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Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the ring creep properties under wet or dry conditions

Tubes en plastiques thermodurcissables renforcés de verre (PRV) — Détermination de la rigidité annulaire spécifique à long terme en fluage en conditions mouillées et calcul du facteur de fluage mouillé

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: 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*.

This second edition cancels and replaces the first edition (ISO 10468:2003), which has been technically revised. It also incorporates the Amendment ISO 10468:2003/Amd1:2010.

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

— modified the title;

— clarified accuracy statements;

— combined wet and dry creep testing (ISO 7684) into a single document;

— referenced ISO 3126 for dimension determination.

Introduction

This edition of ISO 10468 includes both wet and dry creep testing. The basic procedures and calculations are the same for wet or dry creep testing with the only difference whether or not the test piece is immersed in water. This allows better maintenance of the test procedures and calculation methods and collects all material relating to creep testing of GRP pipe products into a single document. Upon publication of this edition of ISO 10468, it is intended to withdraw ISO 7684.

Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the ring creep properties under wet or dry conditions

1 Scope

This document specifies methods for determining the ring creep properties for glass-reinforced thermosetting plastics (GRP) pipes. Properties include the creep factor and the long-term specific creep stiffness. Testing is performed under either wet (total immersion in water) or dry conditions.

Dry creep testing is typically performed for the assessment and control of raw material consistency. Wet creep testing is typically undertaken to determine the long-term creep performance in simulated use conditions.

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 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 7685, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of initial specific ring stiffness*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
vertical compressive force
F
vertical force, applied to a horizontal pipe to cause a vertical deflection

Note 1 to entry: Vertical compressive force is expressed in newtons.

3.2
specific ring stiffness
S
measure of the resistance of a pipe to ring deflection, per metre of length, under external load as defined by Formula (1):

$$S = \frac{E \times I}{d_m^3} \quad (1)$$

where

E is the apparent modulus of elasticity as determined in a ring stiffness test, in newtons per square metre;

I is the second moment of area in the longitudinal direction per metre length, in metres to the fourth power per metre (m^4/m), i.e.

$$I = \frac{e^3}{12} \quad (2)$$

where

e is the wall thickness of the pipe, in metres;

d_m is the *mean diameter* (3.3) of the pipe, in metres.

Note 1 to entry: Specific ring stiffness is expressed in newtons per square meter.

3.3
mean diameter
d_m
diameter, of the circle corresponding with the middle of the pipe wall cross-section and given by either Formula (3) or (4)

$$d_m = d_i + e \quad (3)$$

$$d_m = d_e - e \quad (4)$$

where

d_i is the internal diameter, in metres;

d_e is the external diameter, in metres;

e is the wall thickness of the pipe, in metres.

Note 1 to entry: Mean diameter is expressed in metres.

3.4
initial specific ring stiffness
S_0
value of S determined by testing using constant load in accordance with ISO 7685

Note 1 to entry: Initial specific ring stiffness is expressed in newtons per square metre.

3.5
long-term specific ring creep stiffness at position 1
$S_{x,1}$
value of S at a reference position, position 1 (see 10.2), at x years, obtained by extrapolation of long-term stiffness measurements at a constant force (see 3.2 and 10.2)

Note 1 to entry: Long-term specific ring creep stiffness at position 1 is expressed in newtons per square metre.

3.6
calculated long-term specific ring creep stiffness
$S_{x,\text{creep}}$

calculated value of S at x years obtained using Formula (5):

$$S_{x,\text{creep}} = S_0 \times \alpha_{x,\text{creep}} \quad (5)$$

where

x	is the elapsed time, in years (or hours), specified in the referring standard;
$\alpha_{x,\text{creep}}$	is the *creep factor* (3.7);
S_0	is the initial specific ring stiffness, in newtons per square metre.

Note 1 to entry: Calculated long-term specific ring creep stiffness is expressed in newtons per square metre.

3.7
creep factor
$\alpha_{x,\text{creep}}$
ratio of the long-term specific ring creep stiffness to the initial specific ring stiffness, both at a reference position, position 1 (see 10.2), and given by Formula (6):

$$\alpha_{x,\text{creep}} = \frac{S_{x,1,\text{creep}}}{S_{0,1}} \quad (6)$$

where

$S_{0,1}$	is the ring stiffness at position 1, in newtons per square metre at 0,1 h;
$S_{x,1,\text{creep}}$	is the long-term specific ring creep stiffness at position 1 at time x, in newtons per square metre.

3.8
vertical deflection
y
vertical change in diameter of a pipe in a horizontal position, in response to a *vertical compressive force* (3.1)

Note 1 to entry: Vertical deflection is expressed in metres.

3.9
long-term vertical deflection
$y_{x,1}$
value of the vertical deflection y, at the reference position, position 1 (see 10.2), at x years

Note 1 to entry: Long-term vertical deflection is expressed in metres.

3.10
deflection coefficient
f
dimensionless factor which takes into account general second-order theory as applied to deflection and is given by Formula (7):

$$f = \left[1\,860 + \left(2\,500 \times y_1 / d_\text{m}\right)\right] \times 10^{-5} \quad (7)$$

where

y_1	is the long-term vertical deflection at position 1, in metres;
d_m	is the *mean diameter* (3.3) of the pipe, in metres.