UL 193

STANDARD FOR SAFETY

Alarm Valves for Fire-Protection Service

UL Standard for Safety for Alarm Valves for Fire-Protection Service, UL 193

Eleventh Edition, Dated February 26, 2016

Summary of Topics

This revision of ANSI/UL 193 dated February 16, 2021 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated December 18, 2020.

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This ANSI/UL Standard for Safety consists of the Eleventh Edition including revisions through February 16, 2021.

The most recent designation of ANSI/UL 193 as a Reaffirmed American National Standard (ANS) occurred on February 16, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover alarm valves for use in automatic wet-pipe sprinkler systems for fire-protection service. Alarm valves covered by these requirements are of either the variable- or constant-pressure type and are of the swing-check pattern. Ordinarily, variable-pressure alarm valves are acceptable for constant-pressure service without alteration; however, in some designs, that part of the device having to do with the delaying of alarms may be omitted.

1.2 Alarm valves covered by these requirements include the sizes 1 – 12 inches, inclusive.

1.3 Alarm valves covered by these requirements are intended for installation and use in accordance with the Standard for the Installation of Sprinkler Systems, NFPA 13.

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3 Undated References

3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component.

4.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

4.3 A component shall be used in accordance with its rating established for the intended conditions of use.

4.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

5.2 READY CONDITION – The condition existing when:

a) An alarm valve is installed in a piping system that has been filled with water from an active water supply having a stable pressure; and

b) There is no water flow from any outlet on the system downstream from the alarm valve.

5.3 RETARDING FACTOR – The time in seconds that elapses while any specified rate-of-flow is being discharged from the system between the first passage of water through the alarm port of the valve and the completion of the action which is required of the mechanism to actuate the alarm devices. It does not include the time required to withdraw excess pressure from the riser above the valve, nor the delay incident to transmission of water through the piping from the alarm valve to water-motor gongs or other alarm apparatus that may be installed at some distance from the valve.

5.4 SENSITIVENESS – The minimum rate-of-flow from a system outlet, expressed in gallons per minute (gpm) (L/min) that will open the alarm valve, as indicated by continuous operation of both electrical and mechanical alarms. See 5.5.

5.5 SERVICE PRESSURE – The static pressure at the inlet to an alarm valve when the valve is in the ready condition.

5.6 SOLID FLOW SYSTEM – A system in which no air is present in the sprinkler piping.

5.7 WASTE OF WATER – The discharge of any water from the alarm port of an alarm valve that is in the ready condition.

ASSEMBLY

6 General

6.1 Auxiliary components or attachments to alarm valves, such as water-motor-driven alarm gongs, pressure-operated switches, pressure gauges, and the like, are judged under the requirements for such devices or products and also with respect to their particular application. See the Standard for Alarm Accessories for Automatic Water-Supply Control Valves for Fire-Protection Service, UL 753, and the Standard for Indicating Pressure Gauges for Fire-Protection Service, UL 393.

7 Sizes

7.1 Valve sizes refer to the nominal diameter of the waterway through the inlet and outlet connections and to the nominal pipe size for which the connections are intended. The diameter of the waterway at the water seat ring of a valve may be reduced to less than that of the waterway at the inlet and outlet connections.

8 Working Pressures

8.1 An alarm valve shall be constructed for a minimum rated working pressure of 175 psig (1200 kPa).

9 Positions

9.1 An alarm valve may be constructed to operate when installed in only one specific position (horizontal only or vertical only) or it may be constructed to operate in both of these positions. See 31.2 (e), for marking requirements.

10 Bodies and Covers

10.1 A body and cover shall be made of a material having corrosion resistance equivalent to cast iron. If nonmetallic materials, for example, plastics, are used, they are to be subjected to a design study to evaluate their resistance to external fire exposure and thermal shock.

10.2 A casting shall not be plugged or filled but may be impregnated to remove porosity.

10.3 The dimensions of all flanges, flange pipe joints, and threaded body openings shall conform to the following standards, as applicable. The flange class shall be at least equal to the rated working pressure of the valve.

a) Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.

b) Dryseal Pipe Threads (Inch), ANSI B1.20.3.

c) Cast Iron Pipe Flanges and Flanged Fittings – ANSI B16.1 (Class 125 or higher).

d) Steel Pipe Flanges for Waterworks Service, 4 – 144 inches, ANSI/AWWA C207, for valves having a maximum rated working pressure of 175 psig (1200 kPa); Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys, ANSI/ASME B16.5, for valves having a maximum working pressure greater than 175 psig.

10.4 Provision shall be made in a valve body for connection of all external fittings and attachments specified by the Standard for the Installation of Sprinkler Systems, NFPA 13.

10.5 The point of connection of the alarm piping shall be such that pressure sufficient to operate the alarm will be available at any velocity of flow through the valve of 1 – 20 feet per second (0.3 – 6.1 m/s), at service pressures of 20 psig (138 kPa) to the maximum rated working pressure. See 5.5.

10.6 A tapped opening in a valve body for a retarding chamber connection shall be not less than 1/2 inch pipe size, and an opening used exclusively for a pressure gauge shall be not less than 1/4 inch pipe size.

10.7 A tapped opening in a valve body for main drain connection shall be at least 3/4 inch pipe size for up to 2 inch valves, at least 1-1/4 inch pipe size for a 2-1/2 to 3 inch valve, and 2 inch pipe size for 4 inch and larger valves.

10.8 Tapped openings provided for main drain piping shall be so located as to assist in carrying away sediment or foreign material likely to collect at the valve seat and to drain water from the system piping when the valve is installed in any intended position.

10.9 A body handhole opening shall be provided and shall be sufficiently large:

a) To permit access to all working parts; and

b) To allow the removal of the clapper assembly.

It shall be so located that, when the valve is installed in the intended position, the opening is on the side or on the top.

Exception: A valve need not be provided with a body handhole opening, provided that:

a) The valve is constructed to permit the clapper and all other internal parts to be removed and replaced;

b) A means is provided to allow removal and reinstallation of the valve, or serviceable portion of the valve, without disassembly of the sprinkler system piping; and

c) The means for valve or part removal and reinstallation is integral with the valve.

10.10 If a body handhole opening is provided, a cover plate shall be attached to the body of a valve using bolts and nuts, or bolts alone, or studs and nuts, with the removable parts having external drive surfaces, such as a square or hexagonal head.

10.11 In a 6 inch size or larger valve, no stud or bolt smaller than 1/2 inch (12.7 mm) shall be used to assemble castings subject to full water pressure.

10.12 Bolts, nuts, and studs employed for the bolting of pressure-holding castings shall comply with the applicable requirements in the Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength, ASTM A307, and in the Standard Specification for Carbon and Alloy Steel Nuts, ASTM A563. Bolts shall be Grade A or Grade B, as specified in ASTM A307.

10.13 The load on any bolt, exclusive of the force required to compress the gasket, shall not exceed the minimum tensile strength specified in Table 2 of the Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength, ASTM A307, when the valve is pressurized to four times the rated working pressure. The area of the application of pressure is to be calculated as follows:

a) If a full-face gasket is used, the area of force application is that extending out to a line defined by the inner edge of the bolts.

b) If an "O" ring seal or ring gasket is used, the area of force application is that extending out of the center line of the "O" ring or gasket.

10.14 A handhole cover plate shall be constructed so that it cannot be installed in such a manner as to impair the operation of the valve.

11 Valve Mechanisms

11.1 General

11.1.1 A valve part that is constructed to be disassembled during field servicing shall be such that it cannot be reassembled in an unintended manner.

11.1.2 There shall be no waste of water when the valve is in a "ready" condition. See 5.2, 5.7, and 29.1.6.

11.1.3 A valve mechanism shall provide freedom of movement of operating parts.

11.1.4 The clapper assembly shall be hung in the interior of the valve body so that the clapper assembly will move toward the seat by gravity and seal as intended when no water is flowing. For valves intended for horizontal installation, the use of springs to effect intended seating is acceptable.

11.1.5 A spring used in an alarm valve shall be made of a material having corrosion resistance at least equivalent to phosphor bronze. See 20.2 and 20.3.

11.1.6 A part that bears against, rotates within, or slides on stationary parts, and that must be free to move during valve operation, shall:

a) Be made of corrosion-resistant material, such as bronze, brass, chrome-plated bronze, monel metal, and the like; or

b) If made of materials lacking corrosion-resistant properties, be fitted with bushings, inserts, or other parts made of the corrosion-resistant materials mentioned above, at those points where freedom of motion is required.

11.1.7 Any interior bolt or screw shall be made of bronze or other equally or more corrosion-resistant material.

11.2 Clapper supports

11.2.1 Clapper-arm bushings or hinge pin bearings shall project a sufficient distance to maintain not less than 1/8 inch (3.2 mm) clearance between ferrous-metal parts. If a side plug is used to support a hinge pin, holes in the plugs shall be drilled concentric with the screw threads. A bearing plug shall be made of bronze or other corrosion-resistant material and shall be long enough to extend inside walls of cast-iron bodies to provide an end-bearing surface.

11.2.2 A clapper arm shall be supported by a hinge pin(s) made of bronze or other corrosion-resistant material. The hinge pin(s) shall resist the impact effect caused by a surge of water on the closed clapper. For purposes of this determination, the water surge is assumed to be flowing at a velocity of 15 feet per second (4.6 m/s). Bronze hinge pins not less than 3/8 inch (9.5 mm) in diameter for valves of 3 inch size or less, and not less than 7/16 inch (11.1 mm) in diameter for valves of 3-1/2 inch size or larger, are considered to be in conformance with this requirement.

11.2.3 A bearing shall be constructed to reduce the risk of corrosive action causing parts to bind or cement together.

11.2.4 The hinging of the moving parts of a valve shall be such that the parts will not damage a clapper facing or seat ring during valve operation.

11.2.5 Hinge-pin support bearings and clapper-arm bearings shall each have a length that equals or exceeds 70 percent of the diameter of the hinge pin, but not less than 5/16 inch (7.9 mm). A clapper-arm bearing made of material having strength and corrosion resistance equivalent to a Series 300 stainless steel shall have a minimum length of 0.165 inch (4.2 mm). Equivalence is to be determined by means of comparative corrosion tests, depending upon material type.

12 Clapper Stops

12.1 When fully open, the clapper shall bear against a definite stop, the point of contact being so located that impact or the reaction of the water will not tend to twist or bend the parts.

12.2 The clapper arm and clapper combination shall reduce the risk of the clapper tipping and catching under the seat ring in case the connection between the clapper and its arm becomes badly worn.

13 Clapper Rings and Seat Rings

13.1 A metal-to-metal valve-seating surface shall be of bronze or equally or more corrosion-resistant material and shall have sufficient width of surface contact to withstand compression stresses and damage due to pipe scale or foreign matter carried by the water. The seating surface of a metal clapper ring shall be at least 1/8 inch (3.2 mm) wider than the surface of the body seat ring.

13.2 The face of a metal clapper ring shall have dimensions such that all ferrous-metal parts of the clapper will be at least 1/8 inch (3.2 mm) away from the metal of the body or body seat ring.

13.3 The face of a metal seat ring in the body shall be at least 1/8 inch (3.2 mm) above adjacent portions of the body casting.

13.4 A metal ring on which seating surfaces are formed may be threaded, dove-tailed, swaged, or pressed in place, or may be an integral part of a valve body or clapper if the metal is acceptable for this purpose. See 13.1.

13.5 A metal seat or valve ring contacted by a clapper facing made of rubber or other resilient material shall be made of, or faced with, a material to which the clapper facing will not adhere. See Adhesion Test for Resilient Seat Materials, Section 22.

13.6 A rubber ring shall be held in place by rings or other fasteners made of bronze or equally corrosive-resistant material.

13.7 A screw or other part used to hold a clapper facing clamping ring in place shall be of bronze or equally corrosive-resistant material.

14 Nonmetallic Materials

14.1 A plastic or other nonmetallic part, other than rubber parts such as clapper facings and "O" rings, is to be judged on the basis of:

a) Mechanical strength, including resistance to impact;

b) Water absorption;

c) Resistance to deterioration due to aging; and

d) Volumetric and dimensional changes.

See 21.2.1 – 21.2.4.

14.2 Elastomeric parts, except gaskets, of each size and type used in the various assemblies shall comply with the requirements of 21.3.1 and 21.3.2.

15 Clearances

15.1 Clearances shall be provided between working parts and between working and stationary parts so that corrosion or deposits of foreign matter within an assembly will not render a valve sluggish in action or inoperative.

15.2 The clearance between a clapper or a part attached thereto and the inside walls of iron body castings in every position of the clapper except the fully-open position shall be not less than 1/2 inch (12.7 mm). This clearance shall be not less than 1/4 inch (6.4 mm) for a bronze-bodied valve.

15.3 There shall be clearances to the body casting or other body parts of not less than 1/2 inch (12.7 mm) around the hubs of a clapper arm.

15.4 A diametrical clearance of not less than 1/4 inch (6.4 mm) shall be provided to prevent contact between inner edges of a seat ring and metal parts of a clapper assembly, such as rubber ring retainers, when the valve is in the closed position.

15.5 The clearance between hinge pins and their bearings shall not be less than 0.005 inch (0.127 mm).

15.6 End clearance shall be provided between a clapper-arm bearing and its cooperating side bearing surface.

16 Auxiliary Checks

16.1 Auxiliary checks are either bypass or alarm port types. An auxiliary check shall be so located that deposits or sediment will not tend to accumulate on the clapper or seat ring to an extent sufficient to interfere with intended operation.

16.2 An auxiliary check of the swing-check type shall comply with the applicable requirements relating to main-valve parts.

16.3 An auxiliary check of the vertical-rising type shall be provided with guides or an appropriate housing which will serve as a guide, so as to prevent the check from sticking in the open position.

16.4 An auxiliary check shall have sufficient play between it and its supporting members so that the check can seat as intended.

16.5 If an auxiliary check is supported on, or its housing is a part of, the main valve, the auxiliary check shall be allowed sufficient play so that after seating it will not have a tendency to hold the main clapper off its seat.

16.6 An auxiliary check-valve housing shall be provided with a through opening that will permit system pressure to assist in holding the check on its seat.

16.7 An auxiliary check valve of the vertical-rising type shall be provided with a spring as an aid to seating.

17 Retarding Chambers

17.1 The body of a retarding chamber shall be made of a material having corrosion resistance equivalent to cast iron.

17.2 Metallic diaphragms used in a retard chamber shall be made of a material having corrosion resistance equivalent to phosphor bronze.

17.3 A diaphragm used in a retard chamber shall be capable of withstanding 50,000 cycles of operation without failure. See 20.3.

17.4 The pressure retaining parts of a retarding chamber shall withstand, without rupture, a hydrostatic pressure of twice the maximum rated working pressure applied for 1 minute.

17.5 If a screen is employed in the piping between an alarm valve and a retarding chamber, it shall be made of corrosion-resistant material and shall be accessible for cleaning and replacement.

17.6 The largest dimension of a hole in the screen shall be 1/16 inch (1.6 mm) less than the diameter of the smallest orifice to be protected by the screen. The total area of the openings in the screen shall be not less than 20 times the cross-sectional area of the opening which the screen is designed to protect.

17.7 A retarding chamber shall include means for its support. If piping is to be used for this support, the pipe sizes to be used and the maximum lengths of pipe so used shall be stated on the instruction charts provided with the alarm valve. See 32.4.

17.8 A tapped opening of not less than 3/4 inch pipe size shall be provided in a retarding chamber for connection of alarm devices.

18 Valve Gags

18.1 A valve shall prevent gagging of the valve. Openings which are intended to be plugged but which could be used for the insertion of rods or sticks or other similar objects which would gag the valve without requiring the removal of the cover or faceplate shall not be used.

PERFORMANCE

19 General

19.1 Representative samples of each size alarm valve, together with appropriate auxiliary devices for test, are to be furnished and subjected to the tests described in these requirements. Test bars of metal used in castings and additional samples of parts constructed of nonmetallic materials, such as valve-seat discs, are required for physical tests.

20 Metallic Materials Tests

20.1 Specimen bars of metals used shall be prepared from the same heat or run of metal used in the bodies and covers of valve samples submitted for investigation and test. The specimen bars shall comply with the minimum physical property requirements of the applicable ASTM or nationally recognized specifications.

20.2 A spring used in a valve mechanism shall operate as intended for 50,000 cycles.

20.3 A sample valve of any type employing a spring is to be connected to a hydraulic cylinder and subjected to 50,000 cycles of intended operation. For clapper springs, the clapper is to be rotated off of the seat to a 45 degree angle and slowly returned to the closed position. For internal bypass springs, the bypass is to be operated from the full open position to the closed position. For retard chamber diaphragms, the diaphragm is to be flexed from the normally open to normally closed positions. These tests are to be conducted at a rate not exceeding 6 cycles per minute.

21 Nonmetallic Materials Tests

21.1 General

21.1.1 A plastic or other nonmetallic part, other than rubber parts such as clapper facings and "O" rings, shall comply with the requirements of 21.2.1 – 21.2.4.

21.1.2 Elastomeric parts, except gaskets, of each size and type used in the various assemblies shall comply with the requirements of 21.3.1 and 21.3.2.

21.2 Plastic parts

21.2.1 Following air-oven aging for 180 days at 121°C (250°F), there shall be no warping, creeping, or other signs of deterioration of a plastic component that may preclude the intended operation of the valve. There shall be no cracking of any plastic component. A valve with aged plastic components shall demonstrate acceptable performance when subjected to both the Operational Tests, Section 29, and the Leakage Test, Section 27.

21.2.2 A complete valve assembly, including the plastic parts, and sample plastic components to be aged are to be supported in a full-draft, circulating-air oven that has been preheated at full draft, to 121 ±1°C (250 ±1.8°F). Elastomeric facings or "O" rings may be included or excluded at the manufacturer's option. The manner of support is to be such that the samples are prevented from touching one another or the sides of the oven. The samples are to be aged for 180 days at full draft and then allowed to cool in air at 23 ±2°C (73.4 ±3.6°F) for at least 24 hours before conducting any test or dimensional check. Prior to any tests, elastomeric parts complying with 21.3.1 are to be installed, if not included in the aging test. As used in this test, the term "full draft" refers to the air flow over the samples in the oven with the air inlet and outlets fully open. The oven used for accelerated aging is to be Type IIA as specified in the Standard Specification for Gravity-Convection and Forced-Ventilation Ovens, ASTM E145.

21.2.3 If a plastic material cannot withstand the temperature indicated without softening, distortion, or deterioration, an air-oven aging test at a lower temperature, minimum 87°C (189°F), for a longer period of time may be used.

21.2.4 Following immersion in tap water at 87 ±2°C (189 ±3.6°F) for 180 days, there shall be no warping, creeping, or other signs of deterioration of a plastic component that may preclude the intended operation of the valve. There shall be no cracking of any plastic component. Valves with aged components shall demonstrate acceptable performance when subjected to the Operational Tests, Section 29, and the Leakage Test, Section 27.

21.3 Elastomeric parts (except gaskets)

21.3.1 An elastomeric part used to provide a seal shall have the following properties when tested as specified in the Standard for Gaskets and Seals, UL 157:

a) For silicone rubber (having poly-organo-siloxane as its constituent characteristic), a minimum tensile strength of 500 psi (3.4 MPa) and a minimum ultimate elongation of 100 percent.

b) For natural rubber and synthetic rubber other than silicone rubber, a minimum tensile strength of 1500 psi (10.3 MPa) and minimum ultimate elongation of 150 percent; or a minimum tensile strength of 2200 psi (15.2 MPa) and a minimum ultimate elongation of 100 percent.

c) Those properties relating to maximum tensile set; minimum tensile strength and elongation after oven aging; and hardness after oven aging, all as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is considered to be 60°C.

21.3.2 The Standard for Gaskets and Seals, UL 157, provides for the testing of either finished elastomeric parts or sheet or slab material. Sheet or slab material is to be tested when the elastomeric parts are O-rings having diameters of less than 1 inch (25.4 mm). The material tested is to be the same as that used in the product, regardless of whether finished elastomeric parts or sheet or slab material is tested.

22 Adhesion Test for Resilient Seat Material

22.1 Conformance with the requirements of 13.5 is to be determined by tinning of the metal seat or by immersion in tap water of a compression test fixture capable of use as specified in (a) – (e), and consisting of a full circular seat or valve ring with a full section of resilient clapper facing material held together with a bridging construction; or capable of accommodating a full section of resilient clapper facing material placed between full sections of equal length of the seat or valve ring and clapper facing; or capable of accommodating a 1 inch (25 mm) long section, measured along the central arc, of resilient clapper facing material placed between plates of the same material as the seats or valve rings and clapper facings, similar to that shown in Figure 22.1. The tests are to be conducted as follows:

a) The clapper facing material is to be placed in the compression test fixture and the fixture compressed in a tension-compression machine until a load, Fc, is developed according to the formula

$$Fc = \frac{Dpl}{4}$$

where:

Fc is the test load, in pounds (N x 0.225), rounded to the nearest larger whole number;

D is the diameter, in inches (mm x 0.04), measured along the sectional center line of the resilient valve seat material. This diameter is equal to the outer diameter of the seat material minus the width of the material, see Figure 22.2;

p is the pressure rating of the valve, in psig (kPa x 0.145); and

l is the length, in inches (mm x 0.04), of the sample of resilient valve seat material under test. If the sample is a complete circular sample, this length is the circumference defined by diameter, D, see Figure 22.2.

b) The amount of compression required to achieve the force, Fc, in (a) is to be measured, in millimeters, to the nearest 2 mm.

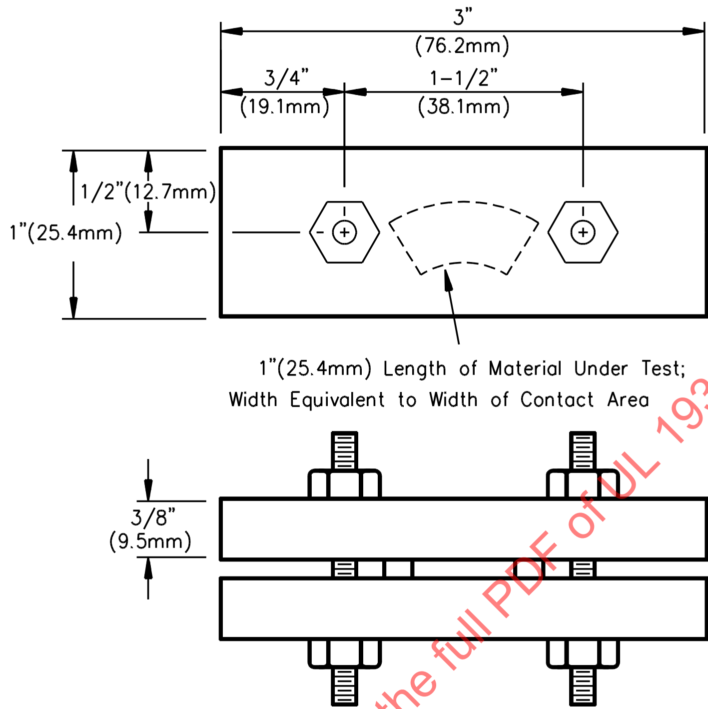
c) The compression fixture is to be removed from the tension-compression machine, and the fixture compressed by its clamping means until the compression measured in (b) is achieved.

d) The clamped fixture is to be immersed for 90 days in tap water maintained at a temperature of 87 ±2°C (189 ±4°F). Following 30 and 60 days of immersion, the assembly is to be removed from the water, (a) – (c) are to be repeated, and the assembly reimmersed in the water.

e) Following 90 days of immersion, the fixture clamping means is to be removed and the fixture left undisturbed for 1 hour. The fixture is then to be secured to the jaws of the tension-compression testing machine. With the jaws separating at the rate of 0.1 inch (2.5 mm) per minute, the tensile force required to separate the resilient clapper facing from the seat or ring material is to be determined, and shall not exceed the force equivalent to a 5 psig (34.5 kPa) differential acting over the area, A, defined by the diameter, D, see Figure 22.2.

Figure 22.1

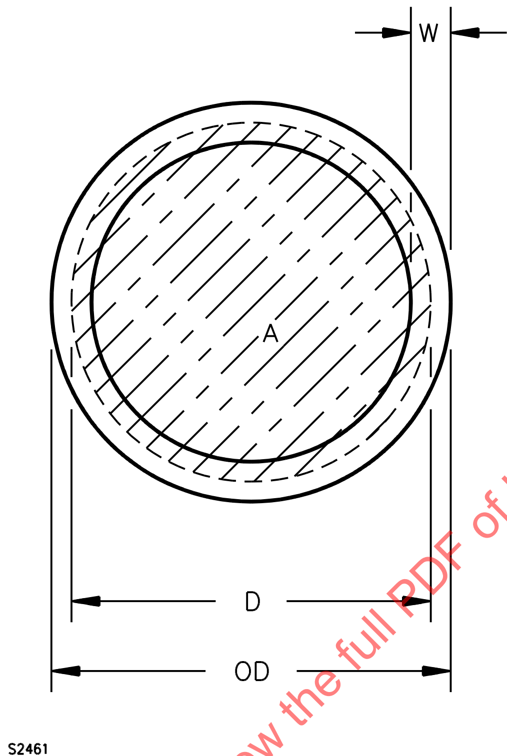
Test fixture for section of facing material



S2460A

Figure 22.2

Dimensions of resilient facing material



23 Installation Assembly Test

23.1 An alarm valve shall be capable of being installed by means of tools ordinarily employed by pipe fitters. Outside attachments and accessory equipment shall be capable of being securely attached without difficulty.

23.2 At least one size of a given type, design, or class of an alarm valve assembly is to be installed in a hydraulic system and trimmed in accordance with the manufacturer's installation instructions. The valve is to be equipped with its attachments and trim. The manufacturer's water-motor alarm is to be installed 6 feet (1.8 m) above the alarm-valve seat and is to be connected using 75 feet (22.9 m) of 3/4 inch size pipe. See Figure 29.1.

24 Servicing Test for Valves Without Handhole Openings

24.1 A valve that does not incorporate a handhole opening, when tested as specified in 24.2 and 24.3, shall be serviceable, including being able to be removed from the system piping and having its clapper and end seals replaced, using ordinary hand tools in conjunction with any integral means provided with the valve.

24.2 A valve, attached at both ends to appropriately-sized 6 inch (152 mm) long pipe spools, is to be placed in a tension-compression testing machine. The valve assembly is to be subjected to a compression force applied along the longitudinal axis of the pipe spools and of a magnitude equivalent to the weight of the valve plus the additional compression force specified in Table 24.1 corresponding to the size of the pipe used with the valve.

Table 24.1
Additional valve compression force

Valve pipe size, Inches	Pounds-force	(N)
2	153	(680)
2-1/2	236	(1050)
3	323	(1437)
4	489	(2175)
6	944	(4199)
8	1507	(6703)
10	2237	(9950)

24.3 Following compression, the valve, or serviceable portion of the valve, as appropriate, and end seals are to be removed from the pipe spools while under the compression load by the use of ordinary hand tools along with any integral means provided with the valve. The seals are to be replaced and the valve or valve portion, as appropriate, is then to be reinstalled between the pipe spools by the use of ordinary hand tools along with any integral means provided with the valve.

25 Positiveness of Response and Transmission Test

25.1 A valve shall actuate mechanical and electrical alarm devices at all rates of water flow in excess of the minimum rating required to actuate alarms, as well as at any velocity of flow through the valve of 1 – 20 feet per second (0.30 – 6.1 m/s).

25.2 A valve shall be equally operative without special adjustment at all service pressures up to and including the rated working pressure.

25.3 A valve shall discontinue alarms when the flow is stopped.

25.4 A valve shall transmit successive alarms without requiring manual resetting.

25.5 A valve shall supply water at 5 psig (34.5 kPa) at the inlet to water-motor gongs located as described in 23.2.

25.6 A valve shall supply water at 5 psig (34.5 kPa) to electric alarms located as close as possible to the outlet of the retard chamber.

26 Hydraulic Friction Loss Test

26.1 Head losses due to hydraulic friction shall not exceed 3 psig (20.7 kPa) at a flow rate which will result in a velocity of 15 feet per second (4.5 m/s) in the full-size pipe connection to a valve.

26.2 The sample alarm valve is to be installed in its intended position in a test piping system. This test line is to be equipped with a calibrated-nozzle setup or other appropriate means by which selected rates of flow can be established. A differential pressure gauge or measuring device is to be connected to piezometer fittings located upstream and downstream from the test valve by means of which the loss-of-head between the two piezometer fittings is measured. Selected flow rates are to be established and the loss-of-head over the valve plus that over the piping between piezometers for each rate of flow is to be calculated.

26.3 The sample valve is then to be removed from the test piping and the loss-of-head for test piping, located between the piezometer fittings, is to be determined for the same rates of flow. The loss-of-head for the alarm valve is then to be determined by subtracting the losses over the piping alone from the losses over the piping and valve.

27 Leakage Test

27.1 An alarm valve shall withstand, without evidence of leakage at joints or at the valve seat, an internal hydrostatic pressure of two times the rated working pressure of the valve applied for 1 minute.

27.2 An alarm valve shall withstand, without leakage at the valve seat, an internal hydrostatic pressure equivalent to the head of a column of water 5 feet (1.5 m) high retained within the downstream portion of the valve body. No leakage shall occur as evidenced by wetting of paper placed beneath the valve assembly for 16 hours. This test is to be conducted with the valves in both the horizontal and vertical position if intended for such use.

28 Strength of Body Test

28.1 An assembled valve shall withstand, without rupture, an internal hydrostatic pressure of four times the maximum rated working pressure applied for 5 minutes. During this test, the valve clappers are to be blocked open to impress the test pressure on all parts of the assembly subjected to the design pressure.

28.2 The hydrostatic test for strength of body castings, flanges, covers, and the like, is not considered a test for gaskets or seals. Gaskets employed with castings or parts of large area may be reinforced. Other materials capable of withstanding the pressure may be substituted for regularly employed gaskets and seals.

29 Operational Tests

29.1 Sensitiveness

29.1.1 The sensitiveness of a valve shall be within the range of water flows of 4 – 20 gpm (15 – 76 L/min) for any service pressure of:

a) 20 – 100 psig (138 – 690 kPa) for a valve having a maximum rated working pressure of 175 psig (1200 kPa); or

b) 20 psig to the maximum rated working pressure of a valve, minus 75 psig (517 kPa), for a valve having a working pressure greater than 175 psig.

Both electrical and mechanical alarm devices shall operate within 5 minutes from the time the downstream test valve is opened.

29.1.2 An alarm valve shall actuate the intended alarm within 5 minutes from the time the downstream test valve is opened when the valve is subjected to a flowing water service pressure equivalent to the valve's rated working pressure. The water flow is to be established using a 3/8 inch nominal orifice size sprinkler.

29.1.3 The ratio of the service pressure to system pressure shall not exceed 1.15:1 for the service pressures indicated in 29.1.1. The operating differential of a valve shall not exceed 13 psig (90 kPa) at the maximum rated working pressure of the valve, minus 75 psig (517 kPa).

29.1.4 Both electrical and mechanical alarms shall be actuated within 5 minutes after onset of flow through the alarm valve when the flow rate through the valve is at any level above the minimum as determined in the tests specified in 29.1.1.

29.1.5 No alarm, either mechanical or electrical, shall be given at a flow rate through the valve of less than 4.0 gpm (15 L/min).

29.1.6 The sample valve, as installed for the Installation Assembly Test, Section 23, and as shown in Figure 29.1 is to be subjected to a series of operation tests at various service pressures and using various rates of water flow from the test system to determine compliance with 29.1.1. At each service pressure used in these tests, observations are to be made to determine the "least-rate" of water flow from the system that will cause continuous electrical and mechanical alarm.

29.1.7 With the valve in the ready condition the special alarm port drain fitting, see 29.2.2, is to be checked for any sign of waste of water immediately before each test is conducted. See 11.1.2.

29.1.8 Prior to each test, the system pressure is to be observed and recorded by means of a pressure gauge. A differential pressure gauge or measuring device is then to be connected to the system with one leg on the downstream side of the clapper and the other leg on the upstream side of the clapper. With the gauge in service, a small amount of water flow is to be taken from the downstream side of the valve until the clapper lifts off of its seat. The pressure differential shown on the gauge at the time the clapper first lifts is to be recorded to determine compliance with 29.1.3. At this time, the gauge is to be shut off or isolated from the system and the remainder of the operational tests using various system flows at this service pressure are to be conducted. The entire process is then to be repeated for each new service pressure.

29.1.9 During these tests, the pressures available at the pressure-operated electric-circuit closer and at the water-motor gong are to be recorded for the various rates of flow established.