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Fire protection — Automatic sprinkler systems —

Part 8: Requirements and test methods for pre-action dry alarm valves

Protection contre l'incendie — Systèmes d'extinction automatique du type sprinkler —

Partie 8: Exigences et méthodes d'essai des postes de préalarme sous air

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

This second edition cancels and replaces the first edition (ISO 6182-8:2006), which has been technically revised.

The main changes compared to the previous edition are as follows:

— clearances on a reciprocating type clapper has been modified.

A list of all parts in the ISO 6182 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Fire protection — Automatic sprinkler systems —

Part 8: Requirements and test methods for pre-action dry alarm valves

1 Scope

This document specifies performance requirements, methods of test and marking requirements for pre-action dry alarm valves, valve sets and manufacturers' specified relevant trim used in non-interlock pre-action automatic fire protection systems. Performance and test requirements for other auxiliary components or attachments to pre-action dry valves are not covered by this document.

2 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 edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

ISO 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
alarm device
mechanical or electrical device to sound an alarm upon operation of the valve

3.2
anti-reseat latch
mechanical device that prevents the sealing assembly from returning to its closed position after operation

3.3
automatic drain valve
normally open device that vents the intermediate chamber of a valve to the atmosphere when the valve is in the ready position, and limits water flow from the chamber after the valve has tripped

3.4
clapper
type of sealing element

Note 1 to entry: See 3.16.

3.5
corrosion-resistant material
bronze, brass, Monel®[1)] metal, austenitic stainless steel, or equivalent, or plastic material conforming with the requirements of this document

3.6
differential
ratio of service pressure to system air pressure (expressed as gauge pressures) at the trip point

Note 1 to entry: See 3.20.

3.7
differential-type valve
type of valve in which air pressure in the system acts directly and/or indirectly on the sealing assembly to maintain it in the closed position

Note 1 to entry: The air seat of the sealing assembly is of equal or larger diameter than the diameter of the water seat of the sealing assembly, with the two separated by an intermediate chamber maintained at atmospheric pressure.

3.8
flow velocity
speed of water flow through a valve, expressed as the equivalent water velocity through a pipe of the same nominal size as the valve

3.9
intermediate chamber
part of a valve which separates the air and/or water sealing assembly seating surfaces and is at atmospheric pressure when the valve is in the ready condition

3.10
mechanical-type valve
type of valve in which the air pressure in the system acts on the sealing assembly and linking mechanism to maintain it in the closed position

3.11
non-interlock pre-action system
automatic fire protection system in which water is admitted to the system upon either activation of a supplemental detection system or loss of system pressure in combination with failure of the detection system

3.12
pre-action valve set
pre-action alarm valve or valve combination which holds air in a closed sprinkler system and which is opened by combination of sprinkler release and/or release system activation

3.12.1
pre-action valve Type A – non-interlocked
valve assembly which, under normal operating conditions, opens when either the release system or a sprinkler operates

1) Monel® is a trademark of Special Metals Corporation and is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.

3.12.2
pre-action valve Type B1 – single-interlocked with fail safe
valve assembly which, under normal operating conditions, opens only on the activation of a release system

Note 1 to entry: Type B1 valves operate as a dry system in the event that the release system fails.

3.12.3
pre-action valve Type B2 – single-interlocked without fail safe
valve assembly, which under normal operating conditions, opens only on the activation of a release system

Note 1 to entry: Type B2 valves can only be manually operated in the event that the release system fails.

3.12.4
pre-action valve Type C1 – double-interlocked with fail safe
valve assembly, which under normal operating conditions, opens when both the release system and a sprinkler have operated

Note 1 to entry: Type C1 valves operate as a dry system in the event that the release system fails.

3.12.5
pre-action valve Type C2 – double-interlocked without fail safe
valve assembly, which under normal operating conditions, opens when both the release system and a sprinkler have operated

Note 1 to entry: Type C2 valves do not operate as a dry system and can only be manually operated in the event that the release system fails.

3.13
priming water
water used to seal a sealing assembly and prevent cementation of working parts

3.14
rated working pressure
maximum service pressure at which a valve is intended to operate

3.15
ready condition
state of a valve with the sealing assembly in the closed and set position with service and system pressure applied

3.16
sealing assembly
main movable sealing element (such as clapper or diaphragm) of the valve which prevents the reverse flow of air and which maintains air pressure in the system piping

3.17
sealing assembly seat ring
main fixed sealing element of a valve which prevents the reverse flow of water and which maintains air pressure in the system piping

3.18
service pressure
static water pressure at the inlet to a valve when the valve is in the ready condition

3.19
system pressure
pressure at the main outlet of a valve when the valve is in the ready condition

3.20
system air pressure
static air pressure in the system piping when the valve is in the ready condition

3.21
trim
external equipment and pipework, excluding the main installation pipework, fitted to valve installation assembly

3.22
trip point
point at which a valve operates, admitting water into the system, measured in terms of the system air pressure at a given service pressure

3.23
water-motor alarm
hydraulically actuated device which provides a local audible alarm as a result of a flow through a valve

4 Requirements

4.1 Nominal sizes

The nominal size of a pre-action alarm valve set shall be the nominal diameter of the inlet and outlet connections, i.e. the pipe size for which the connections are intended. The sizes shall be 40 mm, 50 mm, 65 mm, 80 mm, 100 mm, 125 mm, 150 mm, 200 mm, 250 mm, or 300 mm. The diameter of the waterway through the sealing assembly seat ring(s) may be less than the nominal size.

4.2 Connections

4.2.1 All connections shall be designed for use at the rated working pressure of the pre-action alarm valve set.

4.2.2 The dimensions of all connections shall conform to the applicable requirements of International Standards. If International Standards are not applicable, national standards may be used.

4.2.3 An opening with a nominal diameter not smaller than 15 mm shall be provided for an alarm line connection.

4.2.4 If priming water is required to seal the downstream side of the sealing assembly, internal or external means shall be provided to allow the introduction of the priming water.

4.2.5 Means shall be provided to prevent water columning and to check the level of priming water (if required).

4.2.6 Suitable means shall be provided to facilitate testing of alarms without tripping the valve.

4.2.7 For differential-type pre-action alarm valve sets, suitable means shall be provided to vent water from the intermediate chamber and to prevent a partial vacuum between the upstream and downstream sealing elements of the sealing assembly.

4.3 Rated working pressure

4.3.1 The rated working pressure shall be not less than 1,2 MPa (12 bar).

4.3.2 Inlet and outlet connections may be machined for lower working pressures to match installation equipment provided the valve is marked with the lower working pressure. See 7.3 f).

4.4 Body and cover

4.4.1 The body and cover shall be made of a material having corrosion resistance at least equivalent to cast iron.

4.4.2 Cover fasteners shall be made of steel, stainless steel, titanium, or other materials with equivalent physical and mechanical properties.

4.4.3 Non-metallic materials other than gaskets, diaphragms and seals or metals with a melting point less than 800 °C shall not form part of the valve body or cover.

4.4.4 It shall not be possible to assemble the valve with the cover plate in a position which either improperly indicates flow direction or prevents proper operation of the valve.

4.5 Strength

4.5.1 An assembled pre-action alarm valve set, with the sealing assembly blocked open, shall withstand, without rupture, an internal hydrostatic pressure of four times the rated working pressure for a period of 5 min when tested as specified in 6.8.

4.5.2 If the test in accordance with 6.8 is not done with production fasteners, the supplier shall provide documentation showing that the calculated design load of any fastener, neglecting the force required to compress the gasket, does not exceed the minimum tensile strength specified in ISO 898-1 and ISO 898-2 when the valve is pressurized to four times the rated working pressure. The area of the application of pressure shall be calculated as follows:

a) If a full-face gasket is used, the area of application of pressure 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 application of force is that extending out to the centreline of the "O"-ring or gasket.

4.6 Access for maintenance

Means shall be provided to permit access to working parts and removal of the sealing assembly. Any method adopted should permit ready maintenance by one person.

4.7 Components

4.7.1 Any component that is normally disassembled during servicing shall be designed so that it cannot be reassembled improperly without providing an external visual indication when the valve is returned to service.

4.7.2 With the exception of valve seats, all parts intended for field replacement shall be capable of being disassembled and reassembled using tools normally employed by the trade.

4.7.3 All components shall be non-detachable during normal operation of the valve.

4.7.4 Failure of the sealing assembly diaphragms or seals shall not prevent the valve from opening.

4.7.5 Seat surfaces of sealing assemblies shall be made of a corrosion-resistant material and have sufficient width of surface contact to withstand ordinary wear and tear, rough usage, compression stresses and damage due to pipe scale or foreign matter carried by the water.

4.7.6 Springs and diaphragms shall not fracture or rupture during 5 000 cycles of normal operation when tested in accordance with 6.2.

4.7.7 There shall be no sign, on visual examination, of damage to the sealing assembly after testing for the operational requirements of 4.14 in accordance with 6.10 and 6.12.

4.7.8 When wide open, the sealing assembly shall bear against a definite stop. The opening of the valve or reaction of the water shall not permanently twist, bend or fracture valve parts.

4.7.9 Where rotation or sliding motion is required, the part or its bearing shall be made of a corrosion-resistant material. Materials lacking corrosion resistance shall be fitted with bushings, inserts or other parts made of corrosion-resistant materials at those points where freedom of movement is required.

4.7.10 A valve having a differential ratio of the sealing assembly exceeding of 1,16-to-1 for a water service pressure range of 0,14 MPa (1,4 bar) or the minimum service pressure [see Clause 8 d)], whichever is greater, to the rated working pressure shall be provided with an anti-reseat latch that prevents the valve from resetting automatically. The valve shall require manual means to return the valve to the ready (set) condition.

4.7.11 A valve having a differential ratio of 1,16-to-1 or less over a water service pressure range of 0,14 MPa (1,4 bar) or the minimum service pressure [see Clause 8 d)], whichever is greater, to the rated working pressure (1,4 bar to 12 bar) shall be provided with means to prevent the valve from automatically returning to the ready (set) condition and to permit draining of the pipework after the valve has tripped. Manual means shall be provided to return the valve to the ready (set) condition.

4.8 Leakage

4.8.1 There shall be no leakage, permanent distortion or rupture of a valve when an internal pressure of twice the rated working pressure is applied for 5 min with the sealing assembly open when tested in accordance with 6.7.1.

4.8.2 No leakage shall be permitted across the sealing assembly into the intermediate chamber or into the alarm port when tested in accordance with 6.7.2. There shall be no leakage, permanent distortion or rupture of a valve at an internal pressure of twice the rated working pressure applied to the upstream side of the sealing assembly for 2 h with the downstream end pressurized in accordance with 6.7.2.

4.8.3 Mechanical type pre-action alarm valve sets shall show no signs of leakage, permanent distortion or structural failure when subjected to an internal hydrostatic pressure of twice the rated working pressure applied for a period of 2 h to the upstream end of the valve with the sealing assembly closed and the downstream end vented in accordance with 6.7.3. Following this test, the valve shall operate in accordance with 4.14 when tested once in accordance with 6.9.4.2 at a service pressure of 0,2 MPa (2 bar).

4.8.4 Mechanical type valves shall withstand, without leakage, permanent distortion or structural failure, an internal hydrostatic pressure of twice the maximum air pressure specified by the manufacturer for a period of 5 min applied to the downstream side of the valve with the sealing assembly closed in accordance with 6.7.4. Following this test, the valve shall operate in accordance with 4.14 when tested once in accordance with 6.9.4.2 at a service pressure of 0,2 MPa (2 bar).

4.8.5 Differential type valves shall withstand, without leakage, permanent distortion or structural failure, an internal hydrostatic pressure of twice the rated working pressure for a period of 5 min applied to the downstream side of the valve with the sealing assembly closed in accordance with 6.7.5. Following this test, the valve shall operate in accordance with 4.14 when tested once in accordance with 6.9.4.2 at a service pressure of 0,2 MPa (2 bar).

4.9 Non-metallic components (excluding gaskets, diaphragms, seals and other elastomeric parts)

4.9.1 Non-metallic valve parts that affect proper valve function shall be subjected to the applicable ageing of its non-metallic parts as described in 6.4 and 6.5 using separate sets of samples, as applicable. After ageing, a valve shall meet the requirements of 4.8, 4.13 and 4.14.4 when tested in accordance with the applicable tests described in 6.6, 6.8 and 6.11.

4.9.2 There shall be no cracking, warping, creep, or other signs of deterioration that can preclude proper operation of the valve.

4.10 Sealing assembly elements

4.10.1 A seal made of elastomeric or other resilient materials shall not adhere to the mating surface when tested in accordance with 6.3.1. Where the same design of seat is used for more than one size of valve, it shall be permitted to test only the size with the highest stress on the seating surface.

4.10.2 Sealing surfaces shall prevent leakage of water into the alarm port when the valve is tested in the ready position in accordance with 6.10.

4.11 Clearances

4.11.1 The requirements in 4.11 are applicable to hinged, clapper-type valves only.

4.11.2 The radial clearance between a hinged sealing assembly and the inside walls in every position except wide open shall not be less than 12 mm for cast iron bodies and shall not be less than 6 mm if the body and sealing assembly are of cast iron or steel with corrosion protective coatings tested in accordance with 6.13, non-ferrous material, stainless steel or materials having equivalent physical, mechanical and corrosion-resistant properties. See Figure 1 a).

4.11.3 There shall be a diametrical clearance [see Figure 1 b)] between the inner edges of the seat ring and the metal parts of the sealing assembly when in the closed position (excluding any latching mechanisms) as follows:

— for compression snap-type sealing assemblies of corrosion-resistant materials, the diametrical clearance shall be not less than 0,7 mm;

— for other types of sealing assemblies, the diametrical clearance shall be not less than 3 mm.

4.11.4 Any space in which the sealing assembly can trap debris beyond the seat shall be not less than 3 mm deep.

4.11.5 The diametrical clearance between hinge pins and their bearings shall be not less than 0,125 mm.

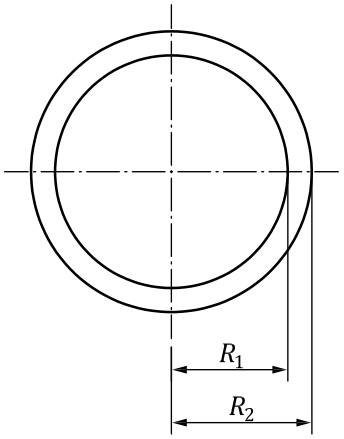
4.11.6 The total axial clearance between the clapper hinge and adjacent valve body bearing surfaces shall be not less than 0,25 mm. See Figure 1 c) or Figure 1 d).

4.11.7 Any reciprocating guide components, which are essential to allow a valve to open, shall have a minimum diametrical clearance of not less than 0,1 mm in that portion over which the moving component enters the fixed component and of not less than 0,04 mm in that portion of the moving component continuously in contact with the fixed component in the ready (set) position. (see Figure 2).

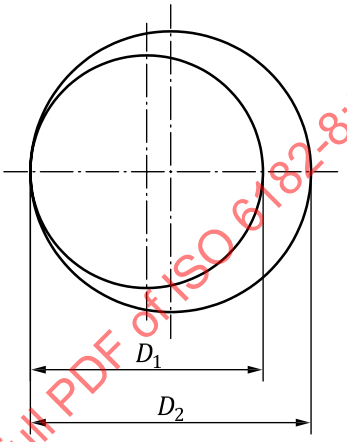
4.11.8 Sealing assembly guide bushings or hinge-pin bearings shall project a sufficient axial distance to maintain not less than 1,5 mm (bushing projection) clearance between ferrous metal parts (see Figure 1).

Clearance of less than 1,5 mm shall be permitted where adjacent parts are of bronze, brass, Monel metal, austenitic stainless steel, titanium, or similar corrosion-resistant materials. When corrosion resistance of steel parts is provided by a protective coating, the parts shall show no visible signs of deterioration of the coating such as blistering, delamination, flaking or increased resistance to movement when tested in accordance with 6.13.

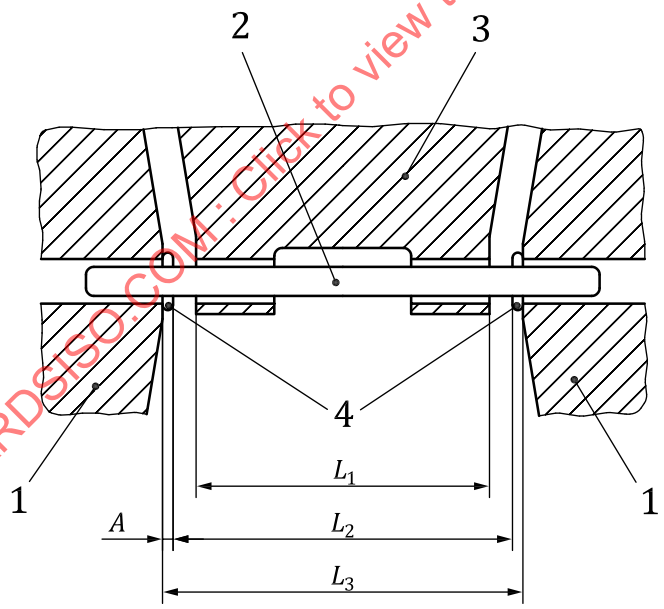
4.11.9 If provided, a compensator shall be designed such that deposits or sediment will not readily accumulate to an extent sufficient to interfere with its proper operation. There shall be sufficient clearances between the working parts to allow proper sealing of the main and any auxiliary valves.



a) Radial clearance, $C_R = R_2 - R_1$



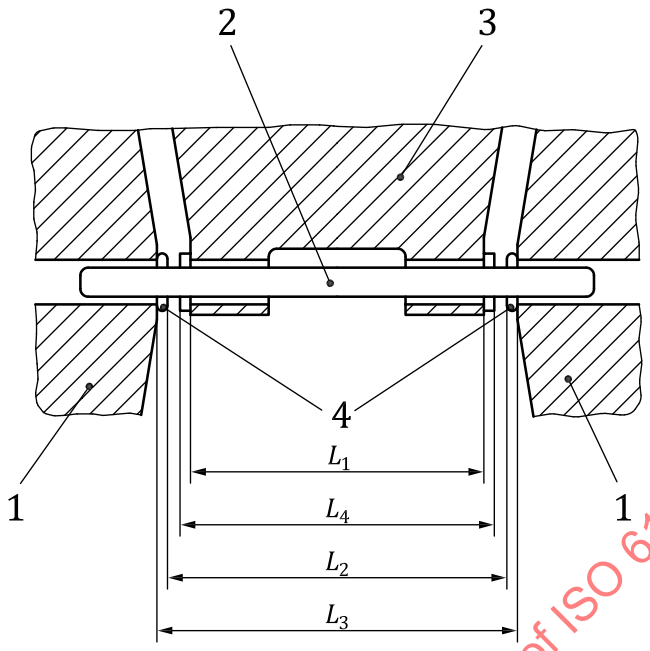
b) Diametrical clearance, $C_D = D_2 - D_1$



c) Total axial clearance, C_{TA}

$C_{TA} = L_2 - L_1$

Clearance $A = (L_3 - L_2) / 2$



d) Inside bushing dimensions

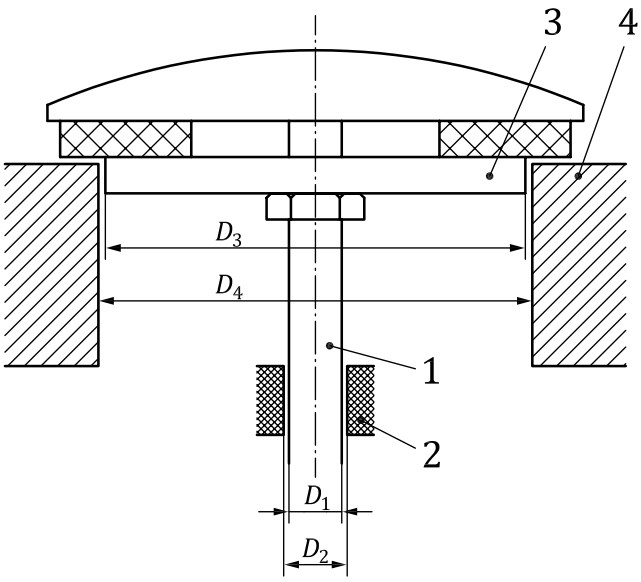
$C_{TA} = L_2 - L_4$

Clearance $A = (L_3 - L_2) / 2 + (L_4 - L_1) / 2$

Key

1 valve body
2 pin
3 sealing assembly
4 bushings

Figure 1 — Clearance



Diametrical clearance of parts not continuously in contact, C_{NC}

$C_{NC} = D_4 - D_3$

Diametrical clearance of parts continuously in contact, C_{CC}

$C_{CC} = D_2 - D_1$

Key

1 shaft
2 bearing or bushing
3 seal retaining washer
4 seat

Figure 2 — Clearance of reciprocating guides

4.12 Hydraulic friction loss

The pressure loss across the valve at the appropriate flow given in Table 1, when tested by the method of 6.6, shall not exceed the pressure loss published in the manufacturer's installation instructions (see Clause 8).

4.13 Endurance

The valve and its moving parts shall show no sign of distortion, cracks, loosening, separation or other sign of failure, following 30 min of water flow in accordance with 6.11.

Table 1 — Required flow rates for pressure drop determination

Nominal size mm	Flow rate l/min
40	380
50	590
65	1 000
80	1 510
100	2 360

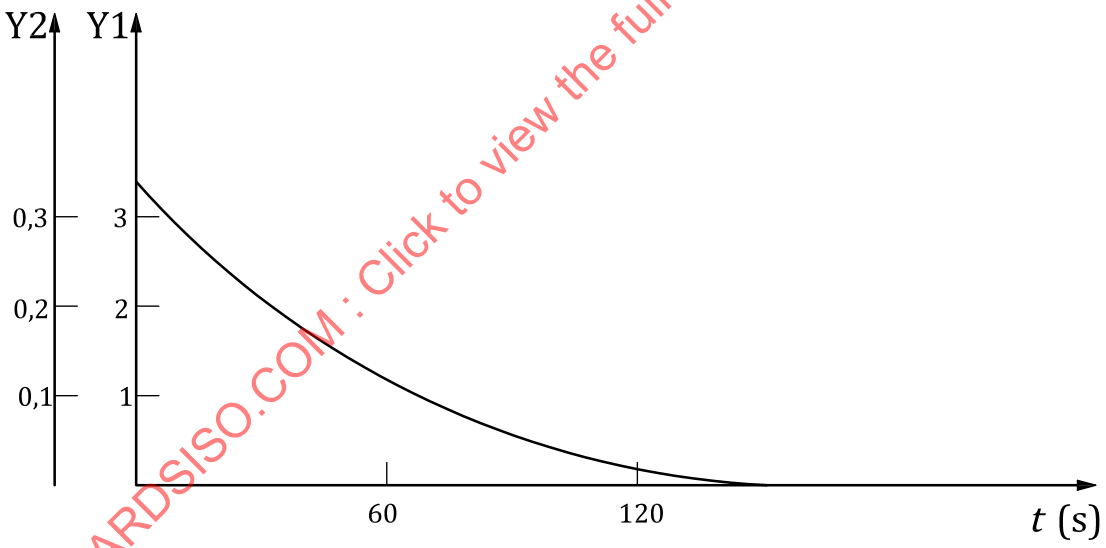
Table 1 *(continued)*

Nominal size mm	Flow rate l/min
125	3 860
150	5 300
200	9 920
250	14 700
300	21 200

4.14 Operational performance

4.14.1 A pre-action alarm valve set with associated trim shall operate and provide an indication of operation by actuating mechanical and/or electrical alarm devices from 0,14 MPa (1,4 bar) to the rated working pressure and at a minimum flow rate of 300 l/min, when tested in accordance with 6.7.2 a). The alarm devices shall sound for more than 50 % of the time for all flow conditions below 0,2 MPa (2 bar) and continuously for all flow conditions at higher pressures.

4.14.2 A pre-action alarm valve set of types B1, B2, C1 and C2 with associated trim shall not operate when the pre-action valve set is in pre-action mode and the air pressure of the downstream side is lowered at no greater than 0,1 MPa (1,0 bar)/min following the test of 6.7.2.



Key

Y1 pressure, expressed in bars

Y2 Pressure, expressed in MPa

Figure 3 — Curve of the air pressure against time, t

4.14.3 A differential-type valve set shall have a working differential within the range 5:1 to 8,5:1 at its minimum service pressure or 0,14 MPa (1,4 bar), whichever is greater, and within the range of 5:1 to 6,5:1 at all higher service pressures when tested in accordance with 6.10. The alarm valve set with associated trim shall operate and provide an indication of operation by actuating mechanical and/or electrical alarm devices at any service pressure within the range of its minimum service pressure to the rated working pressure and at a minimum flow rate of 300 l/min, when tested in accordance with 6.10. The alarm devices shall provide min. 0,05 MPa (0,5 bar) at a nozzle K10, installed at the alarm port, continuously for all flow conditions at pressures above the minimum service pressure.

4.14.4 A mechanical-type valve set shall operate at an air pressure between 0,025 MPa (0,25 bar) and one fifth of the rated working pressure for all water pressures from its minimum service pressure or 0,14 MPa (1,4 bar), whichever is greater, to the rated working pressure when tested in accordance with 6.7.3. The dry alarm valve with associated trim shall operate and provide an indication of operation by actuating mechanical and/or electrical alarm devices at its minimum service pressure or 0,14 MPa (1,4 bar), whichever is greater, to the rated working pressure and at a minimum flow rate of 300 l/min, when tested in accordance with 6.7.3. The alarm devices shall provide min. 0,05 MPa (0,5 bar) at a nozzle K10, installed at the alarm port continuously for all flow conditions at pressures above the minimum service pressure.

4.15 Drains

4.15.1 The valve set shall be provided with a tapped opening to manually drain water from the valve set when the valve set is installed in any position specified or recommended by the manufacturer. The minimum opening size shall be 20 mm nominal.

4.15.2 It shall be possible to use the manual drain openings on the valves for draining the system pipework when sized in conformance with applicable system installation standards.

4.15.3 Automatic drains shall be provided to drain the piping between the valve, or any alarm shut-off valve, and the water motor alarm or water motor transmitter.

4.15.4 An intermediate chamber of a valve set shall be provided with an automatic drain.

4.15.5 Flow or velocity-type drain valves shall close (i.e. substantially restrict flow) when tested in accordance with 6.11. Such valves shall remain closed during drainage of the system until pressure effective at the sealing mechanism becomes less than 0,03 MPa (0,3 bar) and shall open at a pressure between 0,003 5 MPa (0,035 bar) and 0,03 MPa (0,3 bar).

4.15.6 The flow through an open end or automatic drain valve shall not exceed 0,63 l/s at any service pressure up to the rated working pressure.

4.16 Alarms

4.16.1 A valve shall actuate its associated mechanical and electrical alarm devices at flow velocities through the valve up to 5 m/s or its rated flow, whichever is greater, based on nominal pipe size, at inlet supply pressures equal to its minimum service pressure or 0,14 MPa (1,4 bar), whichever is higher, to the rated working pressure when tested for operation in accordance with 6.10.

4.16.2 The valve shall provide at least a pressure of 0,05 MPa (0,5 bar) at its alarm port at its minimum service pressure or 0,14 MPa (1,4 bar), whichever is greater, while actuating relevant alarm devices, when tested in accordance with 6.10.

4.17 Valve impairment

4.17.1 While the valve is in the ready condition, it shall not be possible to interfere with the valve operating mechanism by external tampering.

4.17.2 A valve capable of being pressurized without its cover plate in place shall have some means of signalling a “cover off” condition.

5 Production testing and quality control

5.1 It shall be the responsibility of the manufacturer to implement and maintain a quality control program to ensure that production continuously meets the requirements of this document in the same manner as the originally tested samples.

5.2 Every manufactured pre-action alarm valve set shall pass a hydrostatic body test for a period not less than 1 min at twice the rated working pressure without leakage.

5.3 Following the hydrostatic body test in 5.2, every manufactured valve shall pass an operation test for correct functioning, including latching of the clapper upon tripping, if appropriate, and flow from the alarm port.

5.4 Every manufactured pre-action alarm valve set shall withstand, without leakage at the valve seat, an internal hydrostatic pressure of twice the rated working pressure applied upstream of the clapper.

6 Tests

6.1 Samples

A representative sample of each size of valve shall be subjected to the following tests.

6.2 Spring and diaphragm test

Subject the spring or diaphragm in the normal mounting to 5 000 cycles of normal operation in air or water. The components shall not be operated at a rate exceeding 6 cycles per minute.

For sealing assembly springs, the sealing assembly shall be rotated off the seat to a 45° angle and slowly return to the closed position. For internal bypass springs, the bypass shall be operated from the fully open position to the closed position. Diaphragms shall be flexed from the normally open to the normally closed position.

6.3 Sealing element tests

6.3.1 Release test

Prior to conducting this test, the minimum opening pressure of the valve needs to be determined.

With the valve in a normal working position and the sealing assembly in the closed position, a hydrostatic pressure of 0,35 MPa (3,5 bar) shall be applied to the outlet end of the valve for a period of 90 days. During this period, the water temperature shall be maintained at 87 °C ± 2 °C by an immersion heater or other suitable heating device. Provisions shall be made to maintain the water in the inlet end of the valve at atmospheric pressure.

Upon completion of this period of exposure, the water shall be drained from the valve and the valve shall be allowed to cool to ambient temperature for at least 24 h. With the outlet end of the valve at atmospheric pressure, a hydrostatic pressure of 0,035 MPa (0,35 bar) above the minimum opening pressure shall be gradually applied to the inlet end of the valve. The sealing assembly shall move off the seat and that the seal shall not adhere to the mating surface.

Where the same design of a seal is used for more than one size of valve, only a sample of the size with the highest stress on this seating surface shall be tested.

6.4 Warm-water ageing test for non-metallic components (excluding gaskets, seals and other elastomeric components)

Four untested samples of each component shall be immersed in tap water at 87 °C ± 2 °C for 180 days.

If a material cannot withstand the temperature indicated without excessive softening, distortion, or deterioration, a water ageing test shall be conducted at a lower temperature, but not less than 70 °C, for a longer period of time. The duration of exposure shall be calculated from Formula (1):

$$t = 74\,857\ e^{-0,069\,3\ T} \quad (1)$$

where

t is the exposure duration, expressed in days;

e is the base of natural logarithms (= 2,718 3);

T is the test temperature, expressed in degrees Celsius.

NOTE This formula is based on the 10 °C rule, i.e. for every 10 °C rise, the rate of a chemical reaction is approximately doubled. When applied to plastic ageing, it is assumed that the life at a temperature, t, in °C is half the life at (t − 10) °C.

The samples shall be removed from the water and allowed to cool to room temperature for examination for a minimum of 24 h. The components shall be examined for cracking, warping, creep, or other signs of deterioration which would preclude the proper operation of the device. The parts are then to be assembled into valves and comply with the requirements of 4.8.1 and 4.14 when tested in accordance with 6.7 and 6.10.

6.5 Air ageing test for non-metallic components (excluding gaskets, seals and other elastomeric components)

Four untested samples of each component shall be aged in an air oven at 120 °C ± 2 °C for 180 days. The samples shall be tested in contact with the mating materials under stresses comparable to the intended use at rated working pressure. The components shall be supported so that they do not touch each other or the sides of the oven.

If a material cannot withstand the temperature indicated without excessive softening, distortion or deterioration, an air ageing test shall be conducted at a lower temperature, but not less than 70 °C, for a longer period of time. The duration of exposure shall be calculated from Formula (2):

$$t = 737\,000\ e^{-0,069\,3\ T} \quad (2)$$

where

t is the duration, expressed in days;

e is the base of natural logarithms (= 2,718 3);

T is the test temperature, expressed in degrees Celsius.

NOTE This formula is based on the 10 °C rule, i.e. for every 10 °C rise, the rate of a chemical reaction is approximately doubled. When applied to plastic ageing, it is assumed that the life at a temperature, t, in °C, is half the life at (t − 10) °C.

The samples shall be removed from the oven and shall be allowed to cool to room temperature for at least 24 h. All post-exposure tests shall be conducted within 72 h. The components shall be examined for cracking, warping, creep, or other signs of deterioration which would preclude the proper operation

of the device. The parts are then to be assembled into valves and comply with the requirements of 4.8.1 and 4.14 when tested in accordance with 6.7 and 6.10.

6.6 Hydraulic friction loss test

Install the valve set in a test apparatus using piping of the same nominal diameter. Use a differential pressure-measuring device accurate to ±2 % of value.

Measure and record the differential pressure across the valve set at a range of flows above and below the flows shown in Table 1. Replace the valve in the test apparatus by a section of pipe of the same nominal size and measure the differential pressure over the same range of flows. Using graphical methods, determine the pressure drops at the flows shown in Table 1. Record the hydraulic friction loss as the difference between the pressure drop across the valve and the pressure drop across the replacement pipe.

6.7 Valve leakage and deformation test

6.7.1 Body leakage test

Install the valve set in a pressure test apparatus with the sealing assembly in the open position. Seal all openings in the valve body. Apply hydrostatic pressure of twice the rated working pressure for a period of 5 min and inspect the valve during this time for signs of leakage. The valve shall conform to the requirements of 4.8.2.

6.7.2 Sealing assembly test (below to above sealing assembly)

With the sealing assembly in the closed position, prime the valve set when required by the manufacturer instructions. Apply air pressure at a rate not exceeding 0,14 MPa/min (1,4 bar/min) up to a pressure of 0,07 MPa (0,7 bar) above the trip point for the valve at its rated working pressure. Apply a hydrostatic pressure equal to the rated working pressure upstream of the sealing assembly and maintain this pressure for 2 h. During the application of hydrostatic pressure there shall not be leakage.

a) across the sealing assembly;

b) into the intermediate chamber (differential type);

c) into the alarm port (mechanical type).

The valve shall conform to the requirements of 4.8.2.

6.7.3 Sealing assembly test (mechanical type valves)

Fill the upstream end of the valve with water while keeping the sealing assembly closed by the application of pressure on the appropriate devices and parts. Isolate these, if necessary, from the downstream end of the valve and keep this end vented.

Increase hydrostatic pressure to the upstream end from zero to twice rated working pressure at a rate not exceeding 0,14 MPa/min (1,4 bar/min). Maintain this pressure for 2 h. Examine for leakage, deformation and structural failure. The valve shall conform to the requirements of 4.8.3.

6.7.4 Leakage test for mechanical type valves (above to below sealing assembly)

With the sealing assembly in the closed position, fill the valve body downstream of the sealing assembly with water. Apply hydrostatic pressure downstream of the sealing assembly at a rate not exceeding 0,14 MPa/min (1,4 bar/min) up to a pressure of twice the rated working pressure. The upstream end shall be vented. Maintain the hydrostatic pressure for 5 min. The valve shall conform to the requirements of 4.8.4.

6.7.5 Leakage test for differential type valves (above to below sealing assembly)

With the sealing assembly in the closed position, fill the valve set downstream of the sealing assembly with water. Apply hydrostatic pressure downstream of the sealing assembly at a rate not exceeding 0,14 MPa/min (1,4 bar/min) up to a pressure of twice the rated working pressure. The upstream end shall be vented. Maintain the hydrostatic pressure for 5 min. The valve set shall conform to the requirements of 4.8.5.

6.8 Body strength test

For the purpose of this test, production bolts, gaskets and seals may be replaced by components capable of withstanding the test pressure. The valve inlet and outlet connections and all other openings shall be suitably sealed.

There shall be a connection for hydrostatically pressurizing the assembled sample valve set at the inlet connection and a means of venting air and pressurizing fluid at the outlet connection. With the sealing assembly blocked open, the sample valve assembly shall be internally hydrostatically pressurized at four times the rated working pressure, but not less than 4,8 MPa (48 bar), for a period of 5 min. The valve shall conform to the requirements of 4.5.1.

6.9 Operational test

6.9.1 General

Subject the valve set to a series of operational tests at water service pressures of 0,14 MPa (1,4 bar) and from 0,2 MPa (2 bar) to the rated working pressure in increments of 0,1 MPa (1 bar), using the test installation shown in Figure 4.

6.9.2 Pre-action valve operation test — Set-up

Prior to the tests described in 6.9.3 below, the pre-action valve should be installed and placed in the operational position according to the manufacturer's instructions.

6.9.3 Pre-action valve operation test

Each of the systems types shall be evaluated for each of the conditions outlined in the first column in Table 2.

The test conditions shall be conducted at the maximum working pressure as specified by the manufacturer and at the minimum operating pressure or 0,14 MPa (1,4 bar) whichever is the lower. System air pressure shall be at the lowest recommended level for each water pressure according to the manufacturer's instructions.

Table 2 — Operational

Test condition	Type A Non-interlocked	Type B1 Single interlocked with failsafe	Type B2 Single interlocked without failsafe	Type C1 Double interlocked with failsafe	Type C2 Double interlocked without failsafe
a) System air pressure is reduced to atmospheric pressure at a rate not exceeding 0,1 MPa/min	Valve shall operate	Valve shall not operate	Valve shall not operate	Valve shall not operate	Valve shall not operate
b) Release system is activated in accordance with the manufacturer's instructions	Valve shall operate	Valve shall operate	Valve shall operate	Valve shall not operate	Valve shall not operate
Release system non-operational AND condition a)	Test not applicable	Valve shall operate	Valve shall not operate	Valve shall operate	Valve shall not operate
Conditions a) AND b) together	Test not applicable	Test not applicable	Test not applicable	Valve shall operate	Valve shall operate

6.9.4 Pre-action dry alarm valve set installation

Before each test, clean sealing assembly seats, seat rings and all other operating parts. Seat the main sealing assembly member properly and when applicable place the lever mechanism in the set position in accordance with the manufacturer's instructions. Bolt the cover plate in place. Establish the priming water level (if required). Then fully open the main water supply valve, check for leakage into the alarm port.

6.9.4.1 Activated by a detection system

Install the valve set in its normal installation condition in the test apparatus generally depicted by Figure 4. Under normal pre-action operating conditions, activated by a detection system. Test twice at each of the pressures listed in 6.9.1.

During this test, the following data shall be recorded:

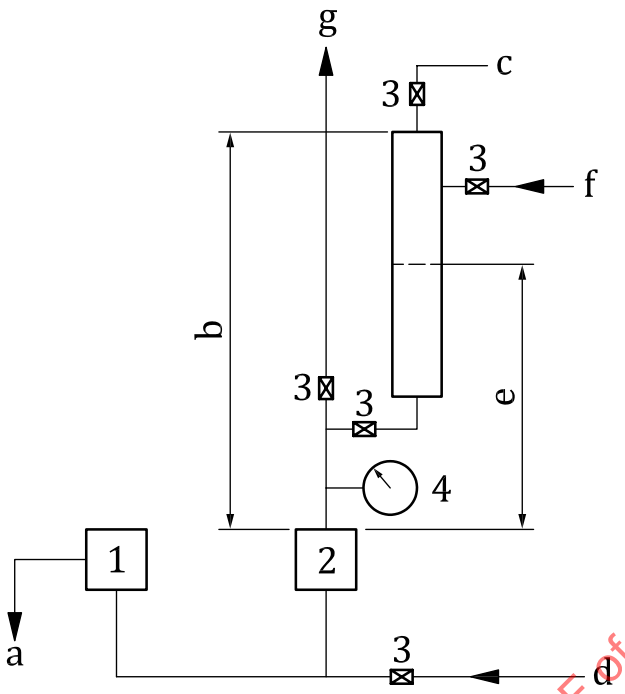
a) pressure at the upstream side;

b) pressure at the downstream side;

c) solenoid current;

d) alarm line pressure.

Examine the valve for correct operation in accordance with 4.14.



Key

1 150 mm quick-opening valve
2 pre-action dry alarm valve under test
3 shut-off valve
4 pressure gauge
a To atmosphere.
b Supply of 7,5 m^3 capacity.
c Air.
d Water (typical).
e Water capacity.
f Water (typical) reservoir.
g To installation of at least 1,0 m^3 capacity.

NOTE Pipe schedule in accordance with text.

Figure 4 — Typical installation for operational and anti-reseating test

Remove all air from piping between quick-opening device and inlet side of dry pipe valve prior to each test.

6.9.4.2 Sprinkler operation only (detection system not activated)

Install the valve according to 6.9.4.1. Do not activate the valve by a detection system, and lower the air pressure in accordance with the curve shown in Figure 3.

Test twice at each of the pressures listed in 6.9.1.

During this test, the following data shall be recorded:

a) pressure at the upstream side;

b) pressure at the downstream side;

c) alarm port pressure (see 4.14.2).

Examine the valve for non-operation in accordance with 4.14.2.

6.9.4.3 Operational test in the dry mode (sprinkler operation with detection fault)

Install the valve according to 6.9.4.1. Simulate a failure in the detection system and trip the valve under dry-valve operating conditions. Simulate a failure by releasing the air pressure in accordance with the curve shown in Figure 3. Test twice at each of the pressures, listed in 6.9.1.

During this test, the following data shall be recorded:

a) pressure at the upstream side;

b) pressure at the downstream side;

c) alarm port pressure.

Examine the valve for correct operation in accordance with 4.14.3.

6.10 Endurance test

Using the test apparatus described in 6.6, adjust the flow rate to the appropriate value given in Table 1. Sustain a water flow through the valve set at this rate for min.

Examine the valve for compliance with the requirements of 4.13.

6.11 Anti-reseating test

6.11.1 Install a valve set in the system piping in its normal installation position. Install a second valve of the quick-opening type of 150 mm nominal size as shown in Figure 4, with a discharge to atmosphere through 150 mm diameter piping. Connect the outlet of the test valve to a reservoir with a volume of at least 1,9 m^3 using piping with diameter not less than the test valve size.

6.11.2 Set the sealing assembly of the test valve in the open position, with the sealing assembly on the lowest latch, and where appropriate refit the cover plate. Fill the system and test valve, exclusive of the 1,9 m^3 reservoir volume, fully with water. Fill the reservoir with air and water in accordance with one set of the values shown in Table 3. Close the supply valve and trip the quick-opening valve causing flow past the test valve sealing assembly.

CAUTION — Make sure that the reservoir is fully depressurized before examining the test valve.

6.11.3 Repeat the test at each set of values given in Table 3.

Table 3 — Reservoir conditions

Service pressure MPa (bar)	Water percentage of reservoir volume %
0,7 (7)	45
0,10 (10)	30
0,10(10)	15
0,12 (12)	25

6.11.4 Inspect the sealing assembly to determine that it has not returned to its ready position, nor sustained any distortion, cracks, separation or other signs of failure.