

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

The European Standard EN 1227:1997 has the status of a
British Standard

ICS 23.040.20

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

National foreword

This British Standard is the English language version of EN 1227:1997.

The UK participation in its preparation was entrusted to Technical Committee PRI/61, Plastics piping systems and components, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

This European Standard is also incorporated into BS 2782-12 *Methods of testing plastics — Part 12: Reinforced plastics pipes, fittings and valves*, as Method 1214F:1998, for association with related test methods for plastics materials and plastics piping systems.

It may be used for the revision or amendment of other national standards, but it should not be presumed to apply to any existing standard or specification which contains or makes reference to a different test method until that standard/specification has been amended or revised to make reference to this method and adjust any requirements as appropriate.

NOTE In Table A.3 of this English language version, the value of LCL given for test piece #18, shown in the ratified text of EN 1227 as “–2,9,5”, has been corrected to read “–2,905”; and the value of Z_u given for test piece #9, shown in the ratified text as “0,11”, has been corrected to read “1,11”.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

WARNING. This British Standard, which is identical with EN 1227:1997, does not necessarily detail all the precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the method should be performed only by trained personnel.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 14, an inside back cover and a back cover.

This British Standard, having been prepared under the direction of the Sector Board for Materials and Chemicals, was published under the authority of the Standards Board and comes into effect on 15 May 1998

© BSI 1998

ISBN 0 580 29124 3

Amendments issued since publication

Amd. No.	Date	Text affected

ICS 23.040.20

Descriptors: Pipelines, plastic pipes, reinforced plastics, glass-reinforced plastics, thermosetting resins, mechanical tests, ultimate ring deflection, long-term, test conditions

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

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

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

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

© 1997 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

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 NNL.

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.

Contents

	Page
Foreword	2
1 Scope	3
2 Normative references	3
3 Definitions	3
4 Principle	4
5 Apparatus	4
6 Test pieces	6
7 Conditioning	6
8 Procedure	6
9 Calculation	8
10 Test report	8
Annex A (normative) Example calculation for validation of procedures	9

1 Scope

This standard specifies a method for determining by extrapolation the long-term ultimate relative ring deflection of glass-reinforced thermosetting 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 thermosetting 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:

- rupture of the pipe wall;
- if applicable (see 8.5.2), estimated rupture of the pipe wall derived from the intersection of:
 - the line described by the logarithm of the rate of deflection, $\lg r$, versus the 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
 - the line as described by the logarithm of the rate of vertical deflection at rupture, $\lg r_u$, versus the logarithm of time, $\lg t_u$, derived from a series of test pieces [see equation (2)],

whereby the equations are the following:

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

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.

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

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 load which is different from that applied to 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:

- the time, x , to which the values are to be extrapolated (see 3.7 and clauses 8 and 9);
- the length and number of test pieces (see clause 6);
- the test temperature (see 8.1);
- 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, as described in 5.2.1 to 5.2.3.