
**Fire protection — Automatic sprinkler
systems —**

Part 16:

**Requirements and test methods for
fire pump relief valves**

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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 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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*.

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 16:

Requirements and test methods for fire pump relief valves

1 Scope

This document defines performance requirements, methods of testing and marking requirements for fire pump relief valves intended to rapidly relieve the excessive water pressure in the supply piping for standpipe systems or sprinkler systems or both. Performance and test requirements for other auxiliary components or attachments to fire pump relief valves are not covered by this standard.

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

corrosion resistant material

bronze, brass, Monel^{®1)} metal, austenitic stainless steel, or equivalent, or plastic material conforming with the requirements of this document

3.2

main valve

part of the valve assembly that controls the flow of water

3.3

maximum set pressure rating

maximum pressure at which the valve is intended to be set to relieve pressure from a water supply system

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.

3.4

pilot valve

part of the valve assembly that controls the operating of the *main valve* (3.2)

3.5

rated working pressure

maximum service pressure at which a valve is intended to operate

3.6

reseal pressure

pressure at which the relief valve is intended to prevent the flow of water

3.7

set pressure

pressure at which the *main valve* (3.2) is intended to start to allow the flow of water

4 Requirements

4.1 Nominal sizes and tolerances

4.1.1 The nominal size of a fire pump relief 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 20 mm, 32 mm, 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 may be no more than one size smaller than the nominal size.

4.1.2 Unless otherwise noted in a specific clause of this document, tolerances shall be in accordance with [Annex A](#).

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 relevant international standards. If international standards are not applicable, national standards may be used.

For example, ISO 6182-12 contains requirements for grooved-end components. Where there is not an ISO standard developed, a national standard may be used for other connection types (i.e. threaded, flanged, or other suitable connections).

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 Connections may be machined for lower working pressures to match installation equipment provided the valve is marked with the lower working pressure, as per [7.3](#), f).

4.4 Body and cover

4.4.1 The body and cover shall be made of a material with 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 Body strength (see [6.4](#))

An assembled fire pump relief 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 [6.4](#).

If the test is not performed 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.

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 water.

4.7.6 Springs shall not fracture or rupture when tested in accordance with [6.2.1](#).

4.7.7 Diaphragms shall not fracture or rupture when tested in accordance with [6.2.2](#).

4.7.8 There shall be no sign, on visual examination, of damage to the sealing assembly after testing for the operational requirements of [4.12](#) in accordance with [6.8](#).

4.7.9 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.

4.7.10 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.

4.8 Leakage and deformation (see 6.3)

4.8.1 There shall be no leakage, permanent distortion or rupture of a valve body when tested in accordance with 6.3.1.

4.8.2 There shall be no leakage of the sealing assembly when tested in accordance with 6.3.2.

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 their non-metallic parts, as described in 6.5 and 6.6, using separate sets of samples, as applicable. After ageing, a valve shall meet the requirements of 4.8, 4.13 and 4.14 when tested in accordance with the applicable tests described in 6.3, 6.9 and 6.10.

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

4.10 Sealing assembly elements (see 6.7)

A seal made of elastomeric or other resilient materials shall not adhere to the mating surface when tested in accordance with 6.7. Where the same design of seat is used for more than one size of valve, it shall be permitted to only test the size with the highest stress on the seating surface.

4.11 Clearances

The clearance between a valve disc or a part attached thereto and the inside walls of iron body castings in every position of the valve disc, except fully open, shall be not less than 12,7 mm. This clearance shall be not less than 6,4 mm for valves with bodies of bronze or equivalent corrosion resistant materials.

4.12 Operation and reseal (see 6.8)

The pressures at which the main valve opens, shall be not less than the set pressure nor more than 105 % of the set pressure when tested in accordance with 6.8.

4.13 Flow capacity (see 6.9)

For set pressures of 0,69 MPa (6,9 bar) and higher, the value of flow specified in Table 1 shall require an inlet pressure at the valve no greater than 125 % of the set pressure when tested in accordance with 6.9.

If the valve is tested with a flow capacity less than the values specified in Table 1, the valve shall be marked to indicate the maximum flow intended as per 7.3, j).

Table 1 — Flow capacity for fire pump relief valves

Relief valve size mm	Flow capacity
	l/min
20	95
32	190
40	380
50	945
65	1 135
80	1 890
100	3 785
125	6 625
150	9 450
200	18 900
250	As declared by manufacturer
300	

4.14 Endurance (see 6.10)

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 6.10.

5 Production testing and quality control

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

5.2 Every manufactured valve shall pass a hydrostatic body test for a period of 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. The valve shall be set at a predetermined pressure. The pressure shall be slowly increased until the valve opens. The valve shall open at a pressure not less than the set pressure, nor more than 105 % of the set pressure.

5.4 Every manufactured valve shall withstand, without leakage at the valve seat, an internal hydrostatic pressure of 90 % of the maximum set pressure rating for a period of not less than 1 min. There shall be no leakage through the body, or past the seat, and no distortion of the valve.

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 (see 4.7.6 and 4.7.7)

6.2.1 Subject the spring 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. The sealing assembly shall be moved to the 50 % open position and slowly returned to the closed position.

6.2.2 A valve incorporating a diaphragm shall cycle 10 times at 200 percent of its maximum set pressure rating without malfunction.

6.3 Leakage and deformation (see 4.8)

6.3.1 Body leakage

Install an assembled valve including the main valve, pilot valve and trim in a pressure test apparatus with the sealing assembly in the open position. 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 4.8.1.

6.3.2 Sealing assembly

Fill the upstream end of the assembled 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 0 % to 90 % of the set pressure at a rate not exceeding 0,14 MPa/min (1,4 bar/min). Maintain this pressure for 5 min. Examine for leakage. The valve shall be tested for leakage at both the minimum and maximum set pressure limits. The valve shall conform to the requirements of 4.8.2.

6.4 Body strength (see 4.5)

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.

6.5 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 $87\text{ °C} \pm 2\text{ °C}$ 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 °C.

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 prevent the proper operation of the device. The parts are then to be assembled into valves and shall conform to the requirements of [4.8.1](#), [4.13](#) and [4.14](#) when tested in accordance with [6.3](#), [6.9](#) and [6.10](#).

6.6 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 $120\text{ °C} \pm 2\text{ °C}$ 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 °C.

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 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 prevent the proper operation of the device. The parts are then to be assembled into valves and shall conform to the requirements of [4.8.1](#), [4.13](#) and [4.14](#) when tested in accordance with [6.3](#), [6.9](#) and [6.10](#).

6.7 Sealing element tests (see [4.10](#))

Prior to conducting this test, the minimum opening pressure of the valve shall 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 $87 \pm 2\text{ °C}$ 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 no piece of the seal other than colour shall 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 the seating surface shall be tested.

6.8 Operational and reseal (see 4.12)

Prior to the tests, the fire pump relief valve should be installed and placed in the operational position according to the manufacturer's instructions and tested at a minimum of four different pressure settings encompassing its entire set pressure range as follows:

- a) Slowly increase the pressure.
- b) The pressure at which the valve opens shall be observed and recorded.
- c) After the valve has opened, the pressure shall be increased until approximately 125 % of the set pressure or the maximum flow as specified in Table 1 is attained.
- d) The pressure is then to be slowly decreased until the valve reseats.
- e) The reseal pressure shall be a minimum of 90 % of the set pressure.
- f) The procedure is to be repeated four additional times for a total of 5 cycles at each setting.

6.9 Flow capacity (see 4.13)

The valve shall be installed in its intended position in a test piping system that is equipped with a calibrated nozzle or other equivalent means by which selected flow rates can be established. The valve shall be set at various selected pressures throughout its set pressure range. The inlet pressure required to produce the specified flow shall be observed.

6.10 Endurance test (see 4.14)

Using the test apparatus described in 6.9, adjust the flow rate to the appropriate value given in Table 1. Sustain a water flow through the valve set at this rate for (30^{+5}_0) min.

Examine the valve for conformance to the requirements of 4.14.

7 Marking

7.1 Fire pump relief valves shall be marked either directly on the body with raised or depressed cast letters, or on a permanent metal label attached mechanically (such as with rivets or screws). Metal labels shall be made of corrosion resistant materials.

7.2 Cast body markings shall be in letters and figures at least 9,5 mm high. The height of the marking may be reduced to 5 mm for 50 mm and smaller valves. Cast body letters and figures shall be raised or depressed by at least 0,75 mm.

The letters on an etched or stamped permanent label shall be a minimum of 2 mm high.