BS ISO 8639:2016

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Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness and proof of structural design of flexible joints

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PRI/88/2, Plastics piping for pressure applications.

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

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ISBN 978 0 580 84932 9

ICS 23.040.60

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2016.

Amendments issued since publication

Date	Text affected

BS ISO 8639:2016

INTERNATIONAL STANDARD

ISO 8639

Second edition
2016-02-15

Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness and proof of structural design of flexible joints

Tubes et raccords en plastiques thermodurcissables renforcés de verre (PRV) — Méthodes d'essai pour l'étanchéité et preuve de conception structurelle de joint flexible

Reference number
ISO 8639:2016(E)

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Contents

Page

Foreword

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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. www.iso.org/directives

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The committee responsible for this document is 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 8639:2000), which has been technically revised. The modifications are:

— changed title and scope to cover the proof of structural design of flexible joints;

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

— changed testing sequences from mandatory to suggested;

— changed wording from misalignment to deformation;

— clarified support conditions;

— additional test sequence for the proof of the structural design (Clause 8);

— changes in Table 1 with additional testing sequences for the proof of the structural design of flexible joints;

Introduction

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

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

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

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

INTERNATIONAL STANDARD ISO 8639:2016(E)

Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness and proof of structural design of flexible joints

1 Scope

This International Standard specifies test methods for flexible non-thrust resistant socket-and-spigot joints with elastomeric sealing elements for buried and above ground glass-reinforced thermosetting plastics (GRP) pipeline applications. It covers methods of test for the leaktightness and resistance to damage of the joint only, when subject to specified combinations of longitudinal extension (draw), angular movement (angular deflection), compression (deformation) perpendicular to the pipe axis and internal pressure. This International Standard is applicable to joints for either pressure or non-pressure applications.

NOTE The joints tested in accordance with this International Standard are subjected to conditions which measure their ability to function and thereby prove the design of the joint, especially for type test purposes.

These test procedures are applicable to joints for pipes and fittings of all nominal sizes. 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 test procedures in this International Standard are damaging to the test piece which will not be suitable for reuse after these tests. The test procedure shall be applied for type testing purposes.

2 Terms and definitions

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

2.1
pressure
hydrostatic gage pressure

2.2
angular deflection
angle between the axes of the joint and the consecutive pipe(s), expressed in degrees (°)

2.3
draw
longitudinal movement of the pipe relative to the socket (joint), expressed in millimetres (mm)

2.4
total draw
sum of the draw, and the additional longitudinal movement, of joint components due to the presence of angular deflection, expressed in millimetres (mm)

2.5
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 in millimeters (mm)

3 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 combinations of draw, angular deflection 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.

In addition, a test at elevated positive static pressure is conducted to prove the structural design of the coupling.

When under pressure, the joint is monitored for leakage.

Between each test condition (see Table 1) the joint is inspected for signs of damage.

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

— the nominal size of the components to be connected by the joint (see 5.1);

— the pressure class of the components (see 5.1);

— the total effective length, *L*, of the test piece (see 5.1);

— the number of test pieces (see 5.2);

— if applicable, the conditioning to be applied (see Clause 6);

— the test temperature (see Clause 7);

— sequence of testing, if appropriate (see 8.1);

— the joint positions (see Table 1);

— the draw, angular deflection (see 8.3) and the force, *F* (see 8.4);

— the permissible change in negative pressure (see 8.2.3).

4 Apparatus

4.1 End-sealing devices

End sealing devices, of sizes and type appropriate to the components under test, anchored to take the axial end thrust and permit free longitudinal movement.

4.2 Supports and restraints

4.2.1 Longitudinal supports, capable of supporting the end thrust induced by the internal pressure but which shall not otherwise support the joint (see Figure 1, Figure 2 and Figure 3).

4.2.2 Straps or cradles, (100 ± 5) mm wide supporting up to an 180° arc of the pipe barrel or of the socket (see Figure 3).

The use is as follows:

a) a strap, cradle or support, to support the socket on a fixed base, as required for deformation testing (see 8.4);

b) a strap or cradle, positioned adjacent to the end of the joint being tested (see Figure 3), through which the force *F* necessary for deformation testing (see 8.4) can be applied;

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

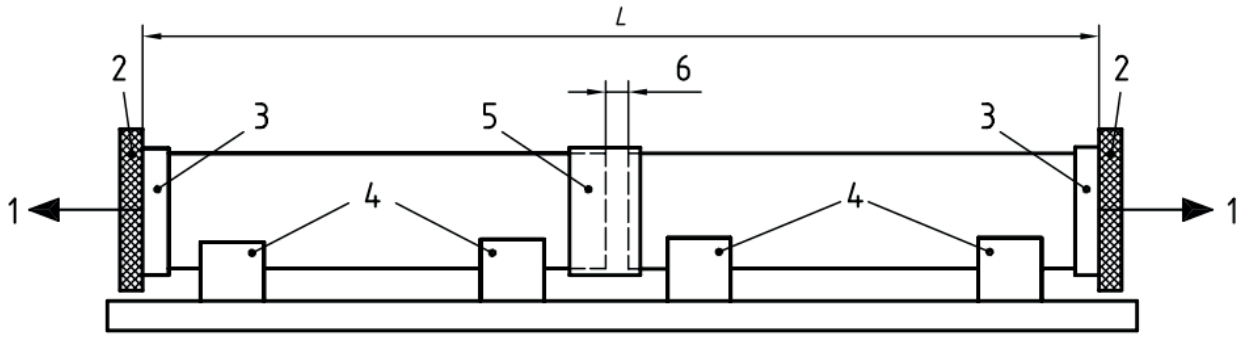
4.2.3 Pipe supports, capable of supporting an arc of approximately 120° of the pipe barrel (see Figure 1, 2 and 3) for use as follows:

a) support *R*, positioned at least 500 mm from the spigot end of the pipe at the point of balance (see Figure 3) to provide support during testing with deformation;

b) supports, for the pipe components of the test piece (see 5.1 and Figure 1, Figure 2 and Figure 3). These can be used to apply angular deflection (see 8.3 and Figure 2). They shall allow deformation to occur (see 8.4, 8.5, 8.6 and Figure 3).

4.2.4 Special supports, if necessary to prevent buckling of the pipe barrel of low stiffness pipe during negative pressure testing.

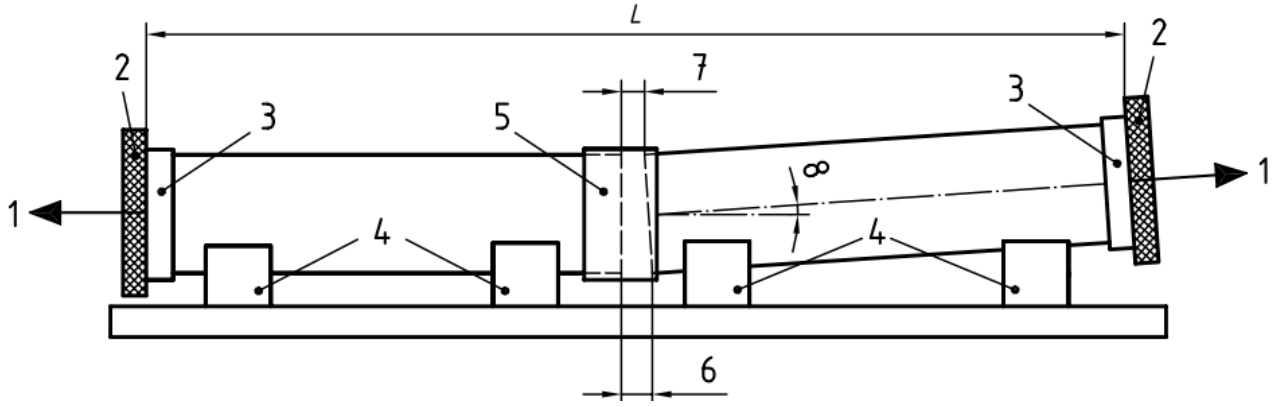
4.2.5 Special restraints, to provide support for the test assembly to prevent uncontrolled movements, particularly when testing at high pressures. Such supports shall be positioned in a manner so as to not influence the test being conducted and shall not induce point loads.



Key

1 thrust resisted by test rig
2 test rig
3 end cap or sealing device (e.g. joint)
4 supports
5 test joint
6 draw
L total effective length

Figure 1 — Test arrangement for total draw



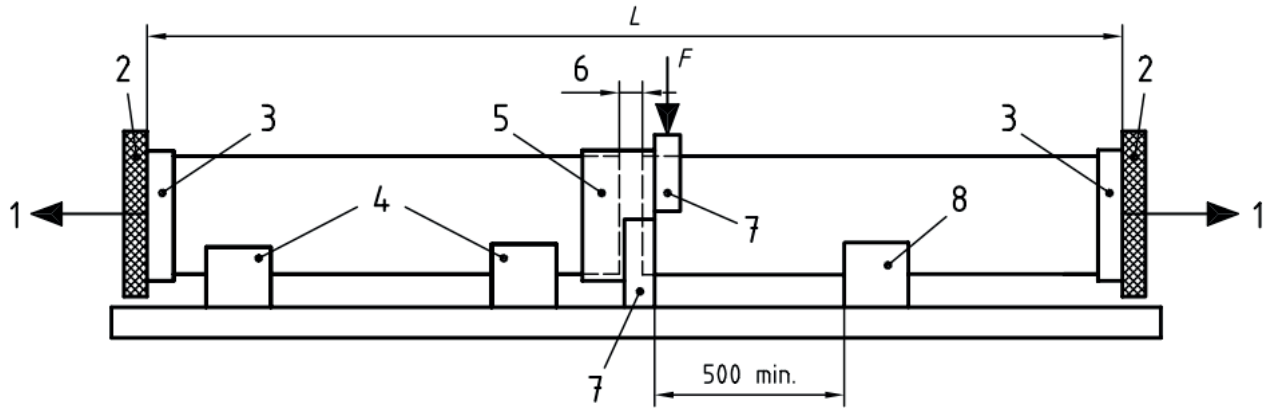
Key

1 thrust resisted by test rig
2 test rig
3 end cap or sealing device (e.g. joint)
4 supports
5 test joint
6 total draw
7 angular deflection between pipes and coupling
8 angle
L total effective length

NOTE In order to prove that the angular deflection is between the centre lines of the pipe(s) and the coupling marks can be made on the pipes to check if there was a coupling rotation after the adjustment of the angular deflection.

Figure 2 — Test arrangement for angular deflection and draw

Dimensions in millimetres



Key

1 thrust resisted by test rig
2 test rig
3 end cap or sealing device (e.g. joint)
4 supports
5 test joint
6 draw
7 strap, cradle or support (bottom)
8 support
F force to be applied
L total effective length

NOTE Figure 1, Figure 2 and Figure 3 show the loading on the test assembly applied in a vertical plane. This is the most common and practical orientation, particularly for large diameters. However, variations on this orientation may be used.

Figure 3 — Test arrangement for deformation and draw

4.3 Means for applying the required force (see Clause 8) and a device to measure the force. The device shall be calibrated to an accuracy of at least ± 5 % of the value to be measured.

4.4 Source of hydrostatic pressure, capable of applying the required pressures including, as necessary, pressure cycling controls (see Table 1).

4.5 Vacuum pump, capable of applying the required negative pressure (see 8.2.3 and Table 1).

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

5 Test pieces

5.1 Assembly

The test piece shall comprise an assembly of two pieces of pipe of the same nominal size and pressure class, as specified in the referring standard, jointed by the socket/spigot, or double-socket, joint to be tested. In some cases it can be desired to test a transition coupling capable of joining two different nominal pipe sizes. In such a case both sides of the transition coupling shall satisfy the test requirements.

The total effective length, *L*, (see Figure 1, Figure 2 and Figure 3) of the test piece shall be not less than that specified in the referring standard.

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

5.2 Number

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

6 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 7) for at least 24 h prior 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 the elevated temperature environment is applied to one or both sides of the specimen.

7 Test temperature

Conduct the following procedure in Clause 8 at the temperature specified in the referring standard.

8 Procedure

8.1 General

Subject a test piece (see 5.1) to the tests specified in the referring standard and as given in Table 1 and in 8.2, 8.3, 8.4, and 8.6. 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.

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 particular test thus affected, after replacing the end sealing device as necessary. The tests may be conducted in any sequence.

The samples shall be inspected for damage and leakage (see 8.2.5, 8.3.5, 8.4.8, 8.5.4, 8.6.5). 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. Any National Health and Safety standards shall be satisfied.

8.2 Negative pressure

8.2.1 Assemble the test arrangement as shown in Figure 1 and apply the draw as specified in the referring standard

8.2.2 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.

8.2.3 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).

8.2.4 Return the pressure to atmospheric pressure.

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

8.3 Simultaneous angular deflection and draw

8.3.1 Apply the draw plus the angular deflection, as specified in the referring standard, to obtain the total draw as shown in Figure 2.

8.3.2 Connect the test piece (see 5.1) to the source of hydrostatic pressure (see 4.4) and fill with water, venting as necessary to remove any air.

8.3.3 Apply and maintain for at least 15 min the initial pressure specified in Table 1, as applicable. Inspect the joint for signs of leakage or damage. If neither are present, continue in accordance with 8.3.5. Otherwise depressurize the test piece and record the observations in accordance with Clause 9.

8.3.4 Apply the positive static pressure specified in Table 1, as applicable. Maintain this pressure equal or above the specified pressure for the specified time.

8.3.5 Inspect the joint for signs of leakage or damage and then depressurize. If there are no signs of leakage or damage, continue in accordance with 8.4. Otherwise record the observations in accordance with Clause 9.

8.4 Simultaneous draw and deformation

8.4.1 Assemble the test arrangement as shown in Figure 3, using supports (see 4.2.1) and straps or cradles (see 4.2.2) as appropriate and reconnect in accordance with 8.3.2, if necessary.

8.4.2 Apply the draw conditions specified in the referring standard.

8.4.3 Connect the test piece (see 5.1) to the source of hydrostatic pressure (see 4.4) and fill with water, venting as necessary to remove any air.

8.4.4 Apply the initial pressure specified in Table 1, as applicable. Maintain this pressure equal or above the specified pressure for the specified time.

8.4.5 Apply the force, F, as specified in the referring standard, to the test piece as shown in Figure 3).

8.4.6 Inspect the joint for signs of leakage or damage. If none are present proceed in accordance with 8.4.7. Otherwise record the observations in accordance with Clause 9.

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

8.4.8 Inspect the joint for signs of damage or leakage. If neither are present proceed if a pressure joint in accordance with 8.5. Otherwise record the observations in accordance with Clause 9.

8.5 Cyclic pressure

8.5.1 Reduce the internal pressure to atmospheric pressure.

8.5.2 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 may be longer for larger DN and or higher PN.

8.5.3 Unless any leakage or damage is clearly apparent, repeat the cycle given in 8.5.2 a further nine times.

8.5.4 Inspect the joint for signs of leakage or damage. If neither are present proceed in accordance with 8.6. Otherwise record the observations in accordance with Clause 9.

8.6 Positive static pressure

8.6.1 Assemble the test arrangement as shown in Figure 1 and apply the draw as specified in the referring standard.

8.6.2 Connect the test piece (see 5.1) to the source of hydrostatic pressure (see 4.4) and fill with water, venting as necessary to remove any air.

8.6.3 Steadily raise the hydrostatic pressure so that a pressure equal to 2,5 times the nominal pressure of the joint, expressed in bars (Table 1). Maintain this pressure equal or above the specified pressure for 100 h. During this time, the joint shall not fracture but leakage of the joint does not constitute a failure.

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

8.6.5 Inspect the joint and record any signs of damage or fracture. Record the observations in accordance with Clause 9.

Table 1 — Summary of test conditions for evaluating joints

Test	Pressure sequence	Minimum test pressure	Minimum duration
Draw	Negative pressure[a]	−0,8 bar (−0,08 MPa)	1 h
Angular deflection and draw	Initial pressure	1,5 × [PN]	15 min
	Positive static pressure	2 × [PN]	24 h
Deformation and draw	Initial pressure	1,5 × [PN]	15 min
	Positive static pressure	2 × [PN]	24 h
	Positive cyclic pressure[b]	Atmospheric to 1,5 × [PN] to atmospheric	10 cycles of 1,5 min to 3 min each
Draw	Positive static pressure	2,5 × [PN]	100 h

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

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

9 Test report

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

a) reference to this International Standard, 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 6);

f) the temperatures during the test;

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

h) details of interruptions, if any;

i) the draw applied to the joint;

j) the angular deflection applied to the joint;

k) the total draw derived from i) and j);

l) the deformation force applied;

m) the pressure applied at each stage;

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

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

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

q) the dates of the test.

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