



# **Non-return valves**

## **Requirements and test methods**

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## VdS Guidelines for water extinguishing systems

# Non-return valves

## Requirements and test methods

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## 1 Scope

These guidelines specify the requirements and test methods for non-return valves for the use in stationary water extinguishing systems according to VdS CEA 4001 und VdS 2109.

These guidelines are applicable to non-return valves  $\geq$  DN50 in the main water flow.

## 2 Normative references

These Guidelines incorporate, by dated or undated references, provisions from other publications (e.g. European Standards EN or International Standards IEC), which are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these Guidelines only when incorporated in them by amendment or revision. For undated references the latest edition of the publication referred to applies.

VdS CEA 4001	Guidelines for sprinkler systems – Planning and installation
VdS 2109	Guidelines for water spray systems – Planning and installation
VdS 2100-06	Guidelines for water extinguishing systems – Requirements and test methods for pipe joints
DIN EN 1092	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated
DIN EN ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation
EN 764-1	Pressure equipment – Part 1: Terminology – Pressure, temperature, volume, nominal size

## 3 Definitions

For the use of these Guidelines the following definitions apply:

**Operating pressure:** Pressure specified by the manufacturer and with which the component may be operated. The test pressures are calculated and the tests are conducted on the basis of this value.

**Maximum allowable pressure:** Maximum pressure for which the device is designed according to the specifications of the manufacturer (EN 764-1). Based on this value the test pressures are calculated and the tests are conducted unless the working pressure has been specified.

**Nominal cross section:** Calculated cross section on basis of the nominal diameter (e.g. 50 mm for DN 50)

**Main water flow:** Pipework between water source and sprinkler/nozzle

## 4 Requirements

### 4.1 Technical documentation

4.1.1 The following shall be specified in the technical documentation:

- the nominal size;
- the maximum allowable pressure and/or operating pressure (at least 10 bar);
- the allowable flow velocity in relation to the nominal cross section (at least 6 m/s).

Remark: In case of a series of non-return valves with several sizes where the different sizes are identical in construction, the individual nominal sizes may be specified differently.

The following should be specified in the technical documentation:

- pressure loss in mbar at flow velocity 5 m/s (table or diagram).

4.1.2 The following documents are required:

a) Manufacturing documents:

- Assembly drawing;
- All detail parts drawings;

The marking according to 4.2 shall be documented in the drawings.

b) User documentation:

- Data sheet with
  - details according to 4.1.1;
  - specification of the joints;
  - outer dimensions of the non-return valve including dimension for the parts protruding from the body;
  - installation instruction (way and sequence of mounting); including distances to be observed with non-return valves where parts can protrude into connected components (e.g. valves, pumps);
  - requirements on environment, if necessary;
  - maintenance instructions.

c) List of documents:

- A list (with revision state and/or date) containing all above mentioned documents (each with designation and drawing number as well as revision state and/or date).

### 4.2 Marking

Non-return valves shall be marked with following details:

- Name or trademark of manufacturer/supplier;
- Type designation;
- Nominal size;
- Maximum allowable pressure and operating pressure (if specified; with wording “maximum operating pressure according VdS”);

- Flow direction;
- "VdS".

This marking shall be non-detachable, non-flammable, permanent and well legible in mounting position.

*Note: A marking by means of adhesive foil or similar measures is not acceptable.*

### 4.3 Connections

The connections at the inlet and outlet of the non-return valve shall be designed as

- Thread connection, preferably according to ISO 7-1 or DIN EN ISO 228-1; or
- Flange connection, preferably according to DIN EN 1092; or
- Pipe coupling connection according to annex A (only allowable for materials according annex A), or
- Pipe coupling connection according to groove specification of one or several manufacturers of couplings or relevant standards.

### 4.4 Design

**4.4.1** There shall be sufficient play between all moving and stationary parts to ensure proper function even if corrosion and deposits have formed. It shall be possible for the closing component to move into and out of the closed position despite deposits.

There shall be a clearance of at least 3 mm between seat rings and metal parts of the valve disc, e.g. the seal support.

There shall be a clearance of at least 12 mm, with corrosion resistant material of at least 6 mm, between casing, edge of the valve disc and lever hub in all positions.

**4.4.2** Corrosion and ageing shall not have any adverse effects on the functioning of the non-return valve. Seals and gaskets shall not tend to stick.

All parts which slide one against the other shall be manufactured from corrosion resistant metal.

Seat rings shall be manufactured from corrosion resistant metal and when used in casings made of ferrous metal they shall protrude with at least 3 mm from the casing surface.

**4.4.3** The body shall be made of metal with a melting point  $> 800^{\circ}\text{C}$ . For pressures  $> 12,5$  bar, the body shall be made of ductile material as e.g. ductile cast iron or at least equivalent.

**4.4.4** Maintenance oder cleaning of the non-return valve as well as replacement of wearing parts (sealings) should be possible through sufficiently dimensioned hand holes, so that the valve does not need to be removed from the pipework and the downtime is minimised.

### 4.5 Performance characteristics

**4.5.1** Non-return valves shall be tested according to 5.3 to 5.8 and shall fulfil the requirements described there.

**4.5.2** Non-return valves with pipe coupling connection which does not comply with Annex A shall additionally be tested according to 5.9 and fulfil the requirements described there.

## 4.6 Dimensional accuracy and wear

In the test according to 5.10 after completion of the performance characteristics tests, the following requirements shall be fulfilled:

- dimensional compliance;
- no plastic deformation which could impair proper function;
- no signs of wear which could impair proper function.

# 5 Tests

## 5.1 Test conditions and test samples

### 5.1.1 Test conditions

The tests are conducted at a temperature of  $(25 \pm 10)$  °C unless otherwise specified for a specific test.

The tolerance of all test parameters is  $\pm 5$  % unless specified otherwise.

### 5.1.2 Test samples

If **one** non-return valve is tested two test samples are needed as well as:

- one additional test sample for corrosion test, if corrosion test is necessary;
- one additional test sample for bending test, if pipe coupling connection does not comply with Annex A.

If a series of non-return valves (with several sizes where the different sizes are identical in construction) is tested one sample of each nominal size is needed as well as additional test samples as agreed with VdS for e.g. pressure loss measurements, corrosion tests (if necessary), bending tests (if necessary).

## 5.2 Compliance test

The test samples are checked visually and dimensionally for compliance with the description given in the technical documentation (drawings, parts lists and instructions for assembly) and for compliance with the auditable requirements of these guidelines.

## 5.3 Resistance to corrosion and ageing test

It is checked on the basis of the drawings, the parts lists and the test sample, whether or not corrosion and ageing may have a detrimental effect on the performance characteristics of the valve. In case of doubt, corresponding tests have to be conducted.

Valves with internal coating are always subjected to a salt spray corrosion test.

The test sample is subjected to a salt spray in a mist chamber. Inlet and outlet of the shut-off valve are open. The essential components and properties of the reagents and the test conditions are

- NaCl dissolved in distilled water
- pH-value: 6,5 - 7,2

- concentration of the solution:  $(50 \pm 5)$  g/l;
- spray pressure: 0.7 bar to 1.7 bar
- spray volume: 1 ml/h to 2 ml/h on a surface of 80 cm<sup>2</sup>;
- temperature in the test chamber:  $(35 \pm 2)$ °C
- spray time:  $(240 + 6)$  h;
- drying time:  $(168 \pm 5)$  h at a relative humidity of maximum 70 %.

After the test the coating shall be undamaged. There shall be no signs of delamination or subsurface corrosion.

#### 5.4 Test of the mechanical strength

The tests described below are preferably conducted in the sequence indicated:

Test	Test medium	Pressure	Test period/cycles	Requirements
Body pressure test	water	4 times maximum allowable pressure or 4 times operating pressure (see section 3)	10 min	no cracks, breakage or inadmissible plastic deformations
Body leakage test	air	10 bar	10 min	no leakage
Leakage test of the closing component	water	2 bar towards closing component	10 min	permissible leak rate: 30 droplets/min
Strength test of closing component	water	4 times maximum allowable pressure or 4 times operating pressure	10 min	no cracks, breakage or inadmissible plastic deformations
Water hammer test of the body	water	between approx 3.5 bar and (maximum allowable pressure or operating pressure plus 25) bar alternately	3000 cycles	no cracks, breakage or inadmissible plastic deformations
Water hammer test of closing component	water	between approx 3.5 bar and (maximum allowable pressure or operating pressure plus 25) bar alternately	3000 cycles	no cracks, breakage or inadmissible plastic deformations



## 5.5 Function test

The non-return valve is installed in the acceptable mounting position or positions in a pipeline. The opening characteristics are checked twice at each inlet pressure of 0.5 bar, 1 bar, 6 bar, 10 bar and maximum allowable pressure or working pressure.

During this test the following values are recorded and plotted against time:

- the pressure upstream the non-return valve (inlet pressure);
- the water flow;
- $\Delta p$  of the non return-valve.

During the test with inlet pressures  $\geq 1$  bar it is required that

- non-return valves up to DN 80 shall have opened when the inlet pressure has reached 1.3 times the pressure downstream the non-return valve;
- non-return valves  $\geq$  DN 80 shall have opened when the inlet pressure has reached 1.2 times the pressure downstream the non-return valve.

During the test with inlet pressures  $< 1$  bar it is required that

- non-return valves up to DN 80 shall have opened at a differential pressure of 0.3 bar;
- non-return valves  $\geq$  DN 80 shall have opened at a differential pressure of 0.2 bar.

## 5.6 Pressure loss test

In case of a series of non-return valves (with several sizes where the different sizes are identical in construction) the test is conducted with each nominal size unless the manufacturer has given details on the pressure loss. If details are specified they are verified in spot checks. The permissible deviation is 15 %.

The pressure loss is measured using a steel pipe measuring section with a straight inlet pipe of a length of at least 10 times the nominal diameter and a straight outlet pipe of a length of at least 5 times the nominal diameter.

The pressure loss is determined at a flow velocity of 5 m/s in relation to the nominal cross section. The value determined is used to calculate the equivalent length.

The pressure loss shall not exceed 0.5 bar at a flow velocity of 5 m/s in relation to the nominal cross section and the clear flow cross section in the fully open position shall be at least 60 % of the nominal cross section.

If the flow cross section is smaller than 60%, the maximum permissible pressure loss is 0.2 bar at 5 m/s.

## 5.7 Flow test

The non-return valve is subjected to 1.25 times the allowable flow velocity specified by the manufacturer for 90 min, however at least 7.5 m/s (in relation to the nominal cross section). The upstream pressure is preferably 1.5 bar.

The flow test shall ensure that the shut-off valve does not endanger the safe operation of the extinguishing system (e.g. by loosening of parts).

During and after the test there shall be no signs visible of:

- inadmissible plastic deformation, or

- loosening of parts, or
- changes which endanger the safe operation.

### **5.8 Wear test**

The non-return valve is operated 3000 times by intermittent water flow.

During and after the test there shall be no signs visible of:

- inadmissible plastic deformation or
- loosening of parts, or
- changes which endanger the safe operation.

### **5.9 Pressure test with bent pipes**

*Note: Only for non-return valves with pipe coupling connection which does not comply with Annex A.*

The test is conducted according to VdS 2100-06 (pressure test with bent pipes).

During the test the connection shall be held safely together and be tight.

### **5.10 Measurement and wear check**

After the tests have been conducted, the non-return valve is disassembled and checked for dimensional accuracy, manufacturing quality and wear in compliance with the drawings. No wear may be present which could impair proper functioning.

### **5.11 Other tests**

Where necessary due to special designs or new manufacturing methods, additional tests will be conducted in agreement with the manufacturer.

## Annex A Dimensions for groove connections

This annex contains the dimensions for valve connections for use with pipe couplings.

Valid for cutting machined connections of malleable iron, cast ductile iron, steel or cast steel with 350 N/mm<sup>2</sup> minimum tensile strength.

Nominal size		Nominal outer diameter in mm	Nominal outer diameter in mm		Pipe length up to groove in mm ± 0,76	Groove width in mm ± 0,76	Diameter at groove ground in mm	
			max.	min.			max.	min.
DN	25	33.7	33.73	33.07	15.87	7.92	30.23	29.85
DN	32	42.4	42.57	41.76	15.87	7.92	38.99	38.61
DN	40	48.3	48.74	47.78	15.87	7.92	45.09	44.70
DN	50	60.3	60.94	59.72	15.87	7.92	57.15	56.77
DN	65	76.1	76.85	75.35	15.87	7.92	72.26	71.80
DN	80	88.9	89.79	88.11	15.87	7.92	84.94	84.48
DN	100	114.3	115.44	113.51	15.87	9.52	110.08	109.58
DN	125	139.7	141.10	138.91	15.87	9.52	135.48	134.97
DN	150	168.3	169.85	167.49	15.87	9.52	163.95	163.40
DN	200	219.1	220.65	218.29	19.05	11.13	214.40	213.77
DN	250	273	274.62	272.26	19.05	12.70	268.27	267.59
DN	300	323.9	325.42	323.06	19.05	12.70	318.29	317.53

Remark 1: Groove shoulder flash-free with cutting up to max. 0.3 mm x 45°.

Remark 2: Groove ground with radius up to max. 0.8 mm.

**Table A.1:** Dimensions for valve connections