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Fire protection — Automatic sprinkler systems —

Part 5:

Requirements and test methods for deluge valves

Protection contre l'incendie — Systèmes d'extinction automatiques de type sprinkler —

Partie 5: Prescriptions et méthodes d'essai des postes déluges

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Contents

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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.

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.

International Standard ISO 6182-5 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed fire extinguishing systems*.

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*

Annex A of this part of ISO 6182 is for information only.

Introduction

ISO 6182 comprises several parts prepared by ISO/TC 21 covering components for automatic sprinkler systems.

ISO 6182 is included in a series of International Standards planned to cover:

— carbon dioxide systems (ISO 6183);

— explosion protection systems (ISO 6184);

— foam systems (ISO 7076).

Fire protection — Automatic sprinkler systems —

Part 5:
Requirements and test methods for deluge valves

1 Scope

This part of ISO 6182 specifies performance and test requirements for deluge valves employed in deluge and pre-action fire protection systems including specified trim.

Deluge valves covered by these requirements may be operated by hydraulic, pneumatic, electric, mechanical, manual, or thermal means or combinations thereof.

Performance and test requirements for other auxiliary components, such as alarm devices, are not covered by this part of ISO 6182.

This part of ISO 6182 does not cover thermally operated valves released by heat acting directly on the valve. This type of valve utilizes a thermal device, such as the link and lever arrangement or glass bulb of a sprinkler, to hold the valve closed. Operation of the thermal device allows the valve to open.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6182. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6182 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties.*

ISO 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 898-1:1988, *Mechanical properties of fasteners — Part 1: Bolts, screws and studs.*

ISO 898-2:1992, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread.*

3 Definitions

For the purposes of this part of ISO 6182, the following definitions apply.

3.1 alarm device: Mechanical or electrical device to sound an alarm upon operation of the deluge valve.

3.2 anti-reseat latch: Mechanism that prevents the sealing assembly from returning to its set position after operation.

3.3 automatic drain valve: Normally open device that automatically drains water from and vents the intermediate chamber of a deluge 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: A type of sealing assembly (see 3.16).

3.5 corrosion resistant material: Metallic material of bronze, brass, Monel metal, austenitic stainless steel, or equivalent, or plastics material conforming with the requirements of 4.10.

3.6 deluge system: Automatic fire protection system using a deluge valve which is operated by an auxiliary means to admit water into a system of non-automatic (open) sprinklers or nozzles.

3.7 deluge valve: Automatic water-supply control valve intended to be operated by an auxiliary means to admit water into a system of open piping for a deluge system, or a system of closed piping for a pre-action system. The auxiliary means of operating a deluge valve may be mechanical, electrical, hydraulic, pneumatic, thermal, manual, or a combination of these.

3.7.1 hydraulically operated deluge valve: Valve which is maintained in the set position by service hydraulic pressure acting against a diaphragm or piston which holds the sealing assembly closed. A change in pressure against the diaphragm or piston allows the valve to open. The pressure is changed by operation of a manual control, an electrical device such as a solenoid valve, or a hydraulically, thermally, or pneumatically operated device.

3.7.1.1 pressure-loss operated deluge valve: A type of hydraulically operated deluge valve in which the valve is released from the set position by reducing the pressure acting against an auxiliary diaphragm or piston.

3.7.1.2 supply-pressure operated deluge valve: Deluge valve which is maintained in the set position by a spring or other means and is hydraulically operated by the application of supply pressure to an auxiliary diaphragm or piston.

3.7.2 mechanically operated deluge valve: Valve which is maintained in the set position by a mechanical means. It is released mechanically, for example by the action of a release weight.

3.8 dry pilot actuator: Differential type valve which, upon loss of pneumatic pressure from a dry pilot line, permits the operation of a hydraulically operated deluge valve.

3.9 dry pilot line: Pneumatic detection and actuation piping system fitted with heat responsive devices, usually sprinklers, which, when subjected to an abnormal source of heat, operate to release pressure from the piping system and dry pilot actuator, causing the automatic operation of a deluge valve.

3.10 flow velocity: The rate of water flow through a deluge valve expressed as the equivalent water velocity through a pipe of the same nominal size as the deluge valve.

3.11 pre-action systems: Automatic fire protection system using a deluge valve which is operated by an auxiliary means to admit water into a system of automatic sprinklers or nozzles.

3.12 priming water: Water used to seal a sealing assembly in a pre-action system or to reduce the water delivery time in a deluge system.

3.13 rated working pressure: Maximum service pressure at which a deluge valve is intended to operate.

3.14 ready (set) condition: State of a deluge valve with the sealing assembly in the closed or set position with service pressure applied.

3.15 reinforced elastomeric element: A composite of an elastomeric compound with one or more components that increase the tensile strength of the combination to at least twice that of the elastomeric material alone.

3.16 sealing assembly: Main movable sealing element (such as a clapper) of the deluge valve.

3.17 service pressure: Static water pressure at the inlet to a deluge valve when the valve is in the ready condition.

3.18 system air pressure: Static air pressure in the system piping downstream of the sealing assembly of the deluge valve in the ready condition.

3.19 trim: External equipment and pipework, excluding the main installation pipework, fitted to a deluge valve installation assembly.

3.20 trip point: Point at which a deluge valve operates, admitting water into the system piping, usually measured in terms of the system, service, or auxiliary pressure at which the valve operates.

3.21 water motor alarm: Hydraulically actuated device which provides a local, audible alarm as a result of water flow through a deluge valve.

3.22 water motor transmitter: Hydraulically actuated device which generates an electrical current for a remote alarm as a result of operation of the deluge valve.

3.23 wet pilot line: Hydraulic detection and actuation piping system fitted with heat responsive devices, usually automatic sprinklers, which, when subjected to an abnormal source of heat, operate to release pressure from the piping system causing the automatic operation of a hydraulically operated deluge valve.

4 Deluge valve requirements

4.1 Nominal sizes

The nominal size of a deluge valve shall be the nominal diameter of the inlet and outlet connections,

i.e. the pipe size for which the connections are intended. Sizes shall be 40 mm, 50 mm, 65 mm, 80 mm, 100 mm, 125 mm, 150 mm, 200 mm or 250 mm.

NOTE 1 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 suitable for use at the rated working pressure of the deluge valve.

NOTE 2 The dimension of all connections should conform to International Standards, where these exist. National standards may be used where International Standards are not appropriate.

4.2.2 If priming water is required to seal the downstream side of the sealing assembly, external means shall be provided to introduce priming water.

4.2.3 Deluge valves, which require priming water, shall be provided with a means of preventing water columning and of facilitating the checking of water level.

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

4.2.5 Means shall be provided to automatically drain the pipe between the alarm shut-off valve and the alarm device.

4.2.6 Deluge valves used in non-primed systems shall be provided with a means of sounding an alarm, if water enters the downstream piping to an elevation of greater than 0,5 m above the sealing assembly, unless the valve is provided with automatic drainage.

4.3 Rated working pressures

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

Inlet and outlet connections may be machined for lower working pressure to match installation equipment of a lower working pressure, in which case the valve shall be marked with the lower working pressure [see 7.2 f)].

4.4 Bodies and covers

4.4.1 If non-metallic materials (other than gaskets and seals) or metals with a melting point of less than 800 °C (other than gaskets and seals) form part of the deluge valve body or cover, the assembled valve shall be subjected to the fire exposure test of 6.8. After the fire test, the sealing assembly shall open freely and the valve body shall withstand a hydrostatic pressure test without leakage, permanent deformation or rupture.

4.4.2 Provisions shall be made, on the upstream side of the valve sealing assembly, for testing alarm devices without tripping the valve.

4.4.3 The body and cover shall be made of a material with corrosion resistance at least equivalent to that of cast iron. For extreme corrosion conditions, other materials can be necessary.

4.4.4 It shall not be possible to assemble the deluge valve with the cover plate (if fitted) in a position which either improperly indicates flow direction or so affects the operation of the deluge valve that it does not meet the requirements of this part of ISO 6182 [see 7.2 d) and 7.2 h)].

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

4.5 Strength

4.5.1 The assembled deluge valve, with the sealing assembly open, shall withstand, without rupture, an internal hydrostatic pressure of four times the rated working pressure, for a period of 5 min when tested in accordance with 6.5.

4.5.2 The calculated 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 deluge 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 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 is that extending out to the centreline of the "O"-ring or gasket.

4.6 Drain

The deluge 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.

NOTE 3 If the drain opening on the valve is to be used for draining pipework, then the size of the opening should comply with any national standards which may be applicable (see 4.2.1).

4.7 Access for maintenance

Means shall be provided to permit access to working parts and to allow removal of the sealing assembly.

NOTE 4 Any method adopted should permit ready maintenance by one person with a minimum of down-time.

4.8 Components

4.8.1 Where practicable, the design of any component which may normally be disassembled during servicing shall be such that it cannot be reassembled wrongly, without providing an external visual indication when the deluge valve is returned to service.

With the exception of the valve seat, all parts intended for field replacement shall be capable of being disassembled with tools normally employed by the trade.

4.8.2 All components shall be non-detachable on operation of the valve.

4.8.3 Springs and diaphragms shall not fracture or rupture when tested in accordance with 6.1.2.

4.8.4 Sealing assembly guide bushings or hinge-pin bearings, which are resistant to corrosion, shall be provided between ferrous metal components.

4.8.5 Reciprocating guide components and their bearings shall be made of corrosion-resistant materials.

4.8.6 The valve and its moving parts shall not sustain any distortion, cracks, separation, or other signs of failure when tested in accordance with 6.6 and 6.7.

4.8.7 Anti-reseat latches or other means shall be provided to permit draining of the pipework after the deluge valve is tripped, as demonstrated in 6.7. This may include a pipework drain opening downstream of the sealing assembly, an upstream drain opening in combination with latches, which hold the sealing assembly off its seat, or other means.

4.8.8 Means shall be provided to prevent the deluge valve from automatically returning to the ready (set) condition (see 3.14) after being tripped, as demonstrated in 6.6 and 6.7. Manual or external means shall be provided to return the valve to the ready (set) condition.

4.8.9 Seat rings not made of bronze shall have corrosion resistance at least equivalent to that of bronze. In addition, any other part and its bearing, where rotation or sliding motion is required, shall be made of a corrosion-resistant material, such as bronze, brass, Monel metal, etc. Alternatively, the part and its bearing, if made of materials, lacking corrosion-resistant properties, shall be fitted with bushings, inserts, or other parts made of corrosion-resistant materials, at those points where freedom of movement is required.

4.8.10 Seat surfaces of sealing assemblies shall have a 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.

4.9 Leakage

4.9.1 Deluge valves with production seals and gaskets, assembled in accordance with the manufacturer's standard practice and with the sealing assembly open, shall be capable of withstanding an internal hydrostatic test in accordance with 6.4.1, without leakage, permanent distortion or rupture.

4.9.2 When tested in accordance with 6.4.2, a deluge valve shall not show any sign of leakage, excessive permanent distortion, or structural failure. The valve shall then be tested to verify its function (see 6.6).

4.10 Non-metallic components (excluding gaskets and seals)

4.10.1 After ageing of its non-metallic parts as described in 6.2.1 and 6.2.2, a deluge valve shall meet the requirements of 4.9 and 4.13 when tested in accordance with 6.4 and 6.6.

NOTE 5 Separate samples should be subjected to the tests described in 6.2.1 and 6.2.2.

4.10.2 There shall be no cracking, warping, creep, or other signs of deterioration which may preclude the proper operation of the device.

4.11 Sealing assembly elements

4.11.1 Sealing surfaces shall prevent leakage of water into the alarm port when the deluge valve is tested in accordance with 6.6.

Valve sealing surfaces shall be able to withstand ordinary wear and tear, rough usage, compression stresses and damage due to pipe scale or foreign matter carried by the water.

4.11.2 A seal made of elastomeric or other resilient materials shall not adhere to the mating surface when tested in accordance with 6.2.3.

NOTE 6 Where the same design of seat is used for more than one size of deluge valve, only a sample of the size with the highest stress on the seating surface need be tested.

4.11.3 Any non-reinforced elastomer forming the seal shall have the following properties when tested in accordance with 6.2.3.1. 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; and

b) either:

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

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

and after exposure to oxygen for 96 h at (70 ± 1,5) °C and 20 bar (2,0 MPa):

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 oxygen, and any change in hardness shall not be greater than 5 type A durometer units;

and after immersion in distilled water for 70 h at (97,5 ± 2,5) °C:

d) 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 of volume of the specimens shall not be greater than 20 %.

4.11.4 A reinforced elastomeric sealing element (of clapper, clapper assembly or seat seal) 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 6.2.3.3.

4.12 Clearances

NOTE 7 Clearances are necessary between moving parts and between moving and stationary parts so that corrosion or deposits of foreign matter within an assembly will not render a valve sluggish in action or inoperative.

4.12.1 The radial clearance [see figure 1 a)] between a hinged sailing assembly and the inside walls of cast iron bodies, in every position except the wide-open excluding moving catches and latching mechanisms, shall be not less than 19 mm. If both the body and sealing assembly are of a non-ferrous material, stainless steel, or a combination, such clearance shall be not less than 9 mm. For sealing assembly hinge boss areas, the radial clearance shall be not less than 12 mm for cast iron valves or 6 mm if body and sealing assembly are of non-ferrous material, stainless steel, or a combination.

4.12.2 There shall be a diametrical clearance [see figure 1 b)] 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 deluge valve is in the closed position.

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

4.12.4 The diametrical clearance [see figure 1 b)] between pins and their bearings shall be not less than 0,100 mm.

4.12.5 The total axial clearance, $l_2 - l_1$ [see figure 1 c)] between the clapper hinge and the adjacent deluge valve body bearing surfaces shall be not less than 0,25 mm.

4.12.6 Any reciprocating guide components in the main deluge valve body, the operation of which is essential to allow a deluge 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 0,100 mm in that portion of the moving component continuously in contact with the fixed component in the ready position.

4.12.7 Clapper-guide bushings or hinge-pin bearings shall project a sufficient axial distance to maintain not less than 3 mm clearance between ferrous metal parts, see dimension A in figure 1 c).

4.13 Operational performance

4.13.1 A deluge valve shall operate correctly at service pressures within the range of 1,4 bar (0,14 MPa) to the rated working pressure, when tested in accordance with 6.6.

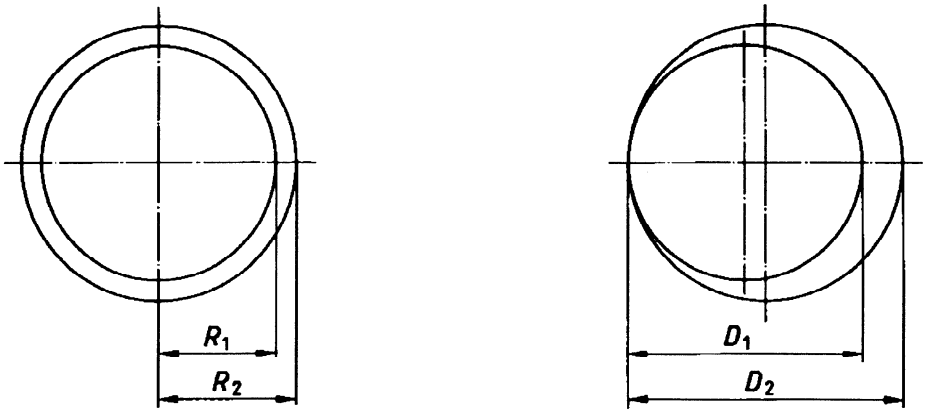
If the deluge valve is in the set position, it shall not open if the supply pressure drops to 0 bar for up to 1 h and then rises again.

4.13.2 A pressure-loss operated deluge valve shall operate when the setting pressure is 0,3 bar (0,03 MPa) or greater, for a water service pressure within the range of 1,4 bar (0,14 MPa) to the rated working pressure.

4.13.3 A supply-pressure operated deluge valve shall operate when the trip pressure is less than or equal to half the service pressure, for a service pressure within the range of 1,4 bar (0,14 MPa) to the rated working pressure.

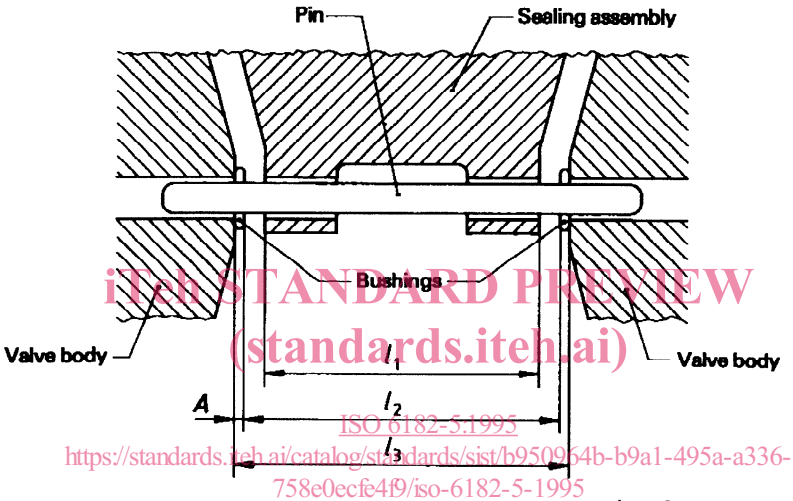
4.13.4 A deluge valve shall be designed to prevent leakage of water from the upstream side of the deluge valve (when set) to the downstream side, or be provided with a positive means of venting any leakage of water from the upstream side of the valve (see note 8).

NOTE 8 Minor leaks in diaphragms, seals, control lines, etc., should not interfere with the opening of the deluge valve. It should be easy to detect seals which are not tight and deficiencies which could hamper or obstruct opening of the valves.



a) Radial clearance = $R_2 - R_1$

b) Diametrical clearance = $D_2 - D_1$



c) Total axial clearance = $l_2 - l_1$; clearance, $A = \frac{l_3 - l_2}{2}$

Figure 1 — Clearances

4.13.5 All deluge valves shall be operable by automatic and manual means.

4.14 Height limitations of wet pilot lines

4.14.1 The operating characteristics of a deluge valve should be determined in relation to the maximum elevation at which a line of wet pilote sprinklers may be placed above the valve. During the testing described in 6.6, data shall be obtained on the valve trip point pressure at each water service pressure.

NOTE 9 If at a given water service pressure, the trip pressure at the valve is exceeded by the pressure resulting from the height of the water column between the deluge valve and the highest wet pilot sprinkler, the deluge valve will not operate when that sprinkler opens.

4.14.2 The maximum height, in metres, of any section of pipe or fitting of a wet pilot line installation, at a specific water service pressure, is equal to the trip point pressure, expressed in meters, of water column divided by 1,5 to obtain a factor of safety. See also 8.2.

4.14.3 Height limitation of pilot lines shall be established for a range of water service pressures from 1,4 bar (0,14 MPa) to the maximum rated working pressure.

4.14.4 The manufacturer shall prepare a method to correctly verify design limitations of wet pilot lines. The design limitations shall include the maximum height limitations of pilot lines determined in 4.14.2, and the maximum pressure drop permitted to the hydraulically most remote sprinkler or manual pull station in the pilot line. This method shall be included as part of the instruction chart provided with each valve (see 8.2).

4.15 Alarms

4.15.1 A deluge 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 1,4 bar (0,14 MPa) to the rated working pressure, when tested for operation in accordance with 6.6

4.15.2 The deluge valve shall provide a pressure of not less than 0,5 bar (0,05 MPa) at its alarm port at a service pressure of 1,4 bar (0,14 MPa) while actuating relevant alarm devices, when tested in accordance with 6.6.

NOTE 10 Requirements for water motor alarms are specified in ISO 6182-2.

4.16 Hydraulic friction loss

The maximum pressure loss across the deluge valve at the appropriate flow given in table 1, when tested in accordance with 6.3, shall not exceed 0,8 bar (0,08 MPa). If the pressure loss exceeds 0,2 bar (0,02 MPa), it shall be marked on the valve [see 7.2 i)] and the instruction chart shall include the pressure loss value (see 8.1).

Table 1 — Required flow rates for determination of pressure drop

Nominal size mm	Flow rate l/min
40	400
50	600
65	800
80	1 300
100	2 200
125	3 500
150	5 000
200	8 700
250	14 000

4.17 Endurance test

NOTE 11 This test may be performed concurrently with the hydraulic friction loss test (see 6.3).

The deluge valve and its moving parts shall show no sign of distortion, cracks, loosening, separation, or other failure when the flow rate specified in table 1 is maintained for 30 min.

4.18 Valve impairment

4.18.1 The design of the valve shall be such that operation cannot readily be prevented by external means.

4.18.2 A valve capable of being pressurized without its cover in place shall have some means of signalling a "cover off" condition.

4.19 Automatic drain valve for alarm lines

4.19.1 Flow or velocity-type drain valves employed for venting alarme lines shall close (i.e. substantially restrict flow) at a pressure of not more than 1,4 bar (0,14 MPa) with a flow rate through the drain valve just prior to closure of between 0,13 l/s and 0,63 l/s.

4.19.2 Such valves shall remain closed (i.e. with a substantially restricted flow) during drainage of the system until the pressure effective at the sealing mechanism (e.g. automatic drain valve) becomes less than 1,4 bar (0,14 MPa) and shall open at a pressure between 0,035 bar (0,003 5 MPa) and 1,4 bar (0,14 MPa).

5 Production testing and quality control

It shall be the responsibility of the manufacturer to implement a quality control programme to ensure that his production continuously meets the requirements of this part of ISO 6182 in the same manner as the originally tested samples.

Every manufactured deluge valve shall pass a hydrostatic body test for a period not less than 1 min at twice the rated working pressure and a test to verify consistency of correct functioning.

6 Test methods

6.1 General

6.1.1 A representative sample of each size of valve shall be subjected to the tests described in 6.2 to 6.8.

6.1.2 A sample of a device employing a spring or diaphragm shall be subjected to 5 000 cycles of normal operation. These tests are to be conducted at a rate not exceeding 6 cycles per minute (see 4.8.3).

6.2 Non-metallic components

See 4.10.

6.2.1 Air-oven ageing for non-metallic components (excluding gaskets and seals)

See 4.10.

6.2.1.1 Test four samples of each component in contact with the mating materials under stresses comparable to those of the intended use at the rated working pressure.

6.2.1.2 The test duration and temperature shall be selected by the manufacturer and shall comply with the following formula: