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**Geosintetične zapore - Zahtevane lastnosti za uporabo pri gradnji lagun za shranjevanje, sekundarnih zadrževalnikov (nad zemljo in pod njo) in drugih zadrževalnikov za kemikalije, onesnaženo vodo in tekočine iz proizvodnje**

Geosynthetic barriers - Characteristics required for use in the construction of storage lagoons, secondary containment (above and below ground) and other containment applications for chemicals, polluted water and produced liquids

Geosynthetische Dichtungsbahnen - Geforderte Eigenschaften für die Anwendung beim Bau von Speicherbecken, Auffangwannen (ober- und unterirdisch) und anderen Anwendungen für Chemikalien, verschmutztes Wasser und produzierte Flüssigkeiten

Géomembranes et géosynthétiques bentonitiques - Caractéristiques requises pour l'utilisation dans la construction des bassins de retenue, enceintes de confinement secondaire (au-dessus et au-dessous du sol) et autres applications de confinement pour les produits chimiques, les eaux polluées et les liquides produits

**Ta slovenski standard je istoveten z: EN 16993:2018**

**ICS:**

59.080.70	Geotekstilije	Geotextiles
91.100.50	Veziva. Tesnilni materiali	Binders. Sealing materials

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Chemikalien, verschmutztes Wasser und produzierte  
Flüssigkeiten

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This European Standard was approved by CEN on 30 October 2017.

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## European foreword

This document (EN 16993:2018) has been prepared by Technical Committee CEN/TC 189 “Geosynthetics”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by September 2018, and conflicting national standards shall be withdrawn at the latest by December 2019.

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 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

For relationship with Regulation (EU) No 305/2011, see informative Annex ZA, which is an integral part of this document.

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

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## Introduction

This document allows manufacturers to describe geosynthetic barriers on the basis of declared values for characteristics relevant to the intended use and if tested to the specified method. It also includes procedures for assessment and verification of constancy of performance (AVCP) including the factory production control.

This document can also be used by designers, end-users and other interested parties as a tool to define relevant and appropriate characteristics for specifications.

Tests for some non-mandated characteristics are still under study and will be included when the standard is revised.

The term “product” used in this document refers to a geosynthetic barrier, including polymeric geosynthetic barriers, clay geosynthetic barriers and bituminous geosynthetic barriers.

This document is part of a group of standards, addressing the requirements for geosynthetic barriers when used in a specific application.

Particular application cases can contain requirements about additional properties and - preferably standardized - test methods, if they are technically relevant and not conflicting with European Standards.

The design life of the product should be determined, since its function may be temporary, as construction expediency, or permanent, for the lifetime of the structure.

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## 1 Scope

This European Standard specifies the characteristics of geosynthetic barriers, including polymeric geosynthetic barriers, clay geosynthetic barriers and bituminous geosynthetic barriers used as fluid barriers and separation layer in the construction of hazardous liquid containment and secondary containment around storage facilities for hazardous liquids and the appropriate test methods to determine these characteristics.

NOTE This document is not applicable to applications where one geosynthetic barrier is manufactured in direct contact with a second geosynthetic barrier in order to reduce the overall permeability of the barrier. Such “multicomponent” products are subject to the required characteristics for the relevant component.

The intended use of these products is to control the leakage of fluids through the construction.

This European Standard is not applicable to geotextiles or geotextile-related products as defined in EN ISO 10318-1.

This European Standard provides for the assessment and verification of constancy of performance (AVCP) of the product to this European Standard including factory production control procedures.

This European Standard defines characteristics to be considered with regard to the presentation of performance.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 495-5:2013, *Flexible sheets for waterproofing — Determination of foldability at low temperature — Part 5: Plastic and rubber sheets for roof waterproofing* (5914c24-2956-42cc-a015-2221c43f5890/sist-en-16993-2018)

EN 1109:2013, *Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of flexibility at low temperature*

EN 1110:2010, *Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of flow resistance at elevated temperature*

EN 1296:2000, *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roofing — Method of artificial ageing by long term exposure to elevated temperature*

EN 1427:2015, *Bitumen and bituminous binders — Determination of the softening point — Ring and Ball method*

EN 1849-1:1999, *Flexible sheets for waterproofing — Determination of thickness and mass per unit area — Part 1: Bitumen sheets for roof waterproofing*

EN 1849-2:2009, *Flexible sheets for waterproofing — Determination of thickness and mass per unit area — Part 2: Plastic and rubber sheets*

EN 12224:2000, *Geotextiles and geotextile-related products — Determination of the resistance to weathering*

EN 12225:2000, *Geotextiles and geotextile-related products — Method for determining the microbiological resistance by a soil burial test*

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EN 12226:2012, *Geosynthetics — General tests for evaluation following durability testing*

EN 12310-1:1999, *Flexible sheets for waterproofing — Part 1: Bitumen sheets for waterproofing - Determination of resistance to tearing (nail shank)*

EN 12311-1:1999, *Flexible sheets for waterproofing — Part 1: Bitumen sheets for roof waterproofing — Determination of tensile properties*

EN 12311-2:2013, *Flexible sheets for waterproofing — Determination of tensile properties — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 12447:2001, *Geotextiles and geotextile-related products — Screening test method for determining the resistance to hydrolysis in water*

EN 13249:2016, *Geotextiles and geotextile-related products — Characteristics required for use in the construction of roads and other trafficked areas (excluding railways and asphalt inclusion)*

EN 13250:2016, *Geotextiles and geotextile-related products — Characteristics required for use in the construction of railways*

EN 13251:2016, *Geotextiles and geotextile-related products — Characteristics required for use in earthworks, foundations and retaining structures*

EN 13252:2016, *Geotextiles and geotextile-related products — Characteristics required for use in drainage systems*

EN 13253:2016, *Geotextiles and geotextile-related products — Characteristics required for use in erosion control works (coastal protection, bank revetments)*

EN 13254:2016, *Geotextiles and geotextile-related products — Characteristics required for the use in the construction of reservoirs and dams*

EN 13255:2016, *Geotextiles and geotextile-related products — Characteristics required for use in the construction of canals*

EN 13256:2016, *Geotextiles and geotextile-related products — Characteristics required for use in the construction of tunnels and underground structures*

EN 13257:2016, *Geotextiles and geotextile-related products — Characteristics required for use in solid waste disposals*

EN 13265:2016, *Geotextiles and geotextile-related products — Characteristics required for use in liquid waste containment projects*

EN 14150:2006, *Geosynthetic barriers — Determination of permeability to liquids*

EN 14151:2010, *Geosynthetics — Determination of burst strength*

EN 14196:2016, *Geosynthetics — Test methods for measuring mass per unit area of clay geosynthetic barriers*

EN 14414:2004, *Geosynthetics — Screening test method for determining chemical resistance for landfill applications*

- EN 14415:2004, *Geosynthetic barriers — Test method for determining the resistance to leaching*
- CEN/TS 14416:2014, *Geosynthetic barriers — Test method for determining the resistance to roots*
- CEN/TS 14417:2014, *Geosynthetic barriers — Test method for the determination of the influence of wetting-drying cycles on the permeability of clay geosynthetic barriers*
- CEN/TS 14418:2014, *Geosynthetic Barriers — Test method for the determination of the influence of freezing-thawing cycles on the permeability of clay geosynthetic barriers*
- EN 14575:2005, *Geosynthetic barriers — Screening test method for determining the resistance to oxidation*
- EN 14576:2005, *Geosynthetics — Test method for determining the resistance of polymeric geosynthetic barriers to environmental stress cracking*
- EN 16416:2013, *Geosynthetic clay barriers — Determination of water flux index — Flexible wall permeameter method at constant head*
- EN ISO 527-1:2012, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1:2012)*
- EN ISO 527-3:1995, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets (ISO 527-3:1995)*
- EN ISO 527-4:1997, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites (ISO 527-4:1997)*
- EN ISO 1133-1:2011, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method (ISO 1133-1:2011)*
- EN ISO 1183-1:2012, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2012)*
- EN ISO 1183-2:2004, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method (ISO 1183-2:2004)*
- EN ISO 1183-3:1999, *Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pycnometer method (ISO 1183-3:1999)*
- EN ISO 3696:1995, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)*
- EN ISO 9863-1:2016, *Geosynthetics — Determination of thickness at specified pressures — Part 1: Single layers (ISO 9863-1:2016)*
- EN ISO 9864:2005, *Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products (ISO 9864:2005)*
- EN ISO 10318-1:2015, *Geosynthetics — Part 1: Terms and definitions (ISO 10318-1:2015)*
- EN ISO 10319:2015, *Geosynthetics — Wide-width tensile test (ISO 10319:2015)*
- EN ISO 10773:2011, *Clay geosynthetic barriers — Determination of permeability to gases (ISO 10773:2011)*

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EN ISO 11357-6:2013, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT) (ISO 11357-6:2008)*

EN ISO 12236:2006, *Geosynthetics — Static puncture test (CBR test) (ISO 12236:2006)*

EN ISO 12957-1:2005, *Geosynthetics — Determination of friction characteristics — Part 1: Direct shear test (ISO 12957-1:2005)*

EN ISO 12957-2:2005, *Geosynthetics - Determination of friction characteristics — Part 2: Inclined plane test (ISO 12957-2:2005)*

EN ISO 13438:2004, *Geotextiles and geotextile-related products — Screening test method for determining the resistance to oxidation (ISO 13438:2004)*

ISO 34-1:2015, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 11465:1993, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

ASTM D696, *Standard test method for coefficient of linear thermal expansion of plastics between -30 °C and 30 °C*

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ASTM D1434, *Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting*

ASTM D4603, *Standard Test Method for Determining Inherent Viscosity of Poly(Ethylene Terephthalate) (PET) by Glass Capillary Viscometer*  
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ASTM D5890, *Standard test method for swell index of clay mineral component of geosynthetic clay liners*

ASTM D7409, *Standard Test Method for Carboxyl End Group Content of Polyethylene Terephthalate (PET) Yarns*

### **3 Terms, definitions and abbreviations**

#### **3.1 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN ISO 10318-1 and the following apply.

##### **3.1.1**

##### **product**

geosynthetic barrier, including polymeric, bituminous and clay barriers

**3.1.2****geosynthetic barrier**

barrier with at least one of whose components is made from a synthetic or natural polymer, in the form of a sheet, a strip or a three dimensional structure, used in contact with soil and/or other materials in geotechnical and civil engineering applications

**3.1.3****project specification**

document in which the works, functions, specific conditions and required material property values of the geosynthetic barrier are described

**3.1.4****hazardous liquid**

liquid of an explosive, flammable, corrosive or toxic nature, including producer water, which has the potential to harm persons or property, or to contaminate ground or water courses if allowed to escape into the environment

**3.1.5****primary containment**

vessel or other structure designed for the storage or processing of liquid of any kind

**3.1.6****secondary containment**

barrier system designed to collect and store any leakage or unintentional discharge of hazardous liquid from a primary containment

**3.1.7****basal liner**

material which forms the main barrier to prevent the escape of contained fluids from the base of the facility

**3.1.8****floating cover**

material placed above the waste or contaminated material to prevent the ingress of water and the uncontrolled escape of fluids and/or gases

**3.1.9****fluid**

gas, liquid and vapour in its pure phase as well as mixtures thereof

[SOURCE: EN 764-1:2015+A1:2016, 3.1.5]

**3.1.10****rework material****RWM**

material that is generated in a process and capable of being reclaimed within the same process that generated it

[SOURCE: EN 13249:2016, 3.1.3]

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**EN 16993:2018 (E)****3.1.11****post-consumer material****PCM**

material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose

Note 1 to entry: This includes returns of material from the distribution chain.

[SOURCE: EN 13249:2016, 3.1.4]

**3.1.12****post-industrial material****PIM**

material diverted from the waste stream during a manufacturing process

[SOURCE: EN 13249:2016, 3.1.5]

**3.2 Abbreviations**

For the purposes of this document, the abbreviations given in EN ISO 10318-1 and the following apply:

**CWFT:** classification without further testing

**EPDM:** ethylene propylene diene monomer

**EVA:** ethylene vinyl acetate

**FPO:** flexible polyolefine

**FPP:** flexible polypropylene

**GBR-P:** polymeric geosynthetic barrier

**GBR-B:** bituminous geosynthetic barrier

**GBR-C:** clay geosynthetic barrier

**HP-OIT:** high pressure oxidation induction time

**OIT:** oxidation induction time

**PE-HD:** high density polyethylene

**PE-LLD:** linear low density polyethylene

**PE-VLD:** very low density polyethylene

**PVC-P:** flexible polyvinylchloride

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[https://standards.iteh.ai/catalog/standards/sist/05914c24-2956-42cc-a015-](https://standards.iteh.ai/catalog/standards/sist/05914c24-2956-42cc-a015-2221c43f5890/sist-en-16993-2018)

[2221c43f5890/sist-en-16993-2018](https://standards.iteh.ai/catalog/standards/sist/05914c24-2956-42cc-a015-2221c43f5890/sist-en-16993-2018)

**4 Characteristics and corresponding methods of test****4.1 General**

The main function of geosynthetic barriers used in the construction of hazardous liquid containment and secondary containment is to prevent the movement of hazardous liquids through the construction and to prevent the stored liquid from escaping into the environment. Damage during installation has not been addressed in this document.

## 4.2 Types of applications

### 4.2.1 General

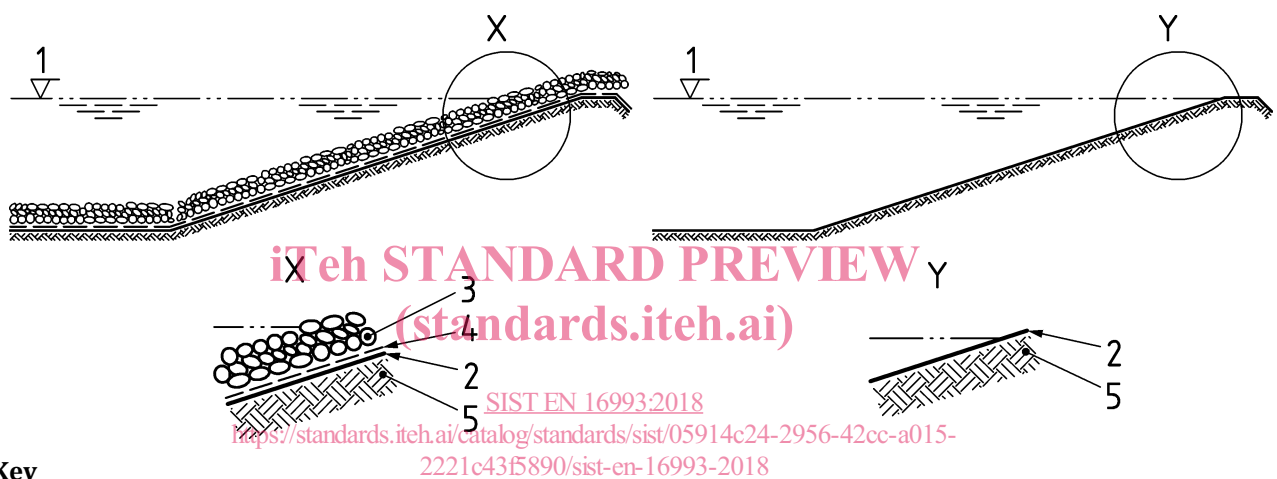
The design of secondary containments is dependent on the type of primary containment, the nature of the contained liquids and the stored volumes, the perceived risks at a particular location, and any relevant local or national regulations or guidelines.

Not all GBR are suitable for use in secondary containment. Chemical compatibility determined according to EN 14414 Condition D using the proposed hazardous liquid is essential.

The Figures in the following sub sections show, in the simplest terms, the typical application of GBRs in the primary and secondary containment of hazardous liquids.

### 4.2.2 Application 1: Primary containment in open lagoon

In this application, the GBR is used as base and side slope barrier. Figure 1 shows typical cross sections.



#### Key

- 1 liquid waste level
- 2 geosynthetic barrier
- 3 revetment
- 4 geotextile
- 5 subgrade

**Figure 1 — Typical geosynthetic barrier in a base and or slope construction of a hazardous liquid primary containment (uncovered)**

### 4.2.3 Application 2: Cover barrier

In this application, the GBR is used to prevent loss of gases or ingress of rain water in hazardous liquid containment sites and secondary containment (floating cover). Figure 2 shows a typical cross-section.