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Thermoplastics piping systems for underground non-pressure applications — Test method for leaktightness of elastomeric sealing ring type joints

Systèmes de canalisations en thermoplastiques pour applications enterrées sans pression — Méthode d'essai d'étanchéité des assemblages à bague d'étanchéité en élastomère

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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 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 138, *Plastic pipes, fittings and valves for the transport of fluids*, Subcommittee SC 1, *Plastics pipes and fittings for soil, waste and drainage (including land drainage)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 13259:2018), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

— in 8.2, the text was clarified and a calculation error was corrected.

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.

Thermoplastics piping systems for underground non-pressure applications — Test method for leaktightness of elastomeric sealing ring type joints

1 Scope

This document specifies a test method for determining the leaktightness of elastomeric sealing ring type joints for buried thermoplastics non-pressure piping systems.

Unless otherwise specified in the referring standard, the tests are carried out at the following basic test pressures:

— p_1: internal negative air pressure (partial vacuum);

— p_2: a low internal hydrostatic pressure;

— p_3: a higher internal hydrostatic pressure.

It also describes the following four test conditions under which the tests are performed:

a) Condition A: without any additional diametric or angular deflection;

b) Condition B: with diametric deflection;

c) Condition C: with angular deflection;

d) Condition D: with simultaneous angular and diametric deflection.

The applicable selection of the test pressure(s) and the test condition(s) is/are specified in the referring standard.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Principle

A test piece assembled from pipes and/or fittings is subjected to a specific initial internal negative air pressure, p_1, followed by a low specific initial internal hydrostatic pressure, p_2, and a higher internal hydrostatic pressure, p_3.

During testing the joint may be subjected to diametric and/or angular deflection(s). The referring product standard shall specify which of the test pressures and deflection conditions have to be carried out.

Each pressure is maintained for a specific period during which the joint is monitored for leakage (see Clause 8).

It is assumed that the following test parameters are set by the referring standard:

a) the test pressure(s), p_1 [see 8.1, item e)], p_2 [see 8.1, item g)] and p_3 [see 8.1, item h)], as applicable, and the percentage of loss of partial vacuum [see 8.1, item e)];

b) the required diametric and angular deflections and their combination with each other and/or the test pressure(s).

5 Apparatus

5.1 General

The apparatus shall consist of a jig or any other arrangement capable of:

a) applying the specified diametric and angular deflection;

b) applying the specified test pressure(s), positive or negative;

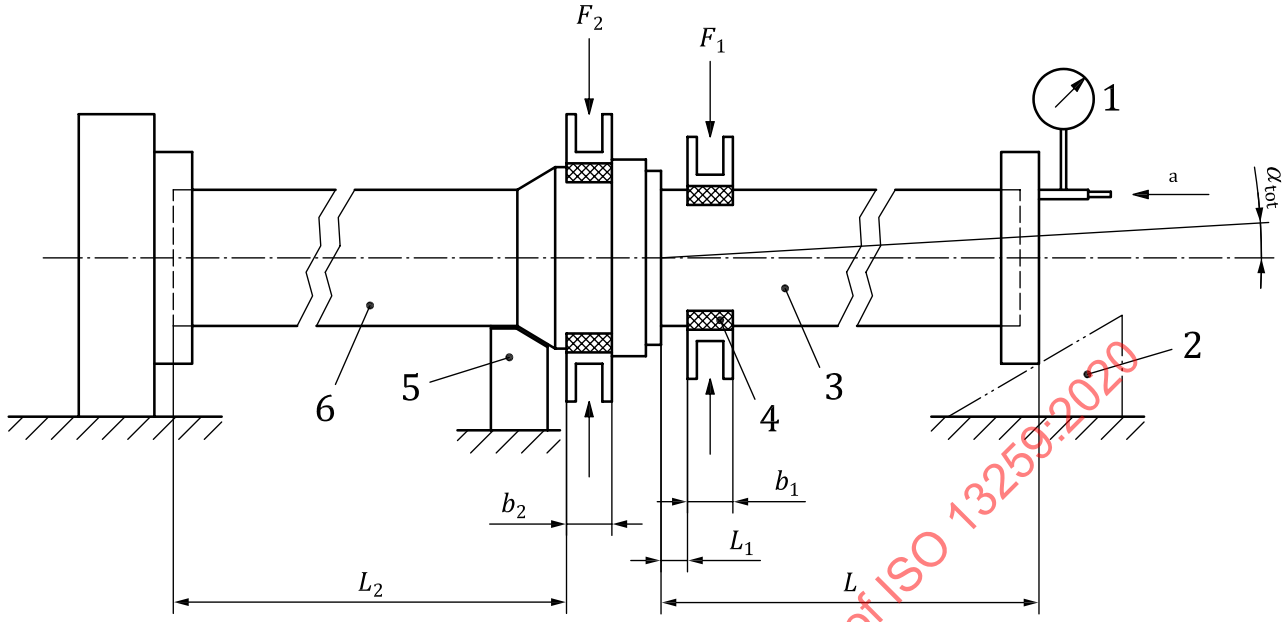
c) maintaining the test assembly in the required position throughout the test;

d) resisting the forces resulting from the mass of the water in the test assembly and from the applied hydrostatic test pressure(s) during the test period.

The apparatus shall not otherwise support the joint against the internal test pressure.

A typical arrangement, allowing angular and diametric deflection, is shown in Figure 1.

Dimensions in millimetres



Key

1	vacuum or pressure gauge
2	adjustable support
3	pipe or fitting with spigot end
4	elliptical beam, when applicable
5	socket support
6	pipe or fitting with socket
α_{tot}	angular deflection applied
b_1, b_2	width of the beam (see 5.2.7 and 5.2.8)
F_1, F_2	compressive force
L	length of spigot-ended pipe or fitting, where $L \geq d_e$ or $L \geq 1\,000$, whichever is the greater, in millimetres
L_1	distance between socket mouth and beam
L_2	distance between the end of pipe and the beam (in contact of the socket), where $L_2 \geq 1\,000$ for testing pipes only. For testing other components (e.g. inspection chambers, manholes, fittings of large diameters) L_2 may be reduced.
a	Connection to pressure source.

Figure 1 — Typical arrangement for applying diametric deflection and angular deflection

5.2 Components of the apparatus

5.2.1 The apparatus shall include the following items which each shall be capable of resisting the forces and pressures generated during the test.

5.2.2 End sealing devices, having a size and using a sealing method appropriate to seal the non-jointed ends of the test assembly. The devices shall be restrained in a manner that does not exert longitudinal forces on the joint at positive pressures.

5.2.3 Hydrostatic pressure source, connected to one of the sealing devices, or to the test piece, and capable of applying and maintaining the specified pressure [see 8.1, items g) and h)].

5.2.4 Negative air pressure source, connected to one of the sealing devices, or to the test piece, and capable of applying and maintaining the specified internal negative air pressure for the specified time. [See 8.1, item e)].

5.2.5 Arrangement, capable of venting air from the assembly.

5.2.6 Pressure measuring devices, capable of checking conformity to the specified test pressure [(see 8.1, items e), g) and h)] located at the upper point of the test assembly.

When testing with diametric deflection is required the following items shall also be included.

5.2.7 Mechanical or **hydraulic device**, capable of applying the necessary diametric deflection to the spigot [see 8.1, item b)] and acting on a beam which is free to move in the vertical plane square to the axis of the pipe. For pipes with a diameter equal to or greater than 400 mm, each beam can be elliptically shaped to suit the expected shape of the pipe when deflected as required, see Figure 4. The length of the beam or the curved part of the beam shall be greater than the contact area with the deflected spigot.

The following width, b_1, (see Figure 1), shall depend upon the external diameter, d_e, of the pipe:

— b_1 = 100 mm for $d_e \leq 710$ mm;

— b_1 = 150 mm for 710 mm < $d_e \leq 1\,000$ mm;

— b_1 = 200 mm for $d_e > 1\,000$ mm.

5.2.8 Mechanical or **hydraulic device**, capable of applying the necessary diametric deflection to the socket [see 8.1, item b)] and acting on a beam which is free to move in the vertical plane square to the axis of the socket. The length of the beam or the curved part of the beam shall be greater than the contact area with the deflected socket.

For pipes with a diameter equal to or greater than 400 mm, each beam may be elliptically shaped to suit the expected shape of the socket when deflected as required, see Figure 4.

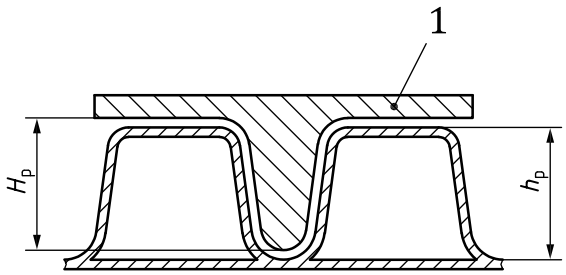
The following width, b_2, shall depend upon the external diameter, d_e, of the pipe:

— b_2 = 30 mm for $d_e \leq 110$ mm;

— b_2 = 40 mm for 110 mm < $d_e \leq 315$ mm;

— b_2 = 60 mm for $d_e > 315$ mm.

When there is a risk that the stiffening elements (profiles) of a structured wall pipe or socket will deflect more than 0,1 times the profile height, the clamps shall be modified such that they will come into contact with the pipe wall between the profiles when the profile is deflected to between 0,9 times and 0,95 times the profile height (see Figure 2).



Key

1 modified loading plate

h_p construction height

H_p profile height of the loading plate; $0{,}9h_p \leq H_p \leq 0{,}95h_p$

Figure 2 — Example of modified loading plate

6 Test pieces

The test piece shall comprise an assembly of (a) pipe section(s) and/or fitting(s) including at least one elastomeric sealing ring joint.

The joint to be tested shall be assembled in accordance with the manufacturer's instructions where available.

The length, L, of the test pieces in pipe form shall be as specified in Figure 1.

The same test assembly shall be used for the entire specified test regime.

To reduce the volume of water needed, a sealed pipe or mandrel may be located within the test piece provided it is 100 % tight to the test pressures applied, and it is not of a shape that can provide support against possible deformation during the test.

When a fitting or any other ancillary component is to be tested, the appropriate end of the test piece shown in Figure 1 is to be replaced by that component.

The component is fixed to the test rig and plugged in its open end(s) as appropriate for its design.

7 Temperature of conditioning and testing

When testing with internal hydrostatic pressure using water, the test temperature shall be at the ambient temperature, unless otherwise specified in the referring standard. In case of dispute, the test shall be carried out at (23 ± 5) °C.

During testing, pipes should be protected from direct sunlight.

NOTE This protection is intended to avoid heating during testing.

When testing with internal partial vacuum the test temperature shall be in the range of (23 ± 5) °C and the temperature variation shall not exceed 2 °C during the testing.

8 Procedure

8.1 General procedure

Carry out the following procedure at the specified temperatures:

a) mount the test piece with sealed ends in the apparatus;

b) when applicable, apply the specified movement of the loading beams for diametric deflection of the spigot and/or socket end(s) as described in 8.2;

c) before applying the specified angular deflection to the joint, a test at 0° angular deflection for each of the three specified pressures shall be performed as described in e), f), g) and h) with a duration of at least 5 min. Release the test pressure before applying the angular deflection;

NOTE Both angular positions are needed to check possible movement in the position of the sealing ring.

d) when applicable, apply the specified angular deflection to the joint. Unless otherwise specified in the referring standard the applied angular deflection, α, shall be the following:

$\alpha = 2°$ for $d_n \leq 315$ mm;

$\alpha = 1{,}5°$ for $315 \text{ mm} < d_n \leq 630$ mm;

$\alpha = 1°$ for $d_n > 630$ mm

Tolerance on all deflections $\alpha^{+0,2}_{0}$.

If a socket is designed to take up an angular deflection, β, the total angular deflection shall be the sum of the design angle β, as declared by the manufacturer, and α.

Maintain the setting of the angular deflection throughout the 15 min duration;

e) when applicable, apply the specified negative air pressure (partial vacuum), p_1, gradually over a period of not less than 5 min. Unless otherwise specified in the referring standard, p_1 shall be −0,3 bar[1] ± 5 %.

Maintain the negative air pressure for a period of not less than 5 min, in order to let the test assembly stabilize.

Close the connection between the test piece and the negative air pressure source. Measure and record the internal negative pressure.

After 15 min, measure and record the internal negative pressure again.

Calculate the loss of partial vacuum and record whether or not it exceeds the specified percentage of p_1. Unless otherwise specified in the referring standard the percentage shall be 10 %;

f) when applicable, fill the test assembly with water while bleeding off the air. To ensure temperature equalization, leave it for not less than 5 min for pipes of nominal diameter, d_n, less than 400 mm, and not less than 15 min for larger sizes;

g) when applicable, raise the hydrostatic pressure gradually over a period of not less than 5 min to the specified test pressure, p_2, and maintain that pressure for at least 15 min, monitor, and record any leakage. Unless otherwise specified in the referring standard, p_2 shall be 0,05 bar ± 10 %;

h) when applicable, raise the hydrostatic pressure gradually over a period of not less than 5 min to the specified test pressure, p_3, and maintain that pressure for at least 15 min, monitor and record any leakage. Unless otherwise specified in the referring standard, p_3 shall be between 0,5 bar and (0,5 bar + 10 %). In case of shortening due to the internal water pressure, it is allowed to adjust the end seals to compensate, accordingly;

i) if applicable, start from b) with another set of required test parameters after an appropriate rest period which, in case of dispute, shall be at least 24 h.

1) 1 bar = 100 kPa.

8.2 Procedure for applying diametric deflection to spigot and socket

Using the mechanical or hydraulic device (see 5.2.7 and 5.2.8), apply the necessary compressive forces, F_1 and F_2 (see Figure 1) to the spigot end of the pipe and the socket of the pipe or fitting in such a way that the distance between the beams, l_{sp} and l_{so}, are as calculated below.

a) Calculate the distance between the beams when the socket and/or spigot is deflected using Formulae (1) and (2):

$$l_{sp} = d_{em} \times \left(1 - \frac{X}{100}\right) \quad (1)$$

$$l_{so} = d_{em,so} - \left(d_{em} \times \frac{Y}{100}\right) \quad (2)$$

where

l_{sp} is the distance between the beams for deflecting the spigot;

l_{so} is the distance between the beams for deflecting the socket;

d_{em} is the mean outside diameter of the spigot end;

$d_{em,so}$ is the mean outside diameter of the socket;

X is the absolute value of the specified nominal spigot deflection;

Y is the absolute value of the specified nominal socket deflection.

If 10 % nominal spigot deflection is specified then X = 10; if 5 % nominal socket deflection is specified then Y = 5.

Unless otherwise specified in the referring standard, X shall be 10 and Y shall be 5. (See Figure 4).

EXAMPLE d_{em} = 1 000 mm; $d_{em,so}$ = 1 100 mm; nominal spigot deflection is 10 % and nominal socket deflection is 5 %; results in

l_{sp} = 1 000 × (1 – 10/100) = 900 mm;

l_{so} = 1 100 – (1 000 × 5/100) = 1 050 mm.

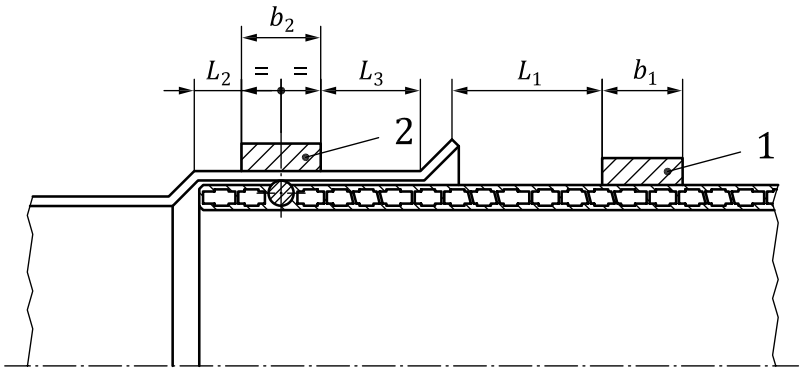
b) position the spigot deflection clamps such that the distance to the mouth of the socket, L_1, when the force is applied, is between 0,14d_e and 0,15d_e or (100 ± 5) mm, whichever is the greater. In case of structured wall pipes where the profiles are positioned further away from the socket mouth, the clamps shall be modified in order to apply the force to the spigot at the specified distance;

c) for joints with the sealing ring positioned in the socket, the socket diameter deflection beams shall be positioned next to the sealing ring groove as shown in Figure 1. For joints with the sealing ring(s) positioned on the spigot end of the pipe, the socket diameter deflection beams shall be positioned such that the axis of the beam is aligned with the centre line of the sealing ring profile(s). If the sealing ring(s) are positioned so the distance from the edge of the beams to the end of the socket, L_2 as shown in Figure 3, is less than 25 mm, the edge of the beams shall be located such that L_3 is at least 25 mm and, if possible L_2 is also at least 25 mm;

d) when testing the tightness of couplers/repair collars, the test arrangement shall be as shown in Figure 5 or Figure 6;

e) apply the forces needed to move the spigot and socket diametric deflection devices to the calculated levels. The diametric distortion shall be applied to the spigot first. The diametric deflection of the socket is permitted to be greater than specified if by deflecting the spigot first to the calculated level, the socket without applying any load to it is deflected to more than specified. This shall not be deemed as a failure and the test shall be carried out under these conditions;

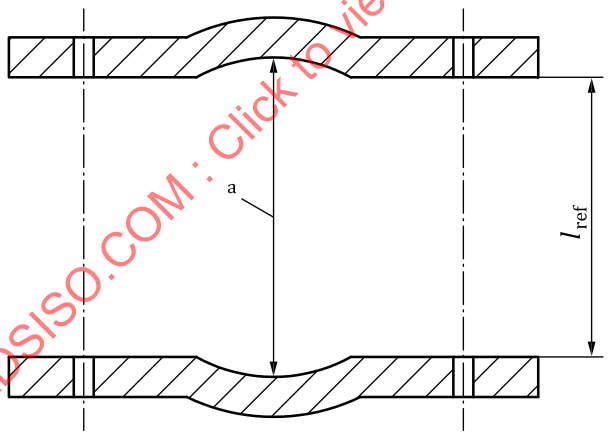
f) continue with 8.1, item d).



Key

1 beam (in contact with the spigot)
2 beam (in contact with the socket)
L_1 distance between the beam and the socket mouth
L_2 distance between the beam and the end of the socket
L_3 distance between the beam and the beginning of the cylindrical part of the socket
b_1 width of the beam 1 (see 5.2.7)
b_2 width of the beam 2 (see 5.2.8)

Figure 3 — Example showing the positioning of the beams where the sealing ring is placed on the spigot



Key

l_{ref} reference distance, e.g. for checking conformity to l_{sp} or l_{so}
[a] l_{sp} or l_{so}, as calculated in accordance with item a) of 8.2.

Figure 4 — Example of diametric deflection device