ICS 23.040.01, 93.030 SLOVENSKÁ TECHNICKÁ NORMA Január 2026

| STN | **Potrubné systémy z plastov pre beztlakové kanalizačné potrubia a stoky uložené v zemi Potrubné systémy so štruktúrovanou stenou z nemäkčeného polyvinylchloridu (PVC-U), polypropylénu (PP) a polyetylénu (PE) Časť 2: Špecifikácie rúr a tvaroviek s hladkým vnútorným a vonkajším povrchom a systému, typ A** | **STN EN 13476-2**<br><br>64 3218 |
|---|---|---|

Plastics piping systems for non-pressure underground drains and sewers - Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) - Part 2: Specifications for pipes and fittings with smooth internal and external surface and the system, Type A

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 12/25

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# EUROPEAN STANDARD
# NORME EUROPÉENNE
# EUROPÄISCHE NORM

# EN 13476-2

October 2025

ICS 23.040.01; 93.030 Supersedes EN 13476-2:2018+A1:2020

English Version

# Plastics piping systems for non-pressure underground drains and sewers - Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) - Part 2: Specifications for pipes and fittings with smooth internal and external surface and the system, 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 : Spécifications pour les tubes et raccords avec une surface interne et externe lisses et le système, de Type A

Kunststoff-Rohrleitungssysteme für erdverlegte drucklose Abwasserkanäle und -leitungen - Rohrleitungssysteme mit profilierter Wandung aus weichmacherfreiem Polyvinylchlorid (PVC-U), Polypropylen (PP) und Polyethylen (PE) - Teil 2: Anforderungen an Rohre und Formstücke mit glatter Innen- und Außenfläche und an das Rohrleitungssystem, Typ A

This European Standard was approved by CEN on 23 June 2025.

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# European foreword

This document (EN 13476-2:2025) has been prepared by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2026, and conflicting national standards shall be withdrawn at the latest by April 2026.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13476-2:2018+A1:2020.

The main changes with respect to EN 13476-2:2018+A1:2020 are listed below:

a) updating of the ”terms” and “definitions” in line with EN 14541-1;

b) “drainage and sewerage” changed into “drains and sewers” through the document;

c) NOTE 1 introduced in Scope;

d) Clause 5 complete updated;

e) Clause 9 Table 8 updated;

f) figures updated;

g) ring stiffness classes (SN) better described;

h) all material Annexes A, B, C, D, E and F updated;

i) Annex J figures updated;

j) editorial updates through the document.

This document is a part of a System Standard for plastics piping systems of particular materials for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work being undertaken in ISO/TC 138 “Plastics pipes, fittings and valves for the transport of fluids”, which is a Technical Committee of the International Organization for Standardization (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and on recommended practice for installation.

EN 13476:2025 consists of the following parts under the general title “Plastics piping systems for non-pressure underground drains and sewers — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE)”:

— *Part 1: General requirements and performance characteristics*;

— *Part 2: Specifications for pipes and fittings with smooth internal and external surface and the system, Type A* (this document);

— *Part 3: Specifications for pipes and fittings with a smooth internal surface and profiled external surface and the system, Type B*;

— *Part 4: Assessment of conformity* (CEN/TS). (CEN/TS 13476-4:2025).

For guidance for installation, see CEN/TS 1046.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

# Introduction

This document provides optional choices for impact resistance (see Annex G, Annex H and Annex J) and ring flexibility, see Annex I.

As appropriate, the individual countries may select between those options in their national forewords.

# 1 Scope

This document, together with EN 13476-1, specifies the definitions and requirements for pipes, fittings and the system based on unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) structured-wall piping systems that are intended for use in non-pressure underground drains and sewers for foul wastewater.

NOTE 1 Products complying with this document can also be used in non-pressure underground drains and sewers for surface water.

This document is applicable to pipes and fittings with smooth internal and external surfaces, designated as Type A.

This document also specifies test methods and test parameters.

This document is applicable to:

a) structured-wall pipes and fittings, which are intended to be used buried underground outside the building structure; reflected in the marking of products by “U”;

b) structured-wall pipes and fittings, which are intended to be used buried underground both outside (application area code “U”) and within the building structure, reflected in the marking of products by “UD”.

This document is applicable to structured-wall pipes and fittings with or without an integral socket with elastomeric ring seal joints as well as welded and fused joints.

This document is applicable to a range of pipe and fitting sizes, materials, pipe constructions, stiffness classes, application areas, tolerance classes 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 any relevant national regulations and installation practices or codes.

# 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.

EN 476, *General requirements for components used in drains and sewers*

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 1401-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: Specifications for pipes, fittings and the system*

EN 1852-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP) — Part 1: Specifications for pipes, fittings and the system*

EN 12666-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system*

EN 13476-1:2025, *Plastics piping systems for non-pressure underground drains and sewers — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 1: General requirements and performance characteristics*

EN 13476-3:2025, *Plastics piping systems for non-pressure underground drains and sewers — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 3: Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B*

EN 14680, *Adhesives for non-pressure thermoplastics piping systems — Specifications*

EN 14758-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene with mineral modifiers (PP-MD) — Part 1: Specifications for pipes, fittings and the system*

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

EN 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 1133-1)*

EN 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 1167-1)*

EN 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 1167-2)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method (ISO 1183-1)*

EN ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method (ISO 1183-2)*

EN ISO 2505, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters (ISO 2505)*

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

EN ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions (ISO 3126)*

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

EN ISO 3451-5, *Plastics — Determination of ash - Poly(vinyl chloride) (ISO 3451-5)*

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

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

EN ISO 9967, *Thermoplastics pipes — Determination of creep ratio (ISO 9967)*

EN ISO 9969, *Thermoplastics pipes — Determination of ring stiffness (ISO 9969)*

EN ISO 10147, *Pipes and fittings made of crosslinked polyethylene (PE-X) — Estimation of the degree of crosslinking by determination of the gel content (ISO 10147)*

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

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

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

EN ISO 13257:2018, *Thermoplastics piping systems for non-pressure applications — Test method for resistance to elevated temperature cycling (ISO 13257:2018)*

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

EN 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 13262)*

EN ISO 13263, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics fittings — Test method for impact strength (ISO 13263)*

EN ISO 13264, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics fittings — Test method for mechanical strength or flexibility of fabricated fittings (ISO 13264)*

EN ISO 13967, *Thermoplastics fittings — Determination of ring stiffness (ISO 13967)*

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

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

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

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

# 4 Symbols and abbreviations

## 4.1 Symbols

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

| | |
|---|---|
| $A$ | length of engagement, or maximum pull-out whilst maintaining tightness |
| $C$ | length of the sealing zone |
| $d_{\mathrm{e}}$ | outside diameter |
| $d_{\mathrm{em}}$ | mean outside diameter |
| $d_{\mathrm{i}}$ | inside diameter |
| $d_{\mathrm{im}}$ | mean inside diameter |
| $d_{\mathrm{n}}$ | nominal diameter |
| $d_{\mathrm{s}}$ | inside diameter of socket |
| $d_{\mathrm{sm,min}}$ | minimum mean inside diameter of socket |
| $e$ | wall thickness (at any point) |
| $e_{\mathrm{c}}$ | construction height |
| $e_{\mathrm{min}}$ | minimum wall thickness of pipe or spigot |
| $e_2$ | wall thickness at any point of the cylindrical part of a socket |
| $e_3$ | wall thickness at any point of a sealing ring groove of a socket |
| $e_4$ | 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 |
| $L_{1,\mathrm{min}}$ | minimum length of a spigot |
| *IMP 23C* | impact resistance determined at +23 °C |
| ❄ | impact resistance determined at −10 °C |

## 4.2 Abbreviations

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

| | |
|---|---|
| $CaCO_3$ | calcium carbonate |
| CT | close tolerance |
| DN | nominal size |
| DN/ID | nominal size related to inside diameter |
| DN/OD | nominal size related to outside diameter |
| H50 | value for impact resistance of a pipe |

| | |
|---|---|
| $MgCO_3$ | magnesium carbonate |
| $Mg_3Si_4O_{10}(OH)_2$ | magnesium silicate, talcum |
| MFR | melt mass-flow rate |
| OIT | oxidation induction time |
| PE | polyethylene |
| PE-X | cross-linked polyethylene |
| PP | polypropylene |
| PP-MD | mineral modified PP |
| PVC-U | unplasticized poly(vinyl chloride) |
| RF | ring flexibility performance |
| S | pipe series S |
| SDR | standard dimension ratio |
| SN | ring stiffness class |
| TIR | true impact rate |
| VST | vicat softening temperature |

# 5 Material

## 5.1 General

The material shall be one of the following: unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) or polyethylene (PE).

## 5.2 Unplasticized poly(vinyl chloride) (PVC-U)

### 5.2.1 General

The formulation for production of pipes and fittings shall be PVC material to which additives are added to enable conformity with the requirements of this document. (See also Annex A.)

PVC material may be virgin material, reworked material or recyclates (pre- or post-consumer).

Recyclates may be used if they comply with Annex B.

The formulation (including virgin material, reworked material, recyclates or a mixture, if applicable) shall comply with the requirements given in 5.2.2.

NOTE 1 Layers can have different formulations.

Test results with 100 % virgin material (internal and external layers) and test results with the maximum specified amount of recyclates with the same agreed specification (in the internal and external layers) shall be taken as proving conformity of products containing a lower amount of recyclates.

NOTE 2 Attention is drawn to changing of European and/or national regulations regarding e.g. heavy metals.

### 5.2.2 Formulation characteristics of pipe and fitting

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

**Table 1 — Characteristics of PVC-U formulation for pipes and injection-moulded fittings**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Resistance to internal pressure a b c | No failure during the test period | End caps | Type A or type B | EN ISO 1167-1 and EN ISO 1167-2 |
| | | Orientation | Free | |
| | | Number of test pieces | 3 | |
| | | Test temperature | 60 °C | |
| | | Circumferential stress for pipe compound / formulation | 10 MPa | |
| | | Circumferential stress for fitting compound / formulation | 6,3 MPa | |
| | | Conditioning period | Shall conform to EN ISO 1167-1 | |
| | | Type of test | Water-in-water | |
| | | Test period | 1 000 h | |

[a] This requirement does not apply to the specified intermediate layer of a Type A1 pipe.

[b] For the extrusion formulation for the internal and external layers of a multilayer pipe A1 as well as for the formulation of A2 pipes (as defined in 6.2), this test shall be carried out in the form of an injection-moulded or extruded sample of a solid wall pipe made from the relevant formulation.

[c] For injection-moulding formulation, 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 formulation.

## 5.3 Polypropylene (PP)

### 5.3.1 General

The compound for production of pipes and fittings shall be PP-base material to which additives can be added to enable conformity with the requirements of this document. (See also Annex C.)

PP material may be virgin material, reworked material or recyclates (pre- or post-consumer).

Recyclates are permitted if they comply with Annex D.

The compound (including virgin material, reworked material, recyclates or a mixture, if applicable) shall comply with the requirements given in 5.3.2 and 5.3.3.

NOTE 1 Layers can have different compounds.

Test results with 100 % virgin material (internal and external layers) and test results with the maximum specified amount of recyclates with the same agreed specification (in the internal and external layers) shall be taken as proving conformity of products containing a lower amount of recyclates.

NOTE 2 Attention is drawn to changing of European and/or national regulations.

### 5.3.2 Compound characteristics for pipe and fitting

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

**Table 2 — Characteristics of PP compound for 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 | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>80 °C<br>Free<br>3<br>4,2 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>140 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Resistance to internal pressure, 1 000 h a b c | No failure during the test period | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>95 °C<br>Free<br>3<br>2,5 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>1 000 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Melt mass-flow rate d | ≤ 1,5 g/10 min | Temperature<br>Loading mass | 230 °C<br>2,16 kg | EN ISO 1133-1 |
| Thermal stability, OIT | ≥ 8 min | Temperature<br>Test atmosphere | 200 °C<br>Oxygen | EN ISO 11357-6 |

a This requirement does not apply to the specified intermediate layer of a type A1 pipe.

b For the extrusion compound for the internal and external layers of a multilayer pipe A1 as well as for the compound of A2 pipes, this test shall be carried out in the form of an injection-moulded or extruded sample of a solid wall pipe made from the relevant compound.

c For injection-moulding compound, 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 compound.

d This requirement only applies to pipes and fittings intended for welding.

### 5.3.3 Melt mass-flow rate classification

Materials for pipes and fittings intended for jointing 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 compound, 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:

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

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

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

NOTE Pipes and fittings type A1 are not intended for field jointing by fusion or welding.

## 5.4 Polyethylene (PE)

### 5.4.1 General

The compound for production of pipes and fittings shall be PE-base material to which additives can be added to enable conformity with the requirements of this document. (See also Annex E.)

PE material may be virgin material, reworked material or recyclates (pre- or post-consumer).

Recyclates are permitted if they comply with Annex F.

The compound (including virgin material, reworked material, recyclates or a mixture, if applicable) shall comply with the requirements given in 5.4.2 and 5.4.3.

NOTE 1 Layers can have different compounds.

Test results with 100 % virgin material (internal and external layers) and test results with the maximum specified amount of recyclates with the same agreed specification (in the internal and external layers) shall be taken as proving conformity of products containing a lower amount of recyclates.

NOTE 2 Attention is drawn to changing of European and/or national regulations.

### 5.4.2 Compound characteristics of pipe and injection moulded fittings

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

**Table 3 — Characteristics of PE compound for pipes and injection-moulded fittings**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Resistance to internal pressure 165 h [a] [b] [c] | No failure during the test period | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>80 °C<br>Free<br>3<br>4,0 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>165 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Resistance to internal pressure 1 000 h [a] [b] [c] | No failure during the test period | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>80 °C<br>Free<br>3<br>2,8 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>1 000 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Melt mass-flow rate [d] | ≤ 1,6 g/10 min | Temperature<br>Loading mass | 190 °C<br>5 kg | EN ISO 1133-1 |
| Thermal stability, OIT | ≥ 20 min | Temperature<br>Test atmosphere | 200 °C<br>Oxygen | EN ISO 11357-6 |
| Reference density | ≥ 930 kg/m$^3$ | Shall conform to EN ISO 1183-1 | | EN ISO 1183-1<br>EN ISO 1183-2 |

[a] This requirement does not apply to the specified intermediate layer of a Type A1 pipe.

[b] For the extrusion compound for the internal and external layers of a multilayer pipe A1 as well as for the compound of A2 pipes, this test shall be carried out in the form of an injection-moulded or extruded sample of a solid wall pipe made from the relevant compound.

[c] For injection-moulding compound, 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 compound.

[d] This requirement only applies to pipes and fittings intended for welding.

### 5.4.3 Compound characteristics of rotational-moulded fittings

When tested in accordance with the test methods as specified in Table 4 using the indicated parameters, the compound shall have characteristics conforming to the requirements given in Table 4.

**Table 4 — Characteristics of PE compound for rotational-moulded fittings**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Resistance to internal pressure 165 h [a] | No failure during the test period | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>60 °C<br>Free<br>3<br>3,9 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>165 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Resistance to internal pressure 1 000 h [a] | No failure during the test period | End caps<br>Test temperature<br>Orientation<br>Number of test pieces<br>Circumferential stress<br>Conditioning period<br>Type of test<br>Test period | Type A or Type B<br>60 °C<br>Free<br>3<br>3,2 MPa<br>Shall conform to EN ISO 1167-1<br>Water-in-water<br>1 000 h | EN ISO 1167-1 and EN ISO 1167-2 |
| Melt mass-flow rate | 3 g/10 min ≤ MFR ≤ 16 g/10 min | Temperature<br>Loading mass | 190 °C<br>5 kg | EN ISO 1133-1 |
| Thermal stability, OIT | ≥ 10 min | Temperature | 200 °C | EN ISO 11357-6 |
| Reference density | ≥ 925 kg/m$^3$ | Temperature | (23 ± 2) °C | EN ISO 1183-1<br>EN ISO 1183-2 |

[a] 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 compound.

### 5.5 Sealing ring retaining components

Sealing rings may be retained using components made from any polymer.

### 5.6 Sealing rings

The sealing ring material shall conform to all requirements in EN 681-1, EN 681-2 or EN 681-4, as applicable.

The sealing ring shall have no detrimental effects on the properties of the components.

### 5.7 Fused or welded joints

The design of fused or welded joints together with the manufacturer's instructions for the jointing process shall not cause the test assembly to fail the performance requirements given in Clause 11.

### 5.8 Adhesives for PVC-U

The adhesive for jointing of PVC-U shall be solvent cement and shall be as specified by the manufacturer of the pipes or fittings where appropriate.

The adhesive shall have no effect on the product or system likely to affect its compliance with this document and shall not cause the test assembly to fail the performance requirements given in Clause 11.

The adhesive shall comply with EN 14680.

As an alternative, adhesive complying with EN 14814 may be used and are deemed to be suitable for U and UD applications.

## 6 Designation of wall constructions and examples of typical jointing methods

### 6.1 General

NOTE The figures are schematic sketches only to indicate the relevant dimensions. They do not necessarily represent the manufactured components.

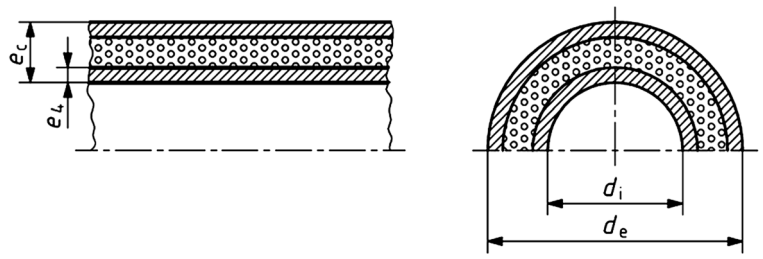
### 6.2 Wall constructions designated as Type A

#### 6.2.1 Multilayer construction or hollow-wall construction with axial hollow sections, Type A1

**Constructions**

A pipe or fitting with a smooth internal and external surface and in which the outer and inner walls are connected by internal axial ribs or a foamed or non-foamed intermediate layer of thermoplastics shall be designated Type A1.

Typical examples of Type A1 constructions are shown in Figure 1 and Figure 2.




**Key**

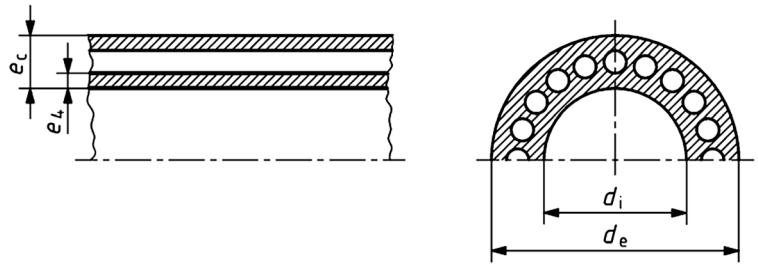
$e_c$ construction height

$e_4$ wall thickness of the inside layer

$d_i$ inside diameter

$d_e$ outside diameter

**Figure 1 — Typical example of wall construction Type A1, foamed or non-foamed intermediate layer**




**Key**

$e_c$ construction height

$e_4$ wall thickness of the inside layer

$d_i$ inside diameter

$d_e$ outside diameter

**Figure 2 — Typical example of wall construction Type A1, internal axial ribs**

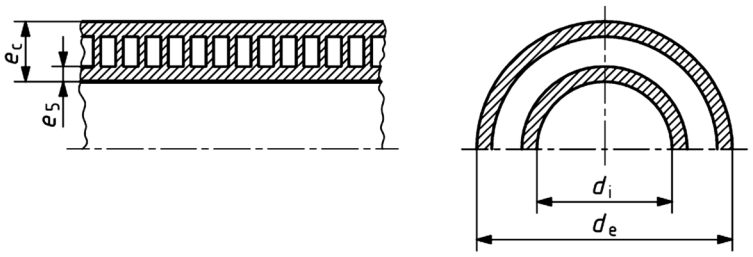
### 6.2.2 Hollow-wall construction with spirally or radial formed hollow sections, Type A2

**Construction**

A pipe or fitting with a smooth inside and external surface and in which the outer and inner walls are connected by internal spiral or radial formed ribs, shall be designated Type A2.

A typical example of Type A2 constructions is shown in Figure 3.

For type A2 constructions where the spirally formed ribs themselves are of a type A1 construction, the intermediate layer material shall fulfil all requirements given in Table 2, 3 or 4.




**Key**

$e_c$ construction height

$e_5$ wall thickness of the inside layer under a hollow section

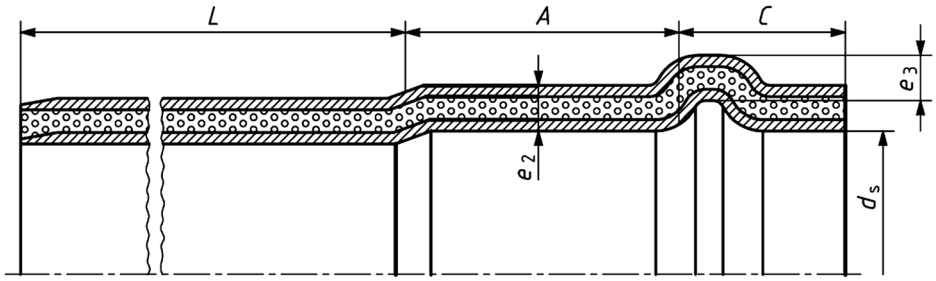
$d_i$ inside diameter

$d_e$ outside diameter

**Figure 3 — Typical example of wall construction Type A2**

### 6.2.3 Typical jointing methods for structured-wall pipes Type A

Relevant dimensions for typical joints of Type A pipes are shown in Figure 4 and Figure 5. When factory mounted sealing rings are used, dimensions *A* and *C* may be defined relative to the effective sealing point.




**Key**

$e_2$ wall thickness at any point of the cylindrical part of a socket

$e_3$ wall thickness at any point of a sealing ring groove of a socket

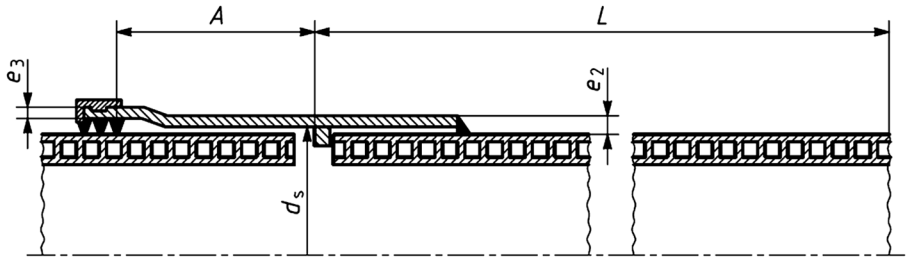
$d_s$ inside diameter of socket

$A$ length of engagement

$C$ length of the sealing zone

$L$ effective length of a pipe

**Figure 4 — Typical example of joints for Type A1 constructions**




**Key**

| | |
|---|---|
| $e_2$ | wall thickness at any point of the cylindrical part of a socket |
| $e_3$ | wall thickness at any point of a sealing ring groove of a socket |
| $d_s$ | inside diameter of socket |
| $A$ | length of engagement |
| $L$ | effective length of a pipe |

**Figure 5 — Typical example of joints for Type A2 constructions**

### 6.3 Designation and design of joints

Pipes and fittings may be designed with spigot ends and sockets of another construction than the pipe or fitting body. Such constructions may be Type A1, Type A2 or Type B or as designed in other product standards. For definitions and specifications for Type B pipes, see EN 13476-3:2025.

## 7 Appearance and colour

The appearance and colour shall conform to EN 13476-1:2025.

## 8 Geometrical characteristics

### 8.1 General

All dimensions shall be measured in accordance with EN ISO 3126.

### 8.2 Dimensions

#### 8.2.1 Designation

Pipes and fittings are sized either according to their outside diameter (DN/OD-series) and/or according to their inside diameter (DN/ID-series).

NOTE Because of the permitted variations in geometric details, conformity to this document does not ensure interchangeability of pipes, fittings and other components from different manufacturers and/or different designs. Within the same class of tolerances, the Type A1 and components in accordance with EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 are interchangeable. EN 1852-1, EN 14758-1 and EN 12666-1 include two sets of tolerances on the outside diameters of spigots.

#### 8.2.2 Lengths of pipe

The effective length of the pipe *l* shall not be less than that specified by the manufacturer when measured as shown in Figure 3.

### 8.2.3 Diameters of Type A pipes and Type A spigots of pipes and fittings

The outside diameters and their tolerances are specified in Table 5 and the other dimensions in Table 6.

Outside diameters of Type A pipes and plain spigots for OD series pipes and fittings intended to have jointing dimensions conforming to EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 shall meet the values specified in Table 5.

Other nominal sizes greater than DN/ID 100 and DN/OD 110 and less than DN/OD 3000 and DN/ID 3000, than given in Table 5 and Table 6 are permitted. They should preferably be selected from the Renard series R 40, ISO 3 [1], or traditional national dimensions.

In such cases, the nominal size DN/ID of pipes and fittings shall be selected in such a way that the designed minimum mean inside diameter $d_{\mathrm{im,min}}$ conforms to the requirement to maximum limit deviations on internal diameters in EN 476.

For DN/ODs and DN/IDs not specified in Table 5 and Table 6, the dimensions shall be linearly interpolated between the adjacent values specified in the tables.

**Table 5 — Outside diameters of Type A pipes and plain spigots for OD series pipes and fittings**

| Nominal size DN/OD | Mean outside diameter [a] | | |
|---|---|---|---|
| | | Close tolerances, CT | Normal tolerances |
| | $d_{em,min}$ | $d_{em,max}$ | $d_{em,max}$ |
| 110 | 110,0 | 110,3 | 111,0 |
| 125 | 125,0 | 125,3 | 126,2 |
| 160 | 160,0 | 160,4 | 161,5 |
| 200 | 200,0 | 200,5 | 201,8 |
| 250 | 250,0 | 250,5 | 252,3 |
| 315 | 315,0 | 315,6 | 317,9 |
| 400 | 400,0 | 400,7 | 403,6 |
| 500 | 500,0 | 500,9 | 504,5 |
| 630 | 630,0 | 631,1 | 635,7 |
| 800 | 800,0 | 801,3 | 807,2 |
| 1000 | 1 000,0 | 1 001,6 | 1 009,0 |
| 1200 | 1 200,0 | 1 201,9 | 1 210,8 |
| 1400 | 1 400,0 | 1 402,2 | 1 412,6 |
| 1600 | 1 600,0 | 1 602,6 | 1 614,4 |
| 1800 | 1 800,0 | 1 802,9 | 1 816,2 |
| 2000 | 2 000,0 | 2 003,2 | 2 018,0 |
| 2200 | 2 200,0 | 2 203,5 | 2 219,8 |
| 2400 | 2 400,0 | 2 403,8 | 2 421,6 |
| 2500 | 2 500,0 | 2 504,0 | 2 522,5 |
| 2600 | 2 600,0 | 2 604,2 | 2 623,4 |
| 2800 | 2 800,0 | 2 804,5 | 2 825,2 |
| 3000 | 3 000,0 | 3 004,8 | 3 027,0 |

[a] The CT series is identical to the corresponding tolerances in EN 1401-1 for dimensions up to and included DN/OD 1000. Plain spigots of PVC-U and spigots used with PVC pipes and fittings shall always conform to the CT series. Plain spigots of PP or PE shall either conform to the close tolerance or the normal tolerance series. When they have close tolerances they shall be marked “CT”.

**Table 6 — Nominal sizes, minimum mean inside diameters, thickness of inside layers and socket length**

Dimensions in millimeters

| Minimum mean inside diameters | | | | | Minimum wall thickness | | | Socket [a] | |
|---|---|---|---|---|---|---|---|---|---|
| DN/OD series | | | DN/ID series | | A1 | | A2 | | |
| | PVC-U [b] | PP/ PE [b c] | | [c] | Multi-layer | Hollow wall | | PVC-U | PP/PE |
| DN/OD | $d_{im,min}$ | $d_{im,min}$ | DN/ID | $d_{im,min}$ | $e_{4,min}$ | $e_{4,min}$ | $e_{5,min}$ | $A_{min}$ | $A_{min}$ |
| 110 | 97 | 90 | 100 | 95 | 0,4 | 0,6 | 1,0 | 32 | 40 |
| 125 | 107 | 105 | | | 0,4 | 0,6 | 1,0 | 35 | 43 |
| | | | 125 | 120 | | | 1,0 | 38 | 46 |
| 160 | 135 | 134 | | | 0,5 | 0,8 | 1,0 | 42 | 50 |
| | | | 150 | 145 | | | 1,0 | 43 | 51 |
| 200 | 172 | 167 | | | 0,6 | 1,0 | 1,1 | 50 | 58 |
| | | | 200 | 195 | | | 1,1 | 54 | 66 |
| 250 | 216 | 209 | 225 | 220 | 0,7 | 1,1 | 1,4 | 55 | 68 |
| | | | 250 | 245 | | | 1,5 | 59 | 76 |
| 315 | 270 | 263 | | | 0,8 | 1,2 | 1,6 | 62 | 81 |
| | | | 300 | 294 | | | 1,7 | 64 | 84 |
| 400 | 340 | 335 | | | 1,0 | 1,5 | 2,0 | 70 | 98 |
| | | | 400 | 392 | | | 2,3 | 74 | 106 |
| 500 | 432 | 418 | | | 1,3 | 2,1 | 2,8 | 80 | 118 |
| | | | 500 | 490 | | | 3,0 | 85 | 128 |
| 630 | 540 | 527 | | | 1,6 | 2,6 | 3,3 | 93 | 144 |
| | | | 600 | 588 | | | 3,5 | 96 | 146 |
| 800 | 680 | 669 | | | 2,0 | 3,0 | 4,1 | 110 | 160 |
| | | | 800 | 785 | | | 4,5 | 118 | 168 |
| 1000 | 864 | 837 | | | 2,5 | 3,5 | 5,0 | 130 | 180 |
| | | | 1000 | 985 | | | 5,0 | 140 | 190 |
| 1200 | 1 037 | 1 005 | | | 2,8 | 4,7 | 5,0 | 150 | 200 |
| | | | 1200 | 1 185 | | | 5,0 | 162 | 212 |
| 1400 | 1 210 | 1 173 | | | 5,0 | 5,0 | 5,0 | 168 | 224 |
| | | | 1400 | 1 385 | | | 5,0 | 182 | 238 |
| 1600 | 1 382 | 1 340 | | | 5,0 | 5,0 | 5,0 | 192 | 256 |
| | | | 1600 | 1 584 | | | 5,0 | 208 | 272 |
| 1800 | 1 555 | 1 508 | | | 5,0 | 5,0 | 5,0 | 216 | 288 |
| | | | 1800 | 1 782 | | | 5,0 | 234 | 306 |
| 2000 | 1 728 | 1 675 | | | 7,0 | 7,0 | 7,0 | 240 | 320 |

| Minimum mean inside diameters | | | | | Minimum wall thickness | | | Socket [a] | |
|---|---|---|---|---|---|---|---|---|---|
| DN/OD series | | | DN/ID series | | A1 | | A2 | | |
| | PVC-U [b] | PP/ PE [b c] | | c | Multi-layer | Hollow wall | | PVC-U | PP/PE |
| DN/OD | $d_{im,min}$ | $d_{im,min}$ | DN/ID | $d_{im,min}$ | $e_{4,min}$ | $e_{4,min}$ | $e_{5,min}$ | $A_{min}$ | $A_{min}$ |
| | | | 2000 | 1 980 | | | 7,0 | 260 | 340 |
| 2200 | 1 901 | 1 843 | | | 7,0 | 7,0 | 7,0 | 264 | 352 |
| | | | 2200 | 2 178 | | | 7,0 | 286 | 374 |
| 2400 | 2 074 | 2 010 | | | 7,0 | 7,0 | 7,0 | 288 | 384 |
| | | | 2400 | 2 376 | | | 7,0 | 312 | 408 |
| 2500 | 2 160 | 2 094 | | | 7,0 | 7,0 | 7,0 | 300 | 400 |
| | | | 2500 | 2 475 | | | 7,0 | 325 | 424 |
| 2600 | 2 246 | 2 178 | | | 7,0 | 7,0 | 7,0 | 312 | 416 |
| | | | 2600 | 2 574 | | | 7,0 | 338 | 442 |
| 2800 | 2 419 | 2 345 | | | 7,0 | 7,0 | 7,0 | 336 | 448 |
| | | | 2800 | 2 772 | | | 7, 0 | 364 | 476 |
| 3000 | 2 592 | 2 513 | | | 10,0 | 10,0 | 10,0 | 360 | 480 |
| | | | 3000 | 2 970 | | | 10,0 | 390 | 510 |

a $A_{min}$ applies only for sockets with elastomeric sealing ring For selection of the $A_{min}$ requirements for a socket, refer to the pipe material and construction. For pipes longer than 6 m it is recommended to produce larger *A*min than specified in this table.

b Actual inside diameter of a pipe depends on the material, construction and stiffness. It may be higher than the minimum specified in this table. For more information see the manufacturer's documentation.

c Minimum mean inside diameter, $d_{sm,min}$, of a fitting shall not be less than 98 % of the specified minimum mean inside diameter of the pipe for which it is designed.

### 8.2.4 Diameters and jointing dimensions of sockets and spigots

Diameters of spigots and jointing dimensions of sockets and spigots shall conform to Table 5 and Table 6.

Minimum and maximum outside diameters of pipes and spigots, $d_{em,min}$ and $d_{em,max}$, and minimum inside diameter of sockets, $d_{sm,min}$, for the preferred sizes are given in EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 depending on the material used. For sizes other than those given in these standards the values shall be calculated using the below mentioned equations.

The minimum inside diameter of sockets, $d_{sm,min}$, shall be equal to $d_{em,max}$.

For pipes and fittings not intended to have jointing dimensions as pipes and/or fittings according to EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 for PVC, PP, PP-MD or PE, the tolerance of the outside diameter of pipe and spigot shall be:

$$d_{em,min} \geq 0{,}994 \times d_e \quad (1)$$

$$d_{em,max} \leq 1{,}003 \times d_e \quad (2)$$

where

$d_e$ equals either the nominal size of a DN/OD pipe or the outside diameter as specified by the manufacturer of a DN/ID pipe.

For pipes with DN/ID >1200 where joints are to be welded, the tolerance on outside diameter shall be specified by the manufacturer.

The results are to be rounded to the next highest 0,1 mm.

Type A1 and Type A2 sockets and spigots of PVC, PP or PE intended to have jointing dimensions as pipes and fittings conforming to EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 shall conform to one or more of those standards regarding the socket and spigot dimensions, $A_{\min}$, $C_{\max}$, $d_{\mathrm{sm,min}}$ and $L_{1,\min}$.

In the case where other nominal sizes than specified in those standards are selected for Type A1 and Type A2 pipes and spigots, see 8.2.3, the requirements regarding the socket and spigot dimensions, $A_{\min}$, $C_{\max}$, $d_{\mathrm{sm,min}}$ and $L_{1,\min}$ shall be linearly interpolated between the adjacent values specified in those standards.

For Type A pipes greater than DN/OD 630 and DN/ID 600 when they are designed for a specific project, $A$min may be shorter than specified in the Table 6, however, it shall not be less than 85 mm. Such pipes shall be marked “SHORT SOCKET” after the EN number of this document.

### 8.2.5 Wall thicknesses

#### 8.2.5.1 General

To facilitate easy tracking wall thickness requirements, the following information is given:

| Wall thickness of: | are given in: |
|---|---|
| - pipes | 8.2.5.2 |
| - sockets | 8.2.5.3 |
| - spigots | 8.2.5.4 |
| - injection moulded fittings | 8.2.5.5 |
| - fabricated fittings | 8.2.5.6 |
| - rotational moulded fittings | 8.2.5.7 |

#### 8.2.5.2 Wall thickness of pipes

The wall thickness of the inside layer $e4$ (see Figure 1 and Figure 2) and $e5$ shall conform to Table 7.

The construction height, $e_C$, for pipes and spigots of pipes or fittings up to DN/OD 200 and up to 200 mm actual outside diameter of pipes DN/ID series shall be at least as specified for $e_{\min}$ in:

a) SDR 41 series in EN 1401-1;

b) S 16 series in EN 1852-1;

c) SDR 26 series in EN 12666-1

for PVC-U, PP and PE.

For sizes not specified in those standards, the values shall be linearly interpolated between the adjacent dimensions.

For DN/ID series pipes, the calculation shall be based on the actual outside diameter of the pipes.

#### 8.2.5.3 Wall thickness of sockets

Type A1 and Type A2 socket of PVC, PP or PE intended to conform to EN 1401-1, EN 1852-1, EN 14758-1 or EN 12666-1 shall comply with one or more of those standards regarding the socket wall-thickness $e_2$ and $e_3$.

In the case where other nominal sizes than specified in those standards are selected for Type A1 and Type A2 pipes, see 8.2.3, the requirements regarding the socket wall-thickness shall be linearly interpolated between the adjacent values specified in those standards.

When a socket is heat formed on a pipe or pipe segment after extrusion, a maximum reduction of the wall-thicknesses, $e_c$, as applicable, of 25 % in the sealing ring groove $e_3$ and 15 % in the cylindrical area of the socket $e_2$ is permitted. The base for calculated values is the manufacturer's specified minimum values for the wall-thicknesses $e_c$.

For other socket designs, see EN 13476-3:2025.

#### 8.2.5.4 Wall thickness of injection moulded spigots

The wall thickness *e*, of plain spigots shall conform to Table 7. The values shall be calculated to the second decimal place and rounded to the next highest 0,1 mm.

**Table 7 — Minimum required wall thickness of plain spigots**

| Material | Outside diameter in mm | Minimum required wall thickness, $e_{min}$ in mm |
|---|---|---|
| PVC-U | $d_e \leq 500$ | $d_e/51$, but not less than 3,2 |
| | $d_e > 500$ | 9,8 |
| PP | $d_e \leq 500$ | $d_e$ /41, but not less than 3,4 |
| | $d_e > 500$ | 12,2 |
| PE | $d_e \leq 500$ | $d_e/33$, but not less than 4,2 |
| | $d_e > 500$ | 15,2 |

Fittings or ancillaries based on Type B and adapted to Type A components shall conform to the minimum dimensions given in EN 13476-3:2025.

#### 8.2.5.5 Wall thickness of injection-moulded fittings Type A1

The minimum wall thickness of the spigot of injection-moulded fittings of Type A1 construction, $e_{4,min}$, shall conform to the requirements to $e_{4,min}$ for Type A1 pipes in Table 6.

The construction height of the body wall, $e_c$, for injection-moulded fittings up to 200 mm, DN/OD and up to 200 mm actual outside diameter of pipes DN/ID series shall be at least as specified for $e_{min}$ for:

a) SDR 41 series in EN 1401-1;

b) S 16 series in EN 1852-1;

c) SDR 26 series in EN 12666-1

for PVC-U, PP and PE.

For ID series fittings, the calculation shall be based on the actual outside diameter of the corresponding pipe.

The jointing design shall conform to 8.2.4.

The socket and spigot dimensions shall conform to 8.2.5.3 or 8.2.5.4 as appropriate.

#### 8.2.5.6 Wall thickness of fabricated fittings

The wall thickness of the body of fittings fabricated from pipes shall conform to the requirements of the corresponding pipe. Wall thickness reduction due to the process is permitted provided it conforms to the mechanical requirements in Table 16.

The jointing design shall conform to 8.2.4.

The socket and spigot dimensions shall conform to 8.2.5.3 or 8.2.5.4 as applicable.

#### 8.2.5.7 Wall thickness of rotational moulded fittings

The minimum wall thickness of the body and spigot of rotational-moulded fittings, $e_{min}$, shall be 1,25 times the values specified in Table 7, rounded to the next highest 0,1 mm.

If a rotational moulded fitting has a socket, the minimum required wall-thicknesses, $e_2$ and $e_3$ as applicable shall be 1,25 times the values derived from 8.2.5.4.

### 8.3 Types of fittings

The types of fittings covered by this document are given in EN 13476-1:2025.

### 8.4 Design length of fittings

The design length of fittings shall conform to with EN 13476-1:2025, 8.2.

## 9 Physical characteristics

### 9.1 Unplasticized poly(vinyl chloride) (PVC-U)

#### 9.1.1 Physical characteristics of PVC-U pipes

When tested in accordance with the test methods as specified in Table 8 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 8.

**Table 8 — Physical characteristics of PVC-U pipes**

| Characteristic | Requirements | Test parameters | | Test |
|---|---|---|---|---|
| Vicat softening temperature (VST) a | VST ≥ 79 °C | Shall conform to EN ISO 2507-1 | | EN ISO 2507-1 |
| Degree of gelation b c d | No attack c d | Test temperature<br>Immersion time | 15 °C<br>30 min | EN ISO 9852 |
| Uniaxial tensile test b c | Strain at break ≥ 80 % | Test speed<br>Test temperature | (5 ± 1) mm/min<br>(23 ± 2) °C | EN ISO 6259-1 and ISO 6259-2 |

| Characteristic | Requirements | Test parameters | | Test |
|---|---|---|---|---|
| Differential Scanning Calorimetry (DSC) [e] (Alternative test method to resistance to Dichloromethane) | B-onset temperature ≥ 185 °C | Shall conform to ISO 18373-1 | Number of test pieces: 4 | ISO 18373-1 |
| Longitudinal reversion [g] | ≤ 5 % The pipe shall show no delamination cracks or bubbles [f] | Test temperature<br>Immersion time for:<br>$e$ ≤ 8 mm<br>$e$ > 8 mm | 150 °C<br><br><br>15 min<br>30 min | EN ISO 2505 Liquid bath |
| | | Or | | |
| | | Test temperature<br>Immersion time for:<br>$e$ ≤ 4 mm<br>4 mm < $e$ ≤ 16 mm<br>$e$ > 16 mm | 150 °C<br><br><br>30 min<br>60 min<br>120 min | EN ISO 2505 Air oven |

[a] Not applicable to the foamed part of a pipe. If $e_4$ is less than 1,8 mm, the test shall be carried out on a profile extruded from the material. Indirect testing may be carried out using the pipe sample.

[b] Only applicable to pipes with a wall thickness $e_4$ > 3 mm or $e_5$ > 3mm. Not applicable to the foamed part of a pipe. Profiles for spirally wound pipes may be tested before winding.

[c] Alternative test methods to be chosen by the producer for factory production control, taking in account National regulation or internal health and safety policy. In case of dispute, the DSC method shall be used.

[d] Isolated spots less than 2 mm shall not be considered as an attack. Bubbles in the foamed structure shall not be taken into account.

[e] This test is not intended to be used for factory production control.

[f] The foamed structure is exempt from this requirement.

[g] Not applicable for A 2 pipes.

### 9.1.2 Physical characteristics of PVC-U fittings

When tested in accordance with the test methods as specified in Table 9 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in Table 9.

**Table 9 — Physical characteristics of PVC-U injection moulded fittings**

| Characteristic | Requirements | Test parameters | | Test |
|---|---|---|---|---|
| Vicat softening temperature (VST) [a] | For application<br>UD :<br>VST ≥ 78 °C;<br>U :<br>VST ≥ 77 °C | Shall conform to EN ISO 2507-1 | | EN ISO 2507-1 |
| Effect of heating a c | b | Test temperature<br>heating time for:<br>$e \leq 3$ mm<br>$3 < e \leq 10$ mm<br>$10 < e \leq 20$ mm | (150 ± 2) °C<br><br>15 min<br>30 min<br>60 min | Method A of EN ISO 580, air |

a Only applicable to injection-moulded fittings and injection-moulded components for fabricated fittings.

b
- Within a radius of 15 times the wall thickness around the injection point(s), the depth of cracks, delamination or blisters shall not exceed 50 % of the wall thickness at that point.
- Within a distance of 10 times the wall thickness from the diaphragm zone, the depth of cracks, delamination or blisters shall not exceed 50 % of the wall thickness at that point.
- Within a distance of 10 times the wall thickness from the ring gate the length of cracks running through the overall thickness of the wall shall not exceed 50 % of the wall thickness at that point.
- The weld line shall not have opened more than 50 % of the wall thickness at that line.
- In all other parts of the surface the depth of cracks and delaminations shall not exceed 30 % of the wall thickness at that point. Blisters shall not exceed a length of 10 times the wall thickness.

c Test pieces to be cut to fit available oven.

## 9.2 Polypropylene (PP)

### 9.2.1 Physical characteristics of PP pipes

When tested in accordance with the test methods as specified in Table 10 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 10.

**Table 10 — Physical characteristics of PP pipes**

| Characteristic | Requirements | Test parameters | Test method |
|---|---|---|---|
| Longitudinal reversion [a b] | ≤ 2 %;<br>The pipe shall show no delaminations, cracks or bubbles [c] | Shall conform to EN ISO 2505 | EN ISO 2505 |

a For the wall thickness, *e,* the maximum measured wall thickness of the pipe shall be taken.

b Not applicable for A 2 pipes.

c The foamed structure is exempt from this requirement.

### 9.2.2 Physical characteristics of PP fittings

When tested in accordance with the test method as specified in Table 11 using the indicated parameters, the fittings shall have physical characteristics conforming to the requirements given in Table 11.

**Table 11 — Physical characteristics of PP injection moulded components**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Effect of heating [a] | b | Test temperature<br>heating time [c] for:<br>$e \leq 3$ mm<br>$3 < e \leq 10$ mm<br>$10 < e \leq 20$ mm | (150 ± 2) °C<br><br>15 min<br>30 min<br>60 min | Method A of EN ISO 580, air |
| [a] Only applicable to injection-moulded fittings and injection-moulded components for fabricated fittings.<br>[b] The depth of cracks, delamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s). No part of the weld line shall open to a depth of more than 20 % of the wall thickness.<br>[c] For the wall thickness, *e,* the maximum measured wall thickness of the fitting shall be taken. | | | | |

## 9.3 Polyethylene (PE)

### 9.3.1 Physical characteristics of PE pipes

When tested in accordance with the test methods as specified in Table 12 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 12.

**Table 12 — Physical characteristics of PE pipes**

| Characteristic | Requirements | Test parameters | Test method |
|---|---|---|---|
| Longitudinal reversion [a] | ≤ 3 %;<br>The pipe shall show no delamination, cracks or bubbles [b] | Shall conform to EN ISO 2505 [c] | EN ISO 2505 |
| [a] Applicable for A1 pipes only.<br>[b] Bubbles in the foamed structure are exempt from this requirement.<br>[c] For the wall thickness, *e*, the maximum measured wall thickness of the pipe shall be taken. | | | |

### 9.3.2 Physical characteristics of PE fittings

When tested in accordance with the test method as specified in Table 13 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in Table 13.

**Table 13 — Physical characteristics of PE injection moulded components**

| Characteristic | Requirements | Test parameters | | Test |
|---|---|---|---|---|
| Effect of heating [a] | b | Test temperature<br>heating time [c] for:<br>$e \leq 3$ mm<br>$3 < e \leq 10$ mm<br>$10 < e \leq 20$ mm | (110 ± 2) °C<br><br>15 min<br>30 min<br>60 min | Method A of EN ISO 580, air |
| [a] Only applicable to injection-moulded fittings and injection-moulded components for fabricated fittings.<br>[b] The depth of cracks, delamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s). No part of the weld line shall open to a depth of more than 20 % of the wall thickness.<br>[c] For the wall thickness, *e,* the maximum measured wall thickness of the fitting, shall be taken. | | | | |

# 10 Mechanical characteristics

## 10.1 Mechanical characteristics of pipes

### 10.1.1 General requirements

When tested in accordance with the test methods as specified in Table 14 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 14.

The pipes shall be designated in one of the following nominal ring stiffness classes (SN):

— DN ≤ 500 ≥ 4,00 kN/m$^2$ is SN4, ≥ 8,00 kN/m$^2$ is SN8, ≥ 16,00 kN/m$^2$ is SN16;

— DN > 500 ≥ 2,00 kN/m$^2$ is SN2, ≥ 4,00 kN/m$^2$ is SN4, ≥ 8,00 kN/m$^2$ is SN8, ≥ 16,00 kN/m$^2$ is SN16.

Pipes with DN > 1200 may be designated as SN 1 (≥ 1,00 kN/m$^2$), if allowed by national foreword.

The manufacturer's guaranteed minimum stiffness, between the SN values, of a component may be used for calculation purposes only. Such pipes shall be classified and marked as the next lower stiffness class.

**Table 14 — Mechanical characteristics of pipes**

| Characteristic | Requirements | Test parameters | | Test |
|---|---|---|---|---|
| Ring stiffness [a] | ≥ relevant SN | Shall conform to EN ISO 9969 | | EN ISO 9969 |
| Impact strength at 0 °C [b]<br>(Round the clock method)<br>$d_{im\ max} \leq 1\ 200$ | TIR ≤ 10 % | Test temperature<br>Conditioning medium<br>Type of striker<br>Mass of striker for:<br>$d_{im\ max} \leq 100$<br>$100 < d_{im\ max} \leq 125$<br>$125 < d_{im\ max} \leq 160$<br>$160 < d_{im\ max} \leq 200$<br>$200 < d_{im\ max} \leq 250$<br>$250 < d_{im\ max} \leq 315$<br>$315 < d_{im\ max} \leq 1\ 200$<br>Fall height of striker for:<br>$d_{im\ max} \leq 110$<br>$d_{im\ max} > 110$ | (0 ± 1) °C<br>Liquid bath or air<br>d90<br><br>0,5 kg<br>0,8 kg<br>1,0 kg<br>1,6 kg<br>2,0 kg<br>2,5 kg<br>3,2 kg<br><br>1 600 mm<br>2 000 mm | EN ISO 3127 |
| Impact strength at 0 °C [c]<br>$d_{im\ max} > 1\ 200$ | See Annex J | $d_{im\ max} > 1\ 200$<br>fall height of striker.<br>mass of striker | 2 000 mm<br>3,2 / 5,0 kg | Annex J |
| Ring flexibility 30 [d] | Shall conform to 10.1.2 | Deflection | 30 % of $d_{em}$ | EN ISO 13968 |
| | | Length of test piece | As specified in EN ISO 9969 | |
| | | Position of test piece | As specified in EN ISO 9969 | |
| | | Age of the test pieces | (21 ± 2) days | |
| Creep ratio [e] | PVC-U: ≤ 2,5 at 2 years extrapolation.<br>PP and PE: ≤ 4 at 2 years extrapolation | Shall conform to EN ISO 9967 | | EN ISO 9967 |
| Tensile strength of seam [f] | Shall conform to 10.1.3 | Rate of movement | 15 mm/min | EN ISO 13262 |

| Characteristic | Requirements | Test parameters | Test |
|---|---|---|---|
| [a] When performing the Ring stiffness test as BRT, it is important to know the relation between result of this short-term test and the result of the test performed as Type test at (21 ± 2) days.<br>[b] In countries where a less stringent impact resistance test is permitted, Annex G may be applied instead of the impact test at 0 °C (for details see national Foreword). In countries where a more stringent impact resistance test is required, Annex H applies in addition to the impact test at 0 °C (for details see national foreword).<br>[c] Only applicable for A2 pipes.<br>[d] When performing the Ring flexibility test as BRT, it is important to know the relation between result of this short-term test and the result of the test performed as Type test at (21 ± 2) days. In countries where a less stringent ring flexibility test is permitted, Annex I may be applied instead of the method given in this table (for details see national foreword).<br>[e] Not applicable for pipes greater than DN/ID or DN/OD 1200.<br>[f] Only applicable to spirally formed pipes. | | | |

### 10.1.2 Ring flexibility

When tested in accordance with the test method as described in Table 14 using the indicated parameters and visually inspected without magnification, a) and b) shall be conformed to during the test:

a) there shall be no decrease of the measured force;

b) there shall be no cracking in any part of the wall structure. For spirally formed pipes, tears initiated along the cut of a rib shall not be considered as a failure if less than $0{,}075 d_{\mathrm{em}}$ mm or 75 mm long, whichever is smaller; and

after the test, c) to e) shall be conformed:

c) there shall be no wall delamination with the exception of possible delamination between the outside and inside wall of double wall pipes occurring in reduced welding zone in the ends of the test piece. Supporting profile of another thermoplastic material than the pipe material, see Figure 1, are not subject to this requirement;

d) there shall be no other types of rupture in the test piece;

e) permanent buckling in any part of the structure of the pipe wall, including depressions and craters, shall not occur in any direction.

### 10.1.3 Tensile strength of seams (Type A.2)

The tensile strength of the seam shall be tested on rectangular specimens cut perpendicularly to the pipe production weld seam. If relevant, outer and inner production welds are tested separately. The samples shall be 15 mm wide. Ductile failures shall occur. Tensile forces according to EN ISO 13262 shall be recorded.

## 10.2 Mechanical characteristics of fittings

The mechanical characteristics of solid-wall fittings are described in the relevant product standards (EN 1401-1, EN 1852-1, or EN 12666-1) or EN 13476-3:2025.

For other fitting designs, the following apply:

When tested in accordance with the test methods as specified in Table 15 using the indicated parameters, the fitting shall have mechanical characteristics conforming to the requirements given in Table 15.

The fittings shall be designated in one of the following nominal stiffness classes (SN):

- DN ≤ 500 ≥ 4,00 kN/m$^2$ is SN4,
  ≥ 8,00 kN/m$^2$ is SN8,
  ≥ 16,00 kN/m$^2$ is SN16;
- DN > 500 ≥ 2,00 kN/m$^2$ is SN2,
  ≥ 4,00 kN/m$^2$ is SN4,
  ≥ 8,00 kN/m$^2$ is SN8,
  ≥ 16,00 kN/m$^2$ is SN16.

Fittings with DN > 1200 may be designated as SN1 (≥ 1,00 kN/m$^2$), if allowed by national foreword.

The manufacturer's guaranteed minimum stiffness, between the SN nominal values of a component, may be used for calculation purposes.

**Table 15 — Mechanical characteristics of fittings**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Stiffness [a] [b] | ≥ relevant SN | Shall conform to EN ISO 13967 | | EN ISO 13967 |
| Impact test [b] | No cracks through the wall; jumped off sealing elements shall be able to be restored into the correct position manually | Test temperature<br>Drop height for:<br>$d_e \leq 125$<br>$d_e > 125$<br>Position of impact | 0 °C<br><br>1 000 mm<br>500 mm<br>Mouth of the socket | EN ISO 13263 |
| Mechanical strength or flexibility [c] | No signs of splitting, cracking, separation and/or leakage | EITHER | | |
| | | Test period<br>Minimum moment for:<br>$d_e \leq 250$<br>$d_e > 250$ | 15 min<br><br>$0{,}15[\mathrm{DN}]^3 \times 10^{-6}$ kNm<br>$0{,}01[\mathrm{DN}]$ kNm | EN ISO 13264 |
| | | OR | | |
| | | Minimum displacement | 170 mm | EN ISO 13264 |

[a] When a fitting according to this document has the same wall construction as a corresponding pipe, the stiffness of the fitting, because of its geometry, is equal to or greater than that of the pipe. Such fittings can be classified with the same stiffness class as that pipe without testing the stiffness. According to EN ISO 13967 the ring stiffness is only performed on bends and branches.

[b] Not required for fittings > 1 200 mm made from pipes that meets the impact and ring stiffness requirements.

[c] Only for fabricated fittings made from more than one piece (a sealing ring retaining component is not considered as a piece) or when the minimum wall thickness in the body, $e_c$, is less than $(0{,}9 \times d_{em}/51)$, $(0{,}9 \times d_{em}/41)$ (or $0{,}9 \times d_{em}/33$) for PVC, PP and PE respectively.

## 11 Performance requirements

When tested in accordance with the test methods as specified in Table 16 using the indicated parameters, the joints and the system shall have characteristics conforming to the requirements given in Table 16.

**Table 16 — Performance requirements**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Tightness of elastomeric ring seal joint | | Temperature<br>Spigot deflection<br>Socket deflection | (23 ± 5) °C<br>10 %<br>5 % | ISO 13259<br>Condition B |
| | No leakage | Water pressure | 0,05 bar [a] | |
| | No leakage | Water pressure | 0,5 bar [a] | |
| | ≤ −0,27 bar [a] | Air pressure | −0,3 bar [a] | |
| Tightness of elastomeric ring seal joint | | Temperature<br>Joint deflection for:<br>$d_e \leq 315$<br>$315 < d_e \leq 630$<br>$630 < d_e \leq 1\,200$<br>$d_e > 1\,200$ | (23 ± 5) °C<br><br>2°<br>1,5°<br>1°<br>0,5° | ISO 13259<br>Condition C |
| | No leakage | Water pressure | 0,05 bar [a] | |
| | No leakage | Water pressure | 0,5 bar [a] | |
| | ≤ −0,27 bar [a] | Air pressure | −0,3 bar [a] | |
| Resistance to combined temp. cycling and external Loading [c] | b | For $d_{im} \leq 160$ mm: Shall conform to Method A of EN ISO 13260 | | Method A of EN ISO 13260 (hot and cold water) |
| | | For $d_{im} > 160$ mm: Shall conform to Method B of EN ISO 13260 | | Method B of EN ISO 13260 (hot water) |
| Elevated temperature cycling [d] | No leakage | Shall conform to EN ISO 13257 | | EN ISO 13257:2018 |
| Water tightness [e f] | No leakage | Water pressure<br>Duration | 0,5 bar [a]<br>1 min | EN ISO 13254 |
| Tensile test of welded or fused joints | No break in the joint | Ductile failure | Shall conform to subclause 10.1.3 | EN ISO 13262 [g] |

| Characteristic | Requirements | Test parameters | Test method |
|---|---|---|---|
| [a] 1 bar = 100 000 Pascal = 100 kPa<br>[b] The following requirements apply:<br>- vertical deformation: ≤ 9 %;<br>- deviation from surface evenness in bottom: ≤ 3 mm;<br>- radius of bottom: ≥ 80 % of original;<br>- opening of weld line: ≤ 20 % of wall thickness;<br>- tightness at 0,35 bar/15 min: No leakage allowed.<br>[c] Only for components in accordance with this document with DN/OD ≤ 315 and DN/ID ≤ 300 and marked UD.<br>[d] Only for components in accordance with this document with DN/OD ≤ 200 and DN/ID ≤ 180 and marked UD.<br>[e] Only for fabricated fittings made from more than one piece. A sealing ring retaining component is not considered as a piece.<br>[f] If it is not practical to carry out the test with water, air can be used at either positive or negative pressures.<br>[g] This test is applicable for all pipe and fitting constructions when jointed by fusion or welding. The test pieces shall be prepared in accordance with EN ISO 13262. The length of the test piece shall include the joint plus a length at each end sufficient to ensure a proper grip in the tensile testing machine. | | | |

# 12 Marking

## 12.1 General

The specifications given in EN 13476-1:2025 apply.

The marking of an EN standard reference on a product requires conformance with all mandatory requirements of the standard, and that the product comes within the scope of standard.

## 12.2 Minimum required marking

### 12.2.1 Pipes

Pipes shall be marked at intervals of a maximum of 2 m, at least once per pipe.

The minimum required marking of pipes shall conform to Table 17.

**Table 17 — Minimum required marking of pipes**

| Aspect | Marking or symbols | Legibility [a] |
|---|---|---|
| Number of this document | EN 13476-2 | A |
| Diameter series, nominal size/actual guaranteed min. inside diameter [b] for: | | |
| DN/OD series | DN/OD 250 [c] | A |
| DN/ID series | DN/ID 225 [c] | A |
| Manufacturer's name and/or trade mark | XXX | A |
| Stiffness class [d] | e.g. SN 8 | A |
| Ring flexibility | "RF20" (when applicable, see Annex I) | A |

| Aspect | Marking or symbols | Legibility [a] |
|---|---|---|
| Material | Either PVC-U, PVC [e], PP or PE | A |
| Application area code | "U" or "UD" | A |
| Manufacturer's information | f | A |
| Impact resistance –10 °C | ❄ (ice crystal) (when applicable, see Annex H) | B |
| Impact resistance +23 °C | IMP 23 C (when applicable, see Annex G) | B |
| Close tolerance class [g] | CT | B |
| Short socket [h] | Short socket | A |
| MFR class [i] | e.g. Class B | B |

[a] Legibility codes
A denotes durable in use;
B denotes legible at least until the system is installed.

[b] Marking of the guaranteed minimum mean inside diameter is voluntary, but if marked it shall be as shown.

[c] If a component is designed for both DN/OD and DN/ID series, one of them may be marked on a label.

[d] The manufacturer may use the minimum guaranteed stiffness in addition to the SN-value For pipes DN > 1200 and < SN 2 the granted stiffness shall be marked without SN -value.

[e] PVC-U is preferred to PVC.

[f] Shall be given in clear figures or in a code providing traceability to the following details:
- production year and month;
- production site if the manufacturer is producing in different sites, nationally and/or internationally.

[g] Only applicable for PP and PE pipes with CT spigots as specified in EN 1852-1 or EN 12666-1.

[h] This marking is only applicable to pipes with short sockets according to 8.2.4.

[i] Only if intended for welding.

### 12.2.2 Fittings

The minimum required marking of fittings shall conform to Table 18.

**Table 18 — Minimum required marking of fittings**

| Aspect | Marking or symbols | Legibility [a] |
|---|---|---|
| Number of this document | EN 13476-2 | B |
| Diameter series, nominal size/actual guaranteed min. inside diameter [b] for: | | |
| DN/OD series | DN 200 [c] | A |
| DN/ID series | DN/ID 200 [c] | A |
| Manufacturer's name and/or trademark | xxx | A |
| Nominal angle | e.g. 45° | B |

| Aspect | Marking or symbols | Legibility [a] |
|---|---|---|
| Stiffness class [d] | e.g. SN 8 | B |
| Material | Either PVC-U [e], PVC, PP or PE | A |
| Application area code | “U” or “UD” | A |
| Manufacturer’s information | f | B |
| Close tolerance class [g] | CT | B |
| Short socket | Short socket | A |
| MFR Class [h] | e.g. Class B | B |

[a] Legibility codes
A denotes durable in use;
B denotes legible at least until the system is installed.

[b] Marking of the guaranteed minimum mean inside diameter is voluntary, but if marked it shall be as shown.

[c] If a component is designed for both DN/OD and DN/ID series, one of them may be marked on a label.

[d] For diameter larger than 1 200 mm the manufacturer may use the minimum guaranteed stiffness in addition to the SN-value.

[e] PVC-U is preferred to PVC.

[f] Shall be given in clear figures or in a code providing traceability to the following details:
- production year;
- production site if the manufacturer is producing in different sites, nationally and/or internationally.

[g] Only applicable for PP and PE fittings with CT spigots as specified in EN 1852-1 or EN 12666-1.

[h] Only if intended for welding.

## 12.3 Additional marking

### 12.3.1 General

Pipes and fittings conforming to this document, which also conform to other standard(s), may be additionally marked with the required marking of that/those other standard(s).

# Annex A
(normative)

# Formulation PVC-U material

The formulation for production of pipes and fittings shall be PVC material to which additives are added to enable conformity with the requirements of this document. The dosage level of each component of the formulation shall be specified.

PVC material may be virgin material, reworked material or recyclates (pre- or post-consumer).

The PVC content shall be at least 80 % by mass for pipes and 85 % by mass for injection-moulded fittings.

The PVC content shall be calculated or determined in accordance with EN ISO 1158 or EN ISO 3451-5, Method A.

When PVC is substituted by $CaCO_3$, the PVC content can be reduced to the following levels:

— intermediate layer of Type A1 pipes : ≥ 60 % by mass;

— internal and external layers of Type A1 pipes : ≥ 75 % by mass.

# Annex B
(normative)

# Utilization of PVC-U recyclates

## B.1 General

The use of recyclates is permitted according to the clauses of this annex, under the following conditions:

— recyclates shall be supplied with an agreed specification;

— the maximum amount of recyclate in the formulation shall be specified in the quality documentation by the manufacturer;

NOTE 1 The maximum amount of recyclate in the formulation is calculated based on the amount of separate recyclate added to the formulation plus the amount of recyclate present in reworked material which is added to the formulation.

— permitted deviation for the recycled material characteristics shall be specified by the manufacturer;

— the quantity of recyclates that is actually added in each production batch shall be recorded by the manufacturer;

— conformity with all the requirements of this document shall be demonstrated with the maximum amount of recyclate specified by the manufacturer.

NOTE 2 CEN/TS 13476-4 [2] gives specific recommendation with regard to test frequency when recyclate is used.

## B.2 Agreed specification

The use of recyclates with an agreed specification, is permitted provided that:

— all conditions specified in Table B.1 and B.3 are met;

— the agreed specification, including maximum batch size, characteristics and permitted deviations, shall be defined on basis of the type testing results from the used formulation;

— the agreed specification includes sampling procedures, sample preparation methods and testing frequencies.

**Table B.1 — Minimum content of an agreed specification for PVC-U recyclate**

| Characteristic | Requirements and permitted deviations | Test method |
|---|---|---|
| PVC-content | ±4 % absolute by mass | EN ISO 1158 |
| or Filler content by ash rest | | or<br>EN ISO 3451-5, Method A |
| Density | To be agreed with the supplier | EN ISO 1183-1 |
| Bulk density | To be agreed with the supplier | EN 15346:2014, Annex B (only applicable for micronized material and granules) |
| k-value | To be agreed with the supplier | - |
| Vicat softening temperature (VST) | ±2 °C | EN ISO 2507-1 |
| Particle size [a] | To be agreed with the supplier | If applicable, the test method (such as EN 15346:2014, Annex D or Annex E, …) shall be stated in the agreed specification. |
| Impurities [a] | To be agreed with the supplier | The test method (such as EN 15346:2014, Annex C, evaluation of sheets or evaluation of micronized material …) shall be stated in the agreed specification. |
| Tensile properties | To be agreed with the supplier | EN ISO 527-2 |
| Source/origin of the material | To be agreed with the manufacturer and declared by the recyclate supplier | |

[a] The relevant requirements and test method depend on the recycling process and on the end product.

## B.3 Additional specifications for recyclate and agreed specifications

Each delivery shall be covered by a declaration to demonstrate conformity of the material batch with the agreed specification. This declaration can be made by either the material supplier or the product manufacturer as agreed between the parties.

It is recommended that the quality plan of the supplier of recyclates is not less stringent that the relevant requirement of EN ISO 9001 [3].

When drafting an agreed specification the following should be considered:

— the recycling process and sources of the material because of risk of impurities;

— the processing of the material into the end product;

— the required characteristics of the end product;

— possible limitations of sources for the recyclable material;

— the intended dosage level of the material.

NOTE Guidance on sampling procedures, sample preparation and testing can be found in CEN/TS 16010 [4] and CEN/TS 16011 [5].

# Annex C
(normative)

# Compound PP material

The compound for production of pipes and fittings shall be PP to which are added additives if needed to facilitate the manufacture of components conforming to the requirements of this document. The dosage level of each component of the compound shall be specified.

PP material may be virgin material, reworked material or recyclates (pre- or post-consumer).

The PP content shall be at least 75 % by mass for pipes, 80 % by mass for injection-moulded fittings and 60 % by mass for intermediate layer of Type A1 pipes.

The PP content shall be calculated or determined in accordance with EN ISO 3451-1.

The mineral modifiers shall be either calcium carbonate, $CaCO_3$ or talc.

Calcium carbonate added by the manufacturer or the material supplier shall be coated.

When it is calcium carbonate following apply:

— content of $CaCO_3$ ≥ 96 % by mass;

— content of $MgCO_3$ ≤ 4 % by mass;

— content of $CaCO_3$ and $MgCO_3$ in total ≥ 98 % by mass.

When it is talc following apply:

— content of magnesium silicate ($Mg_3Si_4O_{10}(OH)_2$) ≥ 97 % by mass.

The physical properties of modifiers shall conform to the following:

— for $CaCO_3$:

  — mean particle size, D50 ≤ 2,5 µm;

  — particle top cut, D98 ≤ 20 µm.

— for talc:

  — mean particle size, D50 ≤ 7 µm;

  — particle top cut, D98 ≤ 30 µm.

# Annex D
(normative)

# Utilization of PP recyclate

## D.1 General

The use of recyclates is permitted according to the clauses of this Annex, under the following conditions:

— recyclates shall be supplied with an agreed specification;

— the maximum amount of recyclate in the formulation shall be specified in the quality documentation by the manufacturer;

NOTE 1 The maximum amount of recyclate in the formulation is calculated based on the amount of separate recyclate added to the formulation plus the amount of recyclate present in reworked material which is added to the formulation.

— permitted deviation for the recycled material characteristics shall be specified by the manufacturer;

— the quantity of recyclates that is actually added in each production batch shall be recorded by the manufacturer;

— conformity with all the requirements of this document shall be demonstrated with the maximum amount of recyclate specified by the manufacturer.

NOTE 2 CEN/TS 13476-4 [2] gives specific recommendation with regard to test frequency when recyclate is used.

## D.2 Agreed specification

The use of recyclates with an agreed specification, is permitted provided that:

— all conditions specified in Table D.1 and D.3 are met:

— the agreed specification, including maximum batch size, characteristics and permitted deviations, shall be defined on basis of the type testing results from the used formulation.

— the agreed specification includes sampling procedures, sample preparation methods and testing frequencies.

**Table D.1 — Minimum content of an agreed specification for PP recyclate**

| Characteristics | Requirements | Test method |
|---|---|---|
| Density | To be agreed between the manufacturer and supplier | EN ISO 1183-1 or<br>EN ISO 1183-2 |
| Thermal stability<br>OIT | To be agreed between the manufacturer and supplier | EN ISO 11357-6<br>Temperature: 200 °C<br>Test atmosphere: Oxygen |

| Characteristics | Requirements | Test method |
|---|---|---|
| MFR | To be agreed between the manufacturer and supplier | EN ISO 1133-1 |
| Ash residue | To be agreed between the manufacturer and supplier | EN ISO 3451-1 |
| Extraneous polymers | ≤ 5 % | IR analyses or DSC |
| Impurities | Sizes and amount to be declared | EN 15346:2014, Annex C<br>CEN/TS 17627 |
| Volatile matter | To be declared | EN 12099 |
| Shape | E.g. ground, micronized, pellets, flakes | Visual inspection |
| Tensile properties | To be agreed with the supplier | EN ISO 527-2 |
| Source/origin of the material | To be agreed with the manufacturer and declared by the recyclate supplier | |

## D.3 Additional specifications for recyclate and agreed specification

Each delivery shall be covered by a declaration to demonstrate conformity of the material batch with the agreed specification. This declaration can be made by either the material supplier or the product manufacturer as agreed between the parties.

It is recommended that the quality plan of the supplier of recyclates is not less stringent that the relevant requirement of EN ISO 9001 [3].

When drafting an agreed specification the following should be considered:

— the recycling process and sources of the material because of risk of impurities;

— the processing of the material into the end product;

— the required characteristics of the end product;

— possible limitations of sources for the recyclable material;

— the intended dosage level of the material.

NOTE Guidance on sampling procedures, sample preparation and testing can be found in CEN/TS 16010 [4] and CEN/TS 16011 [5].

# Annex E
(normative)

# Compound PE material

The compound for production of pipes and fittings shall be PE to which are added additives if needed to facilitate the manufacture of components conforming to the requirements of this document. The dosage level of each component of the compound shall be specified.

PE material may be virgin material, reworked material or recyclates (pre- or post-consumer).

The PE content shall be at least 75 % by mass for pipes, 80 % by mass for injection-moulded fittings and 60 % by mass for intermediate layer of Type A1 pipes. For PE-X additives, the PE content shall be at least 55 % by mass for type A2 pipes, 80 % by mass for injection moulded fittings and 40 % by mass for specified intermediate layer of type A1 pipes.

The PP content shall be calculated or determined in accordance with EN ISO 3451-1, or in the case of PE-X additives, in accordance with EN ISO 10147.

The mineral modifiers shall be either calcium carbonate, $CaCO_3$, or talc.

Calcium carbonate added by the manufacturer or the material supplier shall be coated.

When it is calcium carbonate following apply:

— content of $CaCO_3$ ≥ 96 % by mass;

— content of $MgCO_3$ ≤ 4 % by mass;

— content of $CaCO_3$ and $MgCO_3$ in total ≥ 98 % by mass.

When it is talc following apply:

— content of magnesium silicate ($Mg_3Si_4O_{10}(OH)_2$) ≥ 97 % by mass.

The physical properties of modifiers shall conform to the following:

— for $CaCO_3$:

  — mean particle size, D50 ≤ 2,5 µm;

  — particle top cut, D98 ≤ 20 µm.

— for talc:

  — mean particle size, D50 ≤ 7 µm;

  — particle top cut, D98 ≤ 30 µm.

Specification for PE-X additive:

— content of crosslinked PE shall be at least 70 % by mass;

— content of inert, non-crosslinked thermoplastic material < 10 %.

Physical properties of the PE-X additive shall conform to the following:

— mean particle size, D50 ≤ 400 µm;

— top cut, D98 ≤ 600 µm.

# Annex F
(normative)

# Utilization of PE recyclate

## F.1General

The use of recyclates is permitted according to the clauses of this annex, under the following conditions:

— recyclates shall be supplied with an agreed specification;

— the maximum amount of recyclate in the formulation shall be specified in the quality documentation by the manufacturer;

NOTE 1 The maximum amount of recyclate in the formulation is calculated based on the amount of separate recyclate added to the formulation plus the amount of recyclate present in reworked material which is added to the formulation.

— permitted deviation for the recycled material characteristics shall be specified by the manufacturer;

— the quantity of recyclates that is actually added in each production batch shall be recorded by the manufacturer;

— conformity with all the requirements of this document shall be demonstrated with the maximum amount of recyclate specified by the manufacturer.

NOTE 2 CEN/TS 13476-4 [2] gives specific recommendation with regard to test frequency when recyclate is used.

## F.2Agreed specification

The use of recyclates with an agreed specification, is permitted provided that:

— all conditions specified in Table F.1 and F.3 are met;

— the agreed specification, including maximum batch size, characteristics and permitted deviations, shall be defined on basis of the type testing results from the used formulation;

— the agreed specification includes sampling procedures, sample preparation methods and testing frequencies.

**Table F.1 — Minimum content of an agreed specification for PE recyclate**

| Characteristics | Requirements | Test method |
|---|---|---|
| Density | To be agreed between the manufacturer and supplier | EN ISO 1183-1 or<br>EN ISO 1183-2 |
| Thermal stability<br>OIT | To be agreed between the manufacturer and supplier | EN ISO 11357-6<br>Temperature: 200 °C<br>Test atmosphere: Oxygen |
| MFR | To be agreed between the manufacturer and supplier | EN ISO 1133-1 |
| Ash residue | To be agreed between the manufacturer and supplier | EN ISO 3451-1 |
| Extraneous polymers | ≤ 5 % | IR analyses or DSC |
| Impurities | Sizes and amount to be declared | EN 15346:2014, Annex C<br>CEN/TS 17627 |
| Volatile matter | To be declared | EN 12099 |
| Shape | E.g. ground, micronized, pellets, flakes | Visual inspection |
| Tensile properties | To be agreed with the supplier | EN ISO 527-2 |
| Source/origin of the material | To be agreed with the manufacturer and declared by the recyclate supplier | |

## F.3Additional specifications for recyclate and agreed specification

Each delivery shall be covered by a declaration to demonstrate conformity of the material batch with the agreed specification. This declaration can be made by either the material supplier or the product manufacturer as agreed between the parties.

It is recommended that the quality plan of the supplier of recyclates is not less stringent that the relevant requirement of EN ISO 9001 [3].

When drafting an agreed specification the following should be considered:

— the recycling process and sources of the material because of risk of impurities;

— the processing of the material into the end product;

— the required characteristics of the end product;

— possible limitations of sources for the recyclable material;

— the intended dosage level of the material.

NOTE Guidance on sampling procedures, sample preparation and testing can be found in CEN/TS 16010 [4] and CEN/TS 16011 [5].

# Annex G
(normative)

# Impact test at 23 °C

The impact strength test at 23 °C conforming to this annex may replace the impact strength test at 0 °C (see Table 14) provided it is permitted in the national foreword.

If the national foreword does not permit the impact strength test at 23 °C, this annex shall be considered to be of informative nature for the country concerned.

Pipes tested in accordance with Table G.1 shall conform to the requirement given in this table and shall be marked “IMP 23 C”, see Table 18.

**Table G.1 — Test parameters and requirements for Impact testing at 23 °C**

| Characteristic | Requirement | Test parameters | | Test method |
|---|---|---|---|---|
| Impact strength at 23 °C<br>(round the clock method) | TIR ≤ 10 % | Test temperature | (23 ± 1) °C | EN ISO 3127 |
| | | Conditioning medium | Water or air | |
| | | Type of striker | d90 | |
| | | Mass of striker for: | | |
| | | $d_{\text{im max}} \leq 100$ | 0,5 kg | |
| | | $100 < d_{\text{im max}} \leq 125$ | 0,8 kg | |
| | | $125 < d_{\text{im max}} \leq 160$ | 1,0 kg | |
| | | $160 < d_{\text{im max}} \leq 200$ | 1,6 kg | |
| | | $200 < d_{\text{im max}} \leq 250$ | 2,0 kg | |
| | | $250 < d_{\text{im max}} \leq 315$ | 2,5 kg | |
| | | $315 < d_{\text{im max}} \leq 1\,200$ | 3,2 kg | |
| | | Fall height of striker for [a]: | | |
| | | $d_{\text{im max}} \leq 110$ | 1 600 mm | |
| | | $d_{\text{im max}} > 110$ | 2 000 mm | |
| Impact strength at 23 °C | | $d_{\text{im max}} > 1\,200$ | | Annex J |
| | | fall height of striker | 2 000 mm | |
| | | mass of striker | 3,2 kg / 5,0 kg | |

[a] Refer to the specified $d_{\text{im max}}$.

# Annex H
(normative)

# Impact test at −10 °C

The impact strength test at −10 °C conforming to this annex may be required as an addition to the impact strength test at 0 °C (see Table 14), provided it is required in the national foreword.

If the national foreword does not require the impact strength test at −10 °C, this annex shall be considered to be of informative nature for the country concerned.

Pipes tested in accordance with Table H.1 shall conform to the requirement given in this table and shall be marked with an ice crystal " ❄ ", see Table 18.

**Table H.1 — Mechanical characteristics of pipes**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Impact strength at (−10) °C ❄ (Staircase method) | H50 ≥ 1 000 mm<br>No break below 500 mm | Test and conditioning temperature | (−10 ± 1) °C | EN ISO 11173 |
| | | Type of striker | d 90 | |
| | | Fall mass for: | | |
| | | $d_{im\ max} \leq 110$ | 4,0 kg | |
| | | $110 < d_{im\ max} \leq 125$ | 5,0 kg | |
| | | $125 < d_{im\ max} \leq 160$ | 6,25 kg | |
| | | $160 < d_{im\ max} \leq 200$ | 8,0 kg | |
| | | $200 < d_{im\ max} \leq 225$ | 10,0 kg | |
| | | $225 < d_{im\ max} \leq 1\ 200$ | 12,5 kg | |
| Impact strength at (−10) °C ❄ | | $d_{im\ max} > 1\ 200$ | | Annex J |
| | | fall height of striker | 2 000 mm | |
| | | mass of striker | 3,2 kg / 5,0 kg | |

# Annex I
(normative)

# Ring flexibility test at 20 % diametric deflection

The ring flexibility test at 20 % diametric deflection conforming to this annex may replace the ring flexibility test at 30 % diametric deflection (see Table 14) for DN/ID ≥ 300 and DN/OD ≥ 400 pipes, installed under conditions “WELL COMPACTION”, see CEN/TS 15223, provided it is permitted in the national foreword.

If the national foreword does not permit the ring flexibility test at 20 % deflection, this annex shall be considered to be of informative nature for the country concerned.

Pipes tested in accordance with Table I.1 conform to the requirements of this table and shall be marked “RF20”, see Table 18.

**Table I.1 — Test parameters and requirements for ring flexibility testing at 20 % diametric deflection**

| Characteristic | Requirements | Test parameters | | Test method |
|---|---|---|---|---|
| Ring flexibility 20 (RF20) | Shall conform to 9.1.2 | Deflection | 20 % of $d_{em}$ | EN ISO 13968 |
| | | Length of test piece | As specified in EN ISO 9969 | |
| | | Position of test piece | As specified in EN ISO 9969 | |

# Annex J
(normative)

# Impact test for large diameter pipes with structured wall

## J.1 Principle

Test pieces (as specified in J.3) are each subjected to a single blow by a falling striker of a specified mass and shape in a specified position dropped from a falling height of 2 m.

## J.2 Apparatus

The apparatus to be used are described in EN ISO 11173, except for the rigid test support in the bottom of the striker.

The normal V-block shall be removed or modified as shown in Figure J.1 below.

The smooth and levelled support shall be made of metal, which will not be damaged during the testing.

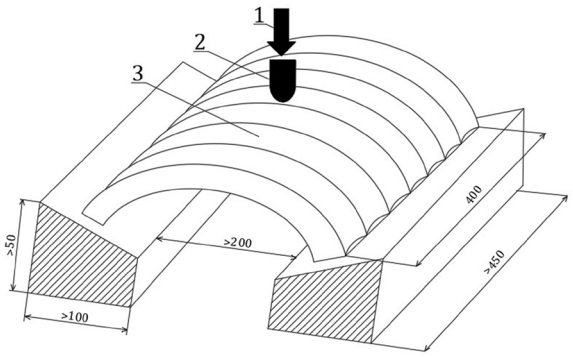
The supports shall have the following dimensions:

| | | |
|---|---|---|
| Length | : | > 450 mm |
| Width | : | > 100 mm |
| Height | : | > 50 mm |

During testing, the distance between the supports shall be > 200 mm.

The inside area between the supports shall be open.

Dimensions in millimetres




**Key**

1 direction of impact
2 striker
3 sample

**Figure J.1 — Example of modified V-block**

## J.3 Test samples

### J.3.1 Preparation

The test pieces shall be cut randomly over the circumference, clean and free for damages square to the axis of the pipe with a width and length of 400 mm ± 5 mm.

### J.3.2 Number of test pieces

The number of test pieces per test shall be 10.

## J.4 Conditioning

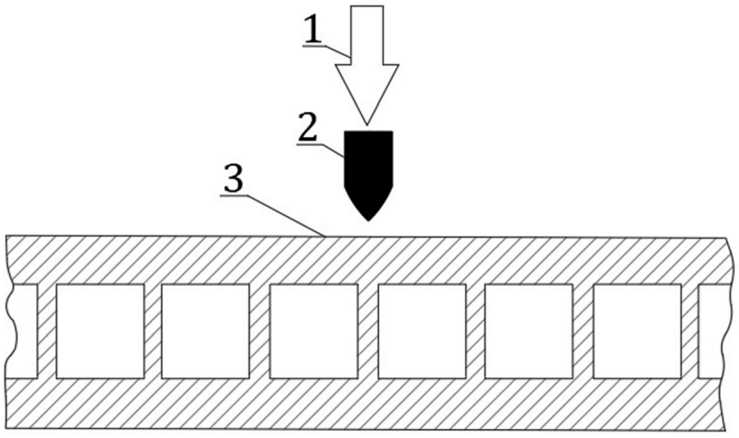
The test pieces shall be conditioned in a liquid bath or in air at a temperature of 0 °C ± 1 °C for at least the period given in Table J.1.

**Table J.1 — Conditioning of test pieces**

| **Wall thickness** ***e*** mm | **Conditioning period min** | |
|---|---|---|
| | **Liquid bath** | **Air** |
| $e \leq 8{,}6$ | 15 | 60 |
| $8{,}6 < e \leq 14{,}1$ | 30 | 120 |
| $14{,}1 < e$ | 60 | 240 |

## J.5 Procedure

Method 1: The striker shall hit on the ribs or other stiffening parts of the wall construction. See Figure J.2.




**Key**

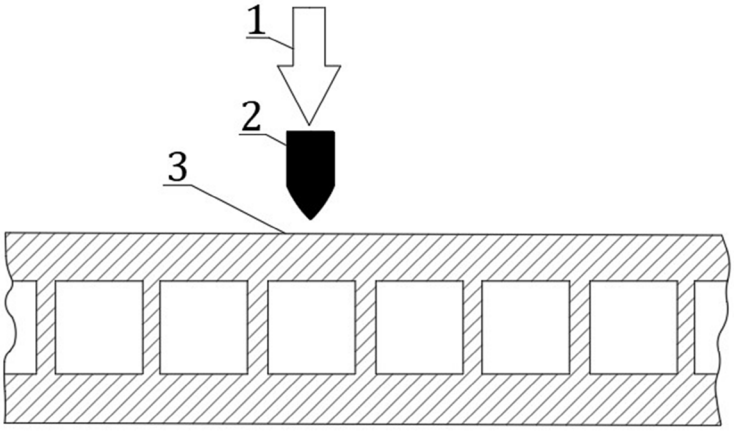
1 direction of impact
2 striker
3 sample

**Figure J.2 — Example method 1**

Test parameters:

| | | |
|---|---|---|
| Test temperature | : | 0 °C ± 1 °C |
| Striker type | : | Type d90 |
| Striker mass | : | 5,0 kg |
| Falling height | : | 2,0 m |
| Number of test samples | : | 10 |

Method 2: The striker shall hit in the middle between the ribs or other stiffening parts of the wall construction. See Figure J.3.




**Key**

1 direction of impact
2 striker
3 sample

**Figure J.3 — Example method 2**

Test parameters:

| | | |
|---|---|---|
| Test temperature | : | 0 °C ± 1 °C |
| Striker type | : | Type d90 |
| Striker mass | : | 3,2 kg |
| Falling height | : | 2,0 m |
| Number of test samples | : | 10 |

## J.6 Test result

The test is fulfilled if test method 1 and 2 are carried out with 9 of 10 samples passing.

Passing means, no shattering, no cracks and no split on the inside of the pipe that was caused by the impact and that can be seen by the naked eye. (Lighting devices may be used to assist examining the specimens).

Indentation of the test piece or crease of the test piece shall be considered as passing.

In countries where a less stringent impact resistance test is permitted the test may be performed at 23 °C (see Annex G) instead of the impact test at 0 °C (Details given in national Foreword).

In countries where a more stringent impact resistance test is permitted, the test may be performed at −10 °C (see Annex H) instead of the impact test at 0 °C (Details given in national Foreword).

# Bibliography

[1] ISO 3, *Preferred numbers — Series of preferred numbers*

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[3] EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

[4] CEN/TS 16010, *Plastics — Recycled plastics — Sampling procedures for testing plastics waste and recyclates*

[5] CEN/TS 16011, *Plastics — Recycled plastics — Sampling preparation*

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

[7] EN 14814, *Adhesives for thermoplastic piping systems for fluids under pressure — Specifications*

[8] EN 15346:2014, *Plastics — Recycled plastics — Characterization of poly(vinyl chloride) (PVC) recyclates*

[9] CEN/TS 1046, *Thermoplastics piping and ducting systems — Outside the building structures for gravity and pressurised systems — Trench installation*

[10] CEN/TS 15223, *Plastic piping systems — Structural design of buried thermoplastics piping systems — Procedure and guidance under various conditions of loading*

[11] CEN/TS 17627, *Plastics — Recycled plastics — Determination of solid contaminants content*

[12] EN ISO 527-2, *Plastics — Determination of tensile properties — Test conditions for moulding and extrusion plastics (ISO 527-2)*