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Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications —

Part 1: General

Systèmes de canalisations en polyéthylène renforcé de fibres de verre courtes (PE-sGF) pour les applications industrielles —

Partie 1: Généralités

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Foreword

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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).

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For an explanation of 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 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 3, *Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications*.

A list of all parts in the ISO 22101 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Polyethylene reinforced with short glass fibres (PE-sGF) piping systems are pipe systems which consist of pipes produced by adding short glass fibres into high density polyethylene resins. Their physical and mechanical properties are influenced by short glass fibre orientation.

The technology of production of PE-sGF pipes is completely different from that traditionally used during PE pipes extrusion. For this reason, this document makes reference to standard inside diameter ratio (SIDR) sized pipe. To prevent the confusion, the standard dimension radio (SDR) size pipe, commonly used for PE products, is not used in this document.

The PE-sGF system is intended to be used for general purpose liquid fluids supply (e.g. chemical plants, industrial sewerage engineering, power plants, agricultural production plants, water treatment).

For the material subject of this document, the mechanical performances are obtained on the basis of International Standards dedicated to thermoplastics. The geometrical characteristics are defined exclusively for this material in line with ISO 3 and ISO 4065.

Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications —

Part 1: General

1 Scope

This document specifies the general aspects of short glass fibre reinforced polyethylene (PE-sGF) piping systems, manufactured by the spiral cross winding method, which are used below ground for the conveyance of liquid fluids for the following industrial and agricultural uses:

— chemical plants;

— industrial sewerage engineering;

— power engineering (cooling and general-purpose water supply);

— agricultural production plants;

— water treatment;

— small hydraulic power plants (general-purpose water supply).

In conjunction with the other parts of the ISO 22101 series, this document applies to PE-sGF pipes, fittings and their joints with each other, with other PE-sGF components, and to components from other materials intended for use under the following conditions:

a) allowable operating pressure (PFA) up to and including 25 bar[1)];

b) operating temperature of 20 °C as the reference temperature.

NOTE For other operating temperatures, guidance is given in Annex A.

Other application areas differing from those listed in the scope can be permitted if the requirements of this document and/or relevant national requirements are taken into account. Drinking water applications are outside the scope of this document.

This document covers only PE-sGF using glass fibre with lengths comprised in the range between 3 mm and 5 mm.

Components conforming to any of the documents listed in the Bibliography or to national standards, as applicable, can be used with components conforming to this document, provided that they conform to the requirements for joint dimensions and to the relevant requirements of this document.

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 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 1167-1, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

ISO 1887, *Textile glass — Determination of combustible-matter content*

ISO 1888, *Textile glass — Staple fibres or filaments — Determination of average diameter*

ISO 2078, *Textile glass — Yarns — Designation*

ISO 3344, *Reinforcement products — Determination of moisture content*

ISO 4427-1, *Plastics piping systems for water supply and for drainage and sewerage under pressure — Polyethylene (PE) — Part 1: General*

ISO 6259-1, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method*

ISO 6259-3, *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes*

ISO 7510, *Plastics piping systems — Glass-reinforced plastics (GRP) components — Determination of the amounts of constituents*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient*

ISO 13479, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes*

ISO 13967, *Thermoplastics fittings — Determination of ring stiffness*

ISO 15512, *Plastics — Determination of water content*

ISO 15853, *Thermoplastics materials — Preparation of tubular test pieces for the determination of the hydrostatic strength of materials used for injection moulding*

ISO 16770, *Plastics — Determination of environmental stress cracking (ESC) of polyethylene — Full-notch creep test (FNCT)*

ISO 22314, *Plastics — Glass-fibre-reinforced products — Determination of fibre length*

3 Terms and definitions

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

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

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

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

3.1 Terms related to geometry

3.1.1
nominal wall thickness
e_n
numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres, corresponding to the minimum wall thickness, e_{min}

3.1.2
wall thickness at any point
e
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.1.3
mean wall thickness
e_m
arithmetic mean of a number of measurements regularly spaced around the circumference of the component in the same cross-section of the component, including the measured minimum and the measured maximum values of the wall thickness

3.1.4
pipe series
S_i
dimensionless number for pipe designation in accordance with the following formula:

$$S_i = \frac{R_{SID} + 1}{2}$$

where R_{SID} is the standard inside dimension ratio (SIDR), and S_i is the pipe designation

Note 1 to entry: The relationship between the pipe series, S_i, and the standard inside dimension ratio (SIDR), is given in 3.1.5.

3.1.5
standard inside dimension ratio
SIDR
R_{SID}
ratio of the nominal inside diameter, d_i, of a pipe to its nominal wall thickness, e_n

Note 1 to entry: The standard inside dimension ratio (SIDR) and the pipe series, S_i, are related as shown in the following formula, where R_{SID} is the SIDR:

$$R_{SID} = 2S_i - 1$$

3.1.6
nominal size
DN/ID
numerical designation of the size of a component related to the inside diameter, other than a component designated by a thread size, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres

3.1.7
nominal inside diameter
d_{in}
specified inside diameter, in millimetres, assigned to a nominal size, DN/ID

3.1.8
inside diameter at any point
d_i
value of the measurement of the inside diameter through its cross-section at any point of the pipe, except the socket, rounded to the next greater 0,1 mm

3.1.9
mean inside diameter
d_{im}
value of the measurement of the inner circumference of the pipe in any cross-section, except the socket, divided by π (= 3,142), rounded to the next greater 0,1 mm

3.1.10
ring stiffness
mechanical characteristic of a pipe or fitting which is a measure of the resistance to ring deflection under an external force

Note 1 to entry: For the purposes of this document, the external force shall be determined in accordance with ISO 9969 (for pipes) and ISO 13967 (for fittings).

3.2 Terms related to material

3.2.1
virgin material
material in a form such as granules that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable materials have been added

3.2.2
PE-sGF compound
compound (compound, short glass fibre and coupling agent) from which the pipes and fittings are produced

Note 1 to entry: This material is made by adding to the PE compound glass fibre and those additives necessary for the manufacture and end use of the products, in accordance with the requirements of the applicable part of this document.

3.2.3
short glass fibre
chopped glass fibre with a low length to diameter aspect ratio

Note 1 to entry: Short glass fibres used for the production of PE-sGF compound can be either alumina-boro-silicate glass or alumina-talco-silicate glass in the form of chopped strands.

3.2.4
coupling agent
substance used in small proportions to increase the adhesion to specific substrates

3.3 Terms related to material characteristics

3.3.1
lower confidence limit of the predicted hydrostatic strength
σ_{LPL}
quantity, with the dimensions of stress, which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength at a temperature and time.

Note 1 to entry: It is expressed in megapascals (MPa).

3.3.2
minimum required strength
MRS
$F_{r,min}$
value of the lower confidence limit σ_{LPL} at 20 °C and 50 years rounded down to the next value in the R10 series as defined in ISO 3 when σ_{LPL} is less than 20 MPa or down to the next value in the R20 series as defined in ISO 3 when σ_{LPL} is greater than or equal to 20 MPa

Note 1 to entry: The minimum required strength is expressed in megapascals (MPa).

3.3.3
design stress
σ_s
allowable stress for a given application at 20 °C that is derived from the MRS by dividing it by the design coefficient, C

Note 1 to entry: Design stress is expressed with the following formula, where $F_{r,min}$ is the minimum required strength (MRS):

$$\sigma_s = \frac{F_{r,min}}{C}$$

Note 2 to entry: Design stress is expressed in megapascals (MPa).

3.3.4
design coefficient
C
coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit

3.3.5
melt flow rate
MFR
value relating to the viscosity of the molten material at a specified temperature and load

3.3.6
sGF orientation angle
θ
angle, the value of which is provided by the extension and elongation flow of the extruder in the winding process

Note 1 to entry: The physical and mechanical properties of PE-sGF piping systems are influenced by this orientation angle.