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Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the apparent axial long-term modulus of pipes subject to beam bending

Tubes en plastiques thermodurcissables renforcés de verre (PRV) — Détermination du module axial apparent à long terme de tubes soumis à la flexion de poutre

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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).

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For an explanation of 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 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*.

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

The apparent axial long-term modulus of pipes subject to beam bending of pipes manufactured according to ISO 23856 is required for designing pipe systems installed aboveground in accordance with ISO/TS 10986.

The modulus is used to calculate deflections and rotations of pipes installed on two or more supports.

Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the apparent axial long-term modulus of pipes subject to beam bending

1 Scope

This document specifies a method for determining the apparent axial long-term modulus of pipes subject to beam bending deflection between vertically supported end-couplers, which allow rotation of the pipe relative to the couplers.

In conjunction with ISO 10928, this document expresses the results of the test as an apparent axial long-term modulus for use in the calculation of mid-span beam deflection and end rotation of GRP pipes as specified in ISO/TS 10986.

Test conditions and requirements are specified in the referring standard.

For practical reasons, the test method is not suited for diameters greater than DN 600.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10928:2016, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use*

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 pipe sample is mounted on supports at the ends and filled with water. The deflection is measured both at mid-span and at the supports. The deflections measured at the supports is subtracted from the deflection measured at the centre to obtain a flexural deflection to be used to compute the modulus. The displacements are measured at pipe springlines to minimize errors caused by pipe cross-section deformation.

The deflection is monitored over time, and the apparent axial long-term modulus computed. The 50-year modulus is computed from the extrapolated deflection after 10 000 h of testing.

5 Apparatus

5.1 Supporting frame, comprising two parallel steel beams, four floor supports, and two circular end closures (see Figure 1 for typical test set-up). The beams shall be sufficiently stiff such that no visible

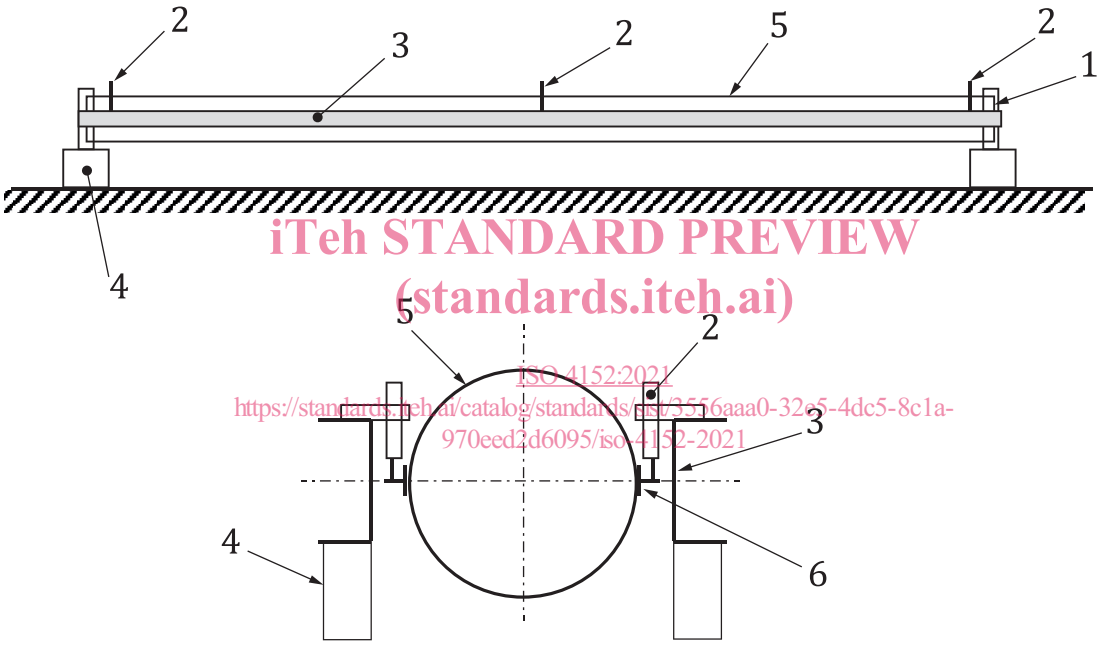
deformation shall occur during the test. Each section shall have a length equal to the length of the test piece plus at least 100 mm.

The end closures shall simulate a realistic coupling with rubber seals and shall remain leak tight during the duration of the test. One of the end closures shall have fittings for filling the pipe and both end closures shall be fitted with air bleeding holes. The end closures shall be welded or bolted to the steel beams, such that no rotation of the end closures occurs during the test (see Figure 2).

5.2 Bracket supports, to be glued to the test sample at spring-line. The brackets serve as contact points for the displacement meters (5.4). A total of six brackets are required for the test.

5.3 Dimensional measuring devices, to measure the dimensions of the test piece, i.e. length, diameter, and wall thickness. Each device shall be calibrated to an accuracy of within ±1 %.

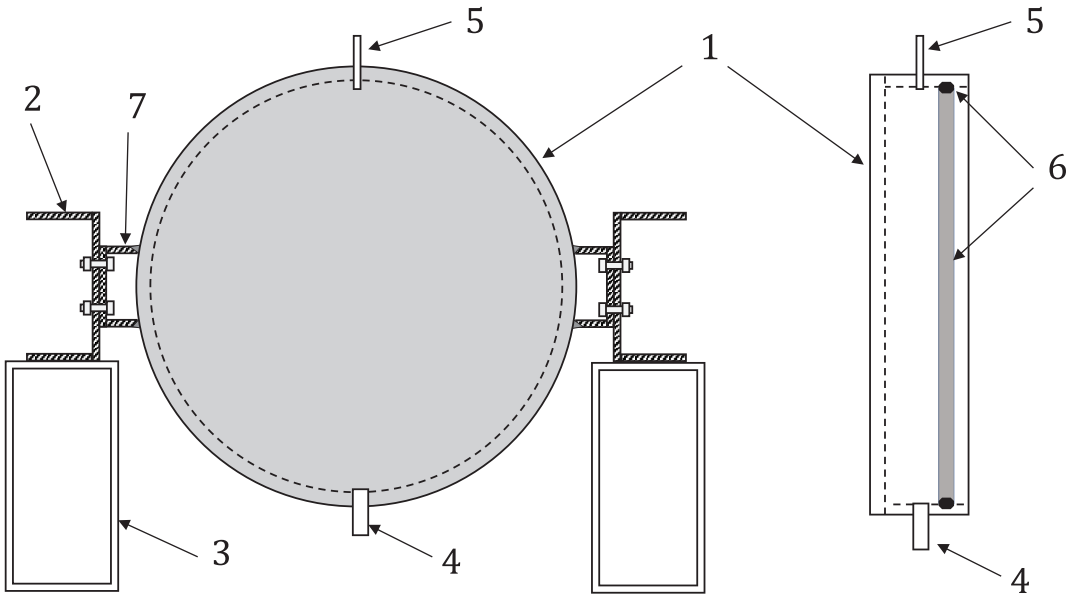
5.4 Displacement measuring devices, with continuous monitoring and a suitable data acquisition system. The whole system shall be calibrated to an accuracy of ±1 %. Six devices are required for the test.



Key

1	end closure	4	floor support
2	displacement transducer	5	test piece
3	steel beam	6	bracket support

Figure 1 — Typical test set-up along the pipe



Key

1	end closure	5	air bleeding fittings
2	steel beam	6	rubber seal
3	floor support	7	mounting bracket
4	filling fittings		

Figure 2 — Typical detail of end closure

6 Test piece

The sample length shall be chosen such that the axial beam bending stresses at mid-span are equal to the planned allowable stress for the pipe under installation conditions within ±10 %.

The relation of data generated in this test to the planned pipe installation shall be described in the referring standard.

7 Number of test pieces

The number of test pieces shall be as specified in the referring standard.

8 Determination of the dimensions of the test piece

8.1 Outside diameter, d_o

Measure the external diameter of the test piece at three locations: the centre of the pipe and at a distance of one sixth of the sample length from the centre in each direction. Calculate the mean value of d_o as the arithmetic average of the three measured values.

8.2 Mean wall thickness, *e*

Measure the wall thickness of the test piece at six equally spaced locations around the circumference at each end. Calculate the mean wall thickness, *e*, as the arithmetic average of the twelve measured values.

8.3 Inner diameter, d_i

Calculate the inner diameter, d_i, of the test piece by subtracting two times the mean wall thickness from the mean value of the outside diameter, d_o.

8.4 Length

Determine and mark the position of the crown of the pipe (e.g. by use of a level). Determine and mark the position of the spring-line at the pipe-ends and at the centre by measuring from the crown down to one quarter of the circumference in each direction. Measure the length of the test piece at spring-line on each side.

9 Conditioning

Unless otherwise specified by the referring standard, the test pieces and the water used in the test shall be stored under testing conditions for at least 24 h prior to testing.

10 Procedure

10.1 Preparation of test piece

Glue the bracket supports onto the test piece at the springlines. Two shall be placed at mid-span of the pipe, while two are placed at each end. These shall be at a certain distance, l, from the supporting seal. See Formula (1):

$$l = 2\,(e\,d_m)^{0,5} \tag{1}$$

where

l is the distance between the supporting seal and the measurement point of the bracket close to the end;

e is the pipe thickness;

d_m is the mean diameter.

10.2 Preparation of supporting frame

Drill two bolt holes on each end of the steel beams and place the beams on the support. The end closures shall be bolted onto the beams. This can be achieved by welding brackets with bolt holes to the end closures. The bolt holes shall fit to the bolt holes on the steel beams (see Figure 2). The rotated pipe ends (from test load) shall not come in contact with the end-closure ends during test.

This shall be assured by:

— choosing the correct distance between end-closures relative to the pipe length;

— obtaining equal spacing between the pipe-end and end-closure end at both sides of the test set-up;

— measuring distance between end-closures and position marks on the pipe showing the position of the pipe end relative to the end-closures.

10.3 Mounting of test piece

Place the-end closures onto the pipe. Mount the end-closures to the support frame by bolting or welding them onto the steel beams.