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Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Arch-shaped, corrugated wall chambers made of PE or PP used for retention, detention, storage and transportation of storm water systems — Product specifications and performance criteria

Systèmes de canalisations en plastique pour le transport et le stockage souterrains sans pression de l'eau non potable — Chambres en forme d'arche en PE ou PP, à parois annelées, utilisées pour les systèmes de transport, de stockage et de rétention des eaux pluviales — Spécifications des produits et critères de performance

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

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 1, *Plastics pipes and fittings for soil, waste and drainage (including land drainage)*.

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

This document specifies systems comprised of arch-shaped, corrugated wall chambers made of PE or PP and used for infiltration, attenuation and storage of storm water.

At the time of drafting, the drafting committee is not aware of the existence of chambers made of unplasticized polyvinylchloride (PVC-U) materials. If unplasticized polyvinylchloride (PVC-U) chambers are produced and become available on the market, they will be included in a future revision of this document.

The arch-shaped, corrugated wall chambers and end caps are part of a buried structural system which includes both the arch-shaped chamber, end caps and the surrounding backfill material. Proper design of installed arch-shaped, corrugated wall chamber systems requires consideration of the structural contribution from the surrounding backfill materials and conformity with installation guidelines.

Arch-shaped chambers are installed as one horizontal layer on a firm foundation and embedded with fill around and above each individual unit.

Although differing in geometry, when properly installed, the structural behaviour of chambers is similar to that of circular thermoplastic pipes. Guidance for structural design can be found in ASTM F2787.[1]

Guidance for installation can be found in Annex G.

Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Arch-shaped, corrugated wall chambers made of PE or PP used for retention, detention, storage and transportation of storm water systems — Product specifications and performance criteria

1 Scope

This document gives the definitions and specifies the minimum requirements for injection moulded and thermoformed thermoplastics corrugated arch-shaped chambers, including integral components, used in underground systems for retention, detention, transportation and storage of non-potable water (e.g. storm water) and manufactured from polyethylene (PE) or polypropylene (PP).

These chambers are intended for buried underground use in one horizontal layer, e.g. in landscape, pedestrian or vehicular traffic areas.

In the case of retention and detention systems, the main purpose of the chambers is to retain water, for later infiltration in the ground or for later use in non-potable applications (irrigation, cleaning, sanitary facilities, etc.) or to detain water during a storm, transferring it in a controlled way to the public storm water network.

Applications include commercial, residential, agricultural and highway drainage, including installation under parking lots and roadways.

Product performance is determined by a combination of material specification, product design and manufacturing process.

These chambers are intended to be used as elements in a modular system where the manufacturer has provided a clearly documented method specifying how the components are assembled to create a complete retention, detention, storage or transportation system.

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*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 472, *Plastics — Vocabulary*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 580:2005, *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings — Methods for visually assessing the effects of heating*

ISO 604, *Plastics — Determination of compressive properties*

ISO 899-2, *Plastics — Determination of creep behaviour — Part 2: Flexural creep by three-point loading*

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

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 1167-1:2006, *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 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*

ISO 3451-1, *Plastics — Determination of ash — Part 1: General methods*

ISO 9967:2016, *Thermoplastics pipes — Determination of creep ratio*

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/TS 28037:2010, *Determination and use of straight-line calibration functions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 1043-1 and the following 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 General terms

3.1.1
arch-shaped chamber
arch-shaped product which defines a subsurface open space when installed

Note 1 to entry: Arch-shaped chambers may have perforations, inspection ports or other features that may or may not reduce the mechanical capacity of a chamber.

3.1.2
end cap
arch-shaped product which covers the open end of a chamber row

3.1.3
corrugation
periodic shape of arch-shaped chamber or end cap walls

Note 1 to entry: A wall profile consists of a regular pattern of alternating crests and valleys connected by webs.

3.1.4
system
construction consisting of a single horizontal layer of connected arch-shaped chambers and end caps and associated with backfill material

3.1.5
detention system
system designed to reduce the peak flow from a given site by providing a temporary underground storm water storage facility

Note 1 to entry: Also known as “attenuation”.

3.1.6
retention system
system designed to provide a temporary underground storage facility from which storm water infiltrates into the surrounding ground

Note 1 to entry: Also known as “infiltration”.

3.1.7
storage system
system designed to provide an underground storage facility for storm water

3.1.8
type testing
initial testing performed according to the testing requirements in this document, the results of which are the specified requirements of the specific product being tested

Note 1 to entry: See ISO/IEC 17000:2020, 5.1, for a definition of "specified requirements".

3.2 Material terms

3.2.1
virgin material
material in a form such as granules or powder that have not been subjected to use or processing other than that required for their manufacture and to which no reprocessed or recycled material has been added

3.2.2
non-virgin material
material from used or unused infiltration and attenuation chambers and end caps which have been cleaned and crushed or ground, or material from used or unused PP or PE products other than infiltration and attenuation chambers and end caps, regardless of where they are manufactured

3.2.3
agreed specification
relevant material characteristics agreed between the supplier of the material and the chamber and end cap manufacturer

3.3 Mechanical terms

3.3.1
flattening capacity
specific mechanical characteristic of arch-shaped chambers determined in the arch stiffness test

3.3.2
arch stiffness constant
ASC
specific mechanical characteristic of arch-shaped chambers determined in arch stiffness test (kN/m)

3.3.3
end cap stiffness constant
CSC
specific mechanical characteristic of end caps determined in shell stiffness test (kN)

3.3.4
stub compression strength
short-term compression strength expressed as the maximum force per length of chamber wall obtained during a specified constant displacement rate compression test of a small section of chamber wall (see Annex D) (kN/m)

4 Symbols and abbreviated terms

4.1 Symbols

For the purposes of this document, the following symbols apply.

A	area of chamber wall (mm^2/mm) in x-y-plane at feet and y-z-plane at crown
C_{AS}	arch stiffness constant
C_{ES}	end cap stiffness constant
e	measured wall thickness at any point of a chamber
e_c	linear distance in radial direction from bottom surface of the valley to the outer surface of the crest, taken in a particular spot in the chamber
F	loading force
G	average weight of soil
h	maximum cover over the crown of the chamber according to the manufacturer's installation manual
H	maximum vertical outside dimension (y-direction) of chamber from bottom to top
I	moment of inertia of chamber wall around x-axis (mm^4/mm)
L	maximum horizontal outer dimension (z-direction) of chamber from one end to the other
L_{ASC}	length of chamber in arch stiffness test
R	maximum vertical clear inside dimension (y-direction) of chamber from bottom to top
R_0	initial rise
S	maximum horizontal clear inside dimension (x-direction) of chamber at feet
W	maximum horizontal outside dimension (x-direction) of chamber at feet
Δy	test deflection
φ_i	creep ratio from stub compression testing (with index i being the number of tests)
$\varphi_{0,25}$	creep ratio from stub compression testing at a load level defined as 25 % of strength

4.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ASC arch stiffness constant

CSC end cap stiffness constant

MFR melt mass-flow rate

OIT oxidation induction time

PE Polyethylene

PP Polypropylene

5 Material

5.1 General

The material shall be either PE or PP, to which may be added:

— mineral modifier(s) of known specification;

— additives needed to facilitate the manufacture of components conforming to this document.

The material used to manufacture the arch-chambers or end caps shall consist of a material or mixtures of different materials each of which shall have an agreed specification between supplier and manufacturer (see Annex A).

5.2 Polyethylene (PE) material

5.2.1 General

The material shall be either PE virgin, PE modified or PE non-virgin material, conforming to 5.2.2 – 5.2.4, as appropriate.

5.2.2 Polyethylene (PE) virgin material

The material for arch-shaped chambers and end caps shall be a compound of PE virgin material and those additives that are needed to facilitate the manufacture of arch-shaped chambers and end caps conforming to the requirements of this document.

When reworked material is added to a level of less than 10 %, the material for chambers can still be considered as virgin.

5.2.3 Polyethylene (PE) modified with minerals

The material for arch-shaped chambers and end caps shall be a compound of PE virgin material modified with minerals and those additives that are needed to facilitate the manufacture of arch-shaped chambers and end caps conforming to the requirements of this document.

If calcium carbonate is used, only coated calcium carbonate shall be used.

The content of minerals in the final compound shall be less than 50 % by mass.

When reworked material is added to a level of less than 10 %, the material for chambers can still be considered as modified.

5.2.4 Polyethylene (PE) non-virgin material

The material for arch-shaped chambers and end caps shall be a compound of non-virgin PE material, and those additives that are needed to facilitate the manufacture of arch-shaped chambers and end caps conforming to the requirements of this document.

Non-virgin materials shall be permitted to be used up to 100 % or added to virgin or reworked material or a mixture of those two materials.

The content of minerals in the final compound shall be less than 50 % by mass.

5.3 Polypropylene (PP) material

5.3.1 General

The material shall be either PP virgin, PP modified, or PP non-virgin material, conforming to 5.3.2 – 5.3.4 as appropriate.

5.3.2 Polypropylene (PP) virgin material

The material for arch-shaped chambers and end caps shall be a compound of PP virgin material and those additives that are needed to facilitate the manufacture of chambers or end caps conforming to the requirements of this document.

When reworked material is added to a level of less than 10 %, the material for chambers can still be considered as virgin.

5.3.3 Polypropylene (PP) modified with minerals

The material for arch-shaped chambers and end caps shall be a compound of PP virgin material modified with minerals and those additives that are needed to facilitate the manufacture of arch-shaped chambers and end caps conforming to the requirements of this document.

If calcium carbonate is used, only coated calcium carbonate shall be used.

The content of minerals in the final compound shall be less than 50 % by mass.

When reworked material is added to a level of less than 10 %, the material for chambers can still be considered as modified.

5.3.4 Polypropylene (PP) non-virgin material

The material for arch-shaped chambers and end caps shall be a compound of non-virgin PP material, and those additives that are needed to facilitate the manufacture of arch-shaped chambers and end caps conforming to the requirements of this document.

Non-virgin materials shall be permitted to be used up to 100 % or added to virgin or reworked material or a mixture of those two materials.

The content of minerals in the final compound shall be less than 50 % by mass.

5.4 Chamber and end cap material characteristics

A product in this document is formed by a combination of a material specification, a design and a manufacturing process. Table 1 specifies the minimum required tests to fingerprint the material and to partly specify the material requirements.

In conformance with the results from type testing, a product specific material specification with specified requirements shall be defined by the manufacturer.

When tested after type testing in accordance with the test methods as specified in Table 1, using the indicated parameters, the material used for the chambers and end caps shall have the characteristics conforming to the requirements given in Table 1.

Table 1 — Material characteristics of chambers and end caps

Characteristic	Material	Requirement	Test parameters		Test method
Tensile strength – Short term	PE	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test speed: Specimen type:	50 mm/min 1A (ISO 527-2)	ISO 527-2
	PP	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test speed: Specimen type:	50 mm/min 1A (ISO 527-2)	ISO 527-2
Tensile modulus – short term	PE	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test speed:	1 mm/min	ISO 527-2
	PP	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test speed:	1 mm/min	ISO 527-2
Flexural-creep modulus – 500 h	PE	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test duration: Test stress: Temperature:	500 h 2,0 MPa (23 ± 2) °C	ISO 899-2
	PP	The values obtained shall meet or exceed the specified requirement for the product being tested.[a]	Test duration: Test stress: Temperature:	500 h 2,0 MPa (23 ± 2) °C	ISO 899-2
Resistance to internal pressure	PE	No failure during the test period.	Test temperature: Circumferential stress: Test duration: Type of test: End caps: Orientation: Number of test pieces: Conditioning period:	80 °C 4,0 MPa 165 h water-in-water or water-in-air Type A or B (ISO 1167-1:2006) Free 3 in accordance with ISO 1167-1	ISO 1167-1 and ISO 1167-2

[a] The specified requirement is generated from type testing of the product using the tests and parameters given in this table.