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

Part 5: Fitness for purpose of the system

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

Partie 5: Aptitude à l'emploi du système

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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 document 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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This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 3, *Plastics pipes and fittings 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 fittings 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 the traditional technology used during PE pipes extrusion. For this reason, this document makes reference to standard inside dimension ratio (SIDR). To prevent confusion, the parameter "standard dimension ratio" (SDR), commonly used for PE products, is not used in this document.

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 for this material in line with ISO 4065.

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

Part 5:
Fitness for purpose of the system

1 Scope

This document specifies the requirements of the fitness for purpose of pipes or fittings assemblies or both made from short glass fibre reinforced polyethylene (PE-sGF) piping systems manufactured by the spiral cross winding method used below ground for the conveyance of fluids in the following industrial and agricultural contexts:

— 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).

This document also specifies the test parameters for the test methods it references.

In conjunction with other parts of the ISO 22101 series, this document is applicable to PE-sGF pipes, fittings, their joints and joints with components of PE-sGF or other materials, intended to be used under the following conditions:

a) a maximum 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 ISO/PAS 22101-1:2022, Annex A.

This document is applicable to pipes with an inside diameter of 200 mm to 1 000 mm with integrated socket and spigot fusion joint.

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 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*

1) 1 bar = 0,1 MPa = 105 Pa; 1 MPa = 1 N/mm^2.

ISO 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

ISO 11413:2019, *Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting*

ISO 11414:2009, *Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion*

ISO 13953, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

ISO 13954, *Plastics pipes and fittings — Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm*

ISO 13955, *Plastics pipes and fittings — Crushing decohesion test for polyethylene (PE) electrofusion assemblies*

ISO 13956, *Plastics pipes and fittings — Decohesion test of polyethylene (PE) saddle fusion joints — Evaluation of ductility of fusion joint interface by tear test*

ISO/PAS 22101-2, *Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications — Part 2: Pipes*

ISO/PAS 22101-3, *Polyethylene reinforced with short glass fibres (PE-sGF) piping systems for industrial applications — Part 3: Fittings*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Fitness for purpose of pipes and/or fittings assemblies

4.1 Method of preparation of assemblies for testing

4.1.1 General

The joint shall be made by using pipes conforming to ISO/PAS 22101-2 or fittings conforming to ISO/PAS 22101-3 or both.

Test pieces for pressure testing shall be closed with pressure-tight, end-load-bearing end caps, plugs or flanges, which shall be provided with connections for the entry of water and release of air.

The peelable layer of peelable-layer pipe shall be removed in the area of the joint prior to jointing.

Test assemblies shall be prepared, taking into consideration applicable national safety regulations.

If failures that call for a redesign of the fittings are detected during testing according to this document, retesting according to ISO/PAS 22101-3 automatically becomes necessary.

4.1.2 Electrofusion joints

PE-sGF pipes and fittings intended to be used for jointing by electrofusion shall be prepared and assembled in accordance with ISO 11413. The conditions for the preparation of joints are given in 4.2.3.1 for the

assessment of fitness for purpose of the system under normal conditions and in 4.2.3.2 for the assessment of fitness for purpose of the system under extreme conditions.

4.1.3 Butt fusion joints

PE-sGF pipes, fittings intended to be used for jointing by butt fusion shall be prepared and assembled in accordance with ISO 11414. The conditions for the preparation of the joints are given in 4.2.2.1 for the assessment of fitness for purpose of the system under normal conditions and in 4.2.2.2 for the assessment of fitness for purpose of the system under extreme conditions.

4.2 Requirements for fitness for purpose of the system

4.2.1 General

When tested in accordance with the test methods in Table 5, using the indicated parameters, joints prepared in accordance with 4.1 shall have mechanical characteristics conforming to the requirements given in Table 5, as applicable to the following types of joints:

a) electrofusion socket fittings;

b) spigot end fitting, pipe.

4.2.2 Fitness for purpose of the system for electrofusion joints

4.2.2.1 Under normal conditions (ambient temperature 23 °C)

For the assessment of fitness for purpose of the system under normal conditions, electrofusion joints shall have the characteristic of decohesive resistance or cohesive strength, as applicable, conforming to the requirements given in Table 5, using the assembly condition 1 as specified in ISO 11413:2019, Annex C, at an ambient temperature of (23 ± 2) °C and the scheme listed in Table 1.

NOTE Table 1 is to be interpreted as follows: as an example, for a pipe or a spigot end fitting made from a PE-sGF 200 compound, the joint is tested with a pipe made from PE-sGF 200 compound.

Table 1 — Scheme for electrofused joints

Electrofusion socket only	Pipe	
	PE 100	PE-sGF 200
PE-sGF 200	X	X

The fitting manufacturer shall declare, according to this subclause, the SIDR range and minimum required strength (MRS) values of pipes conforming to ISO/PAS 22101-2 to which the manufacturer's fittings conforming to ISO/PAS 22101-3 can be fused by using the same procedures (e.g. times, temperatures, and fusion pressures) to conform to this document. If there is a need for deviation in fusion procedures, the fitting or valve manufacturer shall state this clearly.

4.2.2.2 Under extreme conditions

For electrofusion joints, the characteristics to be examined for fitness for purpose of the system under extreme conditions shall conform to Table 2.

When tested in accordance with the test methods as specified in Table 5 using the indicated parameters, the joints shall have characteristics conforming to the requirements given in Table 5.

Table 2 — Relationship between joints and fitness for purpose of the system characteristics

Electrofusion joint including socket fitting [a]	Associated characteristics
Pipe: MRS maximum [b] SIDR minimum [b] Joint: conditions 2.2 and 3.2 [c]	Decohesive resistance
	Evaluation of ductility of fusion joint interface

[a] If accepted by the end-user, the minimum and maximum energy conditions 2.2 and 3.2 can be replaced by a nominal energy at a given ambient temperature T_a, defined by the fitting manufacturer (see ISO 11413:2019, Annex C and 4.3).

[b] As declared by the fitting manufacturer, according to 4.2.2.1.

[c] As specified in ISO 11413:2019, Annex C, with T_{min} and T_{max} as stated in the fitting manufacturer's technical specification.

The fitting manufacturer shall declare according to Table 3, as applicable, the fitness for purpose of the system under extreme conditions of the fittings with the type of pipe being specified.

4.2.3 Fitness for purpose of the system for butt fusion joints

4.2.3.1 Under normal conditions (ambient temperature 23 °C)

For the assessment of fitness for purpose of the system under normal conditions, butt fusion joints shall have the characteristic of tensile strength conforming to the requirements given in Table 5, using the parameters at an ambient temperature of (23 ± 2) °C and the scheme listed in Table 3.

NOTE Table 3 is to be interpreted as follows: as an example, for a pipe or a spigot end fitting made from a PE-sGF 200 compound, the joint is tested with a pipe made from PE-sGF 200 compound.

Table 3 — Scheme for butt-fused joints

Pipe/spigot end fitting with spigot ends[a]	Pipe	
	PE 100	PE-sGF 200
PE-sGF 200		X

[a] Only allowed for butt-fused joint of the same classification

The pipe manufacturer shall declare, according to this subclause, which pipes from their own product range manufactured from different compounds conforming to ISO PAS 22101-2 are compatible with each other for butt fusion.

The fitting manufacturer shall declare, according to 4.2.2.1, the SIDR range and MRS values of pipes conforming to ISO/PAS 22101-2 to which the manufacturer's fittings conforming to ISO/PAS 22101-3 can be fused by using the same procedures (e.g. times, temperatures, and fusion pressures) to conform to this document. If there is a need for deviation in fusion procedures, the fitting manufacturer shall state this clearly.

4.2.3.2 Under extreme conditions

For butt fusion joints, the characteristics to be examined for fitness for purpose of the system under extreme conditions shall conform to Table 4.

Table 4 — Relationship between joints and fitness for purpose of the system characteristics

Butt fusion joint	Associated characteristics
Both components of the joint: same MRS and same SIDR	Hydrostatic strength (80 °C, 165 h)
Joint: minimum and maximum condition [a]	Tensile strength for butt fusion joint

a As specified in ISO 11414:2009, Clause 7, item a) concerning misalignment and the limit values of fusion parameters conforming to ISO 11414:2009, Annex B, conditions 2 and 3.

When tested in accordance with the test methods as specified in Table 5 using the indicated parameters, the joints shall have characteristics conforming to the requirements given in Table 5.

The fitting manufacturer shall declare according to Table 4, as applicable, the fitness for purpose of the system under extreme conditions of the fittings.

The pipe manufacturer shall declare according to Table 4 the fitness for purpose of the system under extreme conditions of the pipes (PE-sGF pipes).

4.3 Conditioning

The test pieces shall be conditioned at (23° ± 2) °C before testing, unless otherwise specified by the applicable test method as specified in Table 5.

4.4 Requirements

The requirements for characteristics of fitness for purpose of the system are given in Table 5.

Table 5 — Characteristics for fitness for purpose of the system

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Hydrostatic Strength (80 °C, 165 h)[d] (B)	No failure during the test period [a]	End caps	ISO 1167-1, Type A	ISO 1167-1 together with ISO 1167-2, or ISO 1167-4, as applicable
		Orientation	Free	
		Conditioning time	Shall conform to ISO 1167-1	
		Number of test pieces [b]	3	
		Type of test	Water-in-water	
		Circumferential (hoop) stress PE-sGF 200	9 MPa	
		Test period	165 h	
		Test temperature	80 °C	

a The stress and the associated minimum test period shall be selected from Table 5.

b The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. Guidance on assessment of conformity can be found in Reference [3].

c L is the nominal length of the fusion zone of the electrofusion socket fitting.

d Alternatively, for d_n > 450 mm, the test can also be performed in air. In case of dispute, water-in-water shall be used.

e Applicable to d_n 300 mm and above.

f The test sample can be mechanically reduced in wall thickness for the testing purpose of large diameter fittings by keeping a minimum of 15 mm wall thickness of each component.