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Plastics piping systems for drainage and sewerage without pressure — Non-circular pipes and joints made of glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resins (UP) — Dimensions, requirements and tests

Systèmes de canalisation en plastiques pour réseaux d'assainissement sans pression — Tuyaux non-circulaires, assemblages de tuyaux et raccords en plastiques thermodurcissables renforcés de verre (PRV) à base de résines de polyester non saturé (UP) — Dimensions, exigences et essais

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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 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.

The committee responsible for this document is ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

Introduction

The goal to establish this product standard is to standardize the requirements for non-circular GRP pipes.

This document specifies the requirements for non-circular GRP pipe systems, designed to be used for the renovation of existing channels or open cut installation.

This document specifies dimensions, requirements and tests of non-circular pipes including short and long-term properties. To establish long-term properties, it is recommended to use the circular pipes samples.

Annex A shows commonly used calculation methods but only as information. The calculation method is selected by the designer.

This document does not include the recommended practice for installation as this should be a separate document.

Plastics piping systems for drainage and sewerage without pressure — Non-circular pipes and joints made of glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resins (UP) — Dimensions, requirements and tests

1 Scope

This document specifies the required properties of the piping system and its components made from glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) intended to be used for drainage or sewerage without pressure including culverts.

It is the responsibility of the purchaser or specifier to make the appropriate selections taking into account their particular requirements and any relevant national regulations and installation practices or codes.

This document is applicable to non-circular GRP-UP pipes, with flexible or rigid joints, primarily intended for use in buried installations but may also be used to reline existing non-circular pipe lines.

NOTE 1 GRP-UP includes pipes with vinyl ester liners or made entirely from vinyl ester.

NOTE 2 Piping systems conforming to this document can be used also for non-buried applications provided the influence of the environment, e.g. from UV-radiation, and the supports are considered in the design of the pipes, fittings and joints.

This document is applicable to pipes, fittings and their joints of nominal sizes from DN 150 to DN 4000, which are intended to be used for the conveyance of surface water or sewage at temperatures up to 50 °C.

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 75-2:2013, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178, *Plastics — Determination of flexural properties*

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

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

ISO 8513:2016, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test methods for the determination of the initial longitudinal tensile strength*

ISO 8533, *Plastics piping systems for pressure and non-pressure drainage and sewerage — Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin — Test methods to prove the design of cemented or wrapped joints*

ISO 8639, *Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness and proof of structural design of flexible joints*

ISO 10468, *Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the long-term specific ring creep stiffness under wet conditions and calculation of the wet creep factor*

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

ISO 10952, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Determination of the resistance to chemical attack for the inside of a section in a deflected condition*

EN 681-1, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN/TS 14632, *Plastics piping systems for drainage, sewerage and water supply, pressure and non-pressure — Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) — Guidance for the assessment of conformity*

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 http://www.iso.org/obp

3.1
nominal size
BN × *HN*
alphanumerical designation of size, which is common to all components in a piping system, it is a convenient pair of numbers for reference purposes that is related to the maximum internal breadth (*B*) and the maximum internal height (*H*)

Note 1 to entry: The designation for reference or marking purposes consists of the letters *BN*(*B*) × *HN*(*H*) and the numerical values for (*B*) and (*H*), when expressed in millimetres.

3.2
declared dimensions
dimensions which a manufacturer states to be the internal breadth (*B*) and height (*H*) produced in respect of a particular nominal size *BN* × *HN*

3.3
specific ring stiffness
S
physical characteristic of a circular pipe which is a measure of the resistance to ring deflection per metre length under external load

Note 1 to entry: Specific ring stiffness is determined using formula below and is expressed in Newtons per square metre (N/m^2):

$$S = \frac{E \cdot I}{d_m^3}$$

where

E is the apparent modulus of elasticity, which can be derived from the result of the ring stiffness test, i.e. ISO 7685, expressed in Newtons per square metre (N/m^2);

d_m is the mean diameter of the pipe, in metres (m) (see 3.5);

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):

$$I = \frac{e^3}{12}$$

where

e is the wall thickness, in metres.

3.4
initial specific ring stiffness
S_0
value of S obtained when a circular pipe is tested in accordance with ISO 7685

Note 1 to entry: Initial specific ring stiffness is expressed in newtons per square metre (N/m^2).

3.5
mean diameter
d_m
diameter of the circle corresponding with the middle of a circular pipe wall cross section

Note 1 to entry: Mean diameter is derived using the formula with the inside diameter and wall thickness expressed in metres (m):

$$d_m = ID + e$$

where

e is the pipe's wall thickness.

3.6
wet creep factor
$\alpha_{x,creep,wet}$
ratio of the long-term specific ring stiffness, $S_{x,wet}$ to the initial specific ring stiffness, S_0 at x years

Note 1 to entry: See 4.4.6 for value of x.

Note 2 to entry: Determined using circular test-pieces under sustained diametrical loading in wet conditions when tested in accordance with ISO 10468.

Note 3 to entry: Wet creep factor is a dimensionless number given by the formula:

$$\alpha_{x,creep,wet} = \frac{S_{x,wet}}{S_0}$$

3.7
long-term specific ring stiffness
$S_{x,wet}$
determined value of specific ring stiffness S at x years for circular pipe

3.8
rerating factor
R_{RF}
multiplication factor that quantifies the relationship of a product's mechanical, physical and chemical properties under service conditions above 35 °C [*design service temperature* (3.16)] to those applicable at a standard test temperature of 23 °C

3.9
short term bending strength
σ_f
maximum flexural stress sustained by the test specimen during a bending test, when tested in accordance with ISO 178

Note 1 to entry: Short-term bending strength is determined using the following formula and is expressed in megapascals (MPa):

$$\sigma_f = \frac{3FL}{2bh^2}$$

where

σ_f is the flexural stress, in megapascals (MPa);

F is the load in newtons (N);

L is the span, in millimetres (mm);

h is the thickness of the specimen, in millimetres (mm);

b is the width of the specimen, in millimetres (mm).

3.10
long-term bending strength
σ_{fx}
calculated value of σ_f at x years for circular pipe

Note 1 to entry: Long-term bending strength is determined using methodology given in 5.2.5.3, using linear regression analysis according to ISO 10928 on data of bending stress in hoop direction, and is expressed in megapascals (MPa):

$$\sigma_{circ} = \frac{6 \cdot f\max \cdot \frac{d_m}{2} \cdot \frac{1}{\pi}}{l \cdot e^2} \cdot \alpha_{ki}$$

with

$$\alpha_{ki} = \frac{3 \cdot d_i + 5 \cdot e}{3 \cdot d_i + 3 \cdot e}$$

where

σ_{circ} is the ring bendning stress, in megapascals (MPa);

F_{max} is the maximum force, in newtons (N);

d_m is the mean diameter, in millimetres (mm);

d_i is the inside diameter, in (mm);

e is the structural wall thickness, in (mm);

l is the length of specimen, in (mm);

α_{ki} is the correction factor inner surface.

3.11
short term bending modulus
E_f
value of flexural modulus obtained when tested in accordance with ISO 178

Note 1 to entry: Short term bending modulus is determined using the following formula and is expressed in megapascals (MPa):

$$E_f = \frac{L^3}{4b \cdot h^3} \cdot \frac{F_{max}}{s_{max}}$$

where

E_f is bending modulus, in megapascals (MPa);

F_{max} is the maximum force corresponds to maximum deflection, in newtons (N);

s_{max} is the maximum deflection of specimen , in millimetres (mm);

b is the width specimen width, in (mm);

h is the wall thickness of the specimen, in (mm);

L is the span, in (mm).

3.12
long-term creep bending modulus
E_{fx}
calculated value of E_f at x years for circular pipe when tested in accordance with ISO 10468

Note 1 to entry: Long-term bending modulus is determined using the following formula and is expressed in megapascals (MPa):

$$E_{fx} = E_0 \cdot \alpha_{x,creep,wet}$$

where

E_{fx} is the long-term creep bending modulus, in megapascals (MPa);

E_0 is the short-term bending modulus as result of the creep test on circular profiles according to ISO 10468, in megapascals (MPa);

$\alpha_{x,creep,wet}$ is the wet creep factor, see 3.6.

3.13
type tests
tests carried out to prove that a material, component, joint or assembly is capable of conforming to the relevant requirement

3.14
laying length
total length of a pipe minus, where applicable, the manufacturer's recommended insertion depth of the spigot(s) in the socket

Note 1 to entry: Laying length is expressed in metres (m).

3.15
normal service conditions
conveyance of surface water or sewage, in the temperature range 2 °C to 50 °C, with maximum water table of 10 m, for 50 years

3.16
design service temperature
maximum sustained temperature at which the system is expected to operate

Note 1 to entry: Expressed in degrees Celsius (°C).

3.17
flexible joint
joint which allows relative movement between the pipes being joined

Note 1 to entry: Examples of this type of joint are: socket-and-spigot joint with an elastomeric sealing element (including double socket designs)

3.18
rigid joint
joint which does not allow relative movement between the pipes being joined

Note 1 to entry: Examples of this type of joint are: flanged joint, including integral and loose flanges, wrapped or cemented joint.

3.19
angular deflection
δ
angle between the axes of two adjacent pipes

Note 1 to entry: See Figure 1.

Note 2 to entry: Angular deflection is expressed in degrees (°).

3.20
draw
D
longitudinal movement of a joint

Note 1 to entry: See Figure 1.

Note 2 to entry: Draw is expressed in millimetres (mm).

3.21
total draw
T
sum of the draw, *D*, and the additional longitudinal movement, *J*, due to the presence of angular deflection

Note 1 to entry: See Figure 1.

Note 2 to entry: Total draw is expressed in millimetres (mm).

3.22
misalignment
M
amount by which the centrelines of adjacent pipes fail to coincide

Note 1 to entry: See Figure 1.

Note 2 to entry: Misalignment is expressed in millimetres (mm).