



# **Pipe Joints**

## **Requirements and Test Methods**

Publisher and Publishing house: VdS Schadenverhütung GmbH

Amsterdamer Str. 174

D-50735 Köln

Phone: #49-221-77 66-0, Fax: #49-221-77 66-341

Copyright by VdS Schadenverhütung GmbH. All rights reserved.

# Guidelines for water extinguishing systems

## Pipe Joints

### Requirements and Test Methods

#### CONTENTS

<b>1</b>	<b>General</b> .....	<b>4</b>
1.1	Scope.....	4
1.2	Validity .....	4
<b>2</b>	<b>Normative references</b> .....	<b>5</b>
<b>3</b>	<b>Definitions</b> .....	<b>5</b>
<b>4</b>	<b>Requirements</b> .....	<b>5</b>
4.1	Technical documentation.....	5
4.2	Marking .....	6
4.3	Nominal diameters and connections .....	6
4.4	Performance characteristics .....	6
<b>5</b>	<b>Tests</b> .....	<b>7</b>
5.1	Test conditions and test specimens .....	7
5.2	Preliminary test and identification.....	9
5.3	Assembly of the test joint.....	9
5.4	Mechanical strength test.....	10
5.5	Flame test .....	12
5.6	Temperature resistance test.....	13
5.7	Torsion test .....	13
5.8	Other tests .....	14
	<b>Appendix A Test apparatus for pipe joints</b> .....	<b>14</b>
	<b>Appendix B Dimensions for valve/fitting connections</b> .....	<b>15</b>

# 1 General

## 1.1 Scope

These guidelines specify the requirements and test methods for detachable pipe joints used for the connection of steel pipes, adapter units and valves/fittings of a nominal diameter of DN 25 to DN 300 in pipe work of water extinguishing systems up to a maximum permissible pressure of 16 bar.

These guidelines can also be used as a guide for tests of detachable pipe joints of smaller or larger nominal diameters and for tests of other types of pipe joints (e.g. non-detachable joints).

These guidelines do not apply special fittings such as for example tapping sleeves or quick tees.

*Note 1: The manufacturer is free to specify a value > 16 bar for the maximum permissible pressure. In such a case the tests are conducted and documented for the specified pressure value. The approval certificate will, however, limit the application to 16 bar. The suitability for application at higher pressures will be assessed on a case to case basis. It will be decided in each individual case whether additional tests and/or measures become necessary.*

*Note 2: The use of pipe joints tested according to these guidelines for use also in combination with valves/fittings and adapter units will be released based on a corresponding declaration of the manufacturer and without any tests with test specimens. This applies, however, only to grooved joints and provided, that the manufacturer's declaration limits the use to machined connections of valves/fittings according to Appendix B.*

*Note 3: These guidelines provide for a torsion test of pipe joints  $\leq$  DN 40 since these components are used also for a connection of pipes exposed to an angular momentum (e.g. by laterally connected sprinklers).*

The pipe ends can be plain ends for couplings without grooves or grooved ends for grooved couplings. The pipe joints may consist of one or several parts and pipe joints may provide for a friction or keyed connection of the pipes. The connection must be detachable.

The pipe joints must be able to take-up both axial and radial forces and bending moments and center the pipe ends to be connected.

A flexible sealing element is normally used for the sealing of the pipe joint.

## 1.2 Validity

These rules apply from 01. January 2003; they replace the rules in VdS 2100 Richtlinien für Wasserlöschanlagen (1988-05), chapter "Anforderungen und Prüfmethode für elastische Rohrkupplungen"; equal to VdS 2100-10:1988-02 on VdS 2573 (CDROM).

*Note: This is a translation of the German rules; if there are any discrepancies, the German version shall be binding.*

## 2 Normative references

These rules contain dated and undated references to other publications. The normative references are cited at the appropriate places in the clauses, the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these rules only when announced by a change of these rules. For undated references the latest edition of the publication referred will be applied.

- **DIN 2448** Seamless steel pipes; dimensions, mass per unit length
- **DIN 2458** Welded steel pipes; dimensions, mass per unit length

## 3 Definitions

**Permissible pressure:** The pressure level at which the test shall be conducted as specified by the manufacturer. The test pressures are calculated on the basis of this pressure level.

## 4 Requirements

### 4.1 Technical documentation

The following documentation shall be submitted:

a) Manufacturing documents

- Assembly drawing
- Drawings of all individual parts

The marking according to clause 4.2 shall be documented in the drawings. If the marking is applied in coded form the meaning of the codes must be documented in the drawings.

b) User documentation

- Data sheet
- Assembly instructions with at least
  - Description of the pipe ends to be connected by the pipe joint (with exact dimensions for the required grooves, if applicable),
  - Type and sequence of assembly
  - Tightening torque values (e.g. table of tightening torque values for different nominal diameters),
  - Specification of the lubricant, if lubricants are necessary
  - Details of incompatibilities of materials, if necessary (e.g. incompatibility of EPDM seals and mineral oil products)

c) List of documents with the manufacturer's designations, drawing No., revision's state, date, containing all above mentioned documents providing designation, drawing No., revision's state and date.

## 4.2 Marking

The pipe joints must be marked with the following information:

- Manufacturer's/supplier's name or trade mark
- Nominal diameter
- Type designation
- Mark according to VdS 2344 as VdS-approved

This marking shall be non-detachable, permanent, non-combustible, and well legible in installed position of the joint.

*Note: Marking by means of plastic foil stickers or similar measures is not acceptable.*

Moreover, the most important individual components (especially the housing and the seal(s)) shall have markings or codes which permit the manufacturer/supplier of the pipe joint to identify at least the following:

- Date or period of manufacture or batch No.
- Place of manufacture (if the individual part is produced in parallel at several manufacturing sites or if the place of manufacture changes)
- Manufacturing process (if the individual part is produced in parallel on the basis of several manufacturing processes/methods or if the manufacturing process/method changes)
- Material (if the individual part is made in parallel using several types of material/mixtures and if the material/material mix changes)

If the seal can be removed without the use of a tool, the seal shall also be permanently marked as follows:

- Type designation of the pipe joint for which it is used
- Mark according to VdS 2344 as VdS-approved

## 4.3 Nominal diameters and connections

The range of nominal diameters DN 25 to DN 300 includes the following nominal diameters (DN): 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250 and 300.

The pipe joints must be specified for the use with outer pipe diameters according to Table 5.2.

For grooved couplings the manufacturer may specify additionally the use for connecting valves/fittings provided he confirms the suitability of his coupling for machined connections of valves/fittings according to Appendix B and provided he specifies these connections for valves/fittings accordingly in his user information.

## 4.4 Performance characteristics

The manufacturer shall specify the permissible pressure. The permissible pressure shall be at least 10 bar.

*Note: See also clause 1.1, Note 1.*

When tested according to clauses 5.4, 5.5 and 5.6, pipe joints shall fulfil the requirements described there.

When tested according to clause 5.7, pipe joints  $\leq$  DN 40 shall fulfil additionally the requirements described there.

The manufacturer may exclude the use in pump suction lines. In this case the vacuum test does not apply.

## 5 Tests

### 5.1 Test conditions and test specimens

#### 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 modules and test specimens

The following test modules (tests and test sequence always for one test specimen) are specified for the testing of the pipe joints.

Test module	A	B1	B2	B3	B4	B5	C1	C2
5.2.1 Compliance	1	1	1	1	1	1	1	1
5.4.1 Pressure		2	2	2				
5.4.2 Pressure under bending stress		3	3	3				
5.4.3 Water hammer		4	4					
5.4.4 Leakage test		5	5					
5.4.5 Vacuum test <sup>1)</sup>		6	6					
5.5 Flame test		7			2			
5.6.1 Temperature resistance -20 °C							2	
5.6.2 Temperature resistance +110 °C								2
5.7 Torsion test <sup>2)</sup>						2		
1) canceled, if manufacturer exclude the use in pump suction lines								
2) only for pipe joints $\leq$ DN 40								
<b>Table 5.1: Test modules and test sequence</b>								

If **one** pipe joint element (one nominal diameter) is tested a test schedule will be set up with at least the following test modules and test specimens:

- a) 1 test specimen for test module A
- b) 1 test specimen for test module B1 **or** 1 test specimen for test module B2 plus 1 test specimen for test module B4 (selected in agreement with the manufacturer)
- c) 1 test specimen for test module C1
- d) 1 test specimen for test module C2

- e) 1 test specimen for test module B5 (only for pipe joints of nominal diameters DN 25 to DN 40)

In connection with clauses 5.2.2 and 5.7 additional test specimens may be necessary.

If a series of several pipe joints of identical design with different nominal diameters is tested, it is not necessary to conduct all tests with each nominal diameter.

A series-specific test schedule will be set up according to the following rules:

- a) 1 test specimen of each nominal diameter for test module A
- b) 1 test specimen of an optional nominal diameter for test module C1 (selected in agreement with the manufacturer)
- c) 1 test specimen of an optional nominal diameter for test module C2 (selected in agreement with the manufacturer)
- d) 1 test specimen of the smallest nominal diameter for test module B2
- e) 1 test specimen of the largest nominal diameter for test module B2
- f) 1 test specimen for test module B1 **or** 1 test specimen for test module B2 plus 1 test specimen for test module B4 (selected in agreement with the manufacturer)

*Note: The nominal diameter is selected according to the following priority: DN 100, DN 125, DN 150, DN 200, DN 250, DN 300, ≤ DN 50, DN 65, DN 80. A positive test result indicates that the requirements of flame resistance have been met for the tested nominal diameter and for the following nominal diameters specified in this priority list.*

- g) 1 test specimen of each nominal diameter for test module B3 except the nominal diameters specified under d), e) and f)
- h) 1 test specimen ≤ DN 40 for test module B5 (only if the series also includes nominal diameters DN 25 to DN 40)

In connection with clauses 5.2.2 and 5.7 additional test specimens may be necessary.

2 pipe ends of 750 mm length shall be supplied together with each test specimen for the test modules B1, B2, B3 and B4.

2 pipe ends of 150 mm length shall be supplied together with each test specimen for test modules B5, C1 and C2. Hexagonal nuts M 10 of wrench size 17 must be welded centrally to the terminations of the pipe ends for test module B5.

S235JR (ST37-2) steel pipes according to Table 5.2 shall be supplied for the pipe ends.

*Note: The pipe dimensions given in Table 5.2 for tests up to the permissible pressure of 12.5 bar are preferred dimensions for welded steel pipes according to DIN 2448 and/or DIN 2458.*

Nominal diameter DN	Nominal diameter Inch	Outer diameter in mm	Wall thickness in mm Permissible pressure up to 12.5 bar	Minimum wall thickness in mm Permissible pressure up to 16 bar	Minimum wall thickness in mm Permissible pressure up to 25 bar
25	1 "	33.7	2.0	2.0	2.0
32	1 ¼"	42.4	2.3	2.3	2.3
40	1 ½ "	48.3	2.3	2.3	2.3
50	2 "	60.3	2.3	2.3	2.6
65	2 ½ "	76.1	2.6	2.6	2.9
80	3 "	88.9	2.9	2.9	3.1
100	4 "	114.3	3.2	3.2	3.6
125	5 "	139.7	3.6	3.6	4.1
150	6 "	168.3	4	4.1	4.7
200	8 "	219.1	4.5	4.9	5.7
250	10 "	273.0	5	5.8	6.8
300	12 "	323.9	5.6	6.7	7.8

**Table 5.2:** Dimensions for pipe ends

If pipe ends must be provided with grooves, these grooves shall be rolled and shall correspond with the dimensions indicated by the manufacturer.

## 5.2 Preliminary test and identification

### 5.2.1 Compliance test

The test specimens 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.

### 5.2.2 Resistance to corrosion and ageing test

It shall be checked on the basis of drawings, parts lists and, if necessary, also test specimens, whether or not corrosion and ageing may have a detrimental effect on the performance characteristics of the pipe joint. In case of doubt, corresponding tests have to be conducted.

## 5.3 Assembly of the test joint

The pipe ends supplied by the manufacturer shall be checked for compliance with the requirements (see clause 5.1).

The test joint (test specimen and pipe ends) is mounted according to the manufacturer's instructions for assembly.

## **5.4 Mechanical strength test**

### **5.4.1 Pressure test**

The test joint is mounted on the test apparatus according to Appendix A.

The test joint is then completely filled with water and exposed to a test pressure which corresponds to 4 times the permissible pressure. The test pressure is maintained for 10 minutes. The test joint is then pressure relieved.

The pipe joint shall keep the test joint safely together and there must be no signs of

- leaks,
- plastic deformations or ruptures of the material of the pipe joint,
- sliding of the pipe joint on the pipe once the test pressure had been reached or
- a projecting sealing element.

### **5.4.2 Pressure test under bending stress**

The screwed union of the pipe joint shall be re-tightened on the pressure relieved test joint which is still filled with water. The test joint shall then be subjected to a test pressure which corresponds to 4 times the permissible pressure.

According to Appendix A, force  $F$  is then applied for generating the bending moment according to Table 5.3 and the generated U-bend is documented. The duration of the exposure is 10 minutes. During this period of time the test force may decrease, however, as soon as the test force drops below 75% of the force required for generating the bending moment according to Table 5.3, the test force is increased again to the required level for generating the bending force according to Table 5.3. The test joint is pressure relieved after 10 minutes (force and internal pressure).

The pipe joint shall keep the test joint safely together and there shall be no signs of

- leaks,
- plastic deformations or ruptures of the material of the pipe joint or
- a projecting sealing element.

Nominal diameter	Outer diameter in mm	Bending moment in Nm
25	33.7	up to 1,000 <sup>1)</sup>
32	42.4	up to 1,000 <sup>1)</sup>
40	48.3	up to 1,000 <sup>1)</sup>
50	60.3	1,000
65	76.1	1,280
80	88.9	1,950
100	114.3	2,940
125	139.7	6,130
150	168.3	8,830
200	219.1	19,080
250	273.0	31,800
300	323.9	52,560
<p>1) Maximum 1000 Nm, however not higher than the bending moment at which the pipe starts deforming plastically.  <i>Note: For reducing joints the dimension of the smaller nominal diameter shall apply for the determination of the bending moment.</i></p>		
<b>Table 5.3:</b> Table of bending moments		

### 5.4.3 Water hammer test

The test joint filled with water, as left after the test according to clause 5.4.2, is shock-pressurised (test medium water) as follows:

- Number of water hammer cycles: 3000
- Test pressure: permissible pressure + 25 bar

Before each water hammer cycle the pressure in the test joint shall not exceed 4 bar.

The pipe joint shall keep the test joint safely together and there shall be no signs of

- leaks,
- plastic deformations or ruptures of the material of the pipe joint or
- a projecting sealing element.

### 5.4.4 Leakage test

The water is completely drained from the test joint.

The test joint is then pressurised with air for 10 minutes with a test pressure corresponding to the maximum permissible pressure or to 12.5 bar, whichever is lower, and is subsequently checked for leaks by a leak indicator spray.

The test joint is then pressure relieved.

The joint must be leak proof.

### 5.4.5 Vacuum test

*Note: This test is not conducted for pipe joints for which application in pump suction lines is excluded by the manufacturer.*

The pressure in the test joint is decreased for 10 minutes by 0.6 bar below ambient pressure.

The test joint must be leak proof.

## 5.5 Flame test

The test shall be conducted in a room free from air draught.

The test joint is mounted, U-bent on the test apparatus according to Appendix A and filled with water. The angle corresponds to the angle documented as a result of the test according to clause 5.4.2. Subsequently the test joint is drained.

*Note: The test sample is considered to be drained, if just only that amount of the water remains in the test joint which would remain after outlet out of the non-bent pipe end over a rolled groove.*

If no information from a test according to clause 5.4.2 is available, the test joint shall be filled with water, pressurised with a test pressure which corresponds to 4 times the maximum permissible pressure and exposed according to Appendix A to a force F for generating the bending moment according to Table 5.3. The angular deflection produced shall be documented. The test joint is then pressure relieved (force and internal pressure), angled as documented and drained (see note above).

The fuel pan (stainless steel (VA) of 2 mm wall thickness, dry and clean) is placed centrally below the pipe joint according to Appendix A.

Fuel is filled into the pan and the fuel is ignited.

Test parameters:

- Fuel                    Methanol
- Filling volume    0.5 litres for nominal diameters < DN 100; 1.0 litre for nominal diameters ≥ DN 100  
                          For reducer couplings the dimension of the smaller nominal diameter shall apply for the determination of the filling volume.
- Burning time       5 min for nominal diameters < DN 100; 8 min for nominal diameters ≥ DN 100  
                          For reducer couplings the dimension of the smaller nominal diameter shall apply for the determination of the burning time.

The flame shall be extinguished immediately once the burning time has expired (5 min or 8 min) and the test joint shall be cooled down. For cooling the test joint is immediately sprayed with water until steam formation is no longer visible, but at least for 3 min.

The test joint is then filled completely with water and exposed to a test pressure which corresponds to the maximum permissible pressure and is checked visibly for leaks. Water may leak in form of drops, however, not in form of flowing water or a water spray. The test joint is then pressure relieved (force and internal pressure).

## 5.6 Temperature resistance test

### 5.6.1 Temperature resistance at -20 °C

The pipe joint is mounted between two pipe ends as shown in the figure of Appendix A measuring, however,  $L = 150$  mm.

The test joint is pressurised with an air pressure of 3.5 bar and is cooled down to -20 °C. This temperature is maintained over 12 days. The test joint is then taken out of the cold room and exposed immediately again to an air pressure of 3.5 bar and is then checked for leaks with a leak indicator spray. The test joint must be leak proof in this condition.

Having warmed up to room temperature the test joint is removed with care and the seal is examined visually without and with physical strain.

**Without strain:** Minor plastic deformation is acceptable. Deformation which may impair the proper function of the unit are not acceptable. Thermal exposure shall not have resulted in the formation of cracks.

**With strain:** After a deformation in form of a figure "eight" (8) the seal shall not show any further cracks or further permanent plastic deformation. The figure "eight" is formed in two ways:

- by compression of two diagonally opposite points and
- by twisting the seal.

The seal is left and observed in each of these two positions for one minute.

### 5.6.2 Temperature resistance at 110 °C

The test is conducted according to clause 5.6.1, however with the following modifications:

- Test temperature 110 °C.
- Before thermal exposure the test joint is pressurised with an air pressure of 3.5 bar only for a short period of time and is checked for leaks and then pressure relieved.
- Before thermal exposure the test joint is filled 10 % to 20 % with water.
- The leakage test directly after thermal exposure is not conducted. Instead a leakage test according to clause 5.4.4 is conducted after the test joint has cooled down to room temperature.

## 5.7 Torsion test

*Note: This test relates to pipe joints  $\leq DN 40$  only.*

The test joint is filled with water and exposed once to the maximum permissible pressure and is then pressure relieved again. Subsequently the test joint is fixed on one pipe end and an increasing torque is applied to the other pipe end.

At the pressure-less test joint the pipe joint shall be able to transmit a torque of up to 80 Nm from one pipe end to the other pipe end without any torsion of the pipe ends against each other.

## 5.8 Other tests

Where special designs or new manufacturing methods make it necessary to conduct additional testing, this will be carried out in co-ordination with the manufacturer.

## Appendix A Test apparatus for pipe joints

Fig. A.1 shows an example for a test apparatus. Other types of test equipment can be used provided the dimensions shown in Fig. A.1 are observed.

Force  $F$  may also be applied to the test joint from below provided the test joint is rigidly clamped on the counter bearing (dimensions 180 mm of the test specimen).

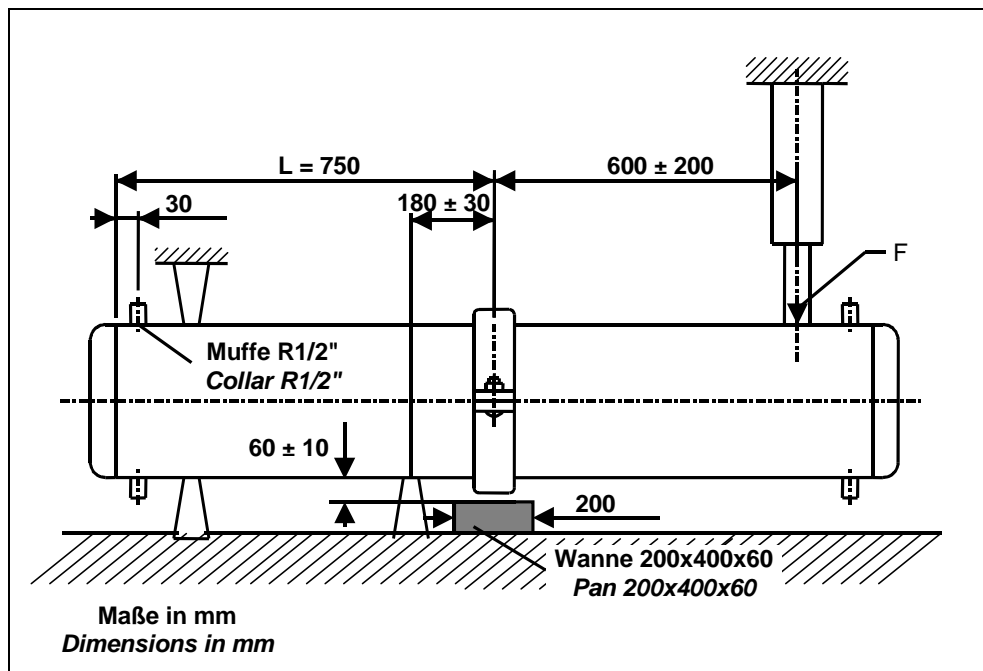


Figure A.1: Test apparatus for pipe joints

## Appendix B Dimensions for valve/fitting connections

This appendix contains the dimensions for valve/fitting connections to be connected to pipe couplings.

Valid for machined connections made of malleable cast iron, cast iron with spheroidal graphite, steel or cast steel of a tensile strength of 350 N/mm<sup>2</sup> at a minimum.

nominal diameter		nominal outer diameter in mm	outer diameter in mm		Pipe length up to groove in mm ± 0,76	Groove width in mm ± 0,76	Diameter on groove bottom 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
<i>Note 1: Groove shoulder free of burs metal removed up to max. 0.3 mm x 45 °.</i>								
<i>Note 2: Groove bottom with radius up to max. 0.8 mm.</i>								
<b>Tabel B.1: Dimensions for valve/fitting</b>								