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**Plastics piping systems for non-  
pressure underground conveyance  
and storage of non-potable water —  
Boxes used for retention, detention,  
storage and transportation systems —  
Specifications for storm water boxes  
made of PE, PP and PVC-U**

*Systèmes de canalisations en plastique pour le transport et le  
stockage souterrains sans pression de l'eau non potable — Structures  
alvéolaires ultra-légères utilisées pour les systèmes de rétention, de  
stockage et de transport — Spécifications relatives aux structures  
alvéolaires ultra-légères pour eaux pluviales fabriquées à partir de  
PE, PP et de PVC-U*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 1, *Plastics pipes and fittings for soil, waste and drainage (including land drainage)*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

This document specifies systems comprised of boxes made of PE, PP or PVC-U and used for retention, detention, storage and transportation of storm water.

This document is based on EN 17152-1, additionally including PE materials.

Guidance for installation can be found in CEN/TR 17179.[\[1\]](#)

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# Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Boxes used for retention, detention, storage and transportation systems — Specifications for storm water boxes made of PE, PP and PVC-U

## 1 Scope

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

The boxes are intended for buried underground use, e.g. in landscape, pedestrian or vehicular traffic areas.

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

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

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

A box can either be factory-assembled or site-assembled from different components.

The boxes are intended to be used as elements in a modular system where the manufacturer has provided a clearly documented method specifying how the components are assembled to create a complete retention, detention, storage and transportation system. The boxes are installed as one or more horizontal layers on a firm foundation and embedded with fill around and above the complete system.

**NOTE** Non-load bearing component(s) can be manufactured by various methods (e.g. extrusion, injection moulding, rotational moulding, compression moulded, thermoforming and low-pressure injection moulding) and are not within the scope of this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

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

ISO 472, *Plastics — Vocabulary*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

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

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

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

ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*

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

ISO 1043-1:2011, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 1167-1:2006, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces*

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

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

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

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

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

ISO 11358-1, *Plastics — Thermogravimetry (TG) of polymers — Part 1: General principles*

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

EN 17150, *Plastics piping systems for non-pressure underground conveyance and storage of non-potable water - Test method for determination of short-term compression strength of boxes*

EN 17151:2019, *Plastics piping systems for non-pressure underground conveyance and storage of non-potable water - Test method for determination of long-term compression strength of boxes*

### 3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### 3.1 box

thermoplastic cuboid shaped element, with or without sidewalls, used to create a modular system

**3.2****integral component**

load bearing component contributing to the overall strength of the box

**3.3****modular system**

system made of repeating boxes

**3.4****detention system**

modular system designed to attenuate the peak flow from a given site by providing a temporary underground storm water storage facility

Note 1 to entry: Also known as 'Attenuation'.

**3.5****retention system**

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

Note 1 to entry: Also known as 'Infiltration'.

**3.6****storage system**

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

**3.7****porosity**

total available volume for water storage divided by the total envelope cuboid volume for a box

**3.8****long-term compression strength**

maximum applied compression stress for which the box will survive without creep rupture for 50 years determined as the lower 95 % confidence limit (LCL) for the stress leading to a failure at the extrapolated lifetime, in  $\text{kN/m}^2$

**3.9****virgin material**

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

**3.10****non-virgin material**

material from used or unused retention, detention, storage and transportation boxes which have been cleaned and crushed or ground, or material from used or unused PE, PP or PVC-U products other than retention, detention, storage and transportation boxes, regardless of where they are manufactured

**3.11****agreed specification**

relevant material characteristics agreed between the supplier of the material and the box manufacturer

**3.12****type testing**

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

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

## 4 Symbols and abbreviated terms

### 4.1 Symbols

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

|                       |                                                                                                            |
|-----------------------|------------------------------------------------------------------------------------------------------------|
| $e$                   | maximum thickness of the component tested                                                                  |
| $h$                   | height, i.e. the vertical distance (in the “z” direction) between the outer surfaces of the unit           |
| $w$                   | width, i.e. the smallest horizontal distance (in the “y” direction) between the outer surfaces of the unit |
| $l$                   | length, i.e. the biggest horizontal distance (in the “x” direction) between the outer surfaces of the unit |
| $P$                   | porosity                                                                                                   |
| $W$                   | weight                                                                                                     |
| $V_{\text{total}}$    | total volume of the unit measured                                                                          |
| $V_{\text{material}}$ | volume taken by the material                                                                               |
| $V_{\text{closed}}$   | volume not accessible to water or from which water cannot be retrieved                                     |
| $\rho$                | material density (as specified by the material supplier in <a href="#">Table A.2</a> )                     |

### 4.2 Abbreviated terms

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

|       |                                 |
|-------|---------------------------------|
| OIT   | oxidation induction time        |
| PE    | polyethylene                    |
| PP    | polypropylene                   |
| PVC-U | unplasticized polyvinylchloride |
| IR    | infrared                        |
| P     | porosity                        |

## 5 Material

### 5.1 General

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

- mineral modifier(s) of known specification;
- additives needed to facilitate the manufacture of components conforming to this document.

The material used to manufacture the boxes and integral components shall consist of a material or mixtures of different materials each of which shall have an agreed specification between the supplier and manufacturer (see [Clause A.2](#)).

## 5.2 Polypropylene (PP) material

### 5.2.1 General

The material shall be either PP virgin, PP modified or PP non-virgin material, conforming to [5.2.2](#) – [5.2.4](#) as appropriate.

### 5.2.2 Polypropylene (PP) virgin material

The material for boxes and integral components shall be a compound of PP virgin material and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

### 5.2.3 Polypropylene (PP) modified with minerals

The material for boxes and integral components shall be a compound of PP virgin material modified with minerals and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

If calcium carbonate is used, only coated calcium carbonate shall be used. The content of minerals in the final compound shall be less than 50 % by mass.

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

### 5.2.4 Polypropylene (PP) non-virgin material

The material for boxes and integral components shall be a compound of non-virgin PP material and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

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

## 5.3 Polyethylene (PE) material

### 5.3.1 General

The material shall be either PE virgin, PE modified or PE non-virgin material, conforming to [5.3.2](#) – [5.3.4](#) as appropriate.

### 5.3.2 Polyethylene (PE) virgin material

The material for boxes and integral components shall be a compound of PE virgin material and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

### 5.3.3 Polyethylene (PE) modified with minerals

The material for boxes and integral components shall be a compound of PE virgin material modified with minerals and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

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

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

### 5.3.4 Polyethylene (PE) non-virgin material

The material for boxes and integral components shall be a compound of non-virgin PE material, and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

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

## 5.4 Unplasticized polyvinylchloride (PVC-U) material

### 5.4.1 General

The material shall be either PVC-U virgin or PVC-U non-virgin material, conforming to [5.4.2](#) and [5.4.3](#) as appropriate.

### 5.4.2 Unplasticized polyvinylchloride (PVC-U) virgin material

The material for boxes or integral components shall be a formulation of PVC-U virgin material and those additives that are needed to facilitate the manufacture of box or integral components conforming to the requirements of this document.

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

### 5.4.3 Unplasticized polyvinylchloride (PVC-U) non-virgin material

The material for boxes or integral components shall be a formulation of PVC-U non-virgin material and those additives that are needed to facilitate the manufacture of box and integral components conforming to the requirements of this document.

Recycled materials from PVC-U products that are available in relevant quantities and intervals of time shall be permitted to be used up to 100 % by mass or added to virgin or reworked material or a mixture of those two materials.

## 5.5 Box and integral components material characteristics

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

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

When tested after type testing in accordance with the test methods as specified in [Table 1](#), using the indicated parameters, the material used for the boxes shall have the characteristics conforming to the requirements given in [Table A.1](#).

**Table 1 — Material characteristics for boxes and integral components**

| Characteristic                                                                  | Material | Requirement                                                                                                                                | Test parameters                                                                                                                          | Test method               |
|---------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Resistance to internal pressure<br><br>(if tensile creep rupture is not tested) | PP       | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | End caps: type A (ISO 1167-1:2006)<br>Type: water-in-water or water-in-air<br>Test temperature: 95 °C<br>Circumferential stress: 2,5 MPa | ISO 1167-1 and ISO 1167-2 |
|                                                                                 | PE       |                                                                                                                                            | End caps: type A (ISO 1167-1:2006)<br>Type: water-in-water or water-in-air<br>Test temperature: 80 °C<br>Circumferential stress: 2,8 MPa | ISO 1167-1 and ISO 1167-2 |
|                                                                                 | PVC-U    |                                                                                                                                            | End caps: type A (ISO 1167-1:2006)<br>Type: water-in-water or water-in-air<br>Test temperature: 60 °C<br>Circumferential stress: 6,3 MPa | ISO 1167-1 and ISO 1167-2 |
| Tensile creep rupture<br><br>(if resistance to internal pressure is not tested) | PP       | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | Test stress: 2,5 MPa<br>Temperature: 95 °C                                                                                               | ISO 899-1                 |
|                                                                                 | PE       |                                                                                                                                            | Test stress: 2,8 MPa<br>Temperature: 80 °C                                                                                               | ISO 899-1                 |
|                                                                                 | PVC-U    |                                                                                                                                            | Test stress: 6,3 MPa<br>Temperature: Vicat -15 °C                                                                                        | ISO 899-1                 |
| Melt mass-flow rate                                                             | PP       | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | Temperature: 230 °C<br>Loading mass: 2,16 kg                                                                                             | ISO 1133-1                |
| Before processing                                                               | PE       |                                                                                                                                            | Temperature: 190 °C<br>Loading mass: 5,0 kg                                                                                              | ISO 1133-1                |
| K-value (only for virgin PVC-U)                                                 | PVC-U    | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | ISO 13229                                                                                                                                | ISO 13229                 |
| Vicat softening temperature (VST)                                               | PVC-U    |                                                                                                                                            | Force: 50 N<br>Heating rate: 50 K/h                                                                                                      | ISO 306                   |
| OIT                                                                             | PP       | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | Temperature: 200 °C                                                                                                                      | ISO 11357-6               |
|                                                                                 | PE       |                                                                                                                                            | Temperature: 200 °C                                                                                                                      | ISO 11357-6               |

<sup>a</sup> The specified requirement is generated from type testing of the product using the tests and parameters given in this table.

**Table 1** (continued)

| Characteristic                                                                                                                           | Material | Requirement                                                                                                                                | Test parameters                                                   | Test method |
|------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------|
| Flexural – creep modulus 500 h                                                                                                           | PP       | The values obtained shall meet or exceed the specific requirement for the product being tested. <sup>a</sup> See <a href="#">Annex A</a> . | Duration: 500 h<br>Test stress: 2 MPa<br>Temperature: (23 ± 2) °C | ISO 899-2   |
|                                                                                                                                          | PE       |                                                                                                                                            | Duration: 500 h<br>Test stress: 2 MPa<br>Temperature: (23 ± 2) °C | ISO 899-2   |
|                                                                                                                                          | PVC-U    |                                                                                                                                            | Duration: 500 h<br>Test stress: 2 MPa<br>Temperature: (23 ± 2) °C | ISO 899-2   |
| <sup>a</sup> The specified requirement is generated from type testing of the product using the tests and parameters given in this table. |          |                                                                                                                                            |                                                                   |             |

## 6 General characteristics

### 6.1 Appearance

When viewed without magnification, the internal and external surfaces of boxes and components shall be clean and free from defects likely to prevent conformity with this document. Sharp edges in the external surface should be avoided.

### 6.2 Colour

Any colour may be used.

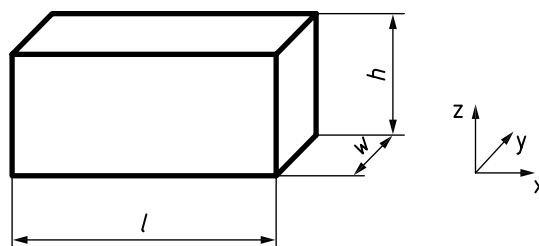
### 6.3 Box covered by this document

Boxes can be assembled from more than 1 component. A tested box shall include all integral components.

## 7 Geometrical characteristics

### 7.1 Shape

The boxes, once assembled, should have a cubic shape of dimensions  $h$  (height),  $w$  (width) and  $l$  (length) as shown in [Figure 1](#).



#### Key

- $h$  height = vertical distance (in the “z” direction) between the outer surfaces of the unit
- $w$  width = smallest horizontal distance (in the “y” direction) between the outer surfaces of the unit
- $l$  length = biggest horizontal distance (in the “x” direction) between the outer surfaces of the unit

**Figure 1** — Box dimensions

The maximum height of a box, which is equivalent to one layer of installation, shall be limited to 1 000 mm.

## 7.2 Dimensions

The dimensions  $l$ ,  $w$  and  $h$  from [Figure 1](#) shall be measured in accordance with ISO 3126.

The dimensions shall be according to the specification given by the manufacturer.

## 7.3 Total volume

The total or “apparent” volume of each unit,  $V_{\text{total}}$ , shall be calculated according to [Formula \(1\)](#):

$$V_{\text{total}} = l \times w \times h \quad (1)$$

The total volume shall be expressed in  $\text{m}^3$ .

## 7.4 Material volume

The material volume,  $V_{\text{material}}$ , is the volume taken by the material and it shall be calculated according to [Formula \(2\)](#):

$$V_{\text{material}} = W / \rho \quad (2)$$

where:

$W$  is the weight measured in [7.5](#);

$\rho$  is the material density (as specified by the material supplier in [Table A.2](#)).

## 7.5 Weight

The weight shall be measured with an accuracy of 0,1 %.

The reference weight shall be the mean weight of the boxes and integral components used for the test specimen for the long-term test according to EN 17151.

## 7.6 Porosity

The porosity,  $P$ , is the ratio of the total available volume for water storage and the total volume for a box, expressed in %. It is calculated according to [Formula \(3\)](#):

$$P = \frac{V_{\text{total}} - V_{\text{material}} - V_{\text{closed}}}{V_{\text{total}}} \quad (3)$$

where

$V_{\text{total}}$  is the total volume of the unit measured according to [7.3](#);

$V_{\text{material}}$  is the volume taken by the material according to [7.4](#);

$V_{\text{closed}}$  is the volume not accessible to water or from which water cannot be retrieved.

The porosity shall be declared to the nearest 1 %.

## 8 Physical characteristics of boxes

### 8.1 Physical characteristics of injection moulded PP boxes

When tested in accordance with the test methods as specified in [Table 2](#) using the indicated parameters, boxes shall have the physical characteristics conforming to the requirements given in [Table 2](#).

**Table 2 — Physical characteristics of PP boxes**

| Characteristic                                                                                                                                                                        | Requirements                                                                                                                                                                                                             | Test parameters                                                                          | Test method                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Effects of heating <sup>a,b,c</sup>                                                                                                                                                   | The depth of cracks, delamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s).<br>No part of the weld line shall open to a depth of more than 20 % of the wall thickness | Temperature: (150 ± 2) °C<br><br>Heating time: in accordance with ISO 580:2005, Clause 3 | Method A: Air oven, in accordance with ISO 580:2005, Clause 4 |
| <sup>a</sup> Large test pieces may be cut to fit the oven.<br><sup>b</sup> All integral components shall be tested.<br><sup>c</sup> Only applicable for injection moulded components. |                                                                                                                                                                                                                          |                                                                                          |                                                               |

### 8.2 Physical characteristics of injection moulded PE boxes

When tested in accordance with the test methods as specified in [Table 3](#) using the indicated parameters, boxes shall have the physical characteristics conforming to the requirements given in [Table 3](#).

**Table 3 — Physical characteristics of PE boxes**

| Characteristic                                                                                                                                                                        | Requirements                                                                                                                                                                                                             | Test parameters                                                                               | Test method                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Effects of heating <sup>a,b,c</sup>                                                                                                                                                   | The depth of cracks, delamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s).<br>No part of the weld line shall open to a depth of more than 20 % of the wall thickness | Test temperature: (110 ± 2) °C<br><br>Heating time: in accordance with ISO 580:2005, Clause 3 | Method A: Air oven, in accordance with ISO 580:2005, Clause 4 |
| <sup>a</sup> Large test pieces may be cut to fit the oven.<br><sup>b</sup> All integral components shall be tested.<br><sup>c</sup> Only applicable for injection moulded components. |                                                                                                                                                                                                                          |                                                                                               |                                                               |

### 8.3 Physical characteristics of injection moulded PVC-U boxes

When tested in accordance with the test methods as specified in [Table 4](#) using the indicated parameters, boxes shall have the physical characteristics conforming to the requirements given in [Table 4](#).

**Table 4 — Physical characteristics of PVC-U boxes**

| Characteristic                                                                                                                                                                        | Requirements                                                                                                                                                                                                          | Test parameters                                                                                  | Test method                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Resistance to heating – Oven test <sup>a,b,c</sup>                                                                                                                                    | 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 | Test temperature (150 ± 2) °C<br><br>Heating time for: in accordance with ISO 580:2005, Clause 3 | Method A: Air oven, in accordance with ISO 580:2005, Clause 4 |
| <sup>a</sup> Large test pieces may be cut to fit the oven.<br><sup>b</sup> All integral components shall be tested.<br><sup>c</sup> Only applicable for injection moulded components. |                                                                                                                                                                                                                       |                                                                                                  |                                                               |

## 9 Mechanical characteristics of boxes including integral components

When tested in accordance with the test methods as specified in [Table 5](#) using the indicated parameters, the boxes including integral components shall have mechanical characteristics conforming to the requirements given in [Table 5](#).

Conforming with the results from type testing of the mechanical characteristics, the specified requirements for each specific product shall be defined by the manufacturer.

**Table 5 — Mechanical characteristics of boxes — Short and long-term compression strength**

| Characteristic                                    | Requirements                                                                                                                                                                                                                                                              | Test parameters        |                               | Test method |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------|-------------|
| Short-term compression strength                   | z-direction is the vertical direction of installation.<br><br>y-direction shall give the lowest compression strength (See <a href="#">Figure 1</a> )<br><br>The value obtained shall meet or exceed the specified requirements for the product being tested. <sup>a</sup> | Method                 | A or B                        | EN 17150    |
|                                                   |                                                                                                                                                                                                                                                                           | Test direction         | x, y and z                    |             |
|                                                   |                                                                                                                                                                                                                                                                           | Number of test samples | At least 3 for each direction |             |
| Long-term compression strength vertical direction | The long-term compression strength shall be $\geq 50 \text{ kN/m}^2$ .<br><br>The value obtained shall meet or exceed the specified requirements for the product being tested. <sup>a</sup>                                                                               | Test direction         | z                             | EN 17151    |
|                                                   |                                                                                                                                                                                                                                                                           | Test duration          | EN 17151:2019, 8.1            |             |
|                                                   |                                                                                                                                                                                                                                                                           | Number of test samples | EN 17151:2019, 8.1            |             |

<sup>a</sup> The specified requirement generated from type testing of the product using the tests and parameters given in this table.

**Table 5 (continued)**

| Characteristic                                                                                                                        | Requirements                                                                                                  | Test parameters        |                    | Test method |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------|--------------------|-------------|
| Long-term compression strength lateral direction (only for storage, transportation, and detention boxes)                              | The value obtained shall meet or exceed the specified requirements for the product being tested. <sup>a</sup> | Test direction         | y                  | EN 17151    |
|                                                                                                                                       |                                                                                                               | Test duration          | EN 17151:2019, 8.1 |             |
|                                                                                                                                       |                                                                                                               | Number of test samples | EN 17151:2019, 8.1 |             |
| <sup>a</sup> The specified requirement generated from type testing of the product using the tests and parameters given in this table. |                                                                                                               |                        |                    |             |

## 10 Marking

### 10.1 General

Marking elements shall be printed or formed directly on the component or be on a label, in such a way that after storage, weathering, handling and installation, the required legibility is maintained. The legibility shall be durable in use.

Marking shall not initiate cracks or other types of defects which adversely influence the performance of the retention, detention, storage and transportation boxes.

The size of the marking shall be such that the marking is legible without magnification.

### 10.2 Minimum required marking of boxes

The minimum required marking of retention, detention, storage and transportation boxes is given in [Table 6](#).

**Table 6 — Minimum required marking of boxes**

| Aspects                                                                                       | Marking or symbols                                                           |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Number of this document                                                                       | ISO 4981                                                                     |
| Manufacturer's name and/or trade mark                                                         |                                                                              |
| Material                                                                                      | PE, PP or PVC-U                                                              |
| Optional<br>Long-term structural strength vertical direction <sup>a</sup>                     | e.g. 100                                                                     |
| Optional<br>Long-term structural strength vertical direction / lateral direction <sup>a</sup> | e.g. 100 / 17                                                                |
| Optional<br>Porosity                                                                          | e.g. 90 %                                                                    |
| Manufacturer's information (permanent marked)                                                 | name or code for the production site and production period (year and month). |
| <sup>a</sup> Values shall be given in integer values in kPa.                                  |                                                                              |

## Annex A (normative)

### Characteristics of materials used in boxes and integral components for PP, PE and PVC-U

#### A.1 Material characteristics

The durability of boxes and integral components is carried out as a check of the material characteristics used in boxes and integral components fulfilling the requirements for the long-term compression strength test described in [Table 5](#).

When determining the material characteristics, as described in [Table A.1](#) during the type testing, the material samples shall be taken from the same production batch of material used to carry out the long-term compression strength test according to EN 17151:2019.

**NOTE** A selection of these material characteristics will be used when defining the test to be carried out for the assessment of conformity.

**Table A.1 — Material characteristics of boxes and integral component made of PP, PE and PVC-U**

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Material | Requirement <sup>a</sup>                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resistance to internal pressure<br>(if tensile creep is not tested)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PP       | ≥ the value obtained on material used for boxes and integral components obtained when type testing the product for long-term compression strength, <sup>b</sup> as specified in the material specification |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PE       | ≥ the value obtained on material used for boxes and integral components obtained when type testing the product for long-term compression strength, <sup>b</sup> as specified in the material specification |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PVC-U    | ≥ the value obtained on material used for boxes and integral components obtained when type testing the product for long-term compression strength, <sup>b</sup> as specified in the material specification |
| Tensile creep rupture<br>(if resistance to internal pressure is not tested)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PP       | ≥ the value obtained on material used for boxes and integral components fulfilling the long-term compression strength test, <sup>b</sup> as specified in the material specification                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PE       | ≥ the value obtained on material used for boxes and integral components fulfilling the long-term compression strength test, <sup>b</sup> as specified in the material specification                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PVC-U    | ≥ the value obtained on material used for boxes and integral components fulfilling the long-term compression strength test, <sup>b</sup> as specified in the material specification                        |
| <sup>a</sup> The characteristic value determined shall be the 95 % lower confidence limit.<br><sup>b</sup> The characteristic value determined shall be the 95 % higher confidence limit.<br><sup>c</sup> Due to the fact that these characteristics only fingerprint the used material, the values can be declared. The durability is tested via compression tests on material/design. This is a different approach to ensure the quality or strength than in other plastic piping systems standards, where the material characteristics are determining the durability. |          |                                                                                                                                                                                                            |