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**Assessment of conformity of plastics  
piping systems for the rehabilitation  
of existing pipelines —**

Part 1:  
**Polyethylene (PE) material**

*L'évaluation de la conformité des systèmes de canalisations en  
plastique destinés à la réhabilitation des réseaux existantes —*

*Partie 1: Matériau Polyéthylène (PE)*

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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](http://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](http://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](http://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 8, *Rehabilitation of pipeline systems*.

A list of all parts in the ISO/TS 23818 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](http://www.iso.org/members.html).

## Introduction

System standards dealing with the following applications are either available or in preparation for pipeline rehabilitation:

- ISO 11296, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks*;
- ISO 11297, *Plastics piping systems for renovation of underground drainage and sewerage networks under pressure*;
- ISO 11298, *Plastics piping systems for renovation of underground water supply networks*;
- ISO 11299, *Plastics piping systems for renovation of underground gas supply networks*;
- ISO 21225, *Plastics piping systems for the trenchless replacement of underground pipeline networks*.

These system standards are distinguished from those for conventionally installed plastics piping systems by the requirement to verify certain characteristics in the as-installed condition, after site processing. This is in addition to specifying requirements for plastics piping system components as manufactured.

For the assessment of conformity, three Technical Specifications for pipes of distinct materials are applicable:

- ISO/TS 23818-1 (this document), *Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines — Part 1: Polyethylene (PE) material*;
- ISO/TS 23818-2<sup>1)</sup>, *Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines — Part 2: Resin-fibre composite (RFC) material*;
- ISO/TS 23818-3<sup>2)</sup>, *Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines — Part 3: Unplasticized poly(vinyl chloride) (PVC-U) material*.

These three Technical Specifications cover the system standards, as presented in [Table 1](#).

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1) Under preparation. Stage at the time of publication: ISO/WD TS 23818-2:2020.

2) Under preparation. Stage at the time of publication: ISO/WD TS 23818-3:2020

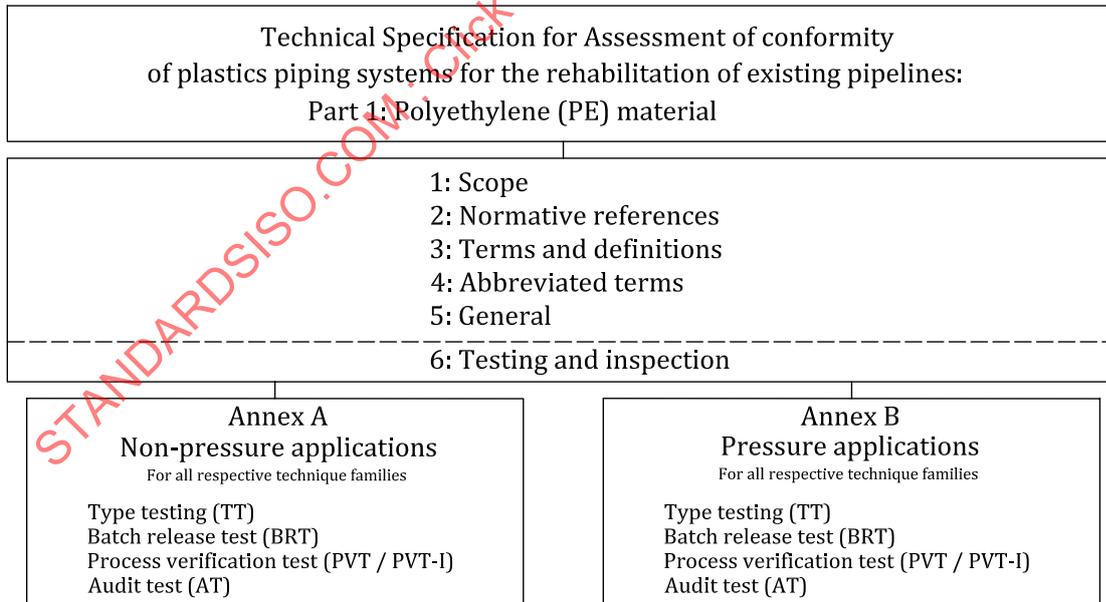
**Table 1 — Structure of Technical Specifications for assessment of conformity**

Technical Specification	Material	Technique	Application			
			Non-pressure drainage and sewerage networks	Drainage and sewerage networks under pressure	Water supply networks	Gas supply networks
ISO/TS 23818-1	PE	LINING WITH CONTINUOUS PIPES, CLOSE-FIT PIPES AND SPIRALLY WOUND PIPES	ISO 11296-2 ISO 11296-3 ISO 11296-7	ISO 11297-2 ISO 11297-3	ISO 11298-2 ISO 11298-3	ISO 11299-2 ISO 11299-3
		TRENCHLESS REPLACEMENT USING PIPE BURSTING, PIPE EXTRACTION, HORIZONTAL DRILLING AND IMPACT MOLING	ISO 21225-1 ISO 21225-2	ISO 21225-1 ISO 21225-2	ISO 21225-1 ISO 21225-2	ISO 21225-1 ISO 21225-2
ISO/TS 23818-2 <sup>a</sup>	RFC	LINING WITH CURED-IN-PLACE PIPES (CIPP)	ISO 11296-4	ISO 11297-4	ISO 11298-4 <sup>a</sup>	—
ISO/TS 23818-3 <sup>a</sup>	PVC-U	LINING WITH CLOSE-FIT PIPES AND SPIRALLY WOUND PIPES	ISO 11296-3 ISO 11296-7	—	—	—

<sup>a</sup> Under preparation. Stage at the time of publication: ISO/DIS 11298-4.

The format of the three Technical Specifications is in line with technical specifications for assessment of conformity to other system standards, apart from presenting the detailed requirements for inspection and testing in two annexes, for non-pressure applications and pressure applications (where applicable) respectively.

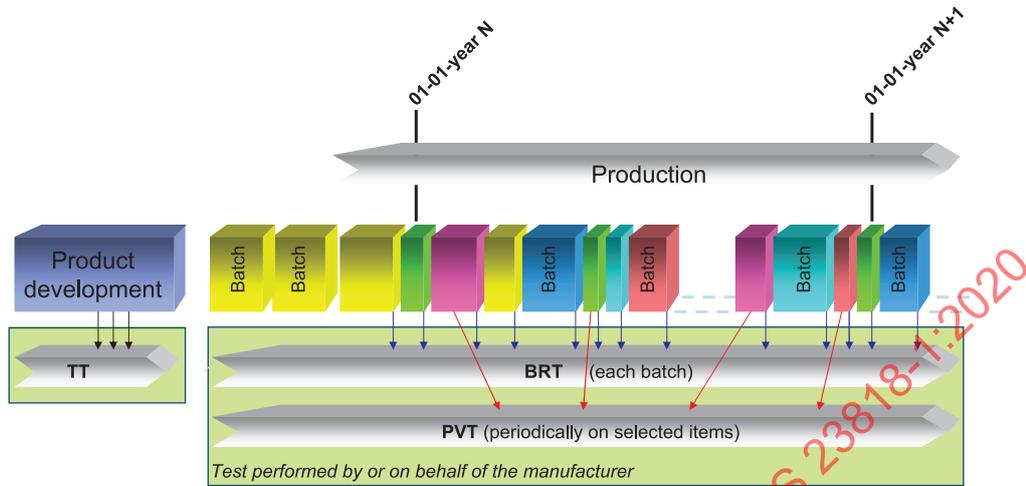
The format is schematically represented in [Figure 1](#).



**Figure 1 — Format of the Technical Specifications for conformity assessment**

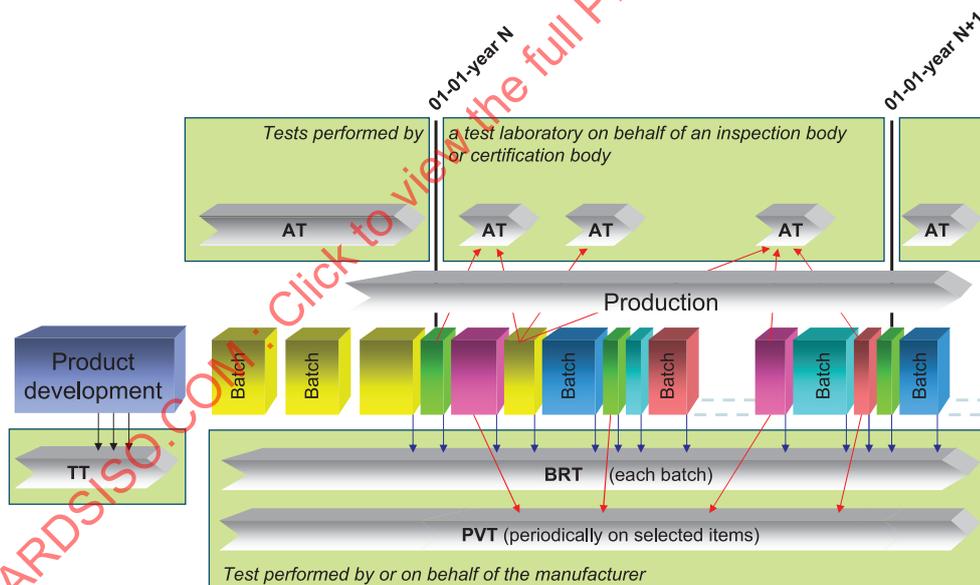
[Figures 2](#) and [3](#) are intended to provide general information on the concept of testing and organisation of those tests used for the purpose of the assessment of conformity. For each type of test, i.e. type testing (TT), batch release test (BRT), process verification test (PVT), and audit test (AT), this document details the applicable characteristics to be assessed as well as the frequency and sampling of testing.

A typical scheme for the assessment of conformity of PE pipes, fittings, joints or assemblies by manufacturers is given in [Figure 2](#).



**Figure 2 — Typical scheme for the assessment of conformity by a manufacturer**

A typical scheme for the assessment of conformity of PE pipes, fittings, joints or assemblies by manufacturers, including certification, is given in [Figure 3](#).



**Figure 3 — Typical scheme for the assessment of conformity by a manufacturer, including certification**

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# Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines —

## Part 1: Polyethylene (PE) material

### 1 Scope

This document provides a scheme for the assessment of conformity of PE products and assemblies for the rehabilitation of existing pipelines, in accordance with the applicable parts of ISO 11296, ISO 11297, ISO 11298, ISO 11299 and ISO 21225, and intended to be included in the manufacturer's quality plan as part of the quality management system and for the establishment of certification procedures.

NOTE In order to help the reader, summary tables of overall scheme requirements are provided in [Annex E](#).

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

ISO 4427-2, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 2: Pipes*

ISO 4427-3, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 3: Fittings*

ISO 4437-1:2014, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

ISO 4437-2:2014, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

ISO 4437-3:2014, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

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

ISO 11296-1:2018, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 1: General*

ISO 11296-2:2018, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 2: Lining with continuous pipes*

ISO 11296-3:2018, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 3: Lining with close-fit pipes*

ISO 11296-7:2019, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 7: Lining with spirally-wound pipes*

ISO 11297-1:2018, *Plastics piping systems for renovation of underground drainage and sewerage networks under pressure — Part 1: General*

ISO 11297-2:2018, *Plastics piping systems for renovation of underground drainage and sewerage networks under pressure — Part 2: Lining with continuous pipes*

ISO 11297-3:2018, *Plastics piping systems for renovation of underground drainage and sewerage networks under pressure — Part 3: Lining with close-fit pipes*

ISO 11298-1:2018, *Plastics piping systems for renovation of underground water supply networks — Part 1: General*

ISO 11298-2:2018, *Plastics piping systems for renovation of underground water supply networks — Part 2: Lining with continuous pipes*

ISO 11298-3:2018, *Plastics piping systems for renovation of underground water supply networks — Part 3: Lining with close-fit pipes*

ISO 11299-1:2018, *Plastics piping systems for renovation of underground gas supply networks — Part 1: General*

ISO 11299-2:2018, *Plastics piping systems for renovation of underground gas supply networks — Part 2: Lining with continuous pipes*

ISO 11299-3:2018, *Plastics piping systems for renovation of underground gas supply networks — Part 3: Lining with close-fit pipes*

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

ISO 13477, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test)*

ISO 13478, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST)*

ISO 21225-1:2018, *Plastics piping systems for the trenchless replacement of underground pipeline networks — Part 1: Replacement on the line by pipe bursting and pipe extraction*

ISO 21225-2:2018, *Plastics piping systems for the trenchless replacement of underground pipeline networks — Part 2: Replacement off the line by horizontal directional drilling and impact moling*

ISO 21751, *Plastics pipes and fittings — Decohesion test of electrofusion assemblies — Strip-bend test*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in the applicable parts of ISO 11296, ISO 11297, ISO 11298, ISO 11299, ISO 21225 and the following 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 Assessment of conformity

#### 3.1.1

##### **certification body**

impartial body, governmental or non-governmental, possessing the necessary competence and responsibility to carry out certification of conformity according to given rules of procedure and management

Note 1 to entry: A certification body should preferably operate in accordance with ISO/IEC 17021-1<sup>[4]</sup> or ISO/IEC 17065<sup>[6]</sup>.

#### 3.1.2

##### **inspection body**

body that performs inspection

Note 1 to entry: An inspection body can be an organization, or part of an organization.

Note 2 to entry: An inspection body should preferably operate in accordance with ISO/IEC 17020<sup>[3]</sup> or ISO/IEC 17021-1<sup>[4]</sup>.

[SOURCE: ISO/IEC 17020:2012<sup>[3]</sup>, 3.5, modified — Note 2 to entry added.]

#### 3.1.3

##### **testing laboratory**

laboratory which measures, tests, calibrates or otherwise determines the characteristics of the performance of *materials* (3.1.13) and products

Note 1 to entry: In the context of this document, the materials and products can be subjected to *type testing* (3.1.6), *batch release test* (3.1.7), *process verification test* (3.1.8), *audit test* (3.1.10), and *witness test* (3.1.12), as applicable.

Note 2 to entry: A testing laboratory should preferably operate in accordance with ISO/IEC 17025<sup>[5]</sup>.

#### 3.1.4

##### **quality management system**

part of a management system with regard to quality

Note 1 to entry: Requirements for quality management systems are given in ISO 9001<sup>[2]</sup>.

[SOURCE: ISO 9000:2015, 3.5.4, modified — Note 1 to entry added.]

#### 3.1.5

##### **quality plan**

document setting out the specific quality practices, resources and sequence of activities relevant to a particular product or range of products

#### 3.1.6

##### **type testing**

##### **TT**

testing performed to prove that the *material* (3.1.13), *pipe, joint* (3.1.21) or *assembly* (3.1.23) is capable of conforming to the requirements given in the relevant standard

Note 1 to entry: The type test results should remain valid until there is a change in the material or product or assembly provided that the *process verification tests* (3.1.8) are done regularly.

#### 3.1.7

##### **batch release test**

##### **BRT**

test performed by or on behalf of the manufacturer on a batch of PE products, which has to be satisfactorily completed before the batch can be released

### 3.1.8

#### **process verification test**

##### **PVT**

test performed by or on behalf of the manufacturer on PE products at specific intervals to confirm that the process continues to be capable of producing products which conform to the requirements given in the relevant standard

Note 1 to entry: Such tests are not required to release batches of products and are carried out as a measure of process control.

### 3.1.9

#### **process verification test at the "I" stage**

##### **PVT-I**

test performed by or on behalf of the manufacturer or installer at specific intervals during the installation process to confirm that the process as specified in the installation manual continues to be capable of producing installed products which conform to the requirements given in the relevant standard

Note 1 to entry: Such tests are not required to release batches of products and are carried out as a measure of process control.

### 3.1.10

#### **audit test**

##### **AT**

test performed by a test laboratory on behalf of an *inspection body* (3.1.2) or *certification body* (3.1.1) to confirm that the product continues to conform to the requirements given in the relevant standard

### 3.1.11

#### **indirect test**

##### **IT**

test performed by or on behalf of the manufacturer, different from that specified test for that particular characteristic, having previously verified its correlation with the specified test

### 3.1.12

#### **witness test**

##### **WT**

test accepted by an inspection or a *certification body* (3.1.1) for *type testing* (3.1.6) and/or *audit test* (3.1.10), which is carried out by or on behalf of the manufacturer and supervised by a representative of the inspection or certification body, competent in testing

### 3.1.13

#### **material**

generic term for compositions grouped by families, expressed by generic names, e.g. polypropylene, stainless steel, brass or EPDM

Note 1 to entry: Definition from European Commission, Directorate-General for Enterprise and Industry, Sub-group on Product Testing Procedures (EC, DG ENT and IND, SG PTP).

### 3.1.14

#### **material batch**

clearly identified quantity of a given homogeneous compound manufactured under uniform conditions and defined and identified by the compound manufacturer

### 3.1.15

#### **product**

pipe, fitting, or valve of a clearly identified type intended to be a part of a piping system which the manufacturer puts on the market

**3.1.16****product batch**

clearly identified collection of products, manufactured consecutively or continuously under the same conditions, using the same compound conforming to the same specification

Note 1 to entry: The production batch is defined and identified by the product manufacturer.

**3.1.17****lot**

clearly identifiable sub-division of a batch for inspection purposes

**3.1.18****sample**

one or more products drawn from the same production batch or *lot* (3.1.17), selected at random without regard to their quality

Note 1 to entry: The number of products in the sample is the sample size.

**3.1.19****group**

collection of similar products from which *samples* (3.1.18) are selected for testing purposes

**3.1.20****component**

product manufactured out of a specific composition compound brought to the market as part of another product or as a spare part.

Note 1 to entry: For drinking water application, components may be considered as products and be individually approved (e.g. O-ring, gasket) or they are tested as an integral part of a finished product (e.g. in a valve).

**3.1.21****joint**

connection between two products

**3.1.22****assembled product**

assembled final product using two or more single parts

**3.1.23****assembly**

product that can be dismantled into a set of *components* (3.1.20)

EXAMPLE A test piece consisting of various products.

**3.1.24****sampling plan**

specification of the type of sampling to be used combined with the operational specification of the entities or increments to be taken, the *samples* (3.1.18) to be constituted and the measurements or tests to be made

EXAMPLE A specific plan which indicates the number of units of products or assemblies to be inspected.

**3.1.25****product type**

generic description of a product

EXAMPLE A pipe or fitting or valve or their main parts, of the same design, from a particular compound.

**3.1.26****cavity**

<moulding> space within a mould to be filled to form the moulded product

EXAMPLE That part of an injection mould which gives the form to the injection-moulded product.

## 3.2 Rehabilitation general

### 3.2.1

#### rehabilitation

measures for restoring or upgrading the performance of existing systems, including *renovation* (3.2.2), *repair* (3.2.4) and *replacement* (3.2.3)

### 3.2.2

#### renovation

work incorporating all or part of the original fabric of the pipeline, by means of which its current performance is improved

### 3.2.3

#### replacement

construction of a new pipeline, on or off the line of an existing pipeline, where the function of the new pipeline system incorporates that of the old

### 3.2.4

#### repair

rectification of local damage

### 3.2.5

#### lining pipe

pipe inserted for *renovation* (3.2.2) purposes

### 3.2.6

#### characteristic

property, dimension or other feature of a *material* (3.1.13) or *component* (3.1.20)

### 3.2.7

#### "M" stage

stage as manufactured, before any subsequent site processing of *components* (3.1.20) associated with the particular *renovation* (3.2.2) technique

### 3.2.8

#### "I" stage

stage as installed, i.e. in final configuration after any site processing of *components* (3.1.20) associated with the particular *renovation* (3.2.2) technique

### 3.2.9

#### nominal size

##### DN

<DN> numerical designation of the size of a *component* (3.1.20), which is a convenient round number approximately equal to the inside or outside diameter in millimetres

### 3.2.10

#### nominal size

##### DN/OD

<DN/OD> numerical designation of the size of a component related to the outside diameter

[SOURCE: ISO 4427-1:2019, 3.1.1]

### 3.2.11

#### nominal outside diameter

##### $d_n$

specified outside diameter assigned to a *nominal size* DN/OD (3.2.9)

Note 1 to entry: Expressed in millimetres.

#### 4 Abbreviated terms

To avoid misunderstanding, the assessment of conformity abbreviated terms in this Clause are defined as being the same in each language. For the same reason, the terms are given in three languages, English, French and German.

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	English	French	German
AT	audit test	essai d'audit	Überwachungsprüfung
BRT	batch release test	essai de libération de campagne de fabrication	Freigabeprüfung einer Charge
IT	indirect test	essai indirect	indirekte Prüfung
PVT	process verification test	essai de vérification du procédé de fabrication	Prozessüberprüfung
PVT-I	process verification test at the "I" stage	essai de vérification du procédé d'installation	Einbauprozessprüfung
TT	type testing	essai de type	Typprüfung
WT	witness test	essai témoin	Prüfung unter Aufsicht

Furthermore, the abbreviated terms given in ISO 1043-1 and the following apply.

- PE polyethylene
- RFC resin fibre composite
- PVC-U unplasticized poly(vinyl chloride)

## 5 General

Materials, products, joints and assemblies shall conform to the requirements given in the applicable parts of ISO 11296, ISO 11297, ISO 11298, ISO 11299 and ISO 21225.

Where these product standards include clauses entitled 'Regional requirements', in countries of the single European market, conformity shall be assessed against certain different normative references (EN equivalents of ISO standards where not yet merged as EN/ISO standards), as specified in the product standards.

Products and assemblies shall be produced by the manufacturer under a quality management system which includes a quality plan.

It is recommended that the quality management system conforms to ISO 9001<sup>[2]</sup> or similar management system.

The production of representative "I" stage samples for type testing shall conform to the requirements given in the Parts 1 of ISO 11296, ISO 11297, ISO 11298 and ISO 11299 as applicable.

## 6 Testing and inspection

### 6.1 Grouping

#### 6.1.1 General

For the purposes of this document, the groups specified in [6.1.2](#) and [6.1.3](#) apply.

#### 6.1.2 Size groups

Five size groups are defined for pipes and fittings, as given in [Table 2](#).

For testing purposes, one individual nominal diameter,  $d_n$ , shall be selected from each group.

Table 2 — Size groups

Size group	Nominal outside diameter, $d_n$ mm
1	$d_n < 75$
2	$75 \leq d_n < 250$
3	$250 \leq d_n < 710$
4	$710 \leq d_n < 1\ 800$
5	$d_n \geq 1\ 800$

### 6.1.3 Fitting groups

Four groups of fittings each having a similar design are defined, as given in [Table 3](#).

Table 3 — Fitting groups

Fitting group	Type of fitting
(A)	Electrofusion socket fitting
(B)	Electrofusion saddle fitting
(C)	Spigot end fitting
(D) <sup>a</sup>	Fabricated fitting
<sup>a</sup> Not applicable for gas networks.	

Fitting groups are divided in fitting types.

- Fitting group (A) includes the following fitting types: Electrofusion couplers, electrofusion 45° elbows, electrofusion 90° elbows, electrofusion tees, electrofusion reducers, electrofusion end caps.
- Fitting group (B) includes the following fitting types: Electrofusion tapping saddles, electrofusion branch saddles.
- Fitting group (C) includes the following fitting types: 45° elbows, 90° elbows, tees, reducers, end caps.
- Fitting group (D) includes the following fitting types: Swept bends, segmented bends, segmented tees.

## 6.2 Type testing

Relevant type testing shall be carried out on every new system and whenever there is a change in design, material, production or installation method, other than routine in-process adjustments, and whenever there is an extension of the product range.

Type testing to be carried out when there is a change of production site depends on the extent of the change and should therefore be defined individually by the manufacturer and certification body.

For other change conditions, characteristics to be type tested and sampling procedures are specified in:

- [A.1](#) TT for systems applied to underground non-pressure drainage and sewer networks.
- [B.1](#) TT for systems applied to water networks, drainage and sewer networks under pressure and gas networks.

The following abbreviated terms are used to identify change conditions requiring new type testing in the respective tables of [A.1](#) and [B.1](#):

- N: New system;

- D: Change in design;
- M: Change of material;
- E: Extension of the product.

Detailed definitions of these change conditions are provided in normative [Annex C](#).

### 6.3 Batch release tests

Characteristics to be batch release tested and sampling procedures are specified in:

- [A.2](#) BRT for systems applied to underground non-pressure drainage and sewer networks.
- [B.2](#) BRT for systems applied to water networks, drainage and sewer networks under pressure and gas networks.

### 6.4 Process verification tests

Process verification tests include tests conducted at the “M” stage (PVT) and, where applicable, tests carried out at the “I” stage (PVT-I).

If a sample or process parameter does not conform to the requirements of the installation process given in the relevant parts of ISO 11296, ISO 11297 or ISO 11298, ISO 8772, ISO 4427 (series), or ISO 4437 (series), as applicable, the relevant retest procedure detailed in the manufacturer’s quality plan should be performed.

For countries of the single European Market ISO 8772 is replaced by EN 12666-1, ISO 4427 (series) is replaced by EN 12201 and ISO 4437 (series) is replaced by EN 1555.

NOTE Failure to meet the required installation process parameters does not necessarily preclude successful installation.

Characteristics to be process verification tested and sampling procedures are specified in:

- [A.3](#) PVT and PVT-I for systems applied to underground non-pressure drainage and sewer networks.
- [B.3](#) PVT and PVT-I for systems applied to water networks, drainage and sewer networks under pressure and gas networks.

### 6.5 Audit tests

Characteristics to be audit tested and sampling procedures are specified in:

- [A.4](#) AT for systems applied to underground non-pressure drainage and sewer networks.
- [B.4](#) AT for systems applied to water networks, drainage and sewer networks under pressure and gas networks.

### 6.6 Indirect tests

Generally, testing shall be performed using the test methods specified in the relevant parts of ISO 11296, ISO 11297, ISO 11298, ISO 11299, or ISO 21225, as applicable.

Indirect testing may be used for BRT characteristics as given in the tables in [A.2](#) and [B.2](#), as applicable. Indirect testing shall not be used for TTs, PVTs and ATs.

The indirect test method used and the correlation or safe relationship of the indirect testing to the specified testing shall be documented in the manufacturer's quality plan. The continuing validity of the indirect testing shall be checked at regular intervals.

In cases of dispute, the BRTs as specified in the tables in [A.2](#) and [B.2](#), as applicable, shall be used.

If certification is involved, the IT shall be undertaken in a manner that is acceptable to the certification body.

## 6.7 Test records

Unless otherwise specified, all records shall be maintained for a minimum of ten years in accordance with the information given in the quality management system.

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## Annex A (normative)

### Test procedures for plastics piping systems for the rehabilitation of networks for underground non-pressure drainage and sewerage

#### A.1 Type testing

For the purposes of this document, the material specification consists of a compound/formulation comprising a polyethylene (PE) compound/formulation with specific trade name and additives with known dosage level.

Type tests shall demonstrate that the products conform to all requirements for the characteristics given in [Tables A.1](#) to [A.3](#), as applicable.

**Table A.1 — Characteristics of lining pipes that require type testing (TT)**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296	Conditions requiring test <sup>a</sup>				Sampling procedure	
		N	D	M	E	Manufacturer	Certification body <sup>b</sup>
Melt mass-flow rate (MFR-value)	Parts 2, 3 [5.3]	+		+		Once per material	Once per material
Resistance to internal pressure	Parts 2, 3 [5.3, 8.3]	+		+		Once per material in a single optional size	Once per material in a single optional size
Thermal stability (OIT)	Parts 2, 3, [5.3]	+		+		Once per material	Once per material
Appearance	Parts 2, 3, 7 [5.2]	+	+	+	+	Once per size	Once per size group
Density	Parts 3 [5.3]	+		+		Once per material	Once per material
Colour	Parts 1, 2, 3, 7 [5.2]	+		+	+	Once per size	Once per size group
Dimensions	Parts 2, 3, 7 [5.4, 8.4]	+	+		+	Once per size	Once per size group
Ring stiffness	Parts 2, 3, 7 [5.5, 8.5]	+	+	+	+	Once per SN class/material	Once per SN class/material
Creep ratio	Parts 3, 7 [8.5]	+	+	+		Once per SN class/material	Once per SN class/material
Longitudinal reversion	Parts 2, 3 [5.6]	+	+	+	+	Once per size	Once per size group
Vicat Softening temperature	Part 7 [5.6]	+	+	+		Once per material per profile strip	Once per material per profile strip
Marking	Parts 1, 2, 3, 7 [5.8]	+		+		Once per size	By checking the test results of the manufacturer
Memory ability	Part 3 [5.6]	+	+	+	+	Once per size	By checking the test results of the manufacturer

<sup>a</sup> Explanation in [6.2](#) and [Annex C](#); +: Test to be carried out.

<sup>b</sup> Recommended sampling procedure for a testing laboratory on behalf of a certification body.

Table A.1 (continued)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296	Conditions requiring test <sup>a</sup>				Sampling procedure	
		N	D	M	E	Manufacturer	Certification body <sup>b</sup>
Modulus of elasticity (tensile)	Part 7 [5.3 or 5.4]	+		+		Once per material	Once per material
Tensile strength longitudinal	Parts 3, 7 [5.3 or 5.4]	+		+		Once per material	Once per material
Elongation at break	Parts 3, 7 [5.3 or 5.4]	+		+		Once per material	Once per material
Tensile strength of a locked seam	Part 7 [8.5]	+	+	+	+	Once per size	Once per size group
Installation practice compliance	Parts 2, 3, 7 [9]	+	+	+	+	Once per size	Once per size group

<sup>a</sup> Explanation in 6.2 and Annex C; +: Test to be carried out.

<sup>b</sup> Recommended sampling procedure for a testing laboratory on behalf of a certification body.

Table A.2 — Characteristics of replacement pipes that require type testing (TT)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 21225	Conditions requiring test <sup>a</sup>				Sampling procedure	
		N	D	M	E	Manufacturer	Certification body <sup>b</sup>
Melt mass-flow rate (MFR-value)	Parts 1, 2 [6.1]	+		+		Once per material	Once per material
Resistance to internal pressure		+		+		Once per material in a single optional size	Once per material in a single optional size
Thermal stability (OIT)		+		+		Once per material	Once per material
Appearance		+		+	+	Once per size	Once per size group
Colour		+		+	+	Once per size	Once per size group
Dimensions		+	+		+	Once per size	Once per size group
Ring stiffness		+		+	+	Once per SN class/material	Once per SN class/material
Longitudinal reversion		+	+		+	Once per size	Once per size group
Creep ratio		+		+	+	Once per SN class/material	Once per SN class/material
Installation practice compliance	Parts 1, 2 [7]	+	+	+	+	Once per material	Once per material

<sup>a</sup> Explanation in 6.2 and Annex C; +: Test to be carried out.

<sup>b</sup> Recommended sampling procedure for a testing laboratory.

**Table A.3 — Characteristics of fittings that require type testing (TT)**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296 and ISO 21225	Conditions requiring test <sup>a</sup>				Sampling procedure	
		N	D	M	E	Manufacturer	Certification body <sup>b</sup>
Melt mass-flow rate (MFR-value)	ISO 11296-1 [6.2] ISO 11296-2, -3, -7 [6 or 6.1] ISO 21225-1, -2 [6.1]	+		+		Once per compound	Once per compound
Resistance to internal pressure <sup>c</sup>		+		+		Once per material in a single optional size	Once per material in a single optional size
Thermal stability (OIT) <sup>c</sup>		+		+		Once per material	Once per material
Appearance		+		+	+	Once per each fitting	Once per fitting group
Colour		+		+	+	Once per each fitting	Once per fitting group
Dimensions		+	+	+	+	Once per each fitting	Once per size group and fitting group
Flexibility or mechanical strength <sup>d</sup>		+		+	+	Once per each fitting	Once per fitting group
Effect of heating	+			+	Once per size	Once per fitting group	
					Once per size group and fitting group	Once per material	
Watertightness	+			+	Once per each fitting	Once per fitting group	

## A.2 Batch release testing

Those characteristics specified in the relevant parts of ISO 11296 and ISO 21225 and listed in [Tables A.4](#) to [A.6](#), shall be subject to BRTs with the minimum sampling frequency given in [Tables A.4](#) to [A.6](#), as applicable.

**Table A.4 — Characteristics of lining pipes and minimum sampling frequencies for BRTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296	Minimum sampling frequency
Appearance	Parts 2, 3, 7 [5.2]	Once per 8 h and start up
Colour	Parts 1, 2, 3, 7 [5.2]	Once per 8 h and start up
Diameter	Parts 2, 3 [5.4]	Once per extrusion run
Profiled strip dimension	Part 7 [5.4]	Once per extrusion run
Wall thickness	Parts 2, 3, 7 [5.4]	Once per 8 h and start up
Length of pipe	Part 2 [5.4]	Once per 8 h and start up
Longitudinal reversion	Parts 2, 3 [5.6]	Once per week and start up
Memory ability	Part 3 [5.6]	Once per 8 h and start up
Tensile strength of a locked seam	Part 7 [8.5]	At the beginning and end of each spool
Marking	Parts 1, 2, 3, 7 [5.8]	Once per 2 h and start up

**Table A.5 — Characteristics of replacement pipes and minimum sampling frequencies for BRTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 21225	Minimum sampling frequency
Appearance	ISO 21225-1, -2 [6.1]	Once per 8 h and start up
Colour		Once per 8 h and start up
Diameter		Once per 8 h and start up
Wall thickness		Once per 8 h and start up
Length of pipe		Once per 8 h and start up
Longitudinal reversion		Once per week and start up
Marking		Once per 8 h and start up

**Table A.6 — Characteristics of fittings and minimum sampling frequencies for BRTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 edi- tions] of ISO 11296 and ISO 21225	Minimum sampling frequency	
Appearance	ISO 11296-1 [6.2]	Once per 8 h and start up	
Colour		Once per 8 h and start up	
Diameter		Once per 8 h and start up	
Wall thickness		Once per 8 h and start up	
Socket and spigot dimensions		ISO 11296-3, -7 [6 or 6.1]	Once per 8 h and start up
Effect of heating		ISO 21225-1, -2 [6.1]	Once per week and start up
Water tightness			One sample for each type of fabricated fitting/8 h
Marking		Once per 8 h and start up	

The manufacturer shall specify a batch in its quality plan.

A batch or lot shall only be released for supply when all the relevant tests and inspections have been carried out at least once at the specified frequencies and the requirements have been met.

If a product fails in respect of any characteristic given in [Tables A.4](#) to [A.6](#) as applicable, the batch or lot shall be rejected or the retest procedures shall be performed for the characteristic on which the product failed.

The retest procedure shall be as follows:

- Find the last product, which conforms to the requirements as specified in the relevant parts of ISO 11296 and ISO 21225.
- Release all products produced before that point and reject the products produced after that point.

Procedures for dealing with rejected products shall be detailed in the manufacturer's quality plan.

### A.3 Process verification testing

Those characteristics specified in the relevant parts of ISO 11296 and ISO 21225 and listed in [Tables A.7](#) to [A.10](#) shall be subject to PVTs and PVT-Is with the minimum sampling frequencies given in [Tables A.7](#) to [A.10](#), as applicable, if not type tested or audit tested in the same period.

**Table A.7 — a) Characteristics of lining pipes and minimum sampling frequencies for PVTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 11296	Minimum sampling frequency
Thermal stability (OIT)	Parts 2, 3 [5.3]	Once per year per material currently used
Melt mass-flow rate (MFR-value)	Parts 2, 3 [5.3]	Once per year per material currently used

**Table A.7 — b) Characteristics of lining pipes and minimum sampling frequencies for PVT-Is**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296	Minimum sampling frequency
Resistance to internal pressure	Parts 2, 3 [5.3]	Once per year per material currently used in a single optional size
Ring stiffness	Parts 2, 3, 7 <sup>a</sup> [5.5, 8.5]	Once per year per material currently used and pipe series
Installation practice compliance	Parts 2, 3, 7 [9]	Once per installation

<sup>a</sup> Once per year per applicable size group for each profile type.

**Table A.8 — a) Characteristics of replacement pipes and minimum sampling frequencies for PVTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 21225	Minimum sampling frequency
Resistance to internal pressure	Parts 1, 2 [6.1]	Once per year per material currently used in a single optional size
Thermal stability (OIT)		Once per year per material currently used
Melt mass-flow rate (MFR-value)		Once per year per material currently used
Ring stiffness		Once per year per material currently used and size group and pipe series

**Table A.8 — b) Characteristics of replacement pipes and min. sampling frequencies for PVT-I's**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 21225	Minimum sampling frequency
Installation practice compliance	Parts 1, 2 [7]	Once per installation

**Table A.9 — Characteristics of fittings and minimum sampling frequencies for PVTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296 and ISO 21225	Minimum sampling frequency
Resistance to internal pressure	ISO 11296-2, 3, 7 [6 or 6.1] ISO 21225-1, 2 [6.1]	Once per year per material currently used in a single optional size
Thermal stability (OIT)		Once per year per material currently used
Melt mass-flow rate (MFR-value) <sup>a</sup>		Once per year per material currently used
Flexibility or mechanical strength <sup>b</sup>		Once per year per size group per socket design
<sup>a</sup> Not to be repeated for fittings material when the material is the same as for pipes and already tested for that purpose.		
<sup>b</sup> Only for fabricated fittings made from more than one piece. A sealing ring retaining mean is not considered as a piece.		

**Table A.10 — Characteristics for fitness for purpose and minimum sampling frequencies for PVTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296 and ISO 21225	Minimum sampling frequency
Tightness of elastomeric sealing ring joints	ISO 11296-2, 3, 7 <sup>b</sup> [6 or 6.1] ISO 21225-1, 2 [6.1]	Once per 2 years per size group and joint design <sup>a</sup>
<sup>a</sup> Joint design at least includes: seal design, groove geometry and seal hardness (t 5 IHRD).		
<sup>b</sup> Once per year per applicable size group for each profile type.		

If the product does not conform to the requirements in respect of any characteristic given in [Tables A.7](#) to [A.10](#), as applicable, the retest procedure detailed in the manufacturer's quality plan shall be performed. If the retest procedure does not confirm conformity of the product to the requirements, then the process shall be investigated and corrected in accordance with the procedures given in the manufacturer's quality plan, as well as to verify the characteristics given in [Tables A.7](#) to [A.10](#), as applicable.

A test performed as an AT does not need to be repeated as a PVT and/or PVT-I.

#### A.4 Audit testing

ATs are only performed where certification is involved.

Those characteristics specified in the relevant parts of ISO 11296 and ISO 21225 and listed in [Tables A.11](#) to [A.14](#) are intended to be audit tested with the minimum sampling frequency given in [Tables A.11](#) to [A.14](#), as applicable.

**Table A.11 — Characteristics of lining pipes and minimum sampling frequencies for ATs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296	Minimum sampling frequency
Melt mass-flow rate (MFR-value)	Parts 2, 3 [5.3]	Once per year per material currently used
Resistance to internal pressure	Parts 2, 3 [5.3, 8.3]	Once per 3 years per materials currently used in a single optional size
Thermal stability (OIT)	Parts 2, 3 [5.3]	Once per year per material currently used
Appearance	Parts 2, 3, 7 [5.2]	Once per year per size group
Colour	Parts 1, 2, 3, 7 [5.2]	Once per year per size group
Dimensions	Parts 2, 3, 7 [5.4, 8.4]	Once per year per size group
Ring stiffness	Parts 2, 3, 7 [5.5]	Once per year per size group
Creep ratio	Parts 3, 7 [8.5]	Once per 5 year per size group
Longitudinal reversion	Parts 2, 3 [5.6]	Once per year per size group
Memory ability	Part 3 [5.6]	Once per year per size group
Modulus of elasticity (tensile)	Part 7 [5.3 or 5.4]	Once per year per material
Tensile strength longitudinal	Part 7,3 [5.3 or 5.4]	Once per year per size group
Elongation at break	Part 7,3 [5.3 or 5.4]	Once per year per size group
Tensile strength of a locked seam	Part 7 [8.5]	Once per year per profile type
Installation practice compliance	Parts 2, 3, 7 [9]	Once per 5 year
Marking	Parts 1, 2, 3, 7 [5.8]	Once per year per size group

**Table A.12 — Characteristics of replacement pipes and minimum sampling frequencies for ATs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] of ISO 21225	Minimum sampling frequency
Melt mass-flow rate (MFR-value) <sup>a</sup>	Parts 1, 2 [6.1]	Once per year per material currently used
Resistance to internal pressure <sup>a</sup>		Once per 3 years per materials currently used in a single optional size
Thermal stability (OIT)		Once per year per material currently used
Appearance		Once per year per size group
Colour		Once per year per size group
Dimensions		Once per year per size group
Ring stiffness		Once per year per size group
Longitudinal reversion		Once per year per size group
Marking		Once per year per size group
Installation practice compliance	Parts 1, 2 [7]	Once per 5 year

**Table A.13 — Characteristics of fittings and minimum sampling frequencies for ATs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296 and ISO 21225	Minimum sampling frequency	
Melt mass-flow rate (MFR-value) <sup>a</sup>	ISO 11296-1 [6.2, 6.8] ISO 11296-2, 3, 7 [6 or 6.1] ISO 21225-1, 2 [6.1]	Once per year per material currently used	
Resistance to internal pressure		Once per 3 years per materials currently used in a single optional size	
Thermal stability (OIT)		Once per year per material currently used	
Appearance		Once per year per fitting group	
Colour		Once per year per fitting group	
Dimensions		Once per year per fitting group	
Ring stiffness		Once per year per fitting group	
Creep ratio		Once per year per fitting group	
Longitudinal reversion		Once per year per fitting group	
Effect of heating <sup>b</sup>		Once per year per fitting group	
Marking		Once per year per fitting group	
<sup>a</sup> Not to be repeated for fittings material when the material is the same as for pipes and already tested for that purpose. <sup>b</sup> Only for injection moulded parts.			

**Table A.14 — Characteristics for fitness for purpose of the system and minimum sampling frequencies for ATs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 or 2019 editions] of ISO 11296 and ISO 21225	Minimum sampling frequency
Tightness of elastomeric sealing ring joints	ISO 11296-2, 3, 7 [6 or 6.1] ISO 21225-1, 2 [6.1]	Once per year on one size
<sup>a</sup> Joint design at least includes: seal design, groove geometry and seal hardness (t 5 IHRD).		

The sizes, types and classes selected for tests should preferably be primarily those which have not previously been selected for audit testing. Samples should be preferably taken from the largest volume of production per group.

Certification bodies may accept process verification tests (PVT/PVT-I) as audit tests (AT) if witnessed by them or by their agencies.

## Annex B (normative)

### Test procedures for plastics piping systems for the rehabilitation of networks for drainage and sewerage under pressure, and for water and gas supply

#### B.1 Type testing

For the purposes of this document, the material specification consists of a compound/formulation comprising a polyethylene (PE) compound/formulation with specific trade name and additives with known dosage level.

Type tests shall demonstrate that the products conform to all requirements for the characteristics given in [Tables B.1](#) to [B.3](#), as applicable.

In cases of change in compound as defined in [C.2](#), relevant type testing requirements as defined in [C.3](#) and in [Tables B.1](#) to [B.3](#), as applicable, shall apply.

In cases of change in design of fittings, the following characteristics are relevant:

- a) dimensions and geometry (See column D1 of [Table B.3](#)): change of visual and functional optimisations, change of overall dimensions, change of a non-PE part;
- b) joint affected part (See column D2 of [Table B.3](#)): change of the dimensions of the fusion zone (e.g. wire pitch, wire depth), the electrical characteristics (e.g. wire, resistance), the fusion parameters (e.g. time, voltage).

For the extension of the product range for fittings, the relevant characteristics given in [Table B.3](#), column E, as applicable, shall be retested, as agreed between the certification body and the manufacturer if certification is involved.

For fabricated fittings, guidance for type testing is given in [Annex D](#).

**Table B.1 — Characteristics of compounds that require type testing (TT) by the compound manufacturer**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Sampling procedure
Compound density		3 samples/compound
Oxidation induction time (thermal stability)		3 samples/compound
Melt mass-flow rate (MFR)		3 samples/compound
Volatile content		1 sample/compound
Water content <sup>a</sup>		1 sample/compound
Carbon black content <sup>b</sup>		3 samples/compound
Carbon black dispersion <sup>b</sup>		1 sample/compound

Table B.1 (continued)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225		Sampling procedure	
	ISO 11297 ISO 11298 and ISO 11299	ISO 21225	Manufacturer <sup>b</sup>	Certification body <sup>c</sup>
Pigment dispersion <sup>c</sup>	ISO 11297-2, -3 [5.1]		1 sample/compound	
Resistance to weathering	ISO 11298-1 [5.3] <sup>f</sup>		Once/compound <sup>d</sup>	
Resistance to rapid crack propagation (critical pressure, $p_c$ ), (250 mm SDR 11 or 500 mm SDR 11)	ISO 11298-2, -3 [5.1] ISO 11299-2, -3 [5.1]		Number of test pieces shall conform to ISO 13477 or ISO 13478, Once/compound	
Resistance to slow crack growth ( $d_n$ : 110 mm SDR 11)	ISO 21225-1, -2 [6.1]		3 test pieces/compound <sup>e</sup>	
Determination of the failure mode in a tensile test on a butt fusion weld ( $d_n$ : 110 mm SDR 11)			3 samples/compound	
Classification			Shall conform to ISO 12162, Once/compound	
Effect on water quality <sup>f</sup>			National regulations apply	
Resistance to gas condensate <sup>g</sup>			1 sample/compound	

<sup>a</sup> Only applicable if the requirement for volatile content is not conformed to. In case of dispute, the requirement for water content shall apply.

<sup>b</sup> Only applicable for black compound.

<sup>c</sup> Only applicable for non-black compound.

<sup>d</sup> Three pieces for elongation at break/Three pieces for hydrostatic strength/One sample for decohesion of an electrofusion joint.

<sup>e</sup> Resistance to RCP and slow crack growth shall be measured on pipe made from the same compound batch.

<sup>f</sup> Only applicable for compounds intended to be used for products intended for the conveyance of water for human consumption.

<sup>g</sup> Only applicable for compounds intended to be used for products intended for the conveyance gas.

In cases of change of compound, all type tests shall apply.

Table B.2 — Characteristics of pipes that require type testing (TT) by the pipe manufacturer

Characteristic <sup>g</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Conditions requiring test <sup>a</sup>				Sampling procedure	
	ISO 11297 ISO 11298 and ISO 11299	ISO 21225	N	D	M	E	Manufacturer <sup>b</sup>	Certification body <sup>c</sup>
Appearance	Parts 2, 3 [5.2]		+		+	+	1 test piece of each diameter	1 test piece of one diameter/size group
Colour	Parts 1, 2, 3 [5.2]		+		+	+	1 test piece of each diameter	1 test piece of one diameter/size group
Dimensions	Parts 2, 3 [5.4, 8.4]		+	+	+	+	1 test piece of each diameter	1 test piece of one diameter/size group

Table B.2 (continued)

Characteristic <sup>g</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Conditions requiring test <sup>a</sup>				Sampling procedure	
	ISO 11297 ISO 11298 and ISO 11299	ISO 21225	N	D	M	E	Manufacturer <sup>b</sup>	Certification body <sup>c</sup>
Hydrostatic strength (20 °C, 100 h)	Parts 2, 3 [8.5]		+	+	+	+	3 test pieces of one diameter/size group 1, 2 and 3	3 test pieces of one diameter/size group 1, 2 and 3
							1 test piece of one diameter/size group 4 and 5 or by agreement with the end-user or purchaser <sup>l</sup>	By checking the test results of the manufacturer
Hydrostatic strength (80 °C, 1 000 h)	Parts 2, 3 [8.5]		+	+	+	+	3 test pieces of one diameter/size group 1, 2 and 3	3 test pieces of one diameter/size group 1, 2 and 3
							1 test piece of one diameter/size group 4 and 5 or by agreement with the end-user or purchaser <sup>l</sup>	By checking the test results of the manufacturer
Elongation at break	Parts 2, 3 [5.6]		+		+	+	Number of test pieces shall conform to ISO 6259-1 One sample/size group	Number of test pieces shall conform to ISO 6259-1 One sample/size group
Resistance to slow crack growth $e \leq 5$ mm (Cone test) <sup>k,m</sup>	Part 2 [5.6]	Parts 1, 2 [6.1]	+	+	+	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/size group
Resistance to slow crack growth $e > 5$ mm ( $d_n$ : 110 mm SDR 11) (Notch test) <sup>k,m</sup>	Part 2 [5.6]		+	+	+	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/size group
Resistance to rapid crack propagation (critical pressure, $p_c$ (250 mm SDR 11 or 500 mm SDR 11)) <sup>k,m</sup>	Part 2 [5.6]		+	+	+	+	Number of samples shall conform to ISO 13477 of one diameter	Number of samples shall conform to ISO 13477 of one diameter
Thermal stability (OIT)	Parts 2, 3 [5.6]		+		+		1 sample per size group	1 sample per size group
Melt mass-flow rate (MFR-value)	Parts 2, 3 [5.6]		+		+		1 sample per size group	1 sample per size group
Longitudinal reversion	Parts 2, 3 [5.6]		+	+	+	+	1 sample per size group	1 sample per size group
Tensile strength for butt fusion	Part 2 [5.6]		+		+		1 sample/size group 2	By checking the test results of the manufacturer
Squeeze off <sup>m</sup>	Part 2 [5.6]		+	+	+		1 sample of one diameter <sup>n,o</sup>	By checking the test results of the manufacturer

Table B.2 (continued)

Characteristic <sup>g</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Conditions requiring test <sup>a</sup>				Sampling procedure	
	ISO 11297 ISO 11298 and ISO 11299	ISO 21225	N	D	M	E	Manufacturer <sup>b</sup>	Certification body <sup>c</sup>
Effect on water quality <sup>l</sup>	ISO 11298-1 [5.3]		+		+		National regulations apply	
Marking	Parts 1, 2, 3 [5.8]		+		+		1 test piece of each diameter	By checking the test results of the manufacturer
Memory ability	Part 3 [5.6]		+	+	+	+	1 test piece of each diameter	By checking the test results of the manufacturer
Installation practice compliance	Parts 2, 3, 7 [9]	Parts 1, 2 [7]	+	+	+	+	Once per size	Once per size group
<b>Additional tests for coextruded pipes<sup>l</sup></b>								
Integrity of the structure after deflection	Part 2 [5.6]	Parts 1, 2 [6.1]	+	+	+	+	1 sample of each diameter	1 sample/size group
<b>Additional tests for peelable layer pipes</b>								
Resistance to weathering <sup>h</sup>			+	+	+		1 sample of one diameter/peelable layer formulation	1 sample of one diameter/peelable layer formulation
Resistance to rapid crack propagation (critical pressure, $p_c$ ), (250 mm SDR 11 or 500 mm SDR 11) <sup>k</sup>	Part 2 [5.6]	Parts 1, 2 [6.1]	+	+	+		Number of test pieces shall conform to ISO 13477, Once/compound	By checking the test results of the manufacturer
Resistance to slow crack growth ( $d_n$ : 110 mm SDR 11) <sup>k</sup>			+	+	+		3 test pieces, Once/compound	By checking the test results of the manufacturer

Table B.2 (continued)

Characteristic <sup>g</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Conditions requiring test <sup>a</sup>				Sampling procedure	
	ISO 11297 ISO 11298 and ISO 11299	ISO 21225	N	D	M	E	Manufacturer <sup>b</sup>	Certification body <sup>c</sup>
<p><sup>a</sup> Explanation in 6.2 and Annex C; +: Test to be carried out.</p> <p><sup>b</sup> Successful testing will validate pipe with the same <math>d_n</math> and a higher SDR, i.e. thinner wall thickness. Where a manufacturer extends his production beyond his approval, additional relevant type testing shall be carried out.</p> <p><sup>c</sup> Recommended sampling procedure for a testing laboratory on behalf of a certification body. Testing undertaken in a manufacturer's laboratory can be taken into account, by the certification body.</p> <p><sup>d</sup> Longitudinal reversion is applicable to wall thickness <math>\leq 16</math> mm.</p> <p><sup>e</sup> For change of compound of the same MRS, 1 test piece of one diameter from the manufacturer's range.</p> <p><sup>f</sup> Applicable for each layer of coextruded pipe and for peelable layer pipes tested with the external layer.</p> <p><sup>g</sup> All characteristics except marking are applicable for the base pipe of peelable layer pipe without the layer. Appearance, colour, resistance to weathering, and marking are also applicable to peelable layer pipes including the layer.</p> <p><sup>h</sup> Weathering of the base pipe is assessed in accordance with ISO 4427-1 for water applications and ISO 4437-1 for gas applications. The weathering of peelable layer pipe with the layer is assessed by testing three test pieces for elongation at break/three test pieces for hydrostatic strength/one sample for decohesion of an electrofusion joint.</p> <p><sup>i</sup> Indirect testing subject to study.</p> <p><sup>j</sup> For coextruded pipes, RCP and slow crack growth properties are covered by the use of compounds in conformance with ISO 4427-1 for water applications and ISO 4437-1 for gas applications.</p> <p><sup>k</sup> Applicable to peelable layer pipes. Tests to be carried out with the peelable layer included. The base pipe is covered by the use of compounds in conformance with ISO 4427-1 for water applications and ISO 4437-1 for gas applications.</p> <p><sup>l</sup> Applicable for compounds intended to be used for products intended for the conveyance of water for human consumption.</p> <p><sup>m</sup> Applicable for products intended for the conveyance of gas.</p> <p><sup>n</sup> To be performed preferably on <math>d_n</math> 63 SDR 11.</p> <p><sup>o</sup> Sampling procedure of one diameter.</p>								

Table B.3 — Characteristics of fittings that require type testing (TT) by the fitting manufacturer

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Conditions requiring test <sup>a</sup>					Sampling procedure		
		N	D1	D2	M	E	Manufacturer	Certification body <sup>b</sup>	
Appearance		+				+	+	5 test pieces/size/ fitting type <sup>c,g</sup>	5 test pieces of one diameter/size group/fitting type
								1 test piece/size group/fitting type <sup>i</sup>	1 test piece of one diameter/size group/fitting type <sup>i</sup>

Table B.3 (continued)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Conditions requiring test <sup>a</sup>					Sampling procedure		
		N	D1	D2	M	E	Manufacturer	Certification body <sup>b</sup>	
Colour	ISO 11298-1 [6.3] <sup>a</sup> ISO 11297-2, 3 [6.1] ISO 11298-2, 3 [6.1] ISO 21225-1, 2 [6.1]	+			+	+	5 test pieces/size/fitting type <sup>c,g</sup>	5 test pieces of one diameter/size group/fitting type	
							1 test piece/size group/fitting type <sup>i</sup>	1 test piece of one diameter/size group/fitting type <sup>i</sup>	
Electrical characteristics (A) (B)		+		+		+	5 test pieces/size/fitting type <sup>c,g</sup>	5 test pieces of one diameter/size group/fitting type	
							1 test piece/size group/fitting type <sup>i</sup>	1 test piece of one diameter/size group/fitting type <sup>i</sup>	
Dimensions		+	+		+	+	5 test pieces/size/fitting type <sup>c,g</sup>	5 test pieces of one diameter/size group/fitting type	
							1 test piece/size group/fitting type <sup>i</sup>	1 test piece of one diameter/size group/fitting type <sup>i</sup>	
Hydrostatic strength (20 °C, 100 h)		+				+ <sup>f</sup>	+	3 test pieces/size/fitting type <sup>g,l,m</sup>	3 test pieces of one diameter/size group/fitting type <sup>i</sup>
								1 test piece/size group/fitting type <sup>i,l,m,n</sup>	By checking the test results of the manufacturer <sup>j</sup>
Hydrostatic strength (80 °C, 165 h)		+		+	+			1 test piece/size group/fitting type	By checking the test results of the manufacturer
Hydrostatic strength (80 °C, 1 000 h)		+		+	+	+ <sup>f</sup>	+	3 test pieces/size/fitting type <sup>g,l,m</sup>	3 test pieces of one diameter/size group/fitting type <sup>i</sup>
	1 test piece/size group/fitting type <sup>i,l,m,n</sup>							By checking the test results of the manufacturer <sup>j</sup>	
Decohesive resistance (A)	+		+		+ <sup>f</sup>	+	1 test piece/size/fitting type/condition <sup>g,o</sup>	1 test piece of one diameter/size group/fitting type, condition	
							1 test piece/size/fitting type <sup>i,k</sup>	By checking the test results of the manufacturer <sup>j</sup>	
Evaluation of ductility of fusion joint interface (B)	+		+		+ <sup>f</sup>	+	1 test piece/size/fitting type/condition <sup>g,o</sup>	1 test piece of one diameter/size group/fitting type, condition <sup>o</sup>	
							1 test piece/size/fitting type <sup>i,k,o</sup>	By checking the test results of the manufacturer <sup>j</sup>	

Table B.3 (continued)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Conditions requiring test <sup>a</sup>					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body <sup>b</sup>
Tensile strength for butt fusion (C)		+			+	+	1 test piece/size group/fitting type/condition	By checking the test results of the manufacturer
Impact resistance (B)		+		+	+ <sup>f</sup>	+	1 test piece/size/fitting type <sup>p</sup>	1 test piece/size group/fitting type <sup>p</sup>
Pressure drop (B)		+	+			+	1 test piece/size/fitting type <sup>p</sup>	By checking the test results of the manufacturer <sup>p</sup>
Short-term internal pressure resistance (A) <sup>d</sup>		+		+	+ <sup>f</sup>	+	3 test pieces/size/fitting type <sup>g, l, p</sup>	3 test pieces of one diameter/size group/fitting type <sup>l, p</sup>
Resistance to tensile load (A) <sup>d</sup>		+		+	+ <sup>f</sup>	+	3 test pieces/size/fitting type <sup>g, l, p</sup>	3 test pieces of one diameter/size group/fitting type <sup>l, p</sup>
Thermal stability (OIT) <sup>c</sup>		+			+		1 sample/size group/fitting type	1 sample/fitting group
Melt mass-flow rate (MFR-value)		+			+		1 sample/size group/fitting type	1 sample/fitting group
Effect on water quality <sup>q</sup>		+			+		National regulations apply	
Marking		+			+	+	1 test piece/size/fitting type <sup>g</sup>	1 test piece of one diameter/size group/fitting type
Fusion system recognition		+		+		+	1 test piece/size/fitting type	—

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Table B.3 (continued)

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Conditions requiring test <sup>a</sup>					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body <sup>b</sup>
<p><sup>a</sup> Explanation in 6.2 and Annex C; In addition:</p> <p>D1: Change of dimensions and geometry such as: change of visual and functional optimization, change of overall dimensions, change of non PE-part;</p> <p>D2: Change of joint affected part such as: change of the dimension of the fusion zone (e.g. wire pitch, wire depth), the electrical characteristics (e.g. wire resistance), the fusion parameters (e.g. time, voltage);</p> <p>+: test to be carried out.</p> <p><sup>b</sup> Recommended sampling procedure for a testing laboratory. Testing undertaken in a manufacturer laboratory shall be taken into account, provided prior acceptance by the certification body.</p> <p><sup>c</sup> (A): Electrofusion socket fitting (B): Electrofusion saddle fitting (C): Spigot end fitting</p> <p><sup>d</sup> Only applicable if ISO 4427-3 for water applications and ISO 4437-3 for gas applications applies.</p> <p><sup>e</sup> Test pieces should be taken from surfaces, especially those forming part of a fusion joint.</p> <p><sup>f</sup> Manufacturer sampling procedure changed from "size/fitting type" to "2 dimensions/size group/fitting type" for size group 1, 2 and 3.</p> <p><sup>g</sup> Shall contain fitting from each cavity. The minimum number of samples shall be at least one from each cavity.</p> <p><sup>h</sup> Only applicable to size group 2 and 3 up to and including <math>d_n</math> 450 mm.</p> <p><sup>i</sup> One test piece for size group 3.</p> <p><sup>j</sup> Only applicable to size group 4 and 5.</p> <p><sup>k</sup> Test sample may be mechanically reduced in wall thickness for testing purposes.</p> <p><sup>l</sup> Largest dimension produced by the fitting manufacturer. Correlation to smaller dimensions to be confirmed, e.g. by theoretical calculation of correlation testing.</p> <p><sup>m</sup> Alternatively, for <math>d_n &gt; 450</math> mm, the test can also be performed water-in-air. In case of dispute, water-in-water shall be used.</p> <p><sup>n</sup> For fitting type (B) alternative testing (e.g. pressurization through saddle outlet) is allowed.</p> <p><sup>o</sup> For size group 3, 4 and 5 to be checked by the strip-bend test according to ISO 21751.</p> <p><sup>p</sup> Test not applicable to size group 4 and 5.</p> <p><sup>q</sup> Only applicable for compounds intended to be used for products intended for the conveyance of water for human consumption.</p>								

## B.2 Batch release testing

Those characteristics specified in the applicable parts of ISO 11297, ISO 11298, ISO 11299 and ISO 21225 and listed in Tables B.4 to B.6 shall be subject to BRTs with the minimum sampling frequency as given in Tables B.4 to B.6, as applicable.

For fabricated fittings, guidance for type testing is given in Annex D.

**Table B.4 — Characteristics of compounds and minimum sampling frequencies for BRTs by the compound manufacturer**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Minimum sampling frequency
Compound density	ISO 11297-2, -3 [5.1] ISO 11298-2, -3 [5.1] ISO 11299-2, -3 [5.1] ISO 21225-1, -2 [6.1]	1 sample/batch/7 days
Oxidation induction time (thermal stability)		1 sample/batch/7 days
Melt mass-flow rate (MFR)		1 sample/batch/7 days
Volatile content		1 sample/batch/7 days
Water content <sup>a</sup>		1 sample/batch/7 days
Carbon black content <sup>b</sup>		1 sample/batch/7 days
Carbon black dispersion <sup>b</sup>		1 sample/batch/7 days
Pigment dispersion <sup>c</sup>		1 sample/batch/7 days
<sup>a</sup> Only applicable if the requirement for volatile content is not conformed to. In case of dispute, the requirement for water content shall apply. <sup>b</sup> Only applicable for black compound. <sup>c</sup> Only applicable for non-black compound.		

Table B.5 — Characteristics of pipes and minimum sampling frequencies for BRTs

Characteristic <sup>f</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Minimum sampling frequency <sup>a</sup>	
	ISO 11297, ISO 11298, ISO 11299	ISO 21225		
Appearance	Parts 2, 3 [5.2]	Parts 1, 2 [6.1]	All start up and at least every 8 h.	
Colour	Parts 1, 2, 3 [5.2]		All start up and at least every 8 h.	
Dimensions	Parts 2, 3 [5.4, 8.4]		All start up and continuously <sup>c</sup> or at least every 8 h.	
Hydrostatic strength (80 °C, 165 h)	Parts 2, 3 [5.5, 8.5]		1 test piece/batch, but at least every 7 d (size groups 1 and 2), 1 test piece/batch (size group 3) By agreement with the end-user or purchaser (size group 4 and 5) <sup>g</sup>	
Elongation at break <sup>d</sup>	Part 2, 3 [5.6]		1 sample/batch	
Oxidation induction time (thermal stability) <sup>b</sup>	Parts 2, 3 [5.6]		1 sample/batch	
Melt mass-flow rate (MFR) <sup>d</sup>	Parts 2, 3 [5.6]		1 sample/batch	
Marking	Part 1, 2, 3 [5.8]		All start up and at least every 8 h.	
Memory ability	Part 3 [5.6]		—	
<b>Additional tests for coextruded pipes</b>				
Delamination <sup>e</sup>	Parts 2 [5.6]	Parts 1, 2 [6.1]	After the hydrostatic strength test	

<sup>a</sup> Batch refers to pipe batch but an alternative approach could be considered based on compound batch if agreed by the certification body.

<sup>b</sup> Test carried out on the inner surface. For coextruded pipes, test inner/outer and each mid layer. Tests may be carried out at higher temperature by indirect testing, see ISO 4427-2 for water applications and ISO 4437-2 for gas applications.

<sup>c</sup> By indirect testing.

<sup>d</sup> Tests to be carried out where own reprocessed materials of the same compound are used. The test is not applicable in cases of use of 100 % virgin material. Applicable for all layers of coextruded pipes for the MFR test.

<sup>e</sup> Test samples from the hydrostatic strength test shall be examined after testing for any signs of delamination, see ISO 4427-2 for water applications and ISO 4437-2 for gas applications.

<sup>f</sup> For peelable layer pipes all characteristics are assessed on the base pipe without the layer except marking. Appearance, colour, and marking are also assessed on the peelable layer pipe with the layer.

<sup>g</sup> Indirect testing subject to study.

**Table B.6 — Characteristics of fittings and minimum sampling frequencies for BRTs**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Minimum sampling frequency
Appearance <sup>c</sup>		1 test piece/cavity at start-up, then 1 test piece per shift, but at least every 8 h.
Colour <sup>c</sup>		1 test piece/cavity at start-up, then: 1 test piece per shift, but at least every 8 h.
Electrical characteristics (A) (B)		1 test piece/cavity at start-up, then: a) 1 test piece per shift (quantitative), but at least every 8 h <sup>c</sup> b) Each fitting during production <sup>d</sup>
Dimensions <sup>c</sup>		1 test piece/cavity at start-up, then 1 test piece per shift, but at least every 8 h.
Hydrostatic strength (80 °C, 165 h) <sup>f,g,h</sup>		1 test piece/batch/cavity, but at least every 10 d.
Evaluation of ductility of fusion joint interface (B) <sup>b,f,h,l</sup>		1 test piece/batch/cavity, but at least every 10 d.
Fusion system recognition (A) (B) <sup>e,f</sup>		1 test piece/batch, but at least every 10 d.
Marking		1 test piece/cavity at start-up, then 1 test piece per shift, but at least every 8 h.
<p><sup>a</sup> (A): Electrofusion socket fitting; (B): Electrofusion saddle fitting.</p> <p><sup>b</sup> Only to be performed if requested by the end-user or purchaser.</p> <p><sup>c</sup> For multiple cavity moulds, a rotating sampling procedure between the cavities for testing during the shifts shall be considered. The manufacturer shall give details in its quality plan accordingly.</p> <p><sup>d</sup> May be checked on a qualitative basis (pass — do not pass).</p> <p><sup>e</sup> May be checked when welding the hydrostatic strength test sample.</p> <p><sup>f</sup> For fittings in size group 3, 4 and 5, tests to be performed either every 10 days or alternatively every 1 000 fittings.</p> <p><sup>g</sup> Alternatively, for <math>d_n &gt; 450</math> mm, the test can also be performed water-in-air. In case of dispute, water-in-water shall be used.</p> <p><sup>h</sup> Test not applicable to size group 4 and 5, or by agreement with the end-user or purchaser.</p> <p><sup>l</sup> For size group 3 to be checked by the strip-bend test according to ISO 21751.</p>		

The manufacturer shall specify a batch in its quality plan.

A batch or lot shall only be released for supply when all the relevant tests and inspections have been carried out at least once at the specified frequencies and the requirements have been met.

If a product fails in respect of any characteristic given in the Table as applicable, the batch or lot shall be rejected or the retest procedures shall be performed for the characteristic on which the product failed.

The retest procedure shall be as follows:

- Find the last product, which conforms to the requirements as specified in the applicable parts of ISO 11297, ISO 11298, ISO 11299 and ISO 21225;
- Release all products produced before that point and reject the products produced after that point.

Procedures for dealing with rejected products shall be detailed in the manufacturer's quality plan.

### B.3 Process verification testing

Those characteristics specified in the applicable parts of ISO 11297, ISO 11298, ISO 11299 and ISO 21225 and listed in [Tables B.7 to B.9](#), shall be subject to PVTs with the minimum sampling frequency given in [Tables B.7 to B.9](#), as applicable, if not type tested or audit tested in the same period.

For fabricated fittings, guidance for type testing is given in [Annex D](#).

**Table B.7 — Characteristics and minimum sampling frequencies for PVTs by the compound manufacturer**

Characteristic <sup>a</sup>	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Minimum sampling frequency
Classification <sup>b</sup>		Once per year per material currently used with one dimension
Resistance to rapid crack propagation (critical pressure, $p_c$ ), ( $e \geq 15$ mm, 250 mm SDR 11 or 500 mm SDR 11)	ISO 11297-2, -3 [5.1] ISO 11298-2, -3 [5.1] ISO 11299-2, -3 [5.1]	Once per year per material currently used
Resistance to slow crack growth ( $d_n$ ; 110 mm SDR 11)	ISO 21225-1, -2 [6.1]	Once per year per material currently used
<sup>a</sup> Only to be performed if no AT is performed during the same period. <sup>b</sup> Check two stress levels at 20 °C as follows: PE 80 at 10,0 MPa/100 h, 9,1 MPa/2 500 h; PE 100 at 12,0 MPa/100 h, 11,1 MPa/2 500 h. In addition, every 8 years a test at 80 °C for PE 80 at 3,8 MPa/5 000 h and for PE 100 at 4,8 MPa/5 000 h shall be carried out. Test three test pieces on 1 diameter of size group 1 pipe. The corresponding time shall be exceeded without failure.		

**Table B.8 — a) Characteristics of pipes and minimum sampling frequencies for PVTs by the pipe manufacturer**

Characteristic <sup>a</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Minimum sampling frequency <sup>b,c</sup>
	ISO 11297, ISO 11298, ISO 11299	ISO 21225	
Elongation at break <sup>d</sup>	Parts 2, 3 [5.6]	Parts 1, 2 [6.1]	1 sample of one diameter/size group/year/compound designation/production site
Longitudinal reversion <sup>e</sup>			1 sample of one diameter/size group/year/compound designation/production site
Circumferential reversion <sup>f</sup>			1 sample of one diameter/size group 3/year/compound designation/production site
<b>Additional tests for coextruded pipes</b>			
<sup>a</sup> For peelable layer pipes all tests are performed on the base pipe without the layer. <sup>b</sup> Only to be performed if no AT is performed during the same period. <sup>c</sup> Rotate sizes, SDR and compound, as applicable. <sup>d</sup> Only to be performed if not carried out in BRT. Test samples from the elongation at break test on coextruded pipes shall be examined after testing for any signs of delamination, see ISO 4427-2 for water applications and ISO 4437-2 for gas applications. <sup>e</sup> Longitudinal reversion applicable to wall thickness $\leq 16$ mm. <sup>f</sup> Only for pipes intended for the conveyance of gas.			

Table B.8 (continued)

Characteristic <sup>a</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Minimum sampling frequency <sup>b,c</sup>
	ISO 11297, ISO 11298, ISO 11299	ISO 21225	
Integrity of the structure after deflection	Parts 2, [5.6]	Parts 1, 2 [6.1]	One diameter/size group/ year/compound designation/ production site
Delamination <sup>d</sup>			After the elongation at break test
<p><sup>a</sup> For peelable layer pipes all tests are performed on the base pipe without the layer.</p> <p><sup>b</sup> Only to be performed if no AT is performed during the same period.</p> <p><sup>c</sup> Rotate sizes, SDR and compound, as applicable.</p> <p><sup>d</sup> Only to be performed if not carried out in BRT. Test samples from the elongation at break test on coextruded pipes shall be examined after testing for any signs of delamination, see ISO 4427-2 for water applications and ISO 4437-2 for gas applications.</p> <p><sup>e</sup> Longitudinal reversion applicable to wall thickness ≤16 mm.</p> <p><sup>f</sup> Only for pipes intended for the conveyance of gas.</p>			

Table B.8 — b) Characteristics of pipes and minimum sampling frequencies for PVT-I's by the pipe manufacturer

Characteristic <sup>a</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Minimum sampling frequency <sup>b,c</sup>
	ISO 11297, ISO 11298, ISO 11299	ISO 21225	
Hydrostatic strength (80 °C, 1 000 h) <sup>d</sup>	Parts 2, 3 [5.5]	Parts 1, 2 [6.1]	One diameter/year/MRS class/size group 1, 2 and 3/production site
			One diameter/year/MRS class/size group 4 and 5/production site, or by agreement with the end-user or customer <sup>e</sup>
Installation practice compliance	Parts 2, 3, 7 [9]	Parts 1, 2 [7]	Once per installation
<p><sup>a</sup> For peelable layer pipes all tests are performed on the base pipe without the layer.</p> <p><sup>b</sup> Only to be performed if no AT is performed during the same period.</p> <p><sup>c</sup> Rotate sizes, SDR and compound, as applicable.</p> <p><sup>d</sup> 3 test pieces of size group 1 or 2, 1 test piece of size group 3, 4 and 5.</p> <p><sup>e</sup> Indirect testing subject to study.</p>			

**Table B.9 — Characteristics of fittings and minimum sampling frequencies for PVTs by the fitting manufacturer**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Minimum sampling frequency
Hydrostatic strength (80 °C, 1 000 h) <sup>f,g</sup>		1 test piece per cavity of one diameter from one fitting type/ fitting group/size group/year/ compound/production site
Decohesive resistance (A) <sup>h</sup>		1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
Evaluation of ductility of fusion joint interface (B) <sup>d,h,i</sup>		1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
Tensile strength for butt fusion (C)	ISO11297-2, -3 [6.1] ISO11298-2, -3 [6.1] ISO11299-2, -3 [6.1]	1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
Impact resistance (B) <sup>k</sup>	ISO 21225-1, -2 [6.1]	1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
Short-term internal pressure resistance (A) <sup>d</sup>		1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
Resistance to tensile load (A) <sup>e,k</sup>		1 test piece per cavity of one diameter from one fitting type/ size group/year/compound/ production site
<p><sup>a</sup> (A): Electrofusion socket fitting (B): Electrofusion saddle fitting (C): Spigot end fitting</p> <p><sup>b</sup> Change of product type, diameter and SDR every year to grant that all fittings are tested over a certain time period. Details shall be given in the manufacturer's quality plan.</p> <p><sup>c</sup> Results from audit tests should be regarded as PVTs.</p> <p><sup>d</sup> Only to be performed if not tested in the BRT.</p> <p><sup>e</sup> Only applicable if ISO 4437 (series) applies.</p> <p><sup>f</sup> Alternatively, for <math>d_n &gt; 450</math> mm, the test can also be performed in air. In case of dispute, water-in-water shall be used.</p> <p><sup>g</sup> For fitting type (B) of size group 3, 4 and 5 alternative testing (e.g. pressurization through saddle outlet) is allowed.</p> <p><sup>h</sup> Test sample may be mechanically reduced in wall thickness for testing purpose.</p> <p><sup>i</sup> For size group 3, 4 and 5 to be checked by the strip-bend test according to ISO 21751.</p> <p><sup>k</sup> Test not applicable to size group 4 and 5.</p>		

If the product does not conform to the requirements in respect of any characteristic given in [Table B.7](#) to [Table B.9](#), as applicable, the retest procedure detailed in the manufacturer's quality plan shall be performed. If the retest procedure does not confirm conformity of the product to the requirements, then the process shall be investigated and corrected in accordance with the procedures given in the manufacturer's quality plan, as well as to verify the characteristics given in [Table B.7](#) to [Table B.9](#), as applicable.

A test performed as an AT does not need to be repeated as a PVT.

### B.4 Audit testing

ATs are performed if a third-party certification is involved only.

Those characteristics specified in the applicable parts of ISO 11297, ISO 11298, ISO 11299 and ISO 21225, and listed in [Tables B.10](#) to [B.12](#), are intended to be audit tested with the minimum sampling frequency given in [Tables B.10](#) to [B.12](#), as applicable.

For fabricated fittings, guidance for type testing is given in [Annex D](#).

**Table B.10 — Characteristics and minimum sampling frequencies for ATs for the compound**

Characteristic	Reference to applicable part(s) [clause(s) in 2018 editions] ISO 11297, ISO 11298, ISO 11299 and ISO 21225	Sampling procedure
Classification <sup>a</sup>		1 sample/two years/compound/ production site
Resistance to rapid crack propagation (critical pressure, $p_c$ ), ( $e \geq 15$ mm, 250 mm SDR 11 or 500 mm SDR 11)	ISO 11297-2, -3 [5.1] ISO 11298-2, -3 [5.1] ISO 11299-2, -3 [5.1] ISO 21225-1, -2 [6.1]	1 sample/five years/compound/ production site
Resistance to slow crack growth ( $d_n$ : 110 mm SDR 11)		3 test pieces/year/compound/ production site
<sup>a</sup> Check two stress levels at 20 °C as follows: PE 80 at 10,0 MPa/100 h, 9,1 MPa/2 500 h; PE 100 at 12,0 MPa/100 h, 11,1 MPa/2 500 h.  In addition, every 8 years a test at 80 °C for PE 80 at 3,8 MPa/5 000 h, and for PE 100 at 4,8 MPa/5 000 h, shall be carried out. Test three test pieces at each stress level on 1 diameter of size group 1 pipe. The corresponding times shall be exceeded without failure.		

Table B.11 — Characteristics and minimum sampling frequencies for ATs for pipes

Characteristic <sup>f</sup>	Reference to applicable part(s) [clause(s) in 2018 editions]		Minimum sampling frequency <sup>a</sup>
	ISO 11297, ISO 11298, ISO 11299	ISO 21225	
Appearance	Parts 2, 3 [5.2]	Parts 1, 2 [6.1]	1 test piece on one diameter/year/ size group/production site
Colour	Parts 1, 2, 3 [5.2]		1 test piece on one diameter/year/ size group/production site
Dimensions	Parts 2, 3 [5.4, 8.4]		1 test piece on one diameter/year/ size group/production site
Hydrostatic strength (80 °C, 1 000 h) <sup>c,d,g</sup>	Parts 2, 3 [5.5]		One diameter/year/one size group/ production site 3 test pieces of size group 1 or 2, 1 test piece of size group 3
Resistance to slow crack growth $e < 5$ mm (Cone test) $e \geq 5$ mm (Notch test) ( $d_n$ : 110 mm SDR 11) <sup>h</sup>	Part 2 [5.6]		One diameter/year/one size group/ production site 3 test pieces of size group 1 or 2, 1 test piece of size group 3
Resistance to rapid crack propagation (critical pressure, $p_c$ ), ( $e \geq 15$ mm, 250 mm SDR 11 or 500 mm SDR 11) <sup>h</sup>	Part 2 [5.6]		1 test piece on one diameter/2 years/ production site
Elongation at break <sup>c</sup>	Parts 2, 3 [5.6]		Number of samples shall conform to ISO 6259-1 one diameter/year/ size group/production site
Oxidation induction time (thermal stability) <sup>e</sup>	Parts 2, 3 [5.6]		1 test piece on one diameter/year/ size group/production site
Melt mass-flow rate (MFR-value) <sup>e</sup>	Parts 2, 3 [5.6]		1 test piece on one diameter/year/ size group/production site
Longitudinal reversion <sup>b</sup>	Parts 2, 3 [5.6]		1 test piece on one diameter/year/ size group/production site
Marking	Parts 1, 2, 3 [5.8]		1 test piece on one diameter/year/ size group/production site
Memory ability	Part 3 [5.6]	—	1 test piece on one diameter/year/ size group/production site
Installation practice compliance	Parts 2, 3, 7 [9]	Parts 1, 2 [7]	Once per 5 year

<sup>a</sup> Rotate sizes and SDR every year.

<sup>b</sup> Longitudinal reversion is applicable to wall thickness  $\leq 16$  mm.

<sup>c</sup> For coextruded pipes, test samples from the hydrostatic strength and elongation at break tests shall be examined after testing for any signs of delamination, see ISO 4427-2 for water applications and ISO 4437-2 for gas applications.

<sup>d</sup> 3 test pieces of size group 1 or 2, 1 test piece of size group 3, 4 or 5.

<sup>e</sup> Applicable for each layer of coextruded pipe.

<sup>f</sup> All tests except marking are applied to the base pipe of peelable layer pipes. Appearance, colour and marking are also assessed for peelable layer pipes with the layer included.

<sup>g</sup> For size group 4 and 5 by agreement with the inspection body. Indirect tests under study.

<sup>h</sup> Only for pipes for the conveyance of gas.