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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6182-8 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

ISO 6182 consists of the following parts, under the general title *Fire protection — Automatic sprinkler systems*:

— Part 1: *Requirements and test methods for sprinklers*

— Part 2: *Requirements and test methods for wet alarm valves, retard chambers and water motor alarms*

— Part 3: *Requirements and test methods for dry pipe valves*

— Part 4: *Requirements and test methods for quick-opening devices*

— Part 5: *Requirements and test methods for deluge valves*

— Part 6: *Requirements and test methods for check valves*

— Part 7: *Requirements and test methods for early suppression fast response (ESFR) sprinklers*

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

— Part 9: *Requirements and test methods for water mist nozzles*

— Part 10: *Requirements and test methods for domestic sprinklers*

— Part 11: *Requirements and test methods for pipe hangers*

— Part 12: *Requirements and test methods for grooved end pipe couplings*

— Part 13: *Requirements and test methods for extended coverage sprinklers*

Introduction

This part of ISO 6182 is one of a number of ISO International Standards prepared by ISO/TC 21 covering components for automatic sprinkler systems, including the following:

a) carbon dioxide systems (ISO 6183),

b) explosion suppression systems (ISO 6184),

An International Standard covering foam systems is planned.

Fire protection — Automatic sprinkler systems —

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

1 Scope

This part of ISO 6182 specifies performance requirements, methods of test and marking requirements for pre-action dry alarm valves and manufacturers' specified relevant trim used in non-interlock pre-action automatic fire protection systems. (See 3.24 for the principle modes of operation of pre-action dry alarm valves.)

Performance and test requirements for other auxiliary components or attachments to pre-action dry valves are not covered by this part of ISO 6182.

2 Normative references

The following referenced documents are indispensable for the application 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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Designation, dimensions and tolerances*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 898–1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs*

ISO 898–2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

3 Terms and definitions

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

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 automatically drains water from and 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
auxiliary pressure
pressure acting against an auxiliary diaphragm or piston, taken from either the service pressure or an external source

3.5
clapper
type of sealing element

NOTE See 3.20.

3.6
corrosion-resistant material
bronze, brass, Monel[1)] metal, austenitic stainless steel, or equivalent, or plastic material conforming with the requirements of this document

3.7
differential
ratio of service pressure to system air pressure (expressed as gauge pressures) at the trip point

NOTE See 3.24.

3.8
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 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.

3.9
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

3.10
intermediate chamber
that 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

3.11
leak point
system air pressure for a specific service pressure at which water begins to flow from the intermediate chamber, automatic drain valve or alarm connection

3.12
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

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1) Monel is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 6182 and does not constitute an endorsement by ISO of this product.

3.13
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

3.14
pre-action system
automatic fire protection system using a valve which is operated by an auxiliary means to admit water into a system of automatic sprinklers or nozzles, as shown in Figure 1

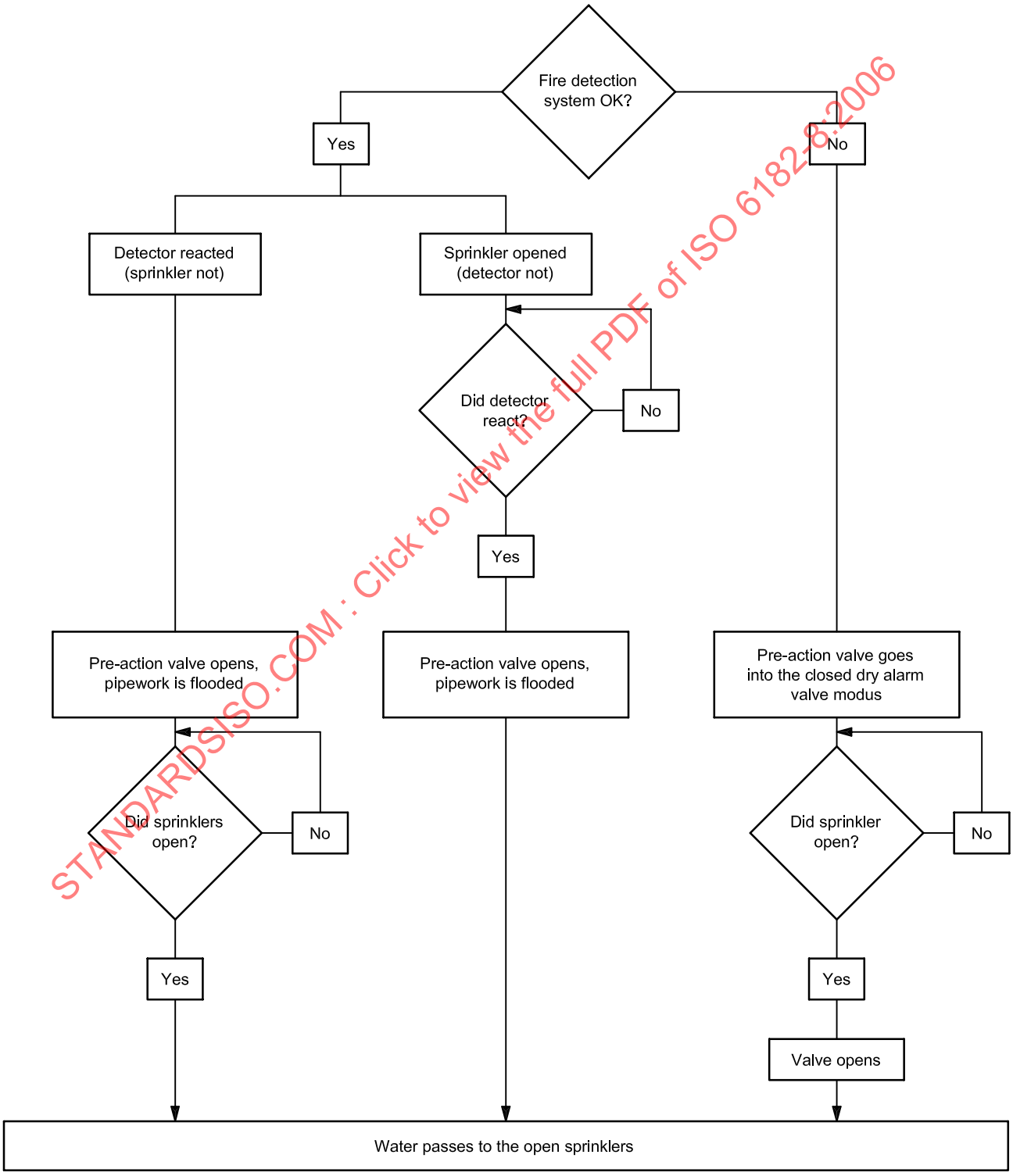


Figure 1 — Operational flow chart for pre-action system

3.15
pre-action dry alarm valve
valve of the check type in which air pressure in the sprinkler system prevents water from filling the system

NOTE Fire detection of auxiliary means causes automatic operation of the pre-action dry alarm valve. If there is any failure of the auxiliary means, the pre-action dry alarm valve shall operate as a dry valve (see ISO 6182-3).

3.16
priming water
water used to seal a sealing assembly and prevent cementation of working parts

3.17
rated working pressure
maximum service pressure at which a valve is intended to operate

3.18
ready condition
set condition
state of a valve with the sealing assembly in the closed and set position with service and system pressure applied

3.19
reinforced elastomeric element
element of clapper, clapper assembly or seat seals in a composite of an elastomeric compound with one or more other components

3.20
sealing assembly
main movable sealing element (such as a clapper) of the valve which prevents the reverse flow of air and which maintains air pressure in the system piping

3.21
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

3.22
service pressure
static water pressure at the inlet to a valve when the valve is in the ready condition

3.23
system pressure
pressure at the main outlet of a valve when the valve is in the ready condition

3.24
system air pressure
static air pressure in the system piping when the valve is in the ready condition

3.25
trim
external equipment and pipework, excluding the main installation pipework, fitted to valve installation assembly

3.26
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

3.27
water-motor alarm
hydraulically actuated device which provides a local audible alarm as a result of a flow through a valve

3.28
water-motor transmitter
hydraulically actuated device which generates an electrical current for a remote alarm as a result of operation of the valve

4 Requirements

4.1 Nominal sizes

The nominal size of a valve 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, or 250 mm. The diameter of the waterway through the sealing assembly seat ring 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 valve.

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

4.2.3 An opening not smaller than 15 mm nominal diameter 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, an external means shall be provided to introduce 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 Valves shall be provided with a means of sounding an alarm if water enters the downstream piping to an elevation exceeding 0,5 m above the sealing assembly unless the valve is provided with an automatic means for drainage.

4.2.8 For differential-type valves, 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 If non-metallic materials, other than gaskets, and seals or metals with a melting point less than 800 °C form part of the body or cover, the valve assembly shall be subjected to a fire exposure test as specified in 6.9. Following the fire exposure test, the sealing assembly shall open freely and fully and the valve shall withstand a hydrostatic pressure test as specified in 6.7.1 without permanent deformation or failure.

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 valve, 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 6.7.1.

4.5.2 If the test in accordance with 6.9 is not done with standard production fasteners, the supplier shall provide documentation showing that the calculated design load of any fastener, neglecting the force required to compress the gasket, shall 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 with a minimum of down time.

4.7 Components

4.7.1 Any component that is normally disassembled during servicing shall be designed so that it can not 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 Sealing surfaces of sealing assemblies shall have corrosion resistance equivalent to bronze 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 point of contact shall be located so that impact or the reaction of the water flow does 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 service pressure range of 0,14 MPa to 1,2 MPa (1,4 bar to 12 bar) 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. It shall not be possible to return the valve to the ready (set) condition before draining the pipework.

4.7.11 A valve having a differential ratio of 1,16-to-1 or less over a service pressure range of 0,14 MPa to 1,2 MPa (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 or external 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 valves 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 6.10.2.2 at a service pressure of 0,2 MPa (2 bar).

4.8.4 Valves fitted with a latch 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 and the upstream end vented in accordance with 6.7.4. Following this test, the valve shall operate in accordance with 4.14 when tested once in accordance with 6.10.2.2 at a service pressure of 0,2 MPa (2 bar).

4.8.5 Valves not fitted with a latch 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 and the upstream end vented in accordance with 6.7.5. Following this test, the valve shall operate in accordance with 4.14 when tested once in accordance with 6.10.2.2 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 Any non-reinforced elastomer forming the seal shall have the following properties when tested in accordance with 6.3.2 and the appropriate sections of ISO 37:

a) maximum set of 5 mm when 25 mm long marks are stretched to 75 mm, held for 2 min, and measured 2 min after release;

b) either

   1) minimum tensile strength 10 MPa (100 bar) and minimum ultimate elongation 300 % (25 mm to 100 mm); or

   2) minimum tensile strength 15 MPa (150 bar) and minimum ultimate elongation 200 % (25 mm to 75 mm);

c) after exposure to oxygen for 96 h at (70 $\pm$ 1,5) °C and 2,0 MPa (20 bar), the tensile strength and ultimate elongation shall not be less than 70 % of the corresponding properties of specimens which have not been heated in oxygen, and any change in hardness shall not be greater than 5 type-A durometer units;

d) after immersion in distilled water for 70 h at (97,5 $\pm$ 2,5) °C, the tensile strength and ultimate elongation shall not be less than 70 % of the corresponding properties of specimens which have not been heated in water and the change in volume of the specimens shall be not greater than 20 %.

4.10.3 A reinforced elastomeric sealing element shall be capable of being flexed without cracking or breaking and shall have a change in volumetric expansion not greater than 20 % when tested in accordance with 6.3.3.

4.10.4 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.

4.10.5 For a composite of an elastomeric compound with one ore more other components, the tensile strength of the combination shall be at least twice that of the elastomeric material alone.

4.11 Clearances

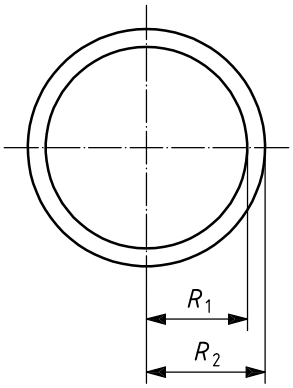
4.11.1 The radial clearance between a hinged sealing assembly and the inside walls in every position except wide open shall not be less than 12 mm for cast iron bodies and shall not be less than 6 mm if the body and sealing assembly are of cast iron or steel with corrosion protective coatings tested in accordance with 6.14, non-ferrous material, stainless steel or materials having equivalent physical, mechanical and corrosion resistant properties. See Figure 2 a).

4.11.2 There shall be a diametrical clearance of not less than 6 mm between the inner edges of a seat ring and the metal parts of a hinged sealing assembly when the valve is in the closed position. See Figure 2 b).

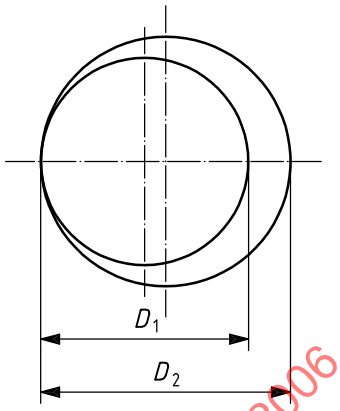
4.11.3 Any space in which the sealing assembly can trap debris beyond the seat shall be not less than 3 mm deep.

4.11.4 The diametrical clearance ($D_2 - D_1$) between hinge pins and their bearings shall be not less than 0,125 mm. See Figure 2 b).

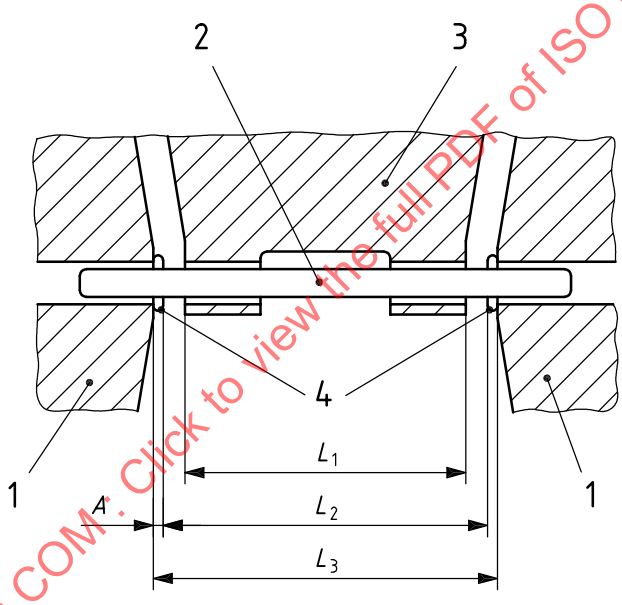
4.11.5 The total axial clearance between the clapper hinge and adjacent valve body bearing ($L_2 - L_1$) surfaces shall be not less than 0,25 mm. See Figure 2 c).



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



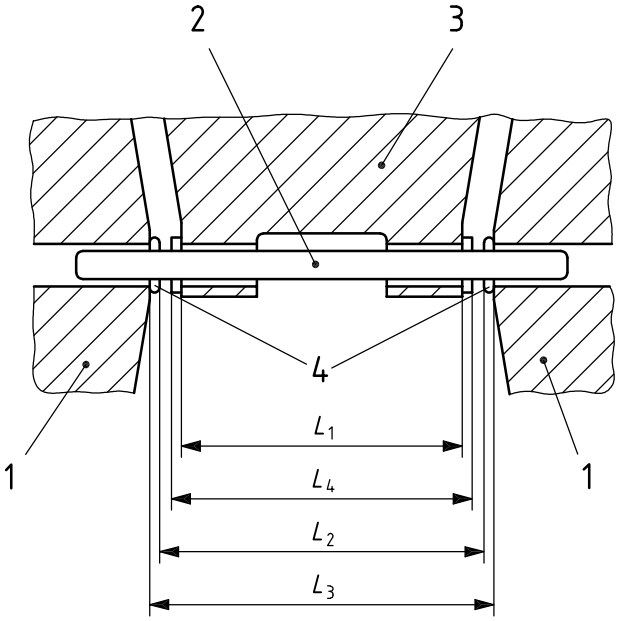
b) Diametrical clearance, $C_D = D_2 - D_1$



c) Total axial clearance, C_{TA}

$C_{TA} = L_2 - L_1$; **Clearance** $A = (L_3 - L_2)/2$

Figure 2 (*continued*)



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 2 — Clearance

4.11.6 Any reciprocating guide components which are essential to allow a valve to open shall have a minimum diametrical clearance of not less than 0,7 mm in that portion over which the moving component enters the fixed component and of not less than 0,05 mm in that portion of the moving component continuously in contact with the fixed component in the ready (set) position.

4.11.7 Sealing assembly guide bushings or hinge-pin bearings shall project a sufficient axial distance to maintain not less than 1,5 mm (Clearance A) clearance between ferrous metal parts. See Figure 2 d). Clearance 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 6.14.

4.12 Hydraulic friction loss

The maximum pressure loss across the valve at the appropriate flow given in Table 1, as tested by the method of 6.6, shall not exceed 0,08 MPa (0,8 bar). If the pressure loss exceeds 0,02 MPa (0,2 bar), the pressure loss shall be marked on the valve. See 7.3 j).

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.

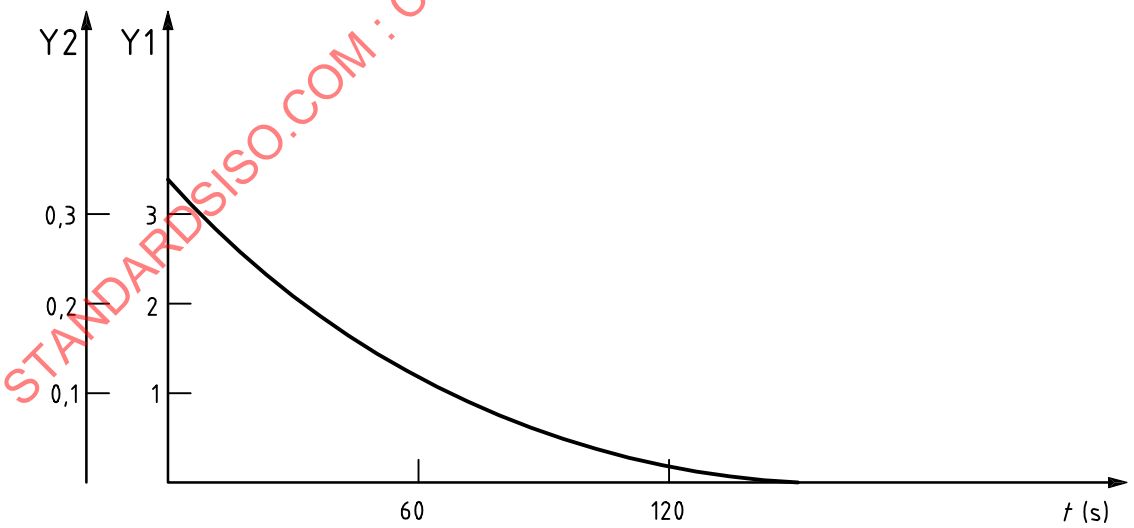
Table 1 — Required flow rates for pressure drop determination

Nominal size mm	Flow rate l/min
40	300
50	470
65	800
80	1 200
100	1 880
125	2 940
150	4 240
200	7 540
250	11 780
300	21 200

4.14 Operational performance

4.14.1 A pre-action dry alarm valve 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 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 dry alarm valve with associated trim shall not operate when the pre-action dry valve is in pre-action mode and the air pressure of the downstream side is lowered in accordance with the pressure drop curve shown in Figure 3, when tested in accordance with 6.7.2 b).



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 shall have a working differential within the range 5:1 to 8,5:1 at 0,14 MPa (1,4 bar) service pressure and within the range of 5:1 to 6,5:1 at all higher service pressures when tested in accordance with 6.10. The dry alarm valve 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 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 6.10. The alarm devices shall sound for more than 50 % of the time for all conditions below 0,2 MPa (2 bar) and continuously for all flow conditions at higher pressures.

4.14.4 A mechanical-type valve shall operate at an air pressure between 0,002 5 MPa (0,25 bar) and one fifth of the rated working pressure for all water pressures from 0,14 MPa (1,4 bar) to the rated working pressure when tested in accordance with 6.7.3. The dry alarm valve with associated trim shall operate and provide and indication of operation by actuating mechanical and/or electrical alarm devices at any service pressure within the range of 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 6.7.3. The alarm devices shall sound for more than 50 % of the time for all flow conditions below one fifth of the rated working pressure and continuously for all flow conditions at higher pressures.

4.15 Drains

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

4.15.2 Drain openings on valves shall be permitted to be used for draining the system pipework when sized in conformance with applicable system installation standards.

4.15.3 Means shall be provided to automatically 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 shall be provided with an automatic drain valve.

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 velocity type 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, based on nominal pipe size, at inlet supply pressures of 0,14 MPa (1,4 bar) 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 a service pressure of 0,14 MPa (1,4 bar) 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 part of ISO 6182 in the same manner as the originally tested samples.

5.2 Every manufactured valve 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 valve 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 50 000 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 full 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

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) 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.

6.3.2 Non-reinforced elastomeric sealing element test

Prepare 16 test specimens in accordance with ISO 37. Four samples shall be used to satisfy each of the following requirements:

a) 4.10.2 a);

b) 4.10.2 b) 1) or b) 2);

c) 4.10.2 c);

d) 4.10.2 d).

6.3.3 Reinforced elastomeric sealing element test

The volume of eight reinforced elastomeric sealing elements shall be measured. Each sample shall be uniquely identified. Four samples shall be exposed to an atmosphere of oxygen in accordance with ISO 188 at a pressure of 2 MPa (20 bar) for 96 h at 70 °C. The remaining four samples shall be submerged in boiling distilled water for 70 h. Following the exposure, the samples shall be allowed to cool to room temperature for at least 24 h. The volume of each shall be measured. Each sample shall then be bent back upon itself by hand three times in the same direction around a rod having a diameter four to five times the material thickness.

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

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 Equation (1):

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

where

t is the exposure duration, expressed in days;

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

T is the test temperature, expressed in degrees Celsius.

NOTE This equation 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 and seals)

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 Equation (2):

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

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

Measure and record the differential pressure across the valve 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 in a pressure test apparatus with the sealing assembly in the open position. Blank off 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 body 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).

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 down stream 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 4.8.2.

6.7.4 **Leakage test for latched 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 maximum manufacturers' specified installation air pressure. Maintain the hydrostatic pressure for 5 min. The valve shall conform to the requirements of 4.8.3.

6.7.5 **Leakage test for unlatched 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. Maintain the hydrostatic pressure for 5 min. The valve shall conform to the requirements of 4.8.4.

6.8 Body strength test

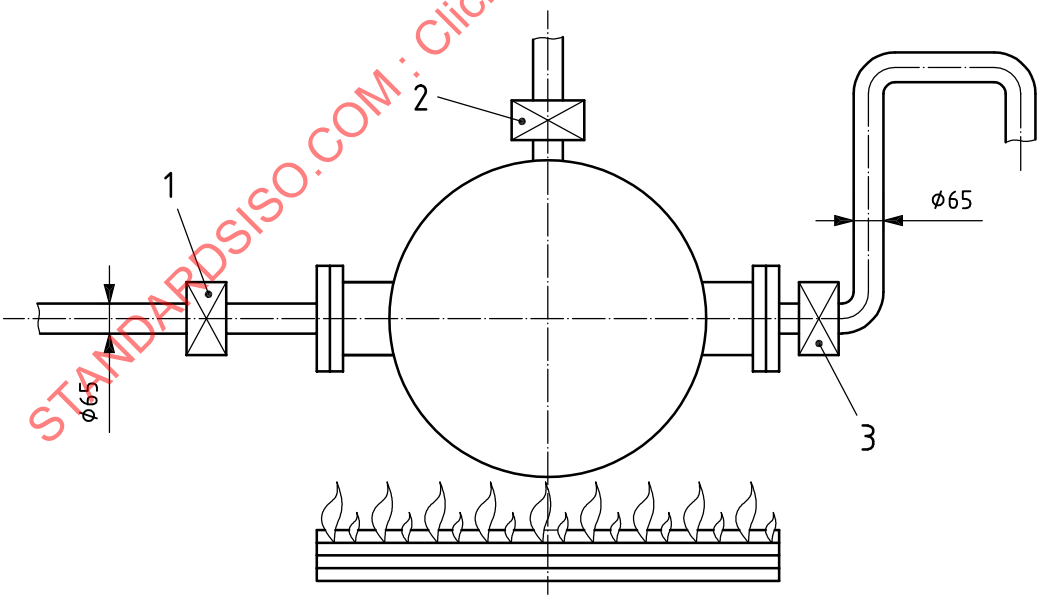
For the purpose of this test, standard production bolts, gaskets and seals may be replaced by components capable of withstanding the test pressure. The valve inlet and outlet connections and all other openings shall be suitably blanked off or plugged.

There shall be a connection for hydrostatically pressurizing the assembled sample valve 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 Fire exposure test

Mount the valve horizontally with body openings sealed as shown in Figure 4. Open shut-off valves A and B. Fill the pipework and valve with water. Open the test valve to vent all air.

Dimensions in millimetres



Key

1 shut-off valve A
2 test valve
3 shut-off valve B

Figure 4 — Fire test installation

Close valve A and valve B.

Position a fire tray, having a surface area not less than 1 m^2, centrally beneath the sample valve. Place a sufficient volume of a suitable fuel in the tray to give an average air temperature between 800 °C and 900 °C around the valve for a period of 15 min after a temperature of 800 °C is reached.

Measure the temperature with a thermocouple positioned 10 mm from the surface of the sample valve on a horizontal plane parallel to the axis at the mid-point between the mounting connections.

CAUTION — Ensure the test valve remains open to atmosphere while testing to permit venting of any pressure build-up.

Ignite the fuel and, 15 min after 800 °C is attained, remove the fire tray or extinguish the fire. Starting within 1 min of extinguishment, or removal of the tray, cool the sample valve by flowing 100 l/min of water through the pipework for 1 min. Test the sample valve with an internal hydrostatic pressure by the method of 6.7.1. Gaskets and seals may be replaced for this hydrostatic test. The valve shall conform to the requirements of 4.4.2.

6.10 Operational test

6.10.1 General

Subject the valve 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 5.

6.10.2 Pre-action dry alarm valve installation

Before each test, clean sealing assembly seats and 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 manufacturers 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.

6.10.2.1 Activated by a detection system

Install the valve in its normal installation condition in the test apparatus generally depicted by Figure 5. Under normal pre-action operating conditions, activated by a detection system. Test twice at each of the pressures listed in 6.10.1.

During this test the following data shall be recorded:

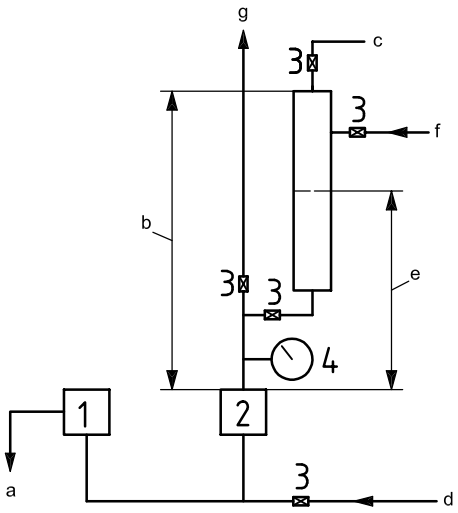
a) pressure at the upstream side;

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

NOTE 2 Pipe schedule in accordance with text.

Figure 5 — Installation for operational and anti-reseating test

6.10.2.2 Sprinkler operation only (detection system not activated)

Install the valve according to 6.10.2.1. 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 6.10.1.

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.