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Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods to prove the design of locked socket-and-spigot joints, including double-socket joints, with elastomeric seals

Tubes et raccords en plastiques thermodurcissables renforcés de verre (PRV) — Méthodes d'essai pour confirmer la conception des assemblages mâle-femelle verrouillés, y compris ceux à double emboîture avec joints d'étanchéité en élastomère

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

This second edition cancels and replaces the first edition (ISO 7432:2002), which has been technically revised.

This edition includes the following significant changes compared to the previous edition:

— changed Scope to mention that the test procedure is a destructive test;

— terms and definitions clause added to this document;

— changed testing sequences from mandatory to recommended;

— changed wording from “misalignment” to “deformation”;

— modified test sequence for the proof of the design (Clause 9);

— changes in Table 1 with modified testing sequences for the proof of the design of joints;

— modification of bending test sequence.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In a pipework system, pipes and fittings of different nominal pressures and nominal stiffnesses may be used.

A joint may be made between pipes and/or fittings and should be designed such that its performance is equal to or better than the requirements for the pipeline, but not necessarily for the components being joined.

The requirements for the assembly of the joint are not included in this document, but they should be in accordance with the manufacturer's recommendations.

The material-dependent parameters and/or performance requirements are stated in the referring standard.

Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods to prove the design of locked socket-and-spigot joints, including double-socket joints, with elastomeric seals

1 Scope

This document specifies methods of test for joints with a locked socket and spigot (including double-socket joints, and with elastomeric seals, for buried and above ground glass-reinforced thermosetting plastics (GRP) piping systems. It covers methods of test for leaktightness and resistance to damage of the joint only, when subjected to specified combinations of angular movement, compression (deformation) perpendicular to the pipe axis and internal pressure. It assumes that the joint will be exposed to the effects of hydrostatic end thrust.

This document is applicable to joints for either pressure or non-pressure applications. The tests are suitable for the evaluation of joints intended for applications in which the liquids are conveyed at temperatures specified in the referring standards.

The joints tested in accordance with this document are subjected to conditions which measure their ability to function and thereby prove the design of the joint, especially for type test purposes. The joint is only qualified according to the test sequences and configurations detailed in this document.

With the exception of the bending test (see 9.5), the test procedures are applicable to joints for pipes and fittings of all nominal sizes. If not otherwise agreed between the manufacturer and the customer, the bending test detailed in 9.5 is applicable to joints with pipes and fittings up to and including DN 600.

The test procedures in this document are damaging to the test piece, which will not be suitable for reuse after these tests. The test procedure is intended to be applied for type testing purposes.

This document is applicable only to the joint and specifies methods of test to prove its design.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
pressure
hydrostatic gauge pressure

Note 1 to entry: Expressed in bar.

3.2
bending
bending in the pipe and coupling configuration as a result of a vertical force on the coupling

3.3
deformation
pipe deformation in the coupling as a result of a vertical force on the pipe and a supported coupling causing a step between the two pipe spigots at the loading position

4 Principle

A test piece comprising two pieces of pipe jointed together, by incorporation of a socket or inclusion of a double-socket coupler, is subjected to specified load conditions, including combinations of bending and deformation. In each specified combination the test piece is subjected to a series of test pressures for specified periods of time, including an internal sub-atmospheric test pressure. This also simulates an external positive pressure.

In addition, a test at elevated positive static pressure is conducted to prove the structural design of the coupling (see Table 1 and 9.6).

In the tests detailed in 9.5 the joint is subjected to a bending load of such a magnitude that the axial tensile stress in the pipe is equal to that developed from a pressure of 0,5 times PN [see Formula (1)].

$$\sigma_b = 0{,}5\frac{0{,}1[\mathrm{PN}]\times(d_i + e)}{4e} \tag{1}$$

In addition, the joint is then pressure tested at 1,5 times PN, which then results in a total axial stress (bending plus pressure), σ_{ax}, equivalent to 2 times PN, i.e.:

$$\sigma_{ax} = \frac{0{,}1[\mathrm{PN}]\times d_i}{2e} \tag{2}$$

When under pressure, the joint is monitored for leakage. After each test condition (see Table 1) the joint is inspected for signs of damage.

NOTE 1 The only reason for testing the joint for resistance to negative pressure is to ensure adequate safety against infiltration of pollutants through the joint into the fluid carried in the piping system. Under the test conditions used, pipes with low stiffness can require support to prevent buckling.

NOTE 2 If not otherwise specified, the ISO product standards ISO 10639, ISO 10467 and ISO 25780 specify the following test parameter. It is assumed these test parameters are also set by other applicable product standards. If this is not the case the parameters detailed in this document and in ISO 10639, ISO 10467 as well as ISO 25780 can be used as default values.

NOTE 3 It is assumed that the following test parameters are set by the standard making reference to this document:

— the nominal size of the components to be connected by the joint (see 6.1);

— the pressure class of the components (see 6.1);

— the total effective length, L, of the test piece (see 6.1);

— the number of test pieces (see 6.2);

— if applicable, the conditioning to be applied (see Clause 7);

— the test temperature (see Clause 8);

— the sequence of testing, if appropriate (see 9.1);

— the test configuration (see Table 1);

— the deformation and bending forces F_1 and F_2 (see 9.3, 9.4, 9.5, and 9.6);

— the permissible change in negative pressure (see 9.2.3).

5 Apparatus

5.1 End-sealing devices

The end sealing devices shall be of sizes and type appropriate to the components under test. The end-sealing devices shall be securely fixed to the pipes to transmit the end thrust loads to the pipes.

5.2 Supports

5.2.1 **Straps or cradles**, for use as follows:

a) a **support R** (item 6 in Figure 2) positioned at least 500 mm from the spigot end of the pipe at the point of balance to provide support during testing with deformation (see 9.3 and 9.4);

b) a **strap or cradle** (100 ± 5) mm wide (item 7 in Figure 2) supporting at least a 120° arc of the socket, as required for deformation testing (see 9.3 and 9.4);

c) a **strap or cradle** (100 ± 5) mm wide supporting an arc up to 180° of the pipe barrel, positioned adjacent to the end of the joint being tested (item 5 in Figure 2) and through which the force F_1 necessary for deformation testing (see 9.3 and 9.4) can be applied;

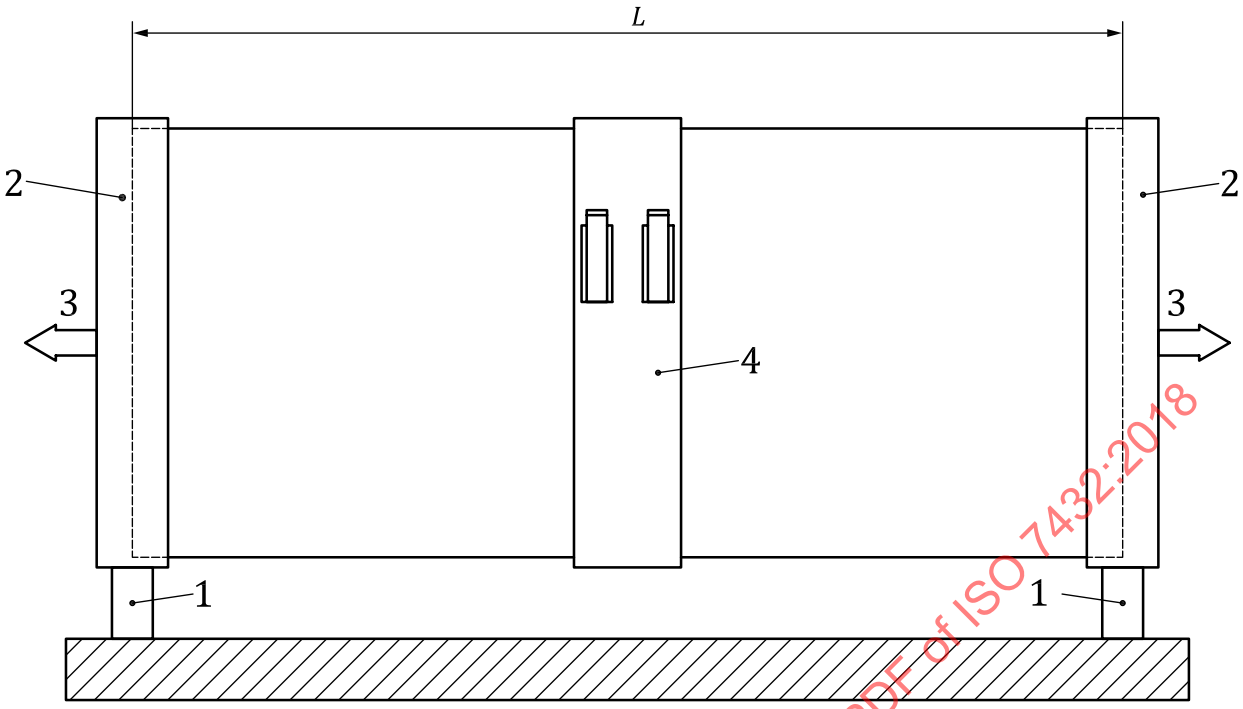
d) a **strap or cradle** (100 ± 5) mm wide supporting an arc up to 180° of the pipe barrel, positioned in the middle of the joint being tested (item 5 in Figure 3) and through which the force F_2 necessary for the bending test (see 9.5) can be applied;

e) **supports** of sufficient width to carry the pipe components of the test piece (item 3 in Figure 2) and designed in such a way that they allow deformation to occur.

The straps or cradles shall not have a detrimental effect on the test piece, e.g. by applying point loads.

5.2.2 Special supports

Special supports shall be used if necessary to prevent buckling of the pipe barrel during deformation (see 9.3 and 9.4) or negative pressure (9.2) testing. Such supports shall be positioned in such a way that they do not affect the force F_1 applied to the joint or the joint's response to such a load.

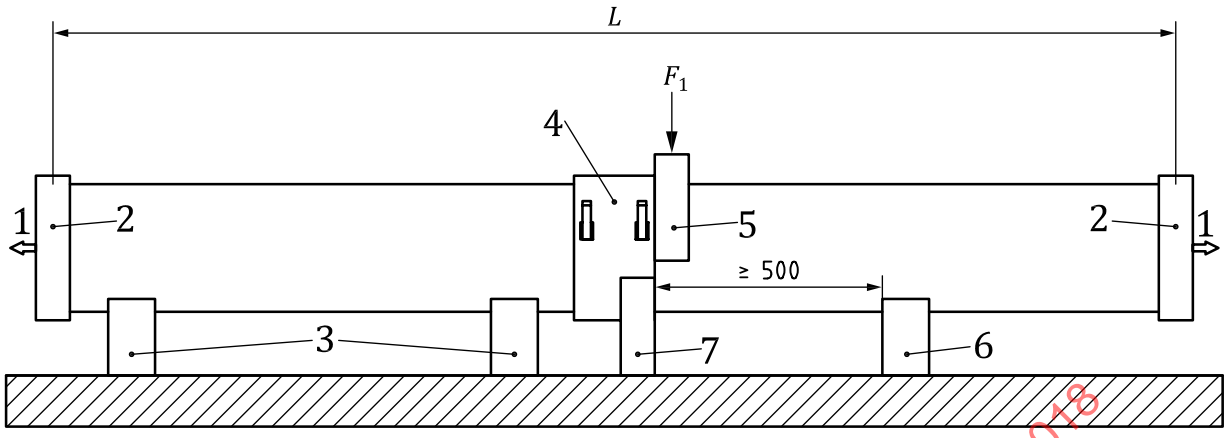


Key

1 support (if required)
2 end-sealing device fixed to test piece
3 thrust transmitted to test piece (will be negative in leaktightness test specified in 9.2)
4 test joint
L total effective length

NOTE The arrangement can be used either horizontally (as shown) or vertically.

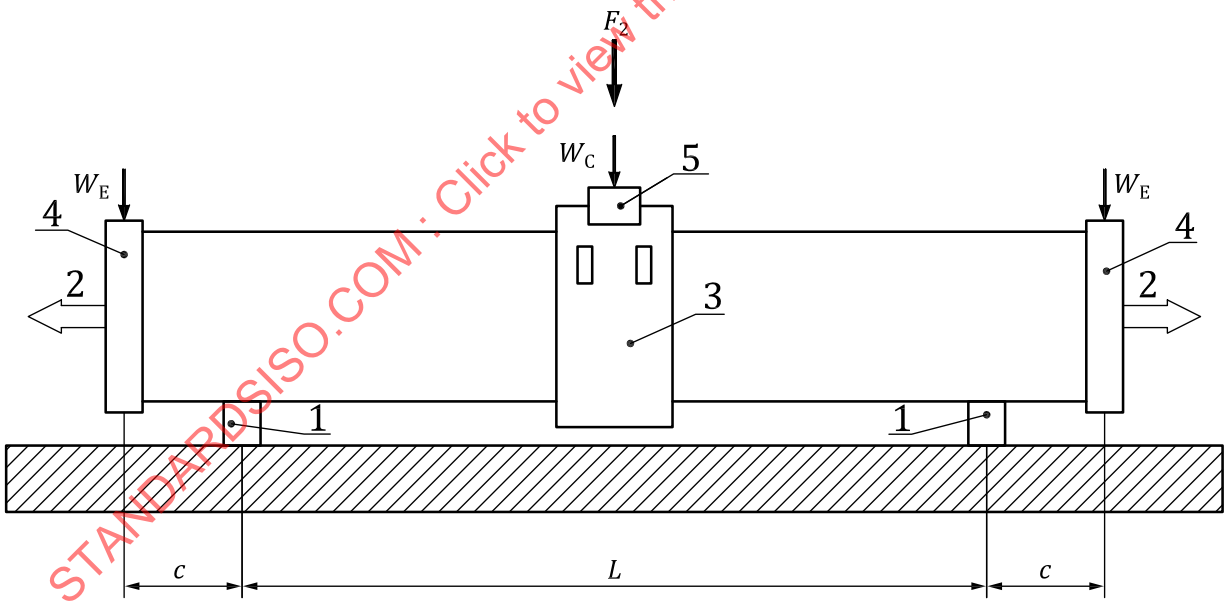
Figure 1 — Test arrangement for the tests detailed in 9.2 and 9.6



Key

1 thrust transmitted to test piece
2 end-sealing device fixed to test piece
3 support [see item e) in 5.2.1]
4 test joint
F_1 force to be applied
L total effective length
5 strap or cradle [see item c) in 5.2.1]
6 support R [see item a) in 5.2.1]
7 strap or cradle [see item b) in 5.2.1]

Figure 2 — Test arrangement for tests detailed in 9.3 and 9.4



Key

1 support
2 thrust transmitted to the test piece
3 test joint
F_2 bending force to be applied
L distance between the centre of the supports
c distance between the centre of the support and the centre of the end sealing device
4 end sealing device
5 strap or cradle for the application of force F_2 [see item d) in 5.2.1]
W_E weight of the end sealing device
W_C weight of the joint

NOTE Dimensional requirements and limits for the test arrangements are detailed in 6.1.

Figure 3 — Test arrangement for test detailed in in 9.5 and Annex A

5.3 Source of hydrostatic pressure

The source of hydrostatic pressure shall be capable of applying the required pressures including, as necessary, pressure cycle controls.

5.4 Pressure gauges

Pressure gauges shall be capable of measuring the positive and negative pressures. The gauges shall be calibrated to an accuracy of ±2 % of the value to be measured. The pressure shall be measured at the top of the pipe.

5.5 Vacuum pump

The vacuum pump shall be capable of producing the required negative gauge pressure (see 9.2).

5.6 Means of applying and measuring the required deformation and bending forces

The means of applying the required deformation and bending forces F_1 and F_2 (see 9.3, 9.4, 9.5 and Annex A) shall be calibrated to an accuracy of ±5 % of the value to be measured.

6 Test pieces

6.1 Assembly and test arrangement

The test piece shall comprise an assembly of two pieces of pipe of the correct size and pressure class, as specified in the referring standard, between which the joint to be tested is located. In some cases, it can be desired to test a transition coupling capable of jointing two different nominal pipe sizes. In such a case both sides of the transition coupling shall satisfy the test requirements.

For the tests detailed in 9.2 and 9.6, the arrangement shall be as shown in Figure 1. For the tests detailed in 9.3 and 9.4, the arrangement shall be as shown in Figure 2. For the test detailed in 9.5, the arrangement shall be as shown in Figure 3. Annex A provides the details for determining the magnitude of the bending force F_2. In all these arrangements, a joint of the same size and design shall be used. The same test piece may be used for more than one test procedure providing it is undamaged and of sufficient size to enable the test conditions to be achieved.

The total effective length L (see Figures 1, 2 and 3) of the assembly shall be not less than specified in the referring specification for pressure test pieces and shall allow, if required, the joint under test to be located in the middle of the test arrangement. For the bending test shown in Figure 3 (see 9.5), the length of pipe between the end closure and the joint, which is positioned in the middle, shall be maximum 8 m, but at least 3 times DN, with a minimum of 0,5 m.

The joint shall be assembled in accordance with the manufacturer's recommendations.

6.2 Number of test pieces

Unless otherwise specified, the number of test pieces shall be one.

7 Conditioning

Unless otherwise specified by the referring standard, following the assembly and filling, the filled test piece shall be conditioned by storing at the test temperature (see Clause 8) for at least 24 h prior to testing until the required temperature is reached (medium and sample).

NOTE Conditioning time is a function of pipe and joint wall thickness, water volume, temperature differential, the film heat transfer coefficient and whether an elevated temperature environment is applied to one or both sides of the specimen.

8 Test temperature

Conduct the following procedure in Clause 9 at the temperature specified in the referring standard.

9 Procedure

9.1 General

Subject a test piece (see 6.1) to the tests given in Table 1 and in 9.2, 9.3, 9.4, 9.5, and 9.6. The pressure shall be measured at the top of the pipe. Each reference to hydrostatic pressure specifies an internal pressure, relative to atmospheric pressure, expressed as multiples of the nominal pressure, [PN] that is relevant to the joint under test.

The tests may be conducted in any sequence. If a test is interrupted, record the fact in the test report and repeat the particular test before carrying on to the next in the series of tests. Failure at the end sealing devices shall not constitute failure of the joint. If the test conditions are invalidated thereby, repeat the affected test, after replacing the end sealing device as necessary.

The samples shall be inspected for damage and leakage (see Clause 9). Where a visual inspection is not possible for security reasons or when the test is performed at elevated temperatures and therefore in enclosed conditioning rooms, precautions shall be taken that leakage can be detected by different methods (e.g. camera inspection, or an electronic detection, colouring of test liquid etc.).

WARNING — It is necessary to take account of the consequences of failure of the components under pressure and/or vacuum and to contain the test piece or apparatus accordingly. Care should be taken to provide suitable protection from flying objects resulting from catastrophic failure or movement of the test assembly.

9.2 Negative pressure

9.2.1 Assemble the test arrangement as shown in Figure 1, using supports (see 5.2) if appropriate.

9.2.2 Apply vacuum to a negative pressure of at least –0,8 bar (–0,08 MPa) gauge pressure (i.e. approximately 0,2 bar absolute), seal and leave for not less than 1 h.

9.2.3 Measure and record any change in pressure and compare the result with the requirement of the referring standard. Unless otherwise specified in the referring standard, the change in pressure shall not be greater than 0,08 bar/h (0,008 MPa/h).

9.2.4 Return the pressure to atmospheric pressure.

9.2.5 Inspect the joint for and record any observations of damage.

9.3 Deformation with internal pressure and end thrust

9.3.1 Assemble the test arrangement as shown in Figure 2, using supports if appropriate (see 5.2).

9.3.2 Connect the test piece (see 6.1) to the source of hydrostatic pressure (see 5.3) and fill with water venting as necessary to remove any air.

9.3.3 Apply an internal pressure as specified in Table 1. Maintain this pressure equal or above the specified pressure for the specified time.

9.3.4 Apply the force F_1, as specified in Table 1 or the referring standard, to the test piece as shown in Figure 2.

9.3.5 Inspect the joint for any signs of leakage or damage. If none are present proceed in accordance with 9.3.6. Otherwise record the observations in accordance with Clause 10.

9.3.6 Increase the pressure to the appropriate positive static pressure for the joint as specified in Table 1, and maintain that pressure for the time specified.

9.3.7 Inspect the joint for signs of leakage or damage and then depressurize. If there are no signs of leakage or damage, proceed in accordance with 9.4. Otherwise record the observations in accordance with Clause 10.

9.4 Deformation with cyclic pressure and end thrust

9.4.1 Reduce the internal pressure to atmospheric pressure and maintain the test arrangement described in 9.3.1 with the force, F_1, as defined in 9.3.4.

9.4.2 In a period of 1,5 min to 3 min, raise the pressure to the level specified in Table 1 and lower it to atmospheric pressure.

NOTE Due to practical reasons (e.g. restriction of the test equipment such as pump capacities, etc.) the cycle time can be longer for larger DN and or higher PN.

9.4.3 Unless any leakage or damage is clearly apparent, repeat the cycle given in 9.4.2 for a further nine times.

9.4.4 Inspect the joint for signs of leakage or damage. If neither are present proceed in accordance with 9.5. Otherwise record the observations in accordance with Clause 10.

9.5 Bending with cyclic pressure and end thrust

9.5.1 Reduce the internal pressure to atmospheric pressure and assemble the test arrangement as shown in Figure 3.

9.5.2 Apply the force F_2, as specified in Annex A (see A.3) or the referring standard, to the test piece as shown in Figure 3.

9.5.3 In a period of 1,5 min to 3 min, raise the pressure to the level specified in Table 1 and lower it to atmospheric pressure.

NOTE Due to practical reasons (e.g. restriction of the test equipment such as pump capacities, etc.) the cycle time can be longer for larger DN and or higher PN.

9.5.4 Unless any leakage or damage is clearly apparent, repeat the cycle given in 9.5.3 for a further nine times.

9.5.4 Inspect the joint for signs of leakage or damage. If neither are present proceed in accordance with 9.6. Otherwise record the observations in accordance with Clause 10.

9.6 Internal pressure and end thrust

9.6.1 Assemble the test arrangement as shown in Figure 1.

9.6.2 Connect the test piece (see 6.1) to the source of hydrostatic pressure (see 5.4) and fill with water, venting as necessary to remove any air.

9.6.3 Increase the pressure to the appropriate positive static pressure as specified in Table 1. Maintain this pressure equal or above the specified pressure for the specified time. During this time, the joint shall not fracture but leakage of the joint does not constitute a failure.

9.6.4 Reduce the pressure to atmospheric and empty the test piece.

9.6.5 Inspect the joint and record any signs of damage or fracture. Record the observations in accordance with Clause 10.

Table 1 — Summary of test conditions for evaluating locked-socket and spigot joints

Test	Pressure sequence	Minimum test pressure	Minimum duration
Negative pressure	Negative pressure[a]	−0,8 bar (−0,08 MPa)	1 h
Deformation with internal pressure and end thrust[b]	Internal pressure	1,5 × [PN]	15 min
	Positive static pressure	2 × [PN]	24 h
Deformation with cyclic pressure and end thrust[b]	Positive cyclic pressure	Atmospheric to 1,5 × [PN] to atmospheric	10 cycles of 1,5 min to 3 min each[c]
Resistance to bending with internal pressure and end thrust[d]	Positive cyclic pressure	Atmospheric to 1,5 × [PN] to atmospheric	10 cycles of 1,5 min to 3 min each[c]
Resistance to internal pressure and end thrust	Positive static pressure, durability test	2,5 × PN	100 h

[a] Relative to atmospheric pressure, i.e. approximately 0,2 bar (0,02 MPa) absolute.

[b] The pipe deformation in the coupling is a result of a total vertical force, F_1, of 20 N/mm of the nominal size expressed in millimetre of the pipe.

[c] Due to practical reasons (e.g. restriction of the test equipment such as pump capacities, etc.) the cycle time can be longer for larger DN and or higher PN.

[d] If not otherwise agreed between the manufacturer and the customer this test is limited to diameters up to and including DN 600.

The tests are intended to be applied for type testing purposes and are damaging to the test piece which shall not be reused after these tests.

NOTE 1 The tests can be conducted in any sequence.

10 Test report

The test report for each test piece shall include the following information, as applicable:

a) reference to this document, i.e. ISO 7432, and the referring standard;

b) full identification of the pipes and joint tested;

c) the nominal size, DN, and the nominal pressure class, PN, of the pipe(s) and joint tested;

d) details of the jointing procedures and, if applicable, the lubricant used;

e) details of any conditioning, if applicable (see Clause 7);

f) the temperatures during the test (see Clause 8);

g) the test conditions to which the test piece was subjected and their sequence;

h) details of interruptions, if any;

i) the angular deflection applied to the joint;

j) the deformation force F_1 applied;

k) the bending force F_2 applied and effective test piece length L used in the bending test;

l) the pressure applied at each stage;

m) observations on the leaktightness of the joint during each test;

n) observations of signs of damage to the joint components after each test;

o) any factors which could have affected the results, such as any incidents or any operating details not specified in this document;

p) the dates of the test.