SLOVENSKI STANDARD
SIST EN 1227:1999

01-julij-1999

Cevni sistemi iz polimernih materialov - Cevi iz duromernih materialov, okrepljenih s steklenimi vlakni (GRP) - Določanje dolgotrajne končno ustrezne deformacije obroča v vlažnih pogojih

Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Determination of the long-term ultimate relative ring deflection under wet conditions

Kunststoff-Rohrleitungssysteme - Rohre aus glasfaserverstärkten duroplastischen Kunststoffen (GFK) - Ermittlung der relativen Langzeit-Ringverformbarkeit unter Feuchteeinfluß

Systemes de canalisations en plastique - Tubes en plastique thermodurcissable renforcé de verre (PRV) - Détermination de la déflexion annulaire relative ultime, a long terme, en conditions mouillées

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English version

Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Determination of the long-term ultimate relative ring deflection under wet conditions

Systèmes de canalisations en plastique - Tubes en plastique thermodurcissable renforcé de verre (PRV) - Détermination de la déflexion annulaire relative ultime, à long terme, en conditions mouillées

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This European Standard was approved by CEN on 16 August 1997.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 155 "Plastics piping systems and ducting systems", the secretariat of which is held by NNI.

This standard is based on the draft proposal for an International Standard ISO/DP 10471.2 "Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Determination of the long-term ultimate ring deflection of pipes under wet conditions" prepared by the International Organization for Standardization (ISO). It is a modification of ISO/DP 10471.2 for reasons of possible applicability to other test conditions and alignment with texts of other standards on test methods.

The modifications are:

- the slope of the logarithm (lg) of the vertical deflection versus lg [time] is not used as a failure criterion;
- test parameters are not specified;
- material dependent or performance requirements are not given;
- editorial changes have been introduced.

The material dependent test parameters and/or performance requirements are incorporated in the referring standard.

Annex A, which is normative, is an example using the procedures described in 8.5.

This standard is one of a series of standards on test methods which support System Standards for plastics piping systems and ducting systems.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1998, and conflicting national standards shall be withdrawn at the latest by June 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies a method for determining by extrapolation the long-term ultimate relative ring deflection of glass-reinforced plastics (GRP) pipes under wet conditions.

Two methods of loading are given, depending upon the use of plates or beam bars.

NOTE: Either method may be used for measurements of relative deflection up to 28 %. When it is expected that this level is exceeded then the procedure is limited to the use of beam bars.

2 Normative references

This standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter.

For dated references, subsequent amendments to, or revisions of, any of these publications apply to this standard only when incorporated in it by amendment or revision.

For undated references the latest edition of the publication referred to applies.

EN 705:1994 *Plastics piping systems - Glass-reinforced plastics (GRP) pipes and fittings - Methods for regression analyses and their use*

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 vertical compressive load (F): The vertical load applied to a horizontal pipe to cause a vertical deflection.

It is expressed in newtons.

3.2 vertical deflection (y): The vertical change in diameter of a horizontal pipe in response to a vertical compressive load.

It is expressed in metres.

3.3 mean diameter (d_m): The diameter of the circle corresponding with the middle of the pipe wall cross section.
It is given, in metres, by either of the following equations:

$$d_m = d_i + e_A$$

$$d_m = d_e - e_A$$

where:

d_i is the average of the measured internal diameters (see 6.3.3), in metres;

d_e is the average of the measured external diameters (see 6.3.3), in metres;

e_A is the average of the measured wall thicknesses of the pipe (see 6.3.2), in metres.

NOTE: For the purpose of this definition and to avoid confusion the symbol "e_A" is used to represent the wall thickness of the pipe. Elsewhere in this standard (for consistency with EN 705) the symbol "e" is used for one of a series of coefficients used in polynomial equations.

3.4 relative vertical deflection (y/d_m): The ratio of the vertical deflection, y, (see 3.2) to the mean diameter of the pipe, d_m, (see 3.3).

3.5 ultimate vertical deflection under wet conditions ($y_{u,wet}$): The vertical deflection (see 3.2) under wet conditions when a failure occurs (see 8.5 and clause 4).

It is expressed in metres.

3.6 ultimate relative vertical deflection under wet conditions ($y_{u,wet}/d_m$): The ratio of the ultimate vertical deflection under wet conditions (see 3.5) to the mean diameter, d_m, of the pipe (see 3.3).

3.7 long-term ultimate ring deflection under wet conditions ($y_{u,wet,x}$): The value of the extrapolated ultimate vertical deflection under wet conditions (see 3.5) at a time x specified in the referring standard.

It is expressed in metres.

3.8 long-term ultimate relative ring deflection under wet conditions ($y_{u,wet,x}/d_m$): The ratio of the long-term ultimate ring deflection under wet conditions (see 3.7) to the mean diameter, d_m, of the pipe (see 3.3).

3.9 rate of vertical deflection (r): The rate of change in diameter in the vertical direction caused by the vertical compressive load (see 3.1).

It is expressed in metres per hour.

3.10 rate of vertical deflection at failure (r_u): The value of r (see 3.9) when failure occurs (see 8.5 and clause 4).

It is expressed in metres per hour.

3.11 failure: Loss of the structural integrity of the test piece as defined by either of the following conditions:

a) rupture of the pipe wall;

b) if applicable (see 8.5.2), estimated rupture of the pipe wall derived from the intersection of

1) the line described by the logarithm of the rate of deflection, lg *r*, versus logarithm of time, lg *t*, as obtained from a series of vertical deflection/time points of an individual test piece, not yet ruptured [see equation (1)]; and

2) the line as described by the logarithm of the rate of vertical deflection at rupture, lg r_u, versus logarithm of time, lg t_u, derived from a series of test pieces [see equation (2)],

whereby the equations are the following:

$$\lg r = w - z + \lg w' \quad \ldots (1)$$

where:

$$w = a + b \times z + c \times z^2 + d \times z^3 + e \times z^4;$$

$$w' = b + 2 \times c \times z + 3 \times d \times z^2 + 4 \times e \times z^3;$$

$$z = \lg t,$$

where:

a, b, c, d, e are coefficients;

t is the time, in hours.

$$\lg r_u = f + g \times \lg t_u - t_v \times \sigma_u \quad \ldots (2)$$

where:

f, g are coefficients;

t_v is *Student's t*;

σ_u is the standard deviation of the values of lg r_u.

3.12 time to failure (t_u): The time elapsed until a failure occurs (see 8.5 and 3.11).

It is expressed in hours.

3.13 deflection regression ratio ($R_{R,def}$): The ratio between the extrapolated long-term (50 years) property and the extrapolated short-term (6 min) property based on deflection.

3.14 strain regression ratio ($R_{R,str}$): The ratio between the extrapolated long-term (50 years) property and the extrapolated short-term (6 min) property based on strain.

3.15 strain factor (D_g): The factor used to transform a deflection value into a strain value at a certain point in time.

4 Principle

Each of several cut lengths of pipe, supported horizontally and under water, is subjected to a vertical load throughout its length such that each test piece is subject to a different load from any of the others. The resulting vertical deflections are recorded at given times.

Depending upon the level of deflection and the time elapsed, cracks will be initiated and propagate to failure.

The long-term ultimate ring deflection under wet conditions is obtained by extrapolation of the data in accordance with EN 705.

A regression ratio for deflection is calculated relative to a specific short-term deflection and this can be converted, if required, to a regression ratio based on strain.

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

a) the time x to which the values are to be extrapolated (see 3.7 and clauses 8 and 9);

b) the length and number of test pieces (see clause 6);

c) the test temperature (see 8.1);

d) if necessary, the distribution of the times to failure (see note to 8.5).

5 Apparatus

5.1 Compressive loading machine, comprising a system capable of applying a load without shock, through two parallel load application surfaces conforming to 5.2 so that a horizontally orientated test piece of pipe conforming to clause 6 and immersed in water in accordance with 8.3, can be compressed vertically and maintained under constant load in accordance with 8.3.

NOTE: For test pieces subjected to high predetermined loads, for which failure is expected to occur within 100 h, an automatic recording device will help pinpoint failure times accurately.

5.2 Load application surfaces

5.2.1 General arrangement

The surfaces shall be provided by a pair of plates conforming to 5.2.2 or a pair of beam bars conforming to 5.2.3, or a combination of one such plate and one such bar. Their major axes shall be perpendicular to, and centred on, the direction of application of load F as shown in figure 1. The surfaces to be in contact with the test piece shall be flat, smooth, clean and parallel.

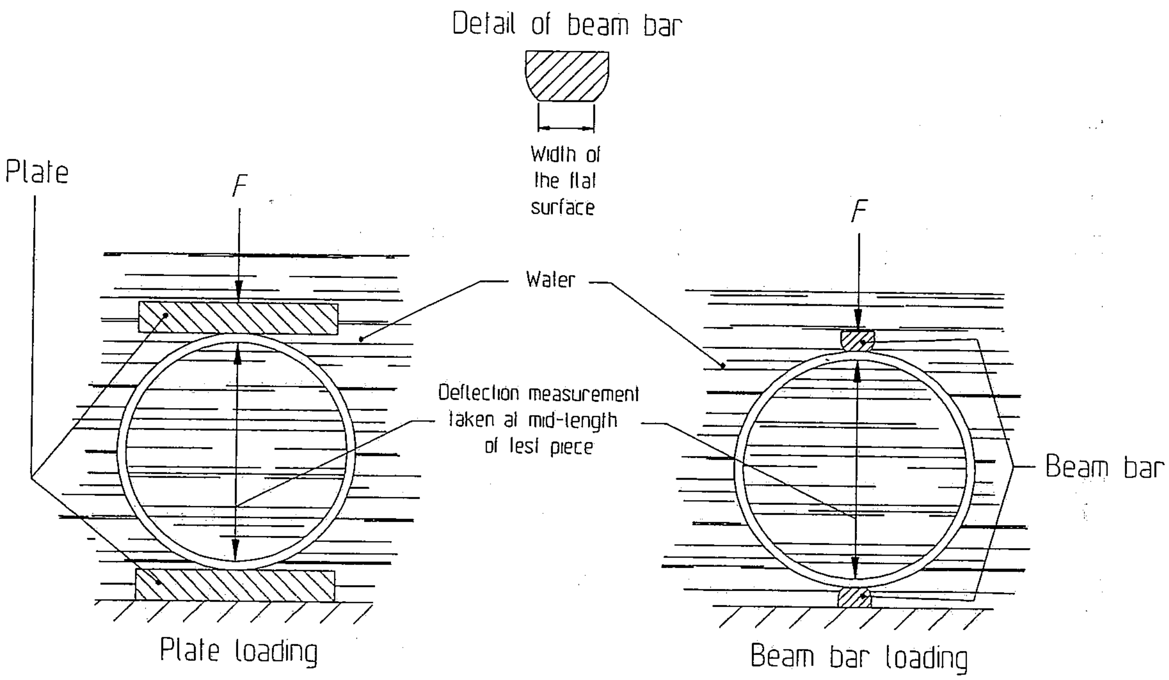

Figure 1: Schematic diagram of the test arrangement

5.2.2 Plates

Each plate shall have a length at least equal to the length of the test piece (see 6.1), a width of at least 100 mm and a thickness such that no visible bending or deformation of the plate shall occur during the test.

5.2.3 Beam bars

Each beam bar shall be rigid and shall have a length at least equal to the length of the test piece (see 6.1) and a flat face (see figure 1) without sharp edges and with a width dependent upon the pipe size as follows:

a) for pipes with a nominal size not greater than DN 300, the width shall be (20 ± 2) mm;

b) for pipes with a nominal size greater than DN 300, the width shall be (50 ± 5) mm.

The beam bar(s) shall be so constructed and supported that no other surface of the beam bar structure shall come into contact with the test piece during the test.

5.3 Water container, large enough to accommodate and if necessary support submerged test pieces, in accordance with clause 6 and 8.3 while they are subject to a compressive load in accordance with 8.4 and 8.5.

The liquid shall be tap water, having a pH of 7 ± 2 and kept at a specified temperature (see 8.1).

The water level shall be maintained sufficiently constant to avoid any significant effect on the vertical load applied to the test piece.

5.4 Dimensional measuring devices, capable of determining the following:

- the necessary dimensions (length, diameter, wall thickness) to an accuracy of within ± 0,1 mm;
- the deflection of the test piece in the vertical direction to an accuracy of within ± 1,0 % of the maximum value.

NOTE: When selecting the device to measure the change in diameter of the test piece, consideration should be given to the potentially corrosive environment in which the device is to be used.

6 Test pieces

6.1 Preparation

The test piece shall be a complete ring cut from the pipe to be tested. The length of the test piece shall be as specified in the referring standard, with permissible deviations of ± 5 %.

The cut ends shall be smooth and perpendicular to the axis of the pipe.

Two straight lines, to serve as reference lines, shall be drawn on the inside or the outside along the length of the test piece at 180° to each other.

6.2 Number

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

6.3 Determination of the dimensions

6.3.1 Length

Measure the length of the test piece along each reference line to an accuracy of 1,0 %.

Calculate the average length, L, of the test piece, in metres.

6.3.2 Wall thickness

Measure to within ± 0,2 mm the wall thickness of the test piece at each end of each reference line.

Calculate the average wall thickness, e_A, as the average of the four measured values, in metres.