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

Part 1:
General

ICS: 23.040.01

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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 03, *Plastics pipes and fittings for industrial applications*.

ISO 22101 consists of the following parts, under the general title *Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications*

Part 1: General

Part 2: Pipes

Part 3: Fittings

Part 5: Fitness for purpose of the system

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

The pipe systems which consist of pipes produced by adding short glass fibres into high density polyethylene resins are called polyethylene reinforced with short glass fibres (PE-sGF) piping systems. The physical and mechanical properties are influenced by short glass fibre orientation. This document is applicable to pipe inside diameter from 200 mm to 2000 mm with integrated socket and spigot fusion joint.

The technology of production of PE-sGF pipes is completely different than the traditional one, used during the PE pipes extrusion, for this reason this document makes reference to SIDR. To prevent the confusion, the parameter SDR, commonly used for PE products, has been deleted from the document.

The PE-sGF system is intended to be used for general purpose 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 standards dedicated to thermoplastics, the geometrical characteristics are defined exclusively for this material in analogy to ISO 4065 [1].

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

Part 1: General

1 Scope

This International Standard specifies the general aspects of short glass fibre reinforced polyethylene (PE-sGF) piping systems manufactured by spiral cross winding method used in above and below ground for the conveyance of fluids for industrial and agricultural use shown below:

— Chemical plant;

— Industrial sewerage engineering;

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

— Agricultural production plants;

— Water treatment;

— Small hydraulic power plant (general-purpose water supply);

In conjunction with the other parts of ISO 22101, it 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;

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

NOTE 1 For other operating temperature, guidance is given in Annex B

NOTE 2 If needed, national regulations for specific applications (e.g. water treatment) apply. This standard is not applicable to drinking water application.

Other application areas are permitted if the requirements of this International Standard and/or applicable national requirements are fulfilled.

National regulations in respect of fire behaviour and explosion risk are applicable. This document is covering only PE-sGF using glass fibre with lengths comprised in the range between 2 and 5 mm.

Components conforming to any of the product standards listed in the bibliography or with national standards, as applicable, may be used with components conforming to this International Standard, provided that they conform to the requirements for joint dimensions and to the relevant requirements of this International Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3, *Preferred numbers — Series of preferred numbers*

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

ISO 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

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

ISO 11922-1, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

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 15512, *Plastics — Determination of water content*

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 International Standard, the following definitions apply.

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

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

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

3.1 Definitions related to geometrical characteristics

3.1.1
out-of-roundness
difference between the maximum and the minimum inside diameters in the same cross-section of a pipe or spigot

3.1.2
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 (mm), corresponding to the minimum wall thickness, e_{min}

3.1.3
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

3.1.4
pipe series
S_i
dimensionless number for pipe designation conforming the following formula:

$$S_i = \frac{SIDR + 1}{2}$$

Note 1 to entry: The relationship between the pipe series, S_i, and the standard inside dimension ratio, SIDR, is given by the following formula as derived from ISO 4065.

3.1.5
standard inside dimension ratio
SIDR
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 are related as shown in the formula :

$$SIDR = 2S_i - 1$$

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 (mm)

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 as determined in accordance with ISO 9969 (for pipes) and ISO 13967 (for fittings)

3.1.11
ring stiffness class
SN
numerical designation of the ring stiffness of the pipe or fitting which is a convenient round number, indicating the minimum required ring stiffness of the pipe or fitting

3.1.12
minimum wall thickness at any point
e_{min}
minimum value of the wall thickness at any point around the circumference of a component as specified

3.1.13
maximum wall thickness at any point
e_{max}
maximum value of the wall thickness at any point around the circumference of a component as specified

3.1.14
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.

3.1.15
tolerance
permissible variation of the specified value of a quantity expressed as the difference between the permissible maximum and permissible minimum values

3.2 Definitions of materials

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-compound
homogenous extruded mixture of base polymer (PE) and additives, i.e. anti-oxidants, pigments, carbon black, UV-stabilizers, and others at a dosage level necessary for the processing and use of components conforming to the requirements of this document

3.2.3
PE-sGF compound
the PE-sGF compound (compound, short glass fibre and coupling agent) from which the pipes and fittings are produced shall be made by adding to the PE compound glass fibre and only those additives necessary for the manufacture and end use of the products, conforming to the requirements of the applicable part of this document.

3.2.4
short glass fibre
the short glass fibres used for the manufacture of the PE-sGF compound. 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.

3.2.5
coupling agent
coupling agent is an anhydride modified high density polyethylene used to manufacture the PE-sGF compound.

3.3 Definitions 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 θ and time *t*.

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

3.3.2
minimum required strength
MRS
value of σ_{LPL} at 20 °C and 50 years, rounded down to the next smaller value of the R10 series when σ_{LPL} is below 10MPa, or to the next lower value of the R20 series when σ_{LPL} is 10MPa or greater.

Note 1 to entry: R10 and R20 series are the Renard number series according to ISO 3 and ISO 497.

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 coefficient C .

Note 1 to entry: It is expressed as:

$$\sigma_s = \frac{\mathrm{MRS}}{C}$$

Note 2 to entry: It 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 measured in accordance with ISO 1133-1