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Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test method to prove the resistance to initial ring deflection

Systèmes de canalisations en plastiques — Tubes en plastiques thermodurcissables renforcés de verre (PRV) — Méthode d'essai pour établir la résistance à la déflexion annulaire initiale

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval of at least 75% of the member bodies casting a vote.

International Standard ISO 10466 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,* in collaboration with CEN/TC 155, *Plastics piping systems and ducting systems.*

This International Standard is one of a series of standards on test methods for plastics piping systems and ducting systems

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Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test method to prove the resistance to initial ring deflection

1 Scope

This International Standard specifies a method for testing the ability of glass-reinforced thermosetting plastics (GRP) pipes to withstand specified levels of initial ring deflection without displaying surface damage and/or structural failure.

2 Definitions

For the purposes of this International Standard, the following definitions apply:

2.1 vertical deflection (y): The vertical change in diameter of a pipe in a horizontal position in response to a vertical compressive load (see 7.3).

It is expressed in metres.

2.2 relative vertical deflection (y/d_m): The ratio of the vertical deflection y (see 2.1) to the mean diameter of the pipe d_m (see 2.3).

2.3 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:

$$d_m = d_i + e$$

$$d_m = d_e - e$$

where:

d_i is the average of the measured internal diameters (see 5.3.2), in metres;

d_e is the average of the measured external diameters (see 5.3.2), in metres;

e is the average of the measured wall thicknesses of the pipe (see 5.3.1), in metres.

2.4 visual evidence of structural failure: Unless otherwise specified by the referring standard, a failure apparent in any of the following forms (see 7.3):

- interlaminar separation;
- tensile failure of the glass fibre reinforcement;
- buckling of the pipe wall;
- if applicable, separation of the thermoplastic liner from the structural wall.

2.5 strength-reduction evidence of structural failure: Unless otherwise specified by the referring standard, a failure apparent in any of the following ways:

a) during the two-minute inspection period (see 7.3.5), there is an instantaneous drop in load in excess of 10 % of the maximum load applied;
b) when an instantaneous drop in load of up to 10 % has occurred and the test piece cannot sustain an increase in load equal to twice the reduction in load.

2.6 compressive load (F_1 or F_2): The load applied to a pipe to cause a diametric deflection.

It is expressed in newtons.

3 Principle

A length of pipe supported horizontally is loaded throughout its length to compress it diametrically to two successive specified levels of vertical deflection (see figure 2). The pipe is inspected at the first deflection level for visual evidence of surface damage and/or structural failure and at the second deflection level for visual evidence of structural failure (see 2.4). A performance test for structural integrity is also carried out, as a function of the resistance to loading.

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

a) the two pipe deflection limits (see 4.1 and 7.3);
b) the length of the test piece (see clause 5);
c) the number of test pieces (see clause 5);
d) the test temperature (see 7.1);
e) the surface(s) of the test piece to be inspected for surface damage (see 7.3);
f) the visual characteristics of surface damage and structural failure (see 7.3).

4 Apparatus

4.1 Compressive-loading machine, comprising a system capable of applying, without shock, a compressive force at a controlled rate through two parallel load application surfaces conforming to 4.2 so that a horizontally orientated pipe test piece conforming to clause 5 can be compressed vertically. The machine shall be able to achieve and sustain in accordance with the periods specified in 7.3 the deflections or relative vertical deflections specified in the referring standard.

4.2 Load application surfaces

4.2.1 General arrangement

The surfaces shall be provided by a pair of plates (see 4.2.2), or a pair of beam bars (see 4.2.3), or a combination of one such plate and one such bar, with their major axes perpendicular to and centred on the direction of application of the load F by the compressive-loading machine, as shown in figure 1. The surfaces in contact with the test piece shall be flat, smooth, clean and parallel.

Plates and beam bars shall have a length at least equal to that of the test piece (see clause 5) and a thickness such that visible deformation does not occur during the test.

4.2.2 Plates

The plate(s) shall have a width of at least 100 mm.

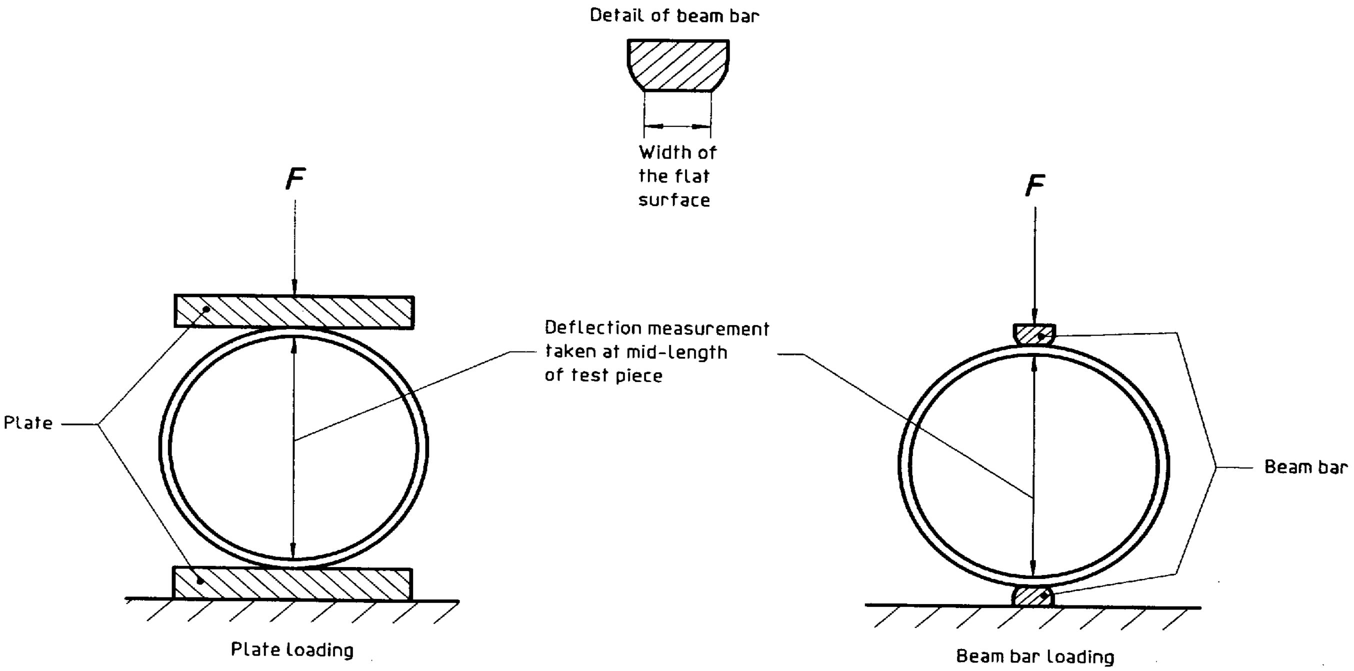

Figure 1 – Schematic diagram of the test arrangement

4.2.3 Beam bars

Each beam bar shall have rounded edges, a flat face (see figure 1) without sharp edges and a width dependent upon the pipe as follows:

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

b) for pipes of nominal sizes greater than DN 300, the width shall be 50 mm ± 5 mm.

The beam bars shall be so designed and supported such that no other surface of the beam bar structure shall come into contact with the test piece during the test.

4.3 Dimension-measuring instruments, capable of determining

- 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: The maximum value of the change to be measured depends upon the vertical deflection or the relative vertical deflection specified in the referring standard.

4.4 Temperature-measuring instrument, if applicable, capable of verifying conformity to the test temperature (see 7.1).

5 Test pieces

5.1 Preparation

Each 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 parallel to each other along the inside or the outside of the test piece.

5.2 Number

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

5.3 Determination of dimensions

5.3.1 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, in metres, of the four measured values.

5.3.2 Mean diameter

Measure to an accuracy of within ± 0,5 mm either of the following:

a) the internal diameter d_i of the test piece between each pair of diametrically opposed reference lines at their mid-length, e.g. by means of a pair of calipers;

b) the external diameter d_e of the test piece at the mid-points of the reference lines, e.g. by means of circumferential-wrap steel tape.

Calculate the mean diameter d_m of the test piece using the values obtained for the wall thickness and either the internal or the external diameter (see 2.3).

6 Conditioning

Unless otherwise specified by the referring standard, store the test pieces for at least 0,5 h at the test temperature (see 7.1) prior to testing.

In cases of dispute, condition the test pieces for 24 h at 23 °C ± 3 °C before testing, or subject them to a mutually agreed conditioning schedule.

7 Procedure

7.1 Test temperature

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

7.2 Choice of load application surfaces and positioning of the test piece

If one of the required relative deflection limits (for surface damage or for structural failure) is in excess of 28 %, use beam bars. Otherwise use either plates and/or beam bars (see 4.2).

Place the test piece in contact with the upper and lower plate or beam bar (see 4.2.1), with the pair of diametrically opposed reference lines vertically aligned. Ensure that the contact between the test piece and each plate or beam bar is as uniform as possible and that the plates and/or beam bars are not tilted laterally.

7.3 Application of load and measurement of deflection

7.3.1 Compress the test piece at a constant rate so that the first minimum initial vertical deflection or minimum initial relative vertical deflection specified in the referring standard is reached to an accuracy of ± 2,0 % of the specified deflection value in 2 min ± 0,5 min and record the corresponding load F_1 (see figure 2).

7.3.2 Maintain this deflection for 2 min ± 0,25 min while inspecting the test piece without magnification for surface damage [see items e) and f) in the note to clause 3].

Record any observations of surface damage together with the corresponding deflection.

7.3.3 Increase the deflection, using either a constant rate of compression or loading chosen so that the second minimum initial vertical deflection or minimum initial relative vertical deflection is reached to an accuracy of within ± 2,0 % of the specified deflection value in 2 min ± 0,5 min and record the corresponding load F_2.

7.3.4 Maintain this deflection for 2 min ± 0,25 min while continuously monitoring and recording the load applied (see figure 2) and continuously inspecting the test piece for structural failure [see item f) in the note to clause 3] in accordance with 2.4 and 2.5 unless otherwise specified.

7.3.5 If no instantaneous drop in load is detected during the inspection period, record that no failure has occurred and unload the test piece.

If an instantaneous drop in load of not more than 10 % of F_2 is detected during the inspection period, determine the size of the drop and increase the load at the end of the inspection period by twice this value (maximum 20 % of F_2).

If the test piece withstands the increased load, record that no failure has occurred and unload the test piece.

If the test piece does not withstand the increased load, record that failure has occurred and unload the test piece.

If the instantanious drop in load is more than 10 % of F_2 during the inspection period, record that failure has occurred and unload the test piece.

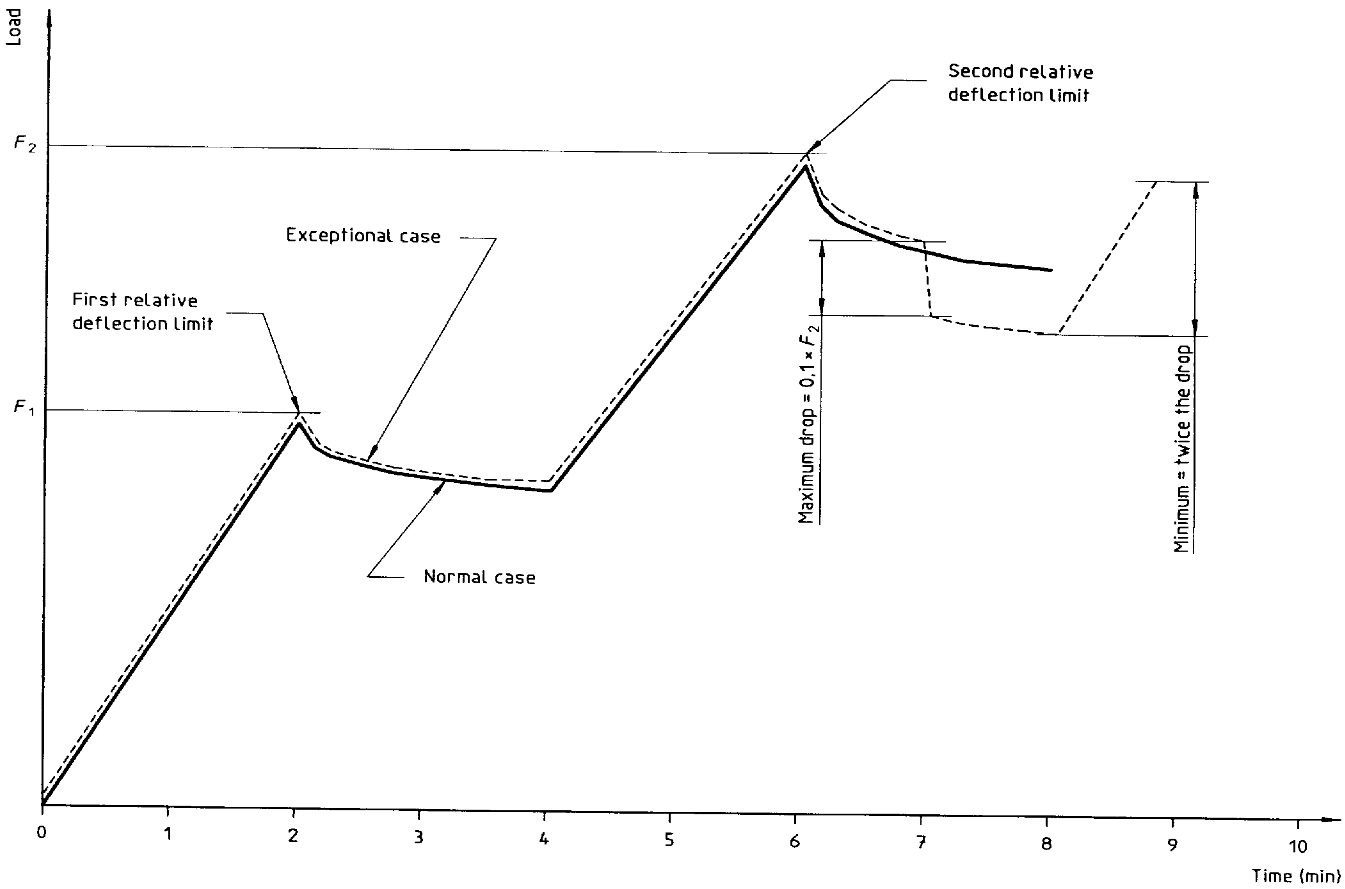

Figure 2 – Schematic diagram of load versus time

8 Test report

The test report shall include the following information:

a) a reference to this International Standard and to the referring standard;

b) all details necessary for complete identification of the pipe tested;

c) the dimensions of each test piece;

d) the number of test pieces;

e) the positions in the pipe from which the test pieces were obtained;

f) the equipment details, including whether beam bars and/or plates were used;

g) the test temperature;

h) for each test piece, details of any observed surface damage and the corresponding deflection(s) (see 7.3);

i) for each test piece, details of any structural failure, together with the relevant deflection(s) and load(s) (see 7.3);

j) details of any incidence of failure in accordance with 7.3.5;

k) any factors which may have affected the results, such as any incidents which may have occurred or any operating details not specified in this International Standard;

l) the date of the test.

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