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**TECHNICAL PRESCRIPTIONS**  
FOR  
**PREFABRICATED SYNTHETIC LINERS FOR  
MANHOLES AND INSPECTION CHAMBERS**  
**Product requirements**

*Version 2.0 dated 2017-07-04*

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## FOREWORD

This document contains the technical prescriptions for a prefabricated synthetic liners for manholes and inspection chambers, including the synthetic connection sockets, if applicable. The requirements included in these PTV respond to needs established by the various interested parties according to local customs.

The prefabricated liners are normally used to improve some properties (hydraulic or chemical) of the manholes or inspection chambers, but they can be used as lost formwork too. It is possible that in combination with the synthetic liner, synthetic connection sockets are used. The prescriptions for these sockets are also included in this PTV.

But not only the requirements for the synthetic liners are important. Also the contact of the synthetic liner with the base material of the manhole or inspection chamber should comply for the intended use. Therefore, PTV 8450-2 described the requirements and the test methods for the combination of the synthetic liner with the base material.

This PTV doesn't describe the requirements for the base material of the manhole or inspection chamber itself. These materials are described in other normative documents.

The conformity of the prefabricated synthetic liners and the connection sockets can be certified under the voluntary COPRO mark. With the COPRO mark, the supplier has to declare the performance of the prefabricated synthetic liners and the connection sockets for all the characteristics relevant to guaranteeing the application and limit values imposed by this PTV 8450-1.

COPRO certification is based on full product certification in accordance with NBN EN ISO/IEC 17067.

# 1 INTRODUCTION

## 1.1 TERMINOLOGY

### 1.1.1 Definitions

Article	Set of units of a product with the same characteristics and performance that are produced in a specific manner and comply with the technical file.
Supplier	The party having to ensure that the product complies with the technical prescriptions. This definition can apply to the producer, the dealer, the importer or the distributor.
Producer	The party responsible for producing the product.
Product	The result of an industrial activity or process. Meant by this in the context of these technical prescriptions is the prefabricated synthetic liners and the connection sockets. It is the collective term for all articles and product types to which these PTV apply.
Production unit	Technical facility/facilities tied to a geographical location used by a producer and in which one or more products are made.
Test	Technical action comprising the determination of one or more properties of a raw material or product according to a specified process.
Reference document	Document specifying the technical characteristics with which the materials, equipment, raw materials, production process and/or the product must comply (a standard, specification or any other technical specification).
Synthetic prefabricated liner	A prefabricated liner is a formed thermoplastic sheet (PU, PP) or is made out of GRP (glass fiber reinforced polyester) with fitted on connection bells and eventually also with a shaft lining in variable height. The bell and liner diameter as well as the channel size and angles are made in order to meet the customers' requests. The back side of the liner is rough and can have bounding bridges in order to assure a solid connection to the base material.

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### 1.1.2 Abbreviations

GRP	Glass fiber Reinforced Polyester resin
PP	PolyPropylene
PS	PolyStyrene
PTV	Technical Prescriptions
PU	PolyUrethane

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### 1.1.3 References

DIN 16946-2	Cured casting resins: types
DIN 18820-1	Laminates of textile glass-reinforced unsaturated polyester and phenacrylic resins for load-bearing structural members (GF-UP, GF-PHA): structure, manufacture and characteristics
NBN EN 14020-1	Reinforcements - Specification for textile glass rovings - Part 1: Designation
NBN EN 14020-2	Reinforcements - Specification for textile glass rovings - Part 2: Methods of test and general requirements
NBN EN 14020-3	Reinforcements - Specification for textile glass rovings - Part 3: Specific requirements
NBN EN ISO 62	Plastics - Determination of water absorption
NBN EN ISO 178	Plastics - Determination of flexural properties
NBN EN ISO 179-1	Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test
NBN EN ISO 179-2	Plastics - Determination of Charpy impact properties - Part 2: Instrumented impact test
NBN EN ISO 527-1	Plastics - Determination of tensile properties - Part 1: General principles
NBN EN ISO 527-2	Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics
NBN EN ISO 527-4	Plastics – Determination of tensile properties – Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites
NBN EN ISO 868	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)
NBN 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
NBN EN ISO 1172	Textile-glass-reinforced plastics – Prepregs, moulding compounds and laminates – Determination of the textile-glass and mineral-filler content – calcination methods
NBN EN ISO 1183-1	Plastics - Methods for determining the density of noncellular plastics - Part 1: Immersion method, liquid : pyknometer method and titration method

NBN EN ISO 2039-1	Plastics - Determination of hardness - Part 1: Ball indentation method
NBN EN ISO 3126	Plastics piping systems - Plastics components - Determination of dimensions
NBN EN ISO 3451-5	Plastics - Determination of ash - Part 5: Polyvinyl chloride
NBN EN ISO/IEC 17067	Conformity assessment - Fundamentals of product certification and guidelines for product certification schemes
PTV 8450-2	Technical prescriptions for prefabricated synthetic liners for manholes and inspection chambers : system requirements.
PTV 8681-1	Technical prescriptions for elastomeric seals : Part 1: Vulcanized rubber.

This PTV contains dated and undated references. Only the cited version applies to dated references. The latest version always applies to undated references, including any errata, addenda and amendments.

Of all the EN standards referred to in these prescriptions, the corresponding Belgian publication NBN EN applies in each case. COPRO can allow the use of a publication other than the Belgian one provided its content is identical to that of the Belgian publication.

## 1.2 AVAILABILITY OF THIS PTV

The current version of this PTV is available free of charge on the COPRO website.

A paper version of this PTV can be ordered from COPRO. COPRO has the right to charge for this.

No changes may be made to the original PTV approved by the advisory board and/or confirmed by the Board of Directors of COPRO.

## 1.3 STATUS OF THIS PTV

### 1.3.1 Version of this PTV

This PTV concerns version 2.0 and replace version 1.0.

### 1.3.2 Approval of this PTV

This PTV was approved by the Advisory Board on the 31<sup>th</sup> of August 2017.

### 1.3.3 Confirmation of this PTV

This PTV was confirmed by the Board of Directors of COPRO on the 13<sup>th</sup> of December 2017.

## **1.4 HIERARCHY OF RULES AND REFERENCE DOCUMENTS**

### **1.4.1 Legislation**

If certain rules contained in this PTV are inconsistent with applicable law, the rules arising from the legislation shall prevail. It is the responsibility of the supplier to monitor this and report any contradictions to COPRO in advance.

### **1.4.2 Directives concerning health and safety**

If certain technical prescriptions are inconsistent with the directives concerning health and safety, such directives shall prevail. It is the responsibility of the supplier to monitor this and report any contradictions to COPRO in advance.

### **1.4.3 Special specification**

If certain rules from the applicable special specification are inconsistent with these technical prescriptions, the supplier can report this to COPRO.

## **1.5 QUESTIONS AND COMMENTS**

Questions or comments concerning these technical prescriptions are directed to COPRO.



## 2 POSITIONING OF TECHNICAL PRESCRIPTIONS

### 2.1 PTV FORMAT

#### 2.1.1 Format of this PTV

These technical prescriptions for the prefabricated synthetic liners for manholes and inspection chambers, including the connection sockets, if applicable, are drawn up by the advisory board for synthetic liners for sewer elements of COPRO.

### 2.2 OBJECTIVES

#### 2.2.1 Purpose of this PTV

- 2.2.1.1 The aim of this PTV is to specify requirements for the prefabricated synthetic liners and connection sockets used in combination with new manholes or inspection chambers (manufactured in a factory) and not for renovation of existing manholes or inspection chambers. They can be used on all parts of the manhole or inspection chamber (base unit, chamber unit, shaft unit, cover slab, reducing slab, adjusting unit, taper).

### 2.3 SCOPE

#### 2.3.1 Subject of these technical prescriptions

- 2.3.1.1 This document contains the requirements to which a prefabricated synthetic liner for manholes and inspection chambers must comply, including the synthetic connection sockets, if applicable. The prefabricated synthetic liner can only be used in combination with new manholes or inspection chambers (manufactured in a factory) and not for renovation of existing manholes or inspection chambers. They can be used on all parts of the manhole or inspection chamber (base unit, chamber unit, shaft unit, cover slab, reducing slab, adjusting unit, taper).

The dimensions for the liner are depending on the intended use of the product, so they are not included in this PTV. These dimensions (and their tolerances) shall be determined by the manufacturer, together with the manufacturer that produces the manhole or inspection chamber with the synthetic liner.

The dimensions (and their tolerances) of the connection sockets shall be determined by the manufacturer, again in consultation with the manufacturer of the manhole or inspection chamber. When determining these dimensions, the requirements for the connecting pipe material shall be taken in consideration. The sockets can only be used in combination with the synthetic liner.

The synthetic liners and the connection sockets can be made of polyurethane (PU), polypropylene (PP), glass fiber reinforced polyester resin (GRP) or hard polystyrene (PS – only for sockets).

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### **2.3.2 Circulars**

COPRO can supplement this PTV with one or more circulars forming an integral part of this PTV.

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## **2.4 REFERENCE DOCUMENTS**

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### **2.4.1 Product standards**

There aren't any applicable product standards.

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### **2.4.2 Tender documents**

There aren't any applicable tender documents.

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### **2.4.3 Other**

There aren't any other applicable reference documents, specific for this product.

## 3 PRESCRIPTIONS

In the tables below pH1 and pH12 is mentioned. These should be obtained as follows:

- pH1: Mixture of de-ionized water with H<sub>2</sub>SO<sub>4</sub> with approximately pH1,
- pH12: Mixture of de-ionized water and NaOH with approximately pH12.

### 3.1 PRODUCTION UNIT AND EQUIPMENT

There aren't any requirements for the production unit and the production equipment.

### 3.2 RAW MATERIALS AND ELASTOMERIC SEALS

3.2.1 The relevant requirements for the raw materials are describes in articles 3.4 and 3.5.

3.2.2 If elastomeric seals are used for connecting the connection socket with the connection sewer, they shall be according PTV 8681-1, (clauses 3.4.14 to 3.4.18 are voluntary requirements), and they have to be delivered by the producer of the liner and socket. Nevertheless, the elastomeric seals shall also be according the requirements for the seals as foreseen in the regulations for the connection sewer.

In case the synthetic liners are used to improve the chemical properties of the sewer-element, then the elastomeric seals, if applicable, shall also comply PTV 8681-1, clause 3.4.16.

### 3.3 PRODUCTION PROCESS

There aren't any requirements for the production process.

### 3.4 REQUIREMENTS FOR THE LINERS

#### 3.4.1 General

3.4.1.1 The prefabricated synthetic liners meets the applicable requirements set out in articles 3.4.2 to 3.4.4. The dimensions and their tolerances must be determined by the manufacturer, depending on the intended use.

3.4.1.2 The supplier shall in each case declare the performance for the applicable characteristics set out in articles 3.4.2 to 3.4.4 for the prefabricated synthetic liners for manholes and inspection chambers.

### 3.4.2 Liners from polyurethane (PU)

This clause gives an overview of the requirements for the raw materials and for the finished products.

**Table 3.4.2 : non-dimensional requirements for the PU-liners**

Property	Test method	Requirement
Density	NBN EN ISO 1183-1	$\geq 1.18 \text{ g/cm}^3$
Shore D hardness	NBN EN ISO 868	$\geq 70 \text{ Shore-D}$
Flexural properties Flexural stress Flexural strain Flexural modulus	NBN EN ISO 178	$\geq 35 \text{ MPa}$ $\geq 2.7 \%$ $\geq 1300 \text{ MPa}$
Charpy impact properties	NBN EN ISO 179-1 or NBN EN ISO 179-2	$\geq 10 \text{ kJ/m}^2$
Wall thickness	NBN EN ISO 3126	$\geq 4.0 \text{ mm}$
Water absorption	NBN EN ISO 62 method 4 50 % R.H., $23 \pm 2 \text{ }^\circ\text{C}$ , 192 h Drying 72 h	$\leq 0.1 \%$
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	$\leq 2 \%$
Change in flexural stress after immersion 28 days in pH1 and pH12	NBN EN ISO 178	$\leq 20 \%$

### 3.4.3 Liners from polypropylene (PP)

This clause gives an overview of the requirements for the raw materials and for the finished products. The compound for the liners shall be PP base material without any mineral filler.

**Table 3.4.3 : non-dimensional requirements for the PP-liners**

Property	Test method	Requirement
Ash content	NBN EN ISO 3451-5	$< 1 \%$
Density	NBN EN ISO 1183-1	$\geq 0.9 \text{ g/cm}^3$
Hardness – Ball indentation method (ball = $5.0 \text{ mm} \pm 0.05 \text{ mm}$ )	NBN EN ISO 2039-1	$\geq 40 \text{ N/mm}^2$
MFR (230 °C – 2160 g)	NBN EN ISO 1133-1	$0.45 \pm 0.05 \text{ g/10 min}$
Heat stability – change in dimensions ( $150 \pm 3 \text{ }^\circ\text{C}$ – $120 \pm 1 \text{ min}$ )		$\leq 2 \%$
Wall thickness	NBN EN ISO 3126	$7.0 \text{ mm} \pm 3 \text{ mm}$

Water absorption	NBN EN ISO 62 method 4 50 % R.H., 23 ± 2 °C, 192 h Drying 72 h	≤ 0.1 %
Tensile strength	NBN EN ISO 527-1/-2	Declaration of the manufacturer
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	≤ 2 %
Change in tensile strength after immersion 28 days in pH1 and pH12	NBN EN ISO 527-1/-2	≤ 20 %

### 3.4.4 Liners from glass reinforced polyester resin (GRP)

This clause gives an overview of the requirements for the raw materials and for the finished products.

**Table 3.4.4 Non-dimensional requirements for the GRP-liners**

Property	Test method	Requirement
Type of resin		* DIN 18820-1, table 1, group 3 * DIN 16946-2, table 3, type 1130
Type of glass fiber		E – or E-CR glass fiber according NBN EN 14020-1, NBN EN 14020-2 and NBN EN 14020-3
Inner layer (*) Thickness Mineral filler content	NBN EN ISO 1172	0.7 ± 0.1 mm ≤ 0.1 %
Outer layer (**) Mineral filler content Mass fiber glass mat Glasfiber content	NBN EN ISO 1172 NBN EN ISO 1172	≤ 17 % ≥ 150 g / m <sup>2</sup> / mm 16 ± 4 % by mass
Total layer Thickness	NBN EN ISO 3126	7 ± 3 mm
Water absorption	NBN EN ISO 62 method 4 50 % R.V., 23 ± 2 °C, 192 h Drying 72 h	≤ 0.1 %
Density	NBN EN ISO 1183-1	Declaration of the manufacturer
Tensile strength	NBN EN ISO 527-1/-4	Declaration of the manufacturer
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	≤ 2 %
Change in tensile strength after immersion 28 days in pH1 and pH12	NBN EN ISO 527-1/-4	≤ 20 %

(\*) Inner layer: part of the layer that is especially designed to provide a low resistance to flow. The layer exists of a thermosetting resin layer without aggregates or fillers and without reinforcement of glass filaments.

(\*\*) Outer layer: this is the structural layer and is designed to give the liner it's strength.

## 3.5 REQUIREMENTS FOR THE CONNECTION SOCKETS

### 3.5.1 General

3.4.1.1 The connection sockets meets the applicable requirements set out in articles 3.5.2 to 3.5.5. The dimensions and their tolerances must be determined by the manufacturer, depending on the intended use.

3.4.1.2 The supplier shall in each case declare the performance for the applicable characteristics set out in articles 3.5.2 to 3.5.5 for the connection sockets, to be used in combination with prefabricated synthetic liners for manholes and inspection chambers.

### 3.5.2 Connection sockets from polyurethane (PU)

This clause gives an overview of the requirements for the raw materials and for the finished products.

**Table 3.5.2 : non-dimensional requirements for the PU-sockets**

Property	Test method	Requirement
Density	NBN EN ISO 1183-1	$\geq 1.18 \text{ g/cm}^3$
Shore D hardness	NBN EN ISO 868	$\geq 70 \text{ Shore-D}$
Flexural properties Flexural stress Flexural strain Flexural modulus	NBN EN ISO 178	$\geq 35 \text{ MPa}$ $\geq 2.7 \%$ $\geq 1300 \text{ MPa}$
Charpy impact properties	NBN EN ISO 179-1 or NBN EN ISO 179-2	$\geq 10 \text{ kJ/m}^2$
Wall thickness	NBN EN ISO 3126	$\geq 4.0 \text{ mm}$
Water absorption	NBN EN ISO 62 method 4 50 % R.V., $23 \pm 2 \text{ }^\circ\text{C}$ , 192 h Drying 72 h	$\leq 0.1 \%$
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	$\leq 2 \%$
Change in flexural stress after immersion 28 days in pH1 and pH12	NBN EN ISO 178	$\leq 20 \%$

### 3.5.3 Connection sockets from polypropylene (PP)

This clause gives an overview of the requirements for the raw materials and for the finished products.

The compound for the sockets shall be PP base material with mineral fillers, to which are added those additives that are needed to facilitate the manufacture of sockets conforming to the requirements of this PTV.

**Table 3.5.3 : non-dimensional requirements for the PP-sockets**

Property	Test method	Requirement
Ash content (mineral filler content)	NBN EN ISO 3451-5	5 – 35 %
Density	NBN EN ISO 1183-1	$\geq 0.92 \text{ g/cm}^3$
Hardness – Ball indentation method (ball = 5.0 mm $\pm$ 0.05 mm)	NBN EN ISO 2039-1	$\geq 45 \text{ N/mm}^2$
MFR (230 °C – 2,16 kg)	NBN EN ISO 1133-1	9.2 + 3/-6 g/10 min
Heat stability – change in dimensions (150 $\pm$ 3 °C – 120 $\pm$ 1 min)		$\leq 2 \%$
Water absorption	NBN EN ISO 62 method 4 50 % R.V., 23 $\pm$ 2 °C, 192 h Drying 72 h	$\leq 0.1 \%$
Wall thickness	NBN EN ISO 3126	5.0 mm $\pm$ 1 mm
Tensile strength	NBN EN ISO 527-1/-2	Declaration of the manufacturer
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	$\leq 2 \%$
Change in tensile strength after immersion 28 days in pH1 and pH12	NBN EN ISO 527-1/-2	$\leq 20 \%$

### 3.5.4 Connection sockets from glass fiber reinforced polyester resin( GRP)

This clause gives an overview of the requirements for the raw materials and for the finished products.

**Table 3.5.4 Non-dimensional requirements for the GRP-sockets**

Property	Test method	Requirement
Type of resin		* DIN 18820-1, table 1, group 3 * DIN 16946-2, table 3, type 1130
Type of glass fiber		E – or E-CR glass fiber according NBN EN 14020-1, NBN EN 14020-2 and NBN EN 14020-3
Inner layer (*) Thickness Mineral filler content	NBN EN ISO 1172	0.7 ± 0.1 mm ≤ 0.1 %
Outer layer (**) Mass fiber glass mat (if used) Glasfiber content	NBN ISO EN 1172	≥ 230 g / m <sup>2</sup> / mm ≥ 20 % by mass
Total layer Thickness	NBN EN ISO 3126	6 ± 2 mm
Density	NBN EN ISO 1183-1	Declaration of the manufacturer
Tensile strength	NBN EN ISO 527-1/-4	Declaration of the manufacturer
Water absorption	NBN EN ISO 62 method 4 50 % R.V., 23 ± 2 °C, 192 h Drying 72 h	≤ 0.1 %
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	≤ 2 %
Change in tensile strength after immersion 28 days in pH1 and pH12	NBN EN ISO 527-1/-4	≤ 20 %

(\*) Inner layer: part of the layer that is especially designed to provide a low resistance to flow. The layer exists of a thermosetting resin layer without aggregates or fillers and without reinforcement of glass filaments.

(\*\*) Outer layer: this is the structural layer and is designed to give the liner it's strength.



### 3.5.5 Connection sockets from hard polystyrene (PS)

This clause gives an overview of the requirements for the raw materials and for the finished products.

**Table 3.5.5 Non-dimensional requirements for the PS-sockets**

Property	Test method	Requirement
Density	NBN EN ISO 1183-1	$\geq 1,03 \text{ g/cm}^3$
Hardness (358 N / 30 s)	NBN EN ISO 2039-1	$\geq 62 \text{ N/mm}^2$
MFR (200 °C – 5 kg)	NBN EN ISO 1133-1	5.0 + 2 g/10 min
Heat stability – change in dimensions (45 ± 3 °C – 120 ± 1 min)		$\leq 1.5 \%$
Water absorption	NBN EN ISO 62 method 4 50 % R.V., 23 ± 2 °C, 192 h Drying 72 h	$\leq 0.1 \%$
Wall thickness	NBN EN ISO 3126	5.0 mm ± 1 mm
Tensile strength	NBN EN ISO 527-1/-2	Declaration of the manufacturer
Change in density after immersion 28 days in pH1 and pH12	NBN EN ISO 1183-1	$\leq 2 \%$
Change in tensile strength after immersion 28 days in pH1 and pH12	NBN EN ISO 527-1/-2	$\leq 20 \%$

## **4 TEST METHODS**

### **4.1 SAMPLING**

#### **4.1.1 Sampling**

Sampling can be either on the finished product or on the raw material before manufacturing the finished product. When possible, sampling on the finished product is preferable.

### **4.2 SAMPLE PREPARATION**

#### **4.2.1 Sample preparation**

See the applicable test methods.

## 5 PRODUCT IDENTIFICATION

### 5.1 PRODUCT NAME

#### 5.1.1 Official name

Prefabricated synthetic liners for manholes and inspection chambers,

#### 5.1.2 Commercial name

The commercial is freely chosen by the supplier insofar as it does not lead to confusion or clash with the official name.

### 5.2 IDENTIFICATION

#### 5.2.1 Delivery modes

5.2.1.1 The product can be delivered in a package.

5.2.1.2 If the product is delivered in a package, it is identified on each packaging unit and on every individual product.

#### 5.2.2 Individual product

The following information must be given on each product:

- name and address of the supplier and/or producer,
- kind of the raws material of the product (GRP, PP, PS, PU),
- reference to this PTV,
- relevant dimensions for the intended use.