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**Fire protection — Automatic sprinkler  
systems —**

**Part 6**

**Requirements and test methods for check  
valves**

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

*Partie 6: Exigences et méthodes d'essai des postes de contrôle*

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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 6182-6 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.

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# Fire protection — Automatic sprinkler systems —

## Part 6: Requirements and test methods for check valves

### 1 Scope

This part of ISO 6182 specifies performance requirements, methods of test and marking requirements for check valves used in automatic fire protection systems.

### 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 check valve

valve that permits flow of water in one direction and prevents the flow of water in the reverse direction

NOTE These valves are manufactured with pipe connections or may be of the wafer type.

#### 3.2 clapper

type of sealing element

NOTE See 3.8.

**3.3 corrosion-resistant material**  
bronze, brass, Monel<sup>1)</sup> metal, austenitic stainless steel, or equivalent, or plastic material conforming with the requirements of this document

**3.4 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

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

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

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

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

**3.9 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

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

**3.11 wafer check valve**  
valve having outside body and end connection dimensions that are less than the inside diameter of the bolt pattern of flanges of the same nominal size

NOTE One set of flange studs long enough to span the valve is used to clamp the wafer check valve between the mating pipe flanges.

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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.

## 4 Requirements

### 4.1 Nominal sizes

The nominal size of a check 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: 25 mm, 32 mm, 40 mm, 50 mm, 65 mm, 80 mm, 100 mm, 125 mm, 150 mm, 200 mm, 250 mm, 300 mm, 350 mm or 400 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 applicable requirements to International Standards. If International Standards are not applicable, national standards shall be permitted to be used.

### 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 pressure to match installation equipment provided the valve is marked with the lower working pressure.

### 4.4 Body and cover

4.4.1 The body and cover shall be made of a material with a 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 of 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 permanent deformation or failure.

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

4.4.5 A valve weighing more than 25 kg shall be provided with an access cover, lifting lug or eyebolt to facilitate servicing.

### 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 in accordance with 6.7.1.

4.5.2 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 force application is that extending out to a line defined by the inner edge of the bolts.
- b) If an "O"-ring seal or ring gasket is used, the area of force application is that extending out 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 the removal of the sealing assembly. Any method adopted shall 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 the 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 seals shall not prevent the valve from opening.

**4.7.5** Seat 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 shall not fracture or rupture during 50 000 cycles of normal operation when tested in accordance with 6.2.

**4.7.7** 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 the valve parts.

**4.7.8** Where rotation or sliding motion is required, the part or its bearing shall be made of 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

**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 a period of 5 min with the sealing assembly open when tested in accordance with 6.7.1.

**4.8.2** There shall be no leakage, permanent distortion or rupture of a valve at an internal pressure of twice the rated working pressure applied at the downstream end with the sealing assembly closed for a period of 5 min and the upstream end vented when tested in accordance with 6.7.2.

**4.8.3** There shall be no leakage, permanent distortion or rupture of a valve at an internal pressure equivalent to the head of a column of water 1,5 m high when applied at the downstream end with the sealing assembly closed for a period of 16 h and the upstream end vented when tested in accordance with 6.7.3.

## 4.9 Non-metallic components (excluding gaskets and seals)

**4.9.1** After ageing of its non-metallic parts as described in 6.4 and 6.5 using separate sets of samples, a valve shall meet the requirements of 4.8 when tested in accordance with 6.7.2.

**4.9.2** There shall be no cracking, warping, creep, or other signs of deterioration that can preclude the 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  $(70 \pm 1,5) ^\circ\text{C}$  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  $(97,5 \pm 2,5) ^\circ\text{C}$ , 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 not be 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 when the valve is tested in accordance with 6.9.

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

## 4.11 Clearances

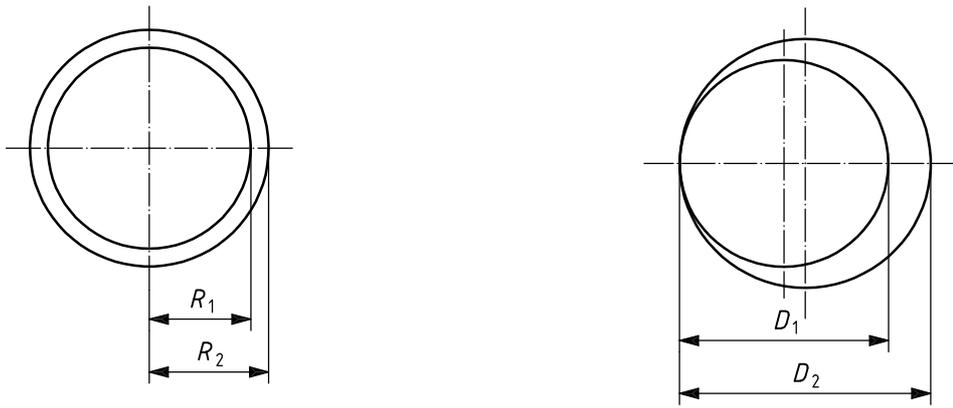
**4.11.1** The radial clearance between a hinged sealing assembly and the inside walls in every position except wide open shall not be less than 12 mm for cast iron bodies and shall not be less than 6 mm if the body and sealing assembly are of cast iron or steel with corrosion protective coatings tested in accordance with 6.14, non-ferrous material, stainless steel or materials having equivalent physical, mechanical and corrosion resistant properties. See Figure 1 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 1 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.

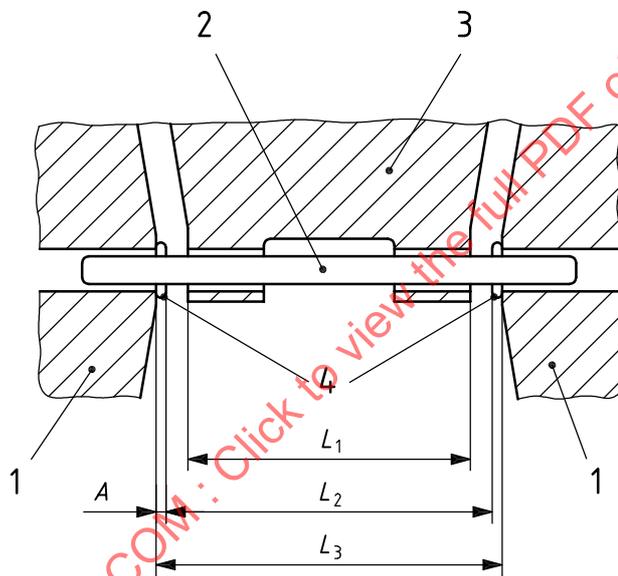
**4.11.4** The diametrical clearance ( $D_2 - D_1$ ) between pin and their bearings shall be not less than 0,125 mm. See Figure 1 b).

**4.11.5** The total axial clearance between the clapper hinge and the adjacent valve body bearing ( $L_2 - L_1$ ) surfaces shall not be less than 0,25 mm. See Figure 1 c).



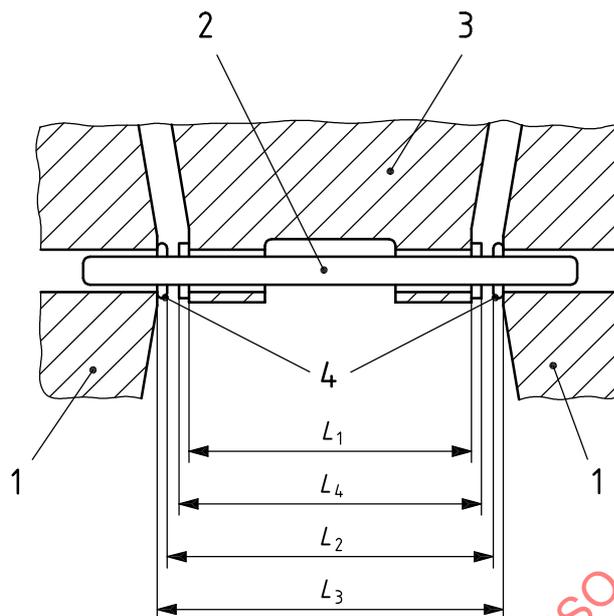
a) Radial clearance,  $C_R = R_2 - R_1$

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 1 (continued)



**d) Inside bushing dimensions**

$$C_{TA} = L_2 - L_4$$

$$\text{Clearance } A = (L_3 - L_2)/2 + (L_4 - L_1)/2$$

**Key**

- 1 valve body
- 2 pin
- 3 sealing assembly
- 4 bushings

**Figure 1 — Clearance**

**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 position.

**4.11.8** Sealing assembly guide bushings or hinge-pin bearings shall project a sufficient axial distance to maintain not less than 1,5 mm (clearance *A*) clearance between ferrous metal parts. 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 6.10.

## 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). The pressure loss shall not exceed 0,08 MPa (0,8 bar) with respect to the lift type check valve.

Table 1 – Required flow rates for pressure drop determination

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
300	19 800

#### 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 6.6.

### 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.

5.4 Every manufactured valve shall withstand, without leakage at the valve seat, an internal hydrostatic pressure of twice the rated working pressure applied downstream of the sealing assembly.

### 6 Tests

#### 6.1 Samples

A representative sample of each size 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 inlet end of the valve for a period of 90 days. During this period, the water temperature shall be maintained at  $87\text{ °C} \pm 2\text{ °C}$  by an immersion heater or other suitable heating device. Provisions shall be made to maintain the outlet 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 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.

#### 6.3.2 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. 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  $70\text{ °C}$ . 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 sample 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 for non-metallic components (excluding gaskets and seals)

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 warm-water ageing test shall be conducted at a lower temperature, but not less than  $70\text{ °C}$ , for a longer period of time. Calculate the duration of exposure from Equation (1):

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

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 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 that would preclude the proper operation of the device. The parts are then to be assembled into valves and shall comply with the requirements of 4.8.1 when tested in accordance with 6.7.1.

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

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 or distortion, an air-oven ageing test shall be conducted at a lower temperature, but not less than 70 °C, for a longer period of time. Calculate the duration of exposure from Equation (2):

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

where

- $t$  is the duration, expressed in days;
- $e$  is the base of natural logarithms (= 2,718 3);
- $T$  is the test temperature, expressed in degrees Celsius.

NOTE This 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 that would preclude the proper operation of the device. The parts are then to be assembled into valves and shall comply with the requirements of 4.8.1 when tested in accordance with 6.7.1.

### 6.6 Hydraulic friction loss test

Install the valve in a test apparatus using piping of the same nominal diameter (see 4.1). Use a differential pressure-measuring device accurate to  $\pm 2\%$ .

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 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 5 min and inspect the valve during this time for signs of leakage. The valve shall conform to the requirements of 4.8.1.