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Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) —

Part 2:

Pipes and fittings with smooth external surface, Type A

Systèmes de canalisations en plastique pour les branchements et les collecteurs d'assainissement sans pression enterrés — Systèmes de canalisations à parois structurées en poly(chlorure de vinyle) non plastifié (PVC-U), polypropylène (PP) et polyéthylène (PE) —

Partie 2: Tubes et raccords avec une surface externe lisse, type A

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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 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)*.

This second edition cancels and replaces the first edition (ISO 21138:2007), which has been technically revised. The main changes compared to the previous edition are as follows:

— the normative references have been updated;

— references to EN test methods have been updated to ISO test methods, when applicable;

— editorial improvements have been made for clarification.

A list of all parts in the ISO 21138 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

The ISO 21138 series of standards covers plastics piping systems for non-pressure underground drainage and sewerage, in particular thermoplastics structured-wall piping systems.

Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) —

Part 2:
Pipes and fittings with smooth external surface, Type A

1 Scope

This document, together with ISO 21138-1, specifies the definitions and requirements for pipes with smooth external and internal surfaces (Type A), fittings and systems based on unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) structured-wall piping systems intended to be used in non-pressure underground drainage and sewerage applications.

NOTE 1 Pipes, fittings and the system complying with this document can also be used for highway drainage and surface water.

This document specifies test methods and test parameters.

This document covers a range of pipe and fitting sizes, materials, pipe constructions and nominal ring stiffnesses, and gives recommendations concerning colours.

NOTE 2 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and installation practices or codes.

In conjunction with ISO 21138-1, this document is applicable to structured-wall pipes and fittings, to their joints and to joints with components of other plastics and non-plastics materials.

It is applicable to pipes and fittings with or without an integral socket with elastomeric ring seal joints as well as welded and fused joints.

NOTE 3 For dimensions larger than DN/OD 1200, or DN/ID 1200, this document can serve as general guidance regarding appearance, colour, physical and mechanical characteristics as well as performance requirements.

Test methods are not included in 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 161-1, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series*

ISO 178, *Plastics — Determination of flexural properties*

ISO 306:2013, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 527-2:2012, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

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

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 1158, *Plastics — Vinyl chloride homopolymers and copolymers — Determination of chlorine content*

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 2505, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters*

ISO 2507-1, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 1: General test method*ab

ISO 2507-2, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 2: Test conditions for unplasticized poly(vinyl chloride) (PVC-U) or chlorinated poly(vinyl chloride) (PVC-C) pipes and fittings and for high impact resistance poly (vinyl chloride) (PVC-HI) pipes*

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 4435:2003, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U)*

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

ISO 6259-2, *Thermoplastics pipes — Determination of tensile properties — Part 2: Pipes made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly (vinyl chloride) (PVC-C) and high-impact poly (vinyl chloride) (PVC-HI)*

ISO 8772:2006, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE)*

ISO 8773:2006, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP)*

ISO 9852, *Unplasticized poly(vinyl chloride) (PVC-U) pipes — Dichloromethane resistance at specified temperature (DCMT) — Test method*

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

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

ISO 11173, *Thermoplastics pipes — Determination of resistance to external blows — Staircase method*

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

ISO 13229, *Thermoplastics piping systems for non-pressure applications — Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings — Determination of the viscosity number and K-value*

ISO 13254, *Thermoplastics piping systems for non-pressure applications — Test method for watertightness*

ISO 13259:2018, *Thermoplastics piping systems for underground non-pressure applications — Test method for leaktightness of elastomeric sealing ring type joints*

ISO 13260:2010, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Test method for resistance to combined temperature cycling and external loading*

ISO 13262, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics spirally-formed structured-wall pipes — Determination of the tensile strength of a seam*

ISO 13265, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Joints for buried non-pressure applications — Test method for the long-term sealing performance of joints with elastomeric seals by estimating the sealing pressure*

ISO 13968, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of ring flexibility*

ISO 18373-1, *Rigid PVC pipes — Differential scanning calorimetry (DSC) method — Part 1: Measurement of the processing temperature*

ISO 21138-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 1: Material specifications and performance criteria for pipes, fittings and the system*

ISO 21138-3, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 3: Pipes and fittings with a non-smooth external surface, Type B*

ISO 22088-3, *Plastics — Determination of resistance to environmental stress cracking (ESC) — Part 3: Bent strip method*

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

EN 681-2, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 2: Thermoplastic elastomers*

EN 681-4, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 4: Cast polyurethane sealing elements*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 12099, *Plastics piping systems — Polyethylene piping materials and components — Determination of volatile content*

EN 15344, *Plastics — Recycled plastics — Characterisation of polyethylene) (PE) recyclates*

EN 15345, *Plastics — Recycled plastics — Characterisation of polypropylene) (PP) recyclates*

EN 15346:2014, *Plastics — Recycled plastics — Characterisation of poly(vinyl chloride) (PVC) recyclates*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21138-1 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

3.2 Symbols

A	length of engagement, or maximum pull-out whilst maintaining tightness
A_{min}	minimum value of A
C	depth of sealing zone
C_{max}	maximum value of C
D_i	inside diameter of a socket
$D_{im,\,min}$	minimum mean inside diameter of a socket
d_e	outside diameter (of a pipe or a spigot)
$d_{em,\,max}$	maximum value of the mean d_e
$d_{em,\,min}$	minimum value of the mean d_e
d_i	inside diameter of a pipe
$d_{im,\,max}$	maximum value of the mean d_i
$d_{im,\,min}$	minimum value of the mean d_i
e	wall thickness (at any point)
e_c	construction height
e_2	wall thickness of the socket
e_3	wall thickness of the groove
e_4	wall thickness of the inside layer (waterway wall thickness)
e_5	wall thickness of the inside layer under a hollow section
l	effective length of a pipe

3.3 Abbreviated terms

$CaCO_3$	calcium carbonate
CT	close tolerance
DSC	differential scanning calorimetry
$MgCO_3$	magnesium carbonate
MFR	melt mass-flow rate
OIT	oxidation induction time
TIR	true impact rate
TPE	thermoplastic elastomer
VST	Vicat softening temperature

4 Material

4.1 General

The material shall be one of the following: unplasticized poly (vinyl chloride) (PVC-U), polypropylene (PP) or polyethylene (PE) to which are added those additives that are needed to facilitate the manufacture of components conforming to this document, including the relevant annexes.

4.2 Unplasticized poly (vinyl chloride) (PVC-U)

4.2.1 General

The raw material shall be PVC-U to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements of this document (see also Annex A).

NOTE Additional information on the characteristics of PVC-U material or components made thereof is given in ISO 21138-1:2020, Annex A.

4.2.2 Pipe and fitting material characteristics

When tested in accordance with the test method specified in Table 1, using the indicated parameters, the material shall have characteristics conforming to the requirements given in Table 1.

Table 1 — Material characteristics of PVC-U pipes and injection-moulded fittings

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure[a,b,c]	No failure during the test period	Test temperature	60 °C	ISO 1167-1 ISO 1167-2
		Circumferential stress — pipe material — fitting material	10 MPa 6,3 MPa	
		Test period	1 000 h	
		Type of test	Water-in-water	
		End caps	Type A or B	
		Orientation	Free	
		Number of test pieces	3	
		Conditioning period	In accordance with ISO 1167-1	

[a] For extrusion compounds, this test shall be carried out in the form of a solid-wall pipe made from the relevant extrusion material.

[b] For injection-moulding compounds, this test shall be carried out in the form of an injection-moulded or extruded sample in solid-wall pipe form made from the relevant material.

[c] Not required for the intermediate layer of Type A1 pipes.

4.2.3 Utilization of non-virgin materials

For the utilization of non-virgin PVC-U materials, conditions and requirements are given in Annex B, and the non-virgin materials shall conform to the characterization specified in EN 15346.

NOTE Annex G gives a survey of the possible uses of reprocessed and recycled materials.

4.3 Polypropylene (PP)

4.3.1 General

The base material shall be polypropylene (PP) to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements of this document (see also Annex C).

NOTE Additional information on the characteristics of PP material or components made thereof is given in ISO 21138-1:2020, Annex A.

4.3.2 Pipe and fitting material characteristics

When tested in accordance with the test methods specified in Table 2, using the indicated parameters, the material shall have characteristics conforming to the requirements given in Table 2.

Table 2 — Material characteristics of PP pipes and injection-moulded fittings

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure 140 h[a,b,c]	No failure during the test period	Test temperature	80 °C	ISO 1167-1
		Circumferential stress	4,2 MPa	ISO 1167-2
		Test period	140 h	
		Type of test	Water-in-water	
		End caps	Type A or B	
		Orientation	Free	
		Number of test pieces	3	
		Conditioning period	In accordance with ISO 1167-1	
Resistance to internal pressure 1 000 h[a,b,c]	No failure during the test period	Test temperature	95 °C	ISO 1167-1
		Circumferential stress	2,5 MPa	ISO 1167-2
		Test period	1 000 h	
		Type of test	Water-in-water	
		End caps	Type A or B	
		Orientation	Free	
		Number of test pieces	3	
		Conditioning period	In accordance with ISO 1167-1	
Melt mass-flow rate (MFR)	≤1,5 g/10 min	Temperature	230 °C	ISO 1133-1
		Loading mass	2,16 kg	
Thermal stability, (OIT)	≥8 min	Temperature	200 °C	ISO 11357-6

[a] For extrusion compounds, this test shall be carried out in the form of a solid-wall pipe made from the relevant extrusion material.

[b] For injection-moulding compounds, this test shall be carried out in the form of an injection-moulded or extruded sample in solid-wall pipe form made from the relevant material.

[c] Not required for the intermediate layer of Type A1 pipes.

4.3.3 Melt mass-flow rate classification

Materials for pipes and fittings intended for jointing in the field by fusion or welding shall be designated by the following MFR classes:

— Class A: MFR ≤ 0,3 g/10 min;

— Class B: 0,3 g/10 min < MFR ≤ 0,6 g/10 min;

— Class C: 0,6 g/10 min < MFR ≤ 0,9 g/10 min;

— Class D: 0,9 g/10 min < MFR ≤ 1,5 g/10 min.

In the case where a raw material, because of its MFR tolerance, arbitrarily falls in one of two adjacent classes, the manufacturer of the components may mark the MFR class on the product as follows:

— for an MFR value across the border between A and B it is permitted to classify as class A;

— for an MFR value across the border between B and C it is permitted to classify as class C;

— for an MFR value across the border between C and D it is permitted to classify as class D.

4.3.4 Utilization of non-virgin materials

For the utilization of non-virgin PP materials, conditions and requirements are given in Annex D, and the non-virgin materials shall conform to the characterization specified in EN 15345.

NOTE Annex G gives a survey of the possible uses of reprocessed and recycled materials.

4.4 Polyethylene (PE)

4.4.1 General

The base material shall be polyethylene (PE) to which are added those additives that are needed to facilitate the manufacture of components conforming to this document. See also Annex E.

NOTE Additional information on the characteristics of PE material or components made thereof is given in ISO 21138-1:2020, Annex A.

4.4.2 Material characteristics of pipes and injection-moulded fittings

When tested in accordance with the test method specified in Table 3, using the indicated parameters, the material shall have characteristics conforming to the requirements given in Table 3.