BRITISH STANDARD

BS EN
13959:2004
Incorporating corrigendum October 2008

Anti-pollution check valves — DN 6 to DN 250 inclusive Family E, type A, B, C and D

ICS 23.060.50

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 13959:2004. It supersedes BS 6282-1:1982 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/504, Water supply, to Subcommittee B/504/14, Backflow prevention.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Attention is drawn to errors in Figures 10 and 11, in which all the clause references 11.8 should read 11.9.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2006

ISBN 978 0 580 63069 9

Amendments/corrigenda issued since publication

Date	Comments
30 November 2008	Addition of supersession details to national foreword

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13959

October 2004

ICS 23.060.50

English version

Anti-pollution check valves - DN 6 to DN 250 inclusive family E, type A, B, C and D

Clapets de non retour antipollution DN 6 à DN 250 - Famille E, Type A, B, C et D

Rückflussverhinderer - DN 6 bis DN 250 - Familie E, Typ A, B, C und D

This European Standard was approved by CEN on 22 July 2004.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Ref. No. EN 13959:2004: E

Contents

Foreword

This document (EN 13959:2004) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

This standard has been worked out in reference EN 1717, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this document:

a) this document provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

b) it should be noted that, while the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

1 Scope

The purpose of this document is to specify:

— field of application of anti-pollution check valves;

— backflow prevention properties, dimensional and physio-chemical properties, and properties of general hydraulic, mechanical and acoustic design for anti-pollution check valves of nominal sizes DN 6 to DN 250 inclusive;

— family E, type A, controllable anti-pollution check valve (with test port);

— family E, type B, non-controllable anti-pollution check valve, including cartridge check valve;

— family E, type C, controllable anti-pollution double check valve (with test ports);

— family E, type D, non-controllable anti-pollution double check valve, including cartridge double check valve;

— test procedures and requirements for verifying the backflow protection properties of stop valves, draw-off taps etc. which incorporate a check valve function. Stop valves, draw off taps etc, need also to comply with a recognised standard;

— marking;

— presentation at delivery.

This document specifies the characteristics of anti-pollution check valves of DN 6 up to and including DN 250 that are suitable for use in drinking water systems. For application feasibility see Table 1.

Table 1 — Nominal size vs Conditions of use

Nominal size (DN)	Max. Operating temperature	Max. Operating pressure	Installation
DN ≤ 50	65 °C + 90 °C, 1 h	1 000 kPa (10 bar)	Any position
DN > 50	65 °C	1 000 kPa (10 bar)	Horizontal only

Anti-pollution check valves covered by this document are of pressure class PN 10. In case of devises with pressure class PN 16, the anti–pollution check valves has to comply with the tests which characterise the PN of the devise.

The field of application of EN 1717 is limited to 10 bar, flanges could be drilled in PN 16 pattern.

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.

EN 558-1, *Industrial valves — Face-to-face and centre-to-face dimensions of metal valves for use in flanges pipe systems — Part 1: PN-designated valves.*

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges.*

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges.*

EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 3: Copper alloy flanges.*

EN 1254-1, *Copper and copper alloys — Plumbing fittings — Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes.*

EN 1254-2, *Copper and copper alloys — Plumbing fittings — Part 2: Fittings with compression ends for use with copper tubes.*

EN 1254-3, *Copper and copper alloys — Plumbing fittings — Part 3: Fittings with compression ends for use with plastics pipes.*

EN 1254-4, *Copper and copper alloys — Plumbing fittings — Part 4: Fittings combining other end connections with capillary or compression ends.*

EN 1267, *Valves - Test of flow resistance using water as test fluid.*

EN 1717, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow.*

EN ISO 3822-1, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 1: Method of measurement (ISO 3822-1:1999).*

EN ISO 3822-3, *Acoustics — Laboratory tests on noise emission from appliances and equipment used in water supply installations — Part 3: Mounting and operating conditions for in-live valves and appliances (ISO 3822-3:1997).*

EN ISO 5167-3, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 3: Nozzles and Venturi nozzles (ISO 5167-3:2003).*

EN ISO 6509, *Corrosion of metals and alloys — Determination of dezincification resistance of brass (ISO 6509:1981).*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests.*

3 Terms and definitions

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

3.1 Anti-pollution check valves

[ul5]**3.1.1**
family E, type A, controllable anti-pollution check valve (with test port)
controllable single check valve, consisting one closing element, is mechanical protection device to permit flow in one direction only. It will open automatically when the pressure in the direction of flow upstream of the valve is greater than the pressure downstream. In case when the pressure is higher downstream or no flow condition exists the valve is closed by anticipation acting under a force, for example of a mechanical assembly or a spring. For verification needs this type of check valve has a test cock upstream of the closing element

3.1.2
family E, type B, non-controllable anti-pollution check valve
non-controllable single check valve, consisting one closing element, is a mechanical protection device to permit flow in one direction only. It will open automatically when the pressure in the direction of flow upstream of the valve is greater than the pressure downstream. In case when the pressure is higher downstream or no flow condition exists the valve is closed by anticipation acting under a force, for example of a mechanical assembly or a spring. A family E, type B, non-controllable anti-pollution check valve is constructed in two formats:

— With housing (final product);
— Without housing (called cartridge check valve)

3.1.3
family E, type C, controllable double anti-pollution check valve (with test ports)
controllable double check valve, consisting of two independent acting closing elements, is a mechanical protection device to permit flow in one direction only. It will open automatically when the pressure in the direction of flow upstream of the valve is greater than the pressure downstream. In case when the pressure is higher downstream or no flow condition exists the valve is closed by anticipation acting under a force, for example of a mechanical assembly or a spring. For verification needs this type of check valve has a test cock upstream of each closing element

3.1.4
family E, type D, non-controllable anti-pollution double check valve
non-controllable double check valve, consisting two independent acting closing elements, is a mechanical protection device to permit flow in one direction only. It will open automatically when the pressure in the direction of flow upstream of the valve is greater than the pressure downstream. In case when the pressure is higher downstream or no flow condition exists the valve is closed by anticipation acting under a force, for example of a mechanical assembly or a spring. A family E, type D, non-controllable anti-pollution double check valve is constructed in two formats:

— With housing (final product);
— Without housing (called cartridge double check valve)

For the purpose of this document, "anti-pollution check valves" are hereafter referred to as "devices"

3.2
flanged anti-pollution check valves; class a and class b
controllable check valves need to be accessible for inspection, test and replacement.

To assist their repair, flanged check valves may be provided with an inspection hatch and for designation purposes two classes are specified:

— Class a : with an inspection hatch;

— Class b : without an inspection hatch;

The installation of either a class a device or a class b device depends on national installation requirements

3.3
combined product
a combined product is an end product which incorporates beside the check valve function other function(s)

EXAMPLES stop valves, draw-off taps etc. which incorporate a check valve function

4 Nominal size

For the purpose of this document the nominal size DN as given in Table 6 relates to flow characteristics.

The dimensions of the end connections shall be either equal to or one DN smaller, or one DN greater than the nominal size of the device, except for the flanged devices of which the connecting size shall correspond to DN.

The DN-range covered by this document for single check valves (type A and B) and double check valves (type C and D) is DN 6 to DN 250 inclusive. Limitations are given in the applicable tables.

5 Designation

Devices are designated by:

— its name;

— its family (E);

— its type (A, B, C and D);

— its class (a or b for flanged devices only, see 3.2 and 8.4.2.1);

— its nominal size (DN) (see Table 6);

— its pressure class (PN);

— its connections: type and size (not applicable to cartridge check valves);

— its housing material (not applicable to cartridge check valves);

— its surface finish (possible coating);

— the acoustic group (up to DN 32 inclusive only);

— reference to this document.

Examples of designation

Non-controllable anti-pollution check valve, family E, type B, DN 20, G ¾ × G ¾, bronze, I, EN 13959.

Controllable anti-pollution check valve, family E, type A, class a, DN 100, Flanged, Pressure class 10, Epoxy coated ductile iron, EN 13959.

6 Marking and technical documents

6.1 Marking

Devices shall be marked permanently and visibly on housings, or on a fixed identification plate. In the case of cartridge check valves marking shall be on the cartridge itself.

This information shall be on the upper side, or on each lateral side of the device. The indications are to be indelible and obtained by moulding, engraving or similar procedures.

The marking shall indicate:

a) name, manufacturer's brand or logo;

b) arrow indicating normal direction of flow;

c) letter indicating family and type of the device;

d) nominal size (DN);

e) nominal pressure (PN);

f) maximum operating temperature in degrees Celsius (°C);

g) acoustic group (up to DN 32 inclusive only);

h) manufacturer’s reference;

i) reference to the present standard;

j) dezincification resistance.

In the countries where the use of products made of dezincification resistant materials is not required, the dezincification resistant products according to EN ISO 6509 as well as the products, which do not contain zinc, are allowed to be marked << DR >>.

In countries where the use of dezincification resistant materials is required, the dezincification resistant products as well as the products, which do not contain zinc, shall be marked <<DR>>.

For all devices marking a), b), c) and d) are obligatory. For flanged devices e) is also obligatory.

In case there is no marking for g), the device has to be considered as not classified acoustically. Where space permits the other information shall be marked in the following order: f) to j).

Cartridge check valve shall be marked with a), b) and d). Other markings are optional.

6.2 Technical documents

Each package and/or each batch and/or each catalogue of the supplier/manufacturer should contain Technical Product Information (TPI) which shall be written in a commonly spoken language of the country in which the product is sold. If the TPI is not supplied it shall be available on request.

TPI shall provide the following information:

— designation and purpose of the product;

— installation instructions;

— (brand) name and address of supplier / manufacturer;

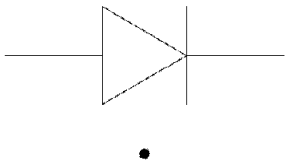
— instructions for maintenance, if any;

— spare part list, if any;

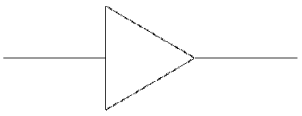
— nature of materials.

7 Symbolization

The graphic representation of the device is as follows (see Figures 1 and 2):



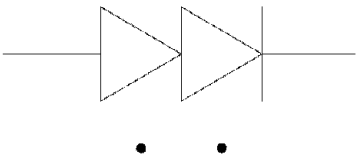
EA
with test port



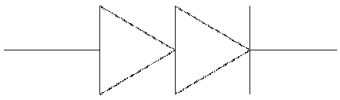
EB
without test port

NOTE Applies also for cartridge check valves.

Figure 1 — Check valve symbols



EC
with test port



ED
without test port

NOTE Applies also for Cartridge Double Check Valves.

Figure 2 — Double check valve symbols

8 General design characteristics

8.1 Overall length and diameters of check valves

8.1.1 General

Where necessary, the overall lengths and diameters of check valves are specified for each type in 8.1.2 to 8.1.5.

8.1.2 Check valves with threaded ends or compression ends

The overall lengths of check valve housings with threaded ends or compression ends or with ends suitable for connection with capillary unions shall be determined by the manufacturer.

8.1.3 Flanged check valves

The overall length of flanged check valves EA shall be in accordance with EN 558-1 (series f1 and f48) and is given in Table 2.

Table 2 — Nominal size vs overall length (face to face) of flanged check valves

Nominal size (DN)		40	50	65	80	100	125	150	200	250
Length (mm)	Short (f48)	180	200	240	260	300	350	400	500	600
	Long (f1)	200	230	290	310	350	400	480	600	730

Alternative face-to-face dimensions within the scope of EN 558-1 are permissible by agreement with the customers.

8.1.4 Cartridge check valves

The cartridge check valves mounting dimensions for retention and leak tightness shall be determined and provided by the cartridge supplier, with the exception of one kind of water meter cartridge check valves (see Figure 3), having dimensions given in Table 3.

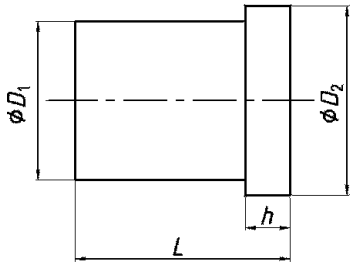


Figure 3 — Water meter cartridge check valve

Table 3 — Dimensions of water meter cartridge check valves

Dimensions in millimetres

DN	15	20	25	40
$D_{1\,(max)}$	18,3	22,1	28,5	40,3
$L_{\,(max)}$	19,5	25,5	38,5	50,0
D_2	$20{,}0\ ^{0}_{-0{,}15}$	$25{,}0\ ^{0}_{-0{,}15}$	$32{,}0\ ^{0}_{-0{,}2}$	$46{,}0\ ^{0}_{-0{,}3}$
h	3,0 ± 0,1	7,0 ± 0,1	8,0 ± 0,1	10,0 ± 0,1

8.1.5 Double Check Valves

The overall length of this type of check valve is left to the discretion of the manufacturer.

8.2 End connections

8.2.1 General

End connections for check valves are specified for each type in 8.2.2 to 8.2.4.

8.2.2 Threaded end connections

Threaded end connections shall comply with EN 1254, parts 1, 2, 3 and 4.

End connections shall be designed so that when a pipe or fitting is connected to the threaded portion of the check valve body it shall not adversely affect the operation of the valve.

Direct soldering or brazing of piping to check valve is not permitted. Any such connections shall be by means of unions with nuts and capillary tailpieces.

8.2.3 Flanged end connections

Flanged end connections shall comply with EN 1092, parts 1, 2 and 3.

Other requirements to end connections of flanged check valves:

a) the inlet and outlet flanges shall be of the same size;

and

b) the flanges shall be of the same DN as the device.

8.2.4 Other connections

Other end connections are not precluded providing:

a) they comply with current national standards;

b) the device complies with all other requirements of this standard.

8.3 Test and drain ports

EA and EC check valve bodies shall include:

— a test port fitted with a plug on the inlet side (EA and EC) and a test port with a plug in the intermediate chamber (EC), so as to permit the leak-tightness of the check valve(s) to be verified in-situ.

— for flanged check valves a quarter-turn test cock fitted to the test port.

Check valve bodies may also include:

— a drain port with a plug on the outlet side, to facilitate downstream draining in-situ.

Internal parts shall not obstruct the test and drain ports.

Controllable check valves shall have test port(s) and optional drain ports according to the specification as shown in Figure 4 and Table 4.

The bores of test and drain ports shall have over their full length a minimum cross-section of 12,56 mm^2. Their smallest dimension shall be 4 mm.

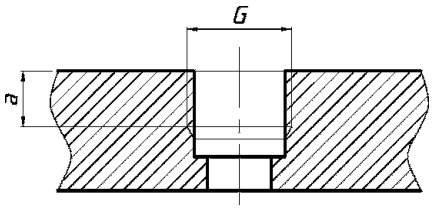


Figure 4 — Test and drain ports

Table 4 — Dimensions of test and drain ports

Nominal size DN	Thread size [a]	*a* (mm)
≤15	G ⅛ or G ¼	> 6,5
15 < DN ≤ 50	G ¼	> 6,5
> 50	G ⅜ or G ½	> 13
[a] Thread shall be in accordance with EN 1254-4.		

The test and drain ports shall be produced so that the plug can be adequately sealed.

8.4 Other characteristics

8.4.1 Double check valves

The components of the two check valves shall not interfere with each other in all operating conditions.

8.4.2 Flanged check valves

8.4.2.1 Accessibility

When installed, controllable check valves shall be accessible for inspection, test and replacement.

To assist their repair, flanged check valves may be provided with an inspection hatch and for designation purposes, 2 classes are specified:

— Class a : with an inspection hatch;

— Class b : without an inspection hatch.

Inspection hatches shall be adequately sized to permit maintenance.

The installation of either a class a device or a class b device depends on national installation requirements.

8.4.2.2 Flanged check valves with inspection hatch

Class a devices which retain water with the inspection hatch removed shall be fitted with a drain port at the bottom of the chamber.

8.4.3 Replaceable components

Replaceable components to be used on site shall be in the form of a sub-assembly and be designed so that they can only be re-assembled in the check valve housing without error in the correct positions (with no risk of insertion reversal etc).

Cartridge check valves are excluded from this requirement. These devices shall be replaced entirely. They are considered to be sub-assemblies.

9 Physio-chemical characteristics

9.1 Materials

The materials and the coatings used, liable to come normally or accidentally in contact with potable water, shall satisfy the EC regulations concerning water quality.

And therefore they:

— shall be corrosion resistant in accordance with ISO 9227;

— shall be prone to the least scaling possible;

— shall be in conformity with the European Standards and regulations;

— shall be compatible among themselves and

  — with the water distributed;

  — with the fluids or matter liable to come into contact with them;

  — with the products normally used for disinfection of installations; potassium permanganate and sodium hypochlorite.

9.2 Nature of materials

a) The choice of materials is left to the discretion of the manufacturer.

   NOTE This standard does not cover non-metallic housings.

   Copper-zinc alloys containing more than 10 % zinc are subject to dezincification when submitted to water capable to dezincification. In countries where the use of products made of dezincification resistant materials is required, the products have to guarantee a dezincification depth less than 200 µm in any direction, they have to be tested in accordance with standard EN ISO 6509 and have to be marked in compliance with the indications under section ”Marking” (see 6.1 of this document).

b) Neither the materials nor coatings used shall, by normal or accidental contact with drinking water, cause any risk of affecting or modifying the water up to a temperature of 90 °C. The suitability of the water for human consumption is defined by national regulations.

c) The manufacturer shall state in his technical and sales literature the nature of the materials and the coatings selected.

d) The materials, and in particular copper alloys, for which recommendations or international standards exist, shall comply with the relevant recommendations or international standards.

10 Test Arrangements

10.1 Sequence of testing

The test device shall be tested in a position so that the inlet/outlet and obturator axis is in one horizontal plane.

The test sequences on samples is suggested in Annex A.

The hydraulical and mechanical testing sequence is as follows:

Stage 1	High velocity test.	See 11.1
Stage 2	Flow rate and pressure loss test.	See 11.2
Stage 3	Mechanical strength of body.	See 11.3
Stage 4	Bending moment test (incl. 1,6 MPa body pressure and 3 cmwc reverse pressure).	See 11.4
Stage 5	Pressure tightness under a low reverse pressure differential (3 cmwc reverse pressure).	See 11.5
Stage 6	Pressure tightness under a high reverse pressure and verification that the device has not jammed (1,6 MPa reverse pressure).	See 11.6
Stage 7	Pressure differential at which the device closes (anticipation).	See 11.7
Stage 8	Compatibility with products used for disinfection of the installation.	See 11.8
Stage 9	Endurance test.	See 11.9
Stage 10	Pressure tightness under a low reverse pressure differential (3cmwc reverse pressure).	See 11.10
Stage 11	Pressure tightness under a high reverse pressure and verification that the device has not jammed (1,6 MPa reverse pressure).	See 11.11
Stage 12	Pressure differential at which the device closes (anticipation).	See 11.12

All devices shall comply with the sequence of testing, with the exception of:

— In case of testing of a check valve with Housing stage 5 is excluded, stage 4 will be followed by stage 6.

— In case of testing of an EB and ED cartridge check valve stage 3 and 4 are excluded, stage 2 will be followed by stage 5.

For cartridge check valves, a suitable test body shall be provided, capable of retaining the cartridge and allowing connections to the relevant test rig.

— In case of combined products with integrated check valves:

  — Non-cartridge construction: product shall comply will all stages with the exception of Stage 2. Flow rate/Pressure loss requirements are taken from the relevant product standard of the end product.
  — Cartridge construction:

    — Certified check valve cartridge: of the end product the leak tightness between housing and cartridge shall be proven (sequence stage 4 and 6). Flow rate / Pressure loss requirements are taken from the relevant product standard of the end product.
    — Non-certified check valve cartridge: see Non-cartridge construction

— In case of double check valves with housings each single check valve shall be tested partly combined and partly separate

  — Combined Stages 1, 2, 3, 8 and 9
  — Separate Stages 4, 6, 7, 10, 11 and 12

If the body is not equipped with test ports either the first (to test the second) or the second (to test the first) check valve is removed, or the obturator is blocked in the fully open position.

10.2 Apparatus

10.2.1 General

Examples shown in the figures are for guidance only. Laboratory equipment shall be designed to ensure that check valves can be tested in accordance with the requirements.

10.2.2 Tolerances of parameters and accuracy of measure instruments

10.2.2.1 Tolerances on set test parameters

In the absence of any particular specifications:

— Flow rate and pressure: ± 2 % of the value indicated

— Temperature: cold water ± 5 K of the value indicated
hot water ± 2 K of the value indicated

— Time: – 0/+ 10 % of the value indicated

10.2.2.2 Accuracy of measuring instruments

All the measuring instruments shall have an accuracy of ± 2 % of the measured value, except for temperature measurement the accuracy shall be ± 1 K.

10.2.2.3 Test media

In the absence of any particular specifications the test media shall be water with a maximum temperature of 30 °C.

11 Hydraulic and mechanical characteristics

11.1 High velocity (stage 1)

11.1.1 Test equipment

The test installation shall be in accordance with Figure 5 according to EN 1267. The laboratory shall choose the position of the components outside the indicated box.

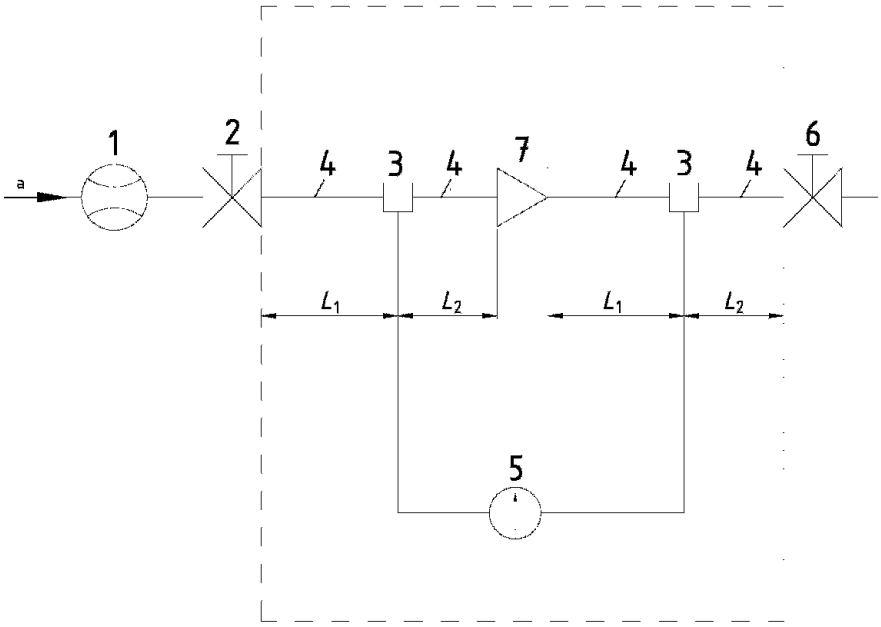


Figure 5 — Flow rate/pressure loss testing equipment

The test rig consists of:

— Flow meter (1) suitable for the flow rate given in Table 5 for the test device.

— Control valve (2) capable of fine regulation.

— Pressure take-off tee (3) according to EN ISO 5167-3.

— Straight lengths of tubes of the smallest size corresponding to the nominal size of the test device. Length of tubes (4):

  — $L_1 \geq 10 \times$ DN of the test device.
  — L_2 is $\geq 2 \times$ DN of the test device.

— Differential pressure measuring device (5).

— Control valve (6) capable of fine regulation.

— Test device (7).

11.1.2 Procedure

11.1.2.1 Install the test device in the test rig as shown in Figure 5.

11.1.2.2 Open valves (2) and (6) and by adjustment of these valves and the water supply pressure, rapidly increase the flow rate until the average flow velocity in the tube (4) reaches a pre-set of 4 m/s equal to a flow rate as given in Table 5. Maintain this flow velocity for a period of 5 min.

Table 5 — Nominal size vs high velocity test flow rate

Nominal size of check-valve DN	6	8	10	15	20	25	32	40	50	65	80	100	125	150	200	250
Flow rate litres/s	0,10	0,20	0,30	0,70	1,25	2,0	3,25	5,0	7,8	13	20	31	49	70	125	196

11.1.3 Requirement

When tested as described in 11.1.2 no component part of the device shall be dislodged or damaged.

11.2 Flow rate/pressure loss (stage 2)

NOTE Combined products are excluded from this requirement. See 10.1.

11.2.1 Test equipment

For test equipment see Figure 5.

11.2.2 Procedure

11.2.2.1 Install the test device in the test rig as shown in Figure 5.

11.2.2.2 Adjust the pressure of the water supply to within the range of the differential pressure measuring device and then with valves (2) and (6) open, purge any air from the test rig by allowing water to pass through the rig.

11.2.2.3 Close valve (6) slowly and allow the differential pressure measuring device to settle.

11.2.2.4 Open valve (6) slowly and progressively and measure and record the flow rate and pressure differential.

11.2.2.5 Carry out the procedure described in 11.2.2.4 until at least ten readings have been obtained or a velocity of 4 m/s is reached (see Table 6).

11.2.2.6 Plot a graph of flow rate against pressure differential.

Where necessary, the pressure loss in the piping between the test device and the pressure taps shall be accounted for.

11.2.3 Requirement

The pressure differential at any flow rate between zero and that indicated in Table 6 for the particular DN shall not exceed 15 kPa (0,15 bar) for single check valves and 30 Pa (0,3 bar) for double check valves.

Table 6 — Nominal size vs minimum rate of flow

Nominal size of Check valve DN	6	8	10	15	20	25	32	40	50	65	80	100	125	150	200	250
Minimum flow rate Litres/s	0,07	0,13	0,2	0,45	0,8	1,4	2,2	3,5	5,4	12	18	27	43	62	110	172

11.3 Mechanical strength of the body (stage 3)

11.3.1 Test equipment

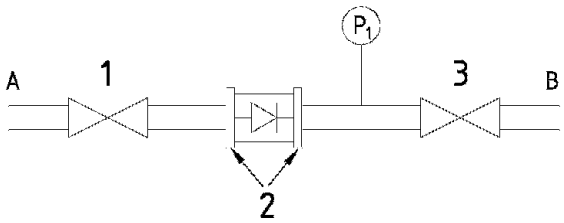


Figure 6 — Mechanical strength testing equipment

The testing rig consists of:

— a stop valve (1) at the inlet (A);

— a set of adapters (2) by which the test device is fixed;

— a pressure gauge (P_1);

— a stop valve (3) to drain (B).

11.3.2 Procedure

11.3.2.1 Install the test device to the test rig shown in Figure 6 using appropriate adapters if necessary.

11.3.2.2 Open valve (1) and (3), purge the air from the test rig by allowing water to pass through the rig.

11.3.2.3 After de-aeration of the test rig close valve (3) and gradually apply cold water pressure through the inlet of the check valve not exceeding 100 kPa (1 bar) per 5 s up to a static pressure of (2 500 ± 100) kPa (25 ± 1 bar)) to the interior of the device body for a period of 5 min.

11.3.2.4 First close valve (1). Open valve (3) slowly to reduce the pressure in the test device.

11.3.3 Requirement

There shall be no breakage or permanent deformation of the body of the test device.

11.4 Bending moment (stage 4)

11.4.1 Test equipment

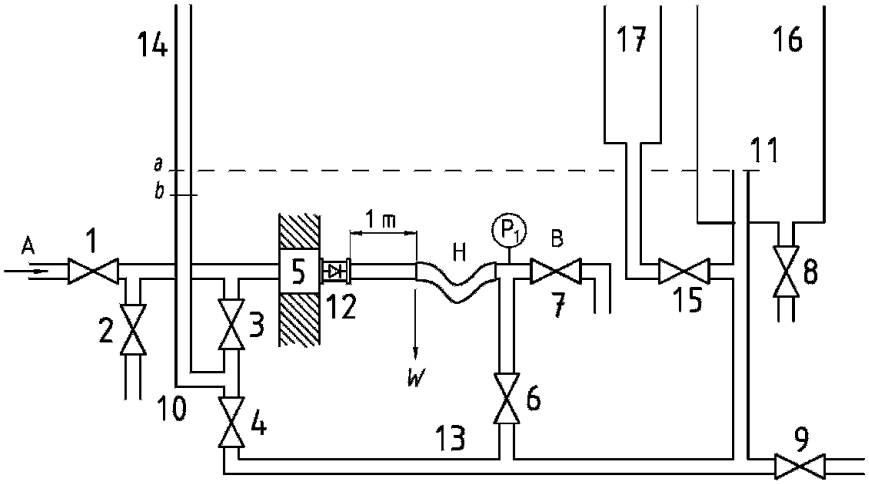


Figure 7 — Bending moment testing equipment

The testing rig consists of:

— Two circuits:

  — supply circuit (A), fitted with a stop valve (1);
  — circuit (B), fitted with a pressure gauge (P_1);

— Circuits are fitted with:

  — drain valve (2, 7);
  — a branch upstream of the mounted test device fitted with two stop valves (3) and (4) and between these stop valves, another branch (10) ending in a transparent tube (14);
  — a 1 m long steel pipe (12) with a flexible connection e.g. a hose (H) to circuit A. The pipe is equipped with a type of connection enabling a direct connection by means of thread, flange or compression end to the outlet of the test device. The outer end is equipped with a connection to load (*W*).
  — a mounting block (5) to which the test device is fixed;
  — a branch (13) fitted with a drain valve (9) connected with another branch ending in a tube (11) that ends in the tank (16) to which is fitted a drain valve (8). The top of the tube (11) shall be above branch (12) equipped with the test device;
  — a stop valve (15) connected to reservoir (17) to refill meniscus on tube (11).

— The internal diameters of tube (11) and tube (14) are for

  — DN ≤ 50 : 10 mm
  — DN > 50 : 20 mm

11.4.2 Procedure

11.4.2.1 Install the test device in the test rig as shown in Figure 7 with couplings, as supplied — adapters not permitted.

11.4.2.2 For one-house constructions of single and double devices the bending moment is measured at the connection to the pipe.

For dual-house constructions of double devices the bending moment is measured at the connection of the two parts of the entire construction.

In calculating the bending moment, make due allowances for the mass of the pipe work, valves and any loads imposed by the test equipment.

11.4.2.3 The bending moment test shall be applied to each size and every end design.

11.4.3 First test

11.4.3.1 Tightness of the device body with a high pressure applied to the inlet of the test device during the bending moment at ambient temperature.

11.4.3.2 Close all valves. Purge the air from pipe (12) by means of valves (1) and (7) open.

11.4.3.3 Close valve (7).

11.4.3.4 Apply a load W as shown in Figure 7 to produce the bending moment given in Table 7.

11.4.3.5 Gradually increase the pressure at A at a rate not exceeding 100 kPa (1 bar) per 5 s up to $1\,600\ ^{0}_{-50}$ kPa $\left(16\ ^{0}_{-0,5}\ \text{bar}\right)$.

11.4.3.6 Hold for 5 min.

11.4.3.7 First close valve (1). Open valve (7) slowly to reduce the pressure in the test device.

11.4.3.8 Requirement

There shall be no breakage, permanent deformation or leakage of the body of the test device as verified during the first test.

11.4.4 Second test

11.4.4.1 Leak-tightness with a low pressure applied to the outlet of the test device during the bending moment application.

11.4.4.2

— Close all the valves.

— Open valves (3), (4), (6), (7) and (8).

— Open valve (1) and fill pipe (12) and the branch circuits (10) and (13). Purge the air by means of valve (7) and tubes (14) and (11).

11.4.4.3 Close valve (7) when the air has been removed from the circuit.

11.4.4.4

— Slowly close valve (1) so as to keep a meniscus at the top of the pipe (11).

— Close valve (4).

11.4.4.5

— In pipe (14), mark the height of the water (*a*), which should be at the same level as in the pipe (11).

11.4.4.6

— Open valve (2) slightly and lower the level in the tube (14) to level (*b*) (30 ± 2) mm below level (*a*). During this operation, close valve (2) very slowly.

11.4.4.7

— Allow the device to settle, then refill meniscus of tube (11) by means of valve (15).

11.4.4.8

— Apply a load *W* as shown in Figure 7 to produce the bending moment given in Table 7.

11.4.4.9 Observe the meniscus for 5 min.

11.4.4.10 Requirement

Under the above test conditions, no leak shall be observed during the 5 min. This is verified by the maintenance of a stable convex meniscus at tube (11).

Table 7 — Nominal size vs bending moment

Nominal size DN		6	8	10	15	20	25	32	40	50	65	80	100	125	150	200	250
Bending Moment Nm	Threaded and Flanged ends	16	30	40	80	150	300	400	500	600	750	950	1 300	1 800	2 400	3 800	5 500
	Compression ends	30	30	30	50	85	125	160	200	300	na	na	na	na	na	na	na

11.5 Pressure tightness under a low reverse pressure differential (stage 5)

11.5.1 Test equipment

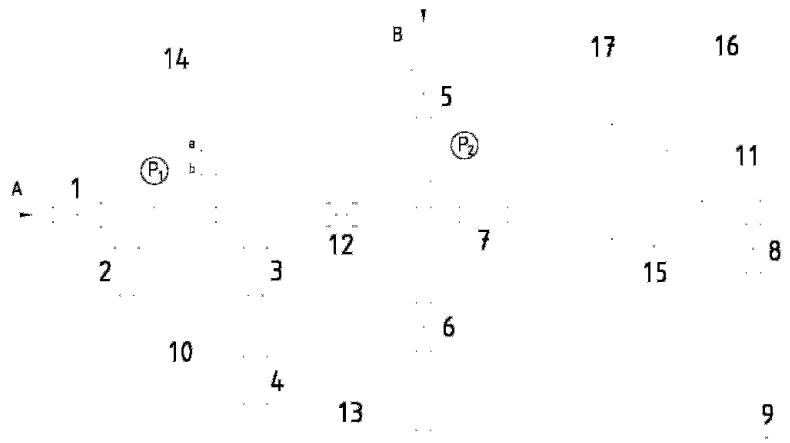


Figure 8 — Leak tightness testing equipment

The testing rig consists of:

— Two supply circuits:

  — circuit (A), fitted with a stop valve (1) and a pressure gauge (P_1);
  — circuit (B), fitted with a stop valve (5) and a pressure gauge (P_2);

— Circuits are fitted with:

  — drain valves (2, 7);
  — a branch upstream of the mounted test device, fitted with two stop valves (3) and (4) and between these stop valves, another branch (10) ending in a transparent tube (14);
  — a branch (12) equipped with the test device and fitted with a stop valve (6);
  — a branch (13) fitted with a drain valve (9) connected with another branch ending in a tube (11) that ends in the tank (16) to which is fitted a drain valve (8). The top of tube (11) shall be above branch (12) in which the test device is mounted;
  — a stop valve (15) connected to reservoir (17) to refill meniscus on tube (11).
  — the internal diameters of tube (11) and (14) are for

    — DN ≤ 50 10 mm
    — DN > 50 20 mm

11.5.2 Procedure

11.5.2.1 Install the test device in the test rig as shown in Figure 8.

11.5.2.2

— Close all the valves.

— Open valves (3), (4), (6), (7) and (8).

— Open valve (1) and fill pipe (12) and the branch circuits (10) and (13). Purge the air by means of valve (7) and tubes (14) and (11). Close valve (7) when the air has been removed from the circuit.

11.5.2.3

— Slowly close valve (1) so as to keep a meniscus at the top of the pipe (11).

— Close valve (4).

11.5.2.4

— In pipe (14), mark the height of the water (a), which should be at the same level as in the pipe (11).

11.5.2.5

— Open valve (2) slightly and lower the water level in the pipe (14) to level (*b*) (30 ± 2) mm below level (*a*). During this operation, close valve (2) very slowly.

11.5.2.6 Allow the test device to settle, then refill meniscus of tube (11) by means of valve (15).

11.5.2.7 Observe the meniscus for 5 min.

11.5.3 Requirement

Under the above test conditions, no leak shall be observed during 5 min. This is verified by the maintenance of a convex meniscus at tube (11).

11.6 Pressure tightness under a high reverse pressure and verification that the check valve has not jammed (stage 6)

11.6.1 Principle

Apply a pressure increasing from 0 MPa to 1,6 MPa (0 bar to 16 bar) by means of cold water to the outlet of the device with zero pressure on the inlet.

11.6.2 Test equipment

For test equipment see Figure 8 in 11.5.1.

11.6.3 Procedures

11.6.3.1 Install the test device in the test rig as shown in Figure 8.

11.6.3.2 Close all the valves.

11.6.3.3 Open valve (2), (3) and (7) then valve (1) and fill the pipe (12) and tube (14). Purge the air. Close (3), (7), (2) and (1) when the air has been removed from the circuit.

11.6.3.4 Slowly open valve (3) and open valve (2) slightly until the level of water in the tube (14) reaches level (*b*) defined in the leak-tightness test in the closed position with a low pressure applied to the device outlet (see 11.5).

11.6.3.5 Slowly close valve (2) so as to maintain this level.

11.6.4 First test

11.6.4.1 General

Leak-tightness in the closed position with a high pressure applied to the device outlet and low pressure at the device inlet.

11.6.4.2 First reading

Open the valve (5) and gradually apply pressure at an approximate rate of 100 kPa (1 bar) per 5 s up to $1\,600\ ^{0}_{-50}$ kPa. Maintain the pressure for 5 min. and record the level of the water in tube (14).

11.6.4.3 Second reading

Maintain the pressure for a further 5 min. and record the level of the water in tube (14).

11.6.4.4 Third reading

Reduce the pressure at the outlet of the device (circuit B) gradually to atmospheric pressure by opening valve (7) and record the level of water in tube (14).

11.6.4.5 Requirement

There shall be no leakage across the valve at any time as verified by the water level in tube (14) remaining constant for first and second readings. The third reading shall be stable. There shall be no rupture or permanent deformation of any part of the valve.

11.6.5 Second test

11.6.5.1 Verify that the obturator of the test device has not become jammed.

11.6.5.2 Close valve (5)

11.6.5.3 Open valve (7) slowly, then valve (1), gradually increase pressure in tube (14) until the test device opens and record the level in tube (14).

11.6.5.4 Requirement

The test device shall open before the pressure reaches 15 kPa (1 500 mm of water column).

11.7 Pressure differential at which the check valve closes (stage 7)

11.7.1 Test equipment

For test equipment see Figure 8 in 11.5.1

11.7.2 Procedure

11.7.2.1 Install the test device in the test rig as shown in Figure 8.

11.7.2.2 Close all the valves. Open valves (3), (4), (6) and (8). Open valve (1) and fill pipe (12) and the branch circuits (10) and (13). Purge the air by means of valve (7) and tubes (14) and (11). Close valves (1), (4) and (7) when the air has been removed from the circuit.

11.7.2.3 Close valve (6), then open valve (1) slowly until the level in tube (14) is 1 500 mm above the level in tube (11), and then close valve (1). This effectively sets a maximum opening pressure of 15 kPa (1 500 mm of water column).

11.7.2.4 Open valve (6) slightly and wait for the levels in tubes (14) and (11) to achieve equilibrium.

11.7.2.5 After 5 min. measure the positive pressure differential at which the test device has closed by determining the difference in water levels in tubes (11) and (14).

11.7.2.6 Result

Record the positive pressure differential at which the test device closes.

11.7.3 Requirement

The positive pressure differential at which the test device closes shall be at least 500 Pa (50 mm of water column).

11.8 Compatibility with products used for disinfection of networks (stage 8)

11.8.1 General

All the constituent parts of the device, and in particular those parts made of elastomers, shall be compatible with the treated water used for the disinfection of the networks using potassium permanganate or sodium hypo-chlorite.

11.8.2 Procedure

This compatibility is verified by exposing the internal parts of devices

— for 96 h into contact with a solution containing 0,30 g of potassium permanganate per litre of deionized water (conductivity ≥ 2,5 µS/m),

— for 24 h into contact with a solution containing 0,10 g of sodium hypo-chlorite per litre of deionized water (conductivity ≥ 2,5 µS/m),

Each of these tests shall be carried out under a static pressure of 0,8 MPa (8 bar) measured upstream, at a temperature of 20 °C.

11.8.3 Requirement

All materials shall be unaffected; this will be proven by executing the remaining tests.

11.9 Endurance (stage 9)

11.9.1 Test equipment

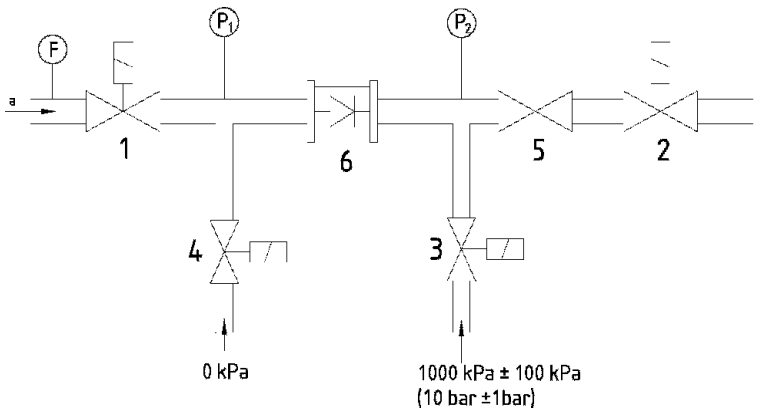


Figure 9 — Endurance testing equipment

The test rig consists of:

— remote control valves (1), (2), (3) and (4). Specifications:

  — The valve arrangement shall ensure a total increase of pressure within one second without the risk of pressure peaks.

  — For devices DN ≥ 65 valves (1) and (2) shall open and close slowly.

— control valve (5), e.g. needle valve, capable of fine regulation to control velocity to between 1 m/s and 2 m/s;

— flow meter (F), accurate to ± 5 % of reading;

— pressure gauges (P_1) and (P_2).

11.9.2 Procedure

11.9.2.1 Install the test device in the test rig as shown in Figure 9, using appropriate adapters, if necessary.

11.9.2.2 With valves (1) and (2) open and valves (3) and (4) closed adjust by valve (5) a flow rate through the device equal to a flow rate as given in Table 8, with a tolerance of ± 10 %.

Table 8 — Nominal size vs endurance test flow rate

Nominal size of Check valve DN	6	8	10	15	20	25	32	40	50	65	80	100	125	150	200	250
Endurance test Flow rate — litres/s	0,06	0,1	0,15	0,35	0,65	1	1,6	2,5	4	4,5	5	7	12	18	31	49

11.9.2.3 With valves (3) and (4) open and valves (1) and (2) closed adjust the supply pressure at valve (3) to (1 000 ± 50) kPa (10 ± 0,5) bar (reading on P_2).

NOTE Having achieved the correct settings in 11.9.2.2 and 11.9.2.3 the pressure gauges P_1 and P_2 may be isolated or snubbed.

11.9.2.4 Cycle time

11.9.2.4.1 Check valve DN ≤ 50

Arrange for the remote control valves to be operated automatically so that the conditions specified in 11.9.2.2 and 11.9.2.3 exist alternately each for a period of 6 s ± 1 s with a changeover time of 1 s ± 0,5 s. Pressure pulse shall be no higher then 10 % of the applied pressure.

For pressure/time diagram see Figure 10 (informative).

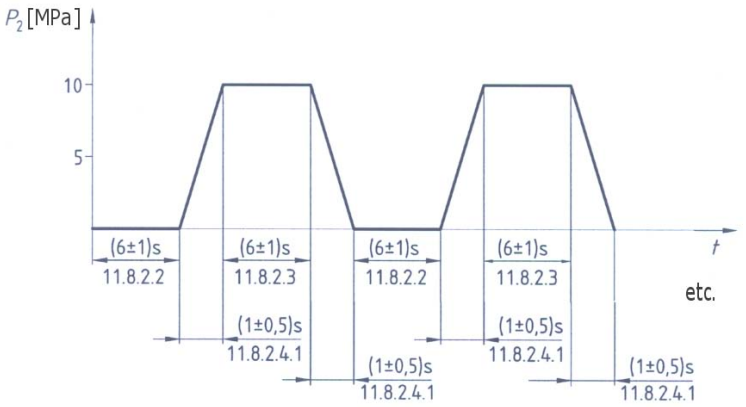


Figure 10 — Pressure/time diagram of endurance testing (DN ≤ 50)

11.9.2.4.2 Check valve DN ≥ 65

Arrange for the remote control valves to be operated automatically so that the conditions specified in 11.9.2.2 and 11.9.2.3 exist alternately each for a period of 6 s ± 1 s with an overall cycle time of 30 s. Pulse pressures shall be no higher than 10 % of the applied pressure. Valves (1) and (2) shall open slowly.

For pressure/time diagram see Figure 11 (informative).

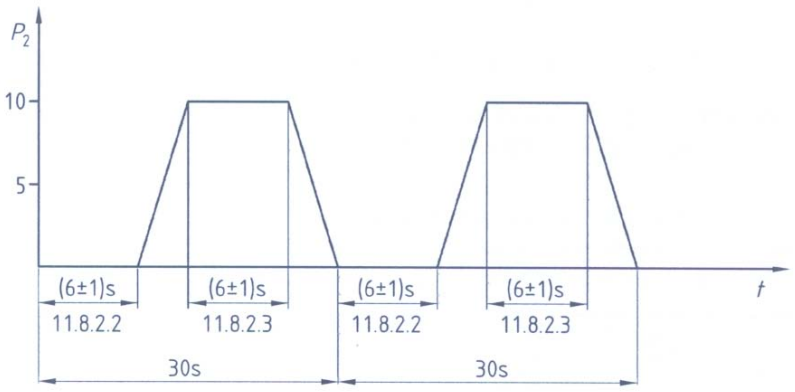


Figure 11 — Pressure / time diagram of endurance testing (DN ≥ 65)

11.9.2.5 Temperature

11.9.2.5.1 Devices DN ≤ 50

The temperature for the water supply shall be 90 °C for 1 h and then lowered to 65 °C.

11.9.2.5.2 Devices DN ≥ 65

The temperature for the water supply shall be 65 °C.

11.9.3 Requirement

11.9.3.1 Devices DN ≤ 50: Repeat this cycle $80{,}000^{+\,100}$ times.

11.9.3.2 Devices DN ≥ 65: Repeat this cycle $25{,}000^{+\,100}$ times.

11.10 Pressure tightness under a low reverse pressure differential (stage 10)

For procedure and requirements, see 11.5.

11.11 Pressure tightness under a high reverse pressure and verification that the check valve has not jammed (stage 11)

For procedure and requirements, see 11.6.

11.12 Pressure differential at which the check valve closes (stage 12)

For procedure and requirements, see 11.7.

12 General working characteristics

12.1 Resistance to corrosion

12.1.1 General

The test applies only to devices having the following:

— a ferrous alloy body;

— a body with an internal coating.

12.1.2 Procedure

The test shall be performed in accordance with the neutral salt spray test of ISO 9227. The test shall last 200 h. Prepare the devices so that the inside is properly exposed (by dismantling or blocking of the obturator in the opening position).

12.1.3 Requirements

At the end of the test, the internal surface shall not exhibit any sign of corrosion, corrosion pitting, cracking or blowholes.

12.2 Acoustic characteristics

12.2.1 General

This clause specifies the test method for classifying devices up to DN 32 inclusive by acoustic group. Cartridge check valves shall be mounted in the appropriate test housings.

12.2.2 Procedure

12.2.2.1 Mounting and operating conditions

This shall be carried out in accordance with the requirements of EN ISO 3822-3.

12.2.2.2 Test methods

The tests shall be carried out in accordance with the requirements of EN ISO 3822-1 and EN ISO 3822-3.

12.2.3 Test criteria

12.2.3.1 Expression of the results

The results of the measurements carried out in accordance with EN ISO 3822-3 shall be expressed as appliance sound level pressures L_{ap} in dB (A).

12.2.3.2 Noise classification

Check valves shall be classified in accordance with the L_{ap} as given in Table 9.

Table 9 — Noise classification of inline check valves

Acoustic group	L_{ap} dB(A) at 0,3 MPa (3 bar)
I	< 20
II	$20 \leq L_{ap} \leq 30$
Not classified	> 30

13 Presentation at delivery

The device shall be protected from the time of manufacture to the time of installation against:

— damage to threaded ends;

— outside contamination of inlet and outlet orifices.

When technical documents are a part of the delivery, these documents shall comply with 6.2 and with the general standard EN 1717.

Annex A
(informative)

Numbers of test devices/tests

Number of Test devices/tests				
Test	Clause	Test device(s)	Test device (s)	Test device (s)
High velocity test	11.1	X		
Flow rate / Pressure loss test	11.2	X		
Mechanical strength of body.	11.3	X		
Bending moment test.	11.4	X		
Pressure tightness under a low reverse pressure differential.	11.5 11.10	X		
Pressure tightness under a high reverse pressure and verification that the device has not jammed.	11.6 11.11	X		
Pressure differential at which the device closes.	11.7 11.12	X		
Compatibility with products used for disinfection of the installation.	11.8	X		
Endurance tests.	11.9	X		
Resistance to corrosion.	12.1		X	
Acoustic characteristics	12.2			X

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