters this chamber, the automatic drain valve shuts and water flows to the alarms associated with the dry pipe system as well as into the sprinkler system piping.

2.1.2 The mechanical type dry pipe valve has one clapper which is held on its seat by a latch, either at the clapper or at some point in a lever system. When system air pressure is reduced to 5 to 30 psig (34.5 to 198 kPa) the latch is disengaged from the clapper by mechanical means and the valve operates similarly to the differential type. This type of dry pipe valve is more or less independent of system water pressure.

2.1.3 Some dry pipe valves may employ a combination of differential and mechanical design principles.

2.2 Sizes

2.2.1 Standard dry pipe valve sizes are: 2 in. (51 mm), 3 in. (76 mm), 4 in. (102 mm), 6 in. (152 mm) and 8 in. (203 mm). Other sizes may be certified if there is a demonstrated need for them and they meet the requirements of this standard.

2.3 Rated Working Pressure

2.3.1 A dry pipe valve shall be designed for a minimum working pressure of 175 psig (1216 kPa).

2.4 End Connections

2.4.1 Valve bodies of 3 in. (76 mm) and larger sizes shall have flanged ends conforming to a recognized national standard for flanged fittings, such as ANSI B16.5. Two in. (51 mm) valve bodies may have flanged ends or threaded ends conforming to a recognized national standard for tapered pipe thread, such as ANSI B2.1. Other end connections may be Approved if there is a demonstrated need for them and these will be examined on a case-by-case basis.

2.4.2 Valves manufactured outside North America may be certified with end connections conforming to National Standards recognized in the country of manufacture.

2.5 Application Requirements

2.5.1 The manufacturer shall provide, at a minimum, the following preliminary information with any request for certification consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- general assembly drawings, one complete set of manufacturing drawings, materials list(s) and physical property specifications, anticipated marking format, brochures, sales literature,

specification sheets, installation, operation and maintenance procedures; and
- the number and location of manufacturing facilities.

2.2.2 All documents shall be controlled by the manufacturer's Quality Assurance procedures and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.6 Requirements for Samples for Examination

2.6.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency.

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

2.6.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

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

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

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

3.2 General

3.2.1 Dry pipe valves often remain inactive for long periods of time, yet they must be able and ready 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.

3.2.2 Valves shall be designed for an extended service life. Valves which meet the requirements of this standard are expected to perform reliably, under favorable conditions, for at least 75 years.

3.3 Operation

3.3.1 Dry pipe valve components shall operate positively, with no sluggishness or hang-ups, when tripped. Bumpers, stops or other means shall be provided to prevent damage to the clapper assembly or other valve parts when the clapper assembly comes to a stop after being tripped.

3.3.2 Latches or other devices shall be provided to prevent the dry pipe valve from reseating automatically after being tripped. The clapper shall remain above the seat to allow system drainage until manually reset.

3.3.3 It shall not be possible to render the valve inoperative by any external mechanical device(s).

3.3.4 Valves shall be designed so that component parts do not strike clapper rings or seat rings during ripping or resetting operations.

3.4 Orientation and Parts Removal

3.4.1 Dry pipe valves shall be designed so that all parts are uniquely oriented to minimize the possibility of improper assembly. All parts shall be easily removed for inspection, cleaning, repair or replacement without injury to the machined surfaces of the clapper and seat rings. Valve parts shall be able to be removed with standard tools.

3.5 Serviceability

3.5.1 Dry pipe valves shall be reasonably easy to set or reset after tripping by one person using standard tools. The body handhole cover(s) shall be designed to fit on the body in only one orientation if the position of the handhole cover(s) can affect the operation of the valve. The handhole(s) shall be large enough to permit normal maintenance, repairs and resetting.

3.6 Friction Loss

3.6.1 The loss in water pressure across the valve shall not exceed 5 psi (34.5 kPa) at the flow rates listed below:

Valve Size in. (mm)	*Flow gpm (m^3/min.)*
2 (51)	150 (0.43)
3 (76)	400 (1.51)
4 (102)	750 (2.84)
6 (152)	1500 (4.30)
8 (203)	3000 (11.35)

3.7 Performance

3.7.2 Differential type dry pipe valves shall have a ratio of system water pressure to air pressure when the valve operates (trips) of between 5 and 6.5 at all water pressures from 20 psig (138 kPa) to the rated working pressure.

3.7.3 Mechanical type dry pipe valves shall operate at air pressures between 5 psig (34.5 kPa) and 30 psig (198 kPa) for all water pressures from 20 psig (138 kPa) to the rated working pressure.

3.8 Clearances

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

3.8.2 The following minimum dimensions shall be maintained:

- 1⁄8 in. (3 mm) between seat rings and metal parts of clapper assemblies such as metal retaining rings.
- 3⁄4 in. (19 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 hubs or hubs of any intermediate levers.
- 1⁄32 in. (1 mm) between hinge pins and bearings.
- 1⁄16 in. (2 mm) between face of metal clapper seat ring and clapper (for clappers with metal seat rings).

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

3.9 Trim Equipment

3.9.1 Dry pipe valves shall be supplied with auxiliary equipment which is necessary for operation of the system, or which may be necessary or desirable for a particular installation. This equipment includes pipes, fittings, valves, gages, alarms and switches. Exhausters and accelerators are auxiliary devices used to decrease the time of operation of the system. Necessary openings in the dry pipe valve must be provided for auxiliary equipment.

3.9.2 The air supply line shall be ¾ in. (19 mm) NPS and located on the air side of the valve above any priming connections.

3.9.3 A drain line shall be provided on the water side of the valve, sized as follows:

2 in. (51 mm) valves	¾ in. (19 mm) NPS
3 in. (76 mm) valves	1¼ in. (28 mm) NPS
4, 66 & 8 in. (102, 152 & 203 mm) valves	2 in. (51mm) NPS

3.9.4 A ¾ in. (19 mm) NPS minimum fitting shall be provided for possible installation of an automatic sprinkler within the dry pipe valve enclosure. (This may be piped to the priming connection.)

3.9.5 If priming water is needed to seal the air seat, provisions for adding it shall consist of the following: a ¾ in. (19 mm) NPS connection on the air side of the dry pipe, a shut-off valve, and a cup to prevent direct connection of a priming water supply line to the priming water line.

3.9.6 If priming water is used, a connection shall be provided so that proper priming water level can be determined.

3.10 Intermediate Chamber

3.10.1 The intermediate chamber of a dry pipe valve shall have an automatic drain valve for venting to atmosphere any water leakage by the clapper(s). The drain valve shall have a means to check the position of the clapper or ball portion of the valve to ensure that it is operating properly. A drain valve may be one of several types and may be located either inside or outside the chamber. One type located within the chamber closes mechanically when the clapper is raised. Other types located outside the chamber are called velocity drain valves, and close when a flow of water enters the chamber. Velocity drain valves shall shut at flow rates of between 2 and 10 gpm (7.6 and 37.9 dm^3/min.).

3.10.2 Dry pipe valves which do not have intermediate chambers shall have some means to detect the presence of water if it rises approximately one foot above the valve clapper.

3.11 Auxiliary Equipment

3.11.1 Dry pipe valves shall have the capability of operating various certified, audible alarm devices, such as water motor gongs (FM Standard Class 1050) and pressure switches (FM Standard Class 3132). The valve shall also have the ability to test these alarm devices without tripping the valve or allowing water into the system piping.

3.11.2 Valve shall be equipped with certified gages (FM Standard Class 2311) to indicate air pressure and water supply pressure.

3.11.3 Air Pressure Maintenance Devices are used to maintain dry pipe system air pressure within pre-set limits and are examined in accordance with FM Standard Class 1032.

3.11.4 Quick-Opening Devices, Accelerators and Exhausters, are used to increase the speed of operation of dry pipe valves and are examined in accordance with FM Standard Class 1031.

3.12 Materials

3.12.1 All materials used in dry pipe valves shall be suitable for the intended purpose. All valve parts which could affect the operation of the valve if they become corroded or tuberculated shall be

constructed of corrosion resistant materials. Metal seat rings which come into contact with rubber seating rings shall be constructed of material which will not naturally stick to rubber.

3.13 Markings

3.13.1 Marking on the product or, if not possible due to size, on its packaging or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, size, rating, capacity, etc., as appropriate.

When hazard warnings are needed, the markings should be universally recognizable.

3.13.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.13.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.13.4 All markings shall be legible and durable.

3.13.5 A corrosion resistant nameplate permanently fastened to the valve in a prominent position shall show: manufacturer's or vendor's name or trademark, rated working pressure, nominal valve size, distinctive model designation, year of manufacture and the certification agency's mark of conformity. All or part of this marking may be cast in raised letters on the valve body. If the valves are manufactured at more than one location, each valve shall be uniquely marked to indicate place of origin.

3.14 Manufacturer's Installation and Operation Instructions

3.14.1 The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide 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.

3.15 Calibration

3.15.1 All equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. that the certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an accredited ISO/IEC 17025 accredited 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 provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available .

3.15.2 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 thus equipment.

4. PERFORMANCE REQUIREMENTS

4.1 Operational Tests – Dry Pipe Valves

4.1.1 A sample valve will be installed in a vertical riser. The valve will be set with air pressure above and water below, with the water control valve at least 1/3 open.

4.1.2 The valve will be tripped at various water supply pressures from 20 psig (138 kPa) to the rated working pressure by slowly reducing the system air pressure above the valve. Normally each valve will be operated at least three times at each supply pressure increment (approximately 20 psig or 138 kPa). All operations must fall within the specifications of Paragraph 3.7.

4.2 Friction Loss - Dry Pipe Valves

4.2.1 A sample valve will be installed between two flanged test pipes of the same nominal diameter as the valve and equipped with piezometer rings.

4.2.2 The head loss between the piezometers will be measured for sufficient flows to determine the valve head loss characteristics. The head loss shall be in accordance with Paragraph 3.6.

4.3 Strength of Clapper Latch- Dry Pipe Valves

4.3.1 In some situations a dry pipe valve may experience a reverse flow through the valve.

4.3.2 To test the strength of the clapper latch, a sample valve will be subject to a reverse flow of approximately 2000 gpm (7.57 m^3/min.) for 5 minutes with the clapper on the wide open latch. The valve shall remain open during the test and no permanent distortion or function impairment shall occur.

4.4 Strength of Clapper- Dry Pipe Valves

4.4.1 To further the strength of the clapper assembly, a sample valve will be tripped with air below the valve instead of water. The valve will be set with approximately 100 psig (690 kPa) air above and below the valve with a supply volume below the valve of approximately 375 gals. (1.4 m^3).

4.4.2 The valve will be tripped by rapidly releasing the air pressure above the valve through a 2 in. (51 mm) drain valve. No damage to any valve parts shall result from this test and the valve shall operate satisfactorily after the test.

4.5 Hydrostatic Test- Dry Pipe Valves

4.5.1 With the clapper assembly removed, a sample valve will be subjected to a hydrostatic test of 700 psig (4.8 M Pa) or 4 times the rated working pressure, whichever is greater, for 5 minutes.

4.5.2 No leakage or permanent distortion shall result from this test.

4.6 General – Rubber Facings

4.6.1 Rubber facing utilized in many dry pipe valves play a critical role in the reliable operation of the valve especially after extended periods of time. These rubber parts (natural or synthetic) will be the subject of a special examination as deemed necessary by the certification agency and will include the below listed tests.

4.7 Water Absorption - Rubber Facings

4.7.1 A sample of the valve facing will be maintained in water at a temperature of 212°F (373°C) for 6 hours.

4.7.2 At the end of this period, the increase in weight of the sample shall not exceed 1.5% of the original weight and the increase in thickness shall not exceed 1.5% of the original thickness.

4.8 Hardness – Rubber Facings

4.8.1 A sample facing will be tested for hardness.

4.8.2 A value of 50 to 70 based on the Shore durometer "A" scale will be acceptable.

4.9 Aging – Rubber Facings

4.9.1 A sample facing will be subject to an accelerated aging test in accordance with ASTM D572 (Accelerated Aging of Vulcanized Rubber by the Oxygen-Pressure Method).

4.9.2 After the test the sample will be examined for resilience; no cracking shall occur when the sample is bent double.

4.10 Adhesion – Rubber Facings

4.10.1 Due to the reaction between sulfur and copper, rubber products that contain sulfur may stick to valves with bronze seating surfaces. This situation will generally be limited to natural rubber facings; however, some synthetic rubber products may be sulfur cured. Testing will not be necessary if seating surfaces are made from materials that do not contain copper or if seating surfaces are tinned or coated with a suitable material.

4.10.2 If it is suspected that this situation may occur, the valve will be tested as follows:

- the clapper with rubber facing will be set on its seating surface with a pressure of 50 psig (340 kPa).
- the valve will be maintained in an environment of approximately 150°F (338°K) for 30 days.
- at the end of this period the clapper shall be able to be lifted off its seat by hand

4.11 Additional Tests

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

5. OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality control program is required to assure that subsequent indicating valves produced by the manufacturer at an authorized location shall present the same quality and reliability as the specific indicating valves examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified be the certifier's surveillance audit.
- Quality of performance is determined by field performances and by periodic re-examination and testing.

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

- Existence of corporate quality assurance guidelines;
- Incoming quality assurance, including testing;
- In-process quality assurance, including testing;
- Final inspection and tests;
- Equipment calibration;
- Drawing and change control;
- Packaging and shipping;
- Handling and disposition of non-conformance materials; and,
- In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed, for a minimum period of two years from the date of manufacture.

5.1.3 Documentation/Manual

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

5.1.4 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.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall not allow unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by, the certification agency prior to implementation in production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audits

5.2.1 An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality control program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 The client shall manufacture the product or service only at the location(s) disclosed as part of the certification examination. Manufacture of products bearing the certification mark is not permitted at any other locations prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify the certification agency of changes in product construction, design, components, raw materials, physical characteristics, component formulation or quality assurance procedures prior to implementation of such changes.

5.3.2 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.