



SLOVENSKI STANDARD
SIST EN 16994:2018

01-maj-2018

Geosintetične zapore - Zahtevane lastnosti pri gradnji podzemnih objektov (razen predorov in pripadajočih konstrukcij)

Clay Geosynthetic Barriers - Characteristics required for use in the construction of underground structures (other than tunnels and associated structures)

Geosynthetische Tondichtungsbahnen - Eigenschaften, die für die Anwendung beim Bau von Tiefbauwerken (andere als Tunnel und damit verbundene Tiefbauwerke) erforderlich sind

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Géosynthétiques bentonitiques - Caractéristiques requises pour l'utilisation comme barrière aux fluides dans la construction de structures souterraines (hors tunnels)

Ta slovenski standard je istoveten z: EN 16994:2018

ICS:

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

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Clay Geosynthetic Barriers - Characteristics required for use in the construction of underground structures (other than tunnels and associated structures)

Geosynthétiques Bentonitiques - Caractéristiques requises pour l'utilisation dans la construction de structures souterraines (hors tunnels et structures associées)

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This European Standard was approved by CEN on 23 October 2017.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EN 16994:2018 (E)

European foreword

This document (EN 16994:2018) 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of an identical text or by endorsement, at the latest by September 2018, and conflicting national standards shall be withdrawn at the latest by December 2019.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 [and/or CENELEC] 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.

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Introduction

This document allows manufacturers to describe clay 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 clay geosynthetic barriers only.

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 document specifies the characteristics of clay geosynthetic barriers (GBR-C) as well as multicomponent geosynthetic clay barriers (e.g. a GBR-C with a polymeric or bituminous geosynthetic barrier attached to it), when used as fluid barriers and separation layer in the construction of underground structures (other than tunnels and associated structures), and the appropriate test methods to determine these characteristics.

If in a multicomponent GBR-C, the GBR-P or GBR-B is the predominant hydraulic barrier then the appropriate standard should be used.

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

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

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

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

This document does not cover applications where the geosynthetic barrier is to be in contact with water that has been treated for human consumption.

NOTE Where potable water is or can be in direct contact with the product, other relevant standards, requirements and/or regulations can be considered for the design.

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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 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 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*

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

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

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 14151:2010, *Geosynthetics - Determination of burst strength*

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

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EN 14414:2015, *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 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 527-3:1995, *Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3:1995)*

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)*

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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 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 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 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 D4603, *Standard Test Method for Determining Inherent Viscosity of Poly(Ethylene Terephthalate) (PET) by Glass Capillary Viscometer*

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**multicomponent GBR-C**

polymeric or bituminous geosynthetic barrier attached to the GBR-C

3.1.4**project specification**

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

3.1.5**underground structure (other than tunnels and associated structures)**

constructed void below ground which is not a tunnel or associated with a tunnel

3.1.6**tunnel**

underground passageway, completely enclosed except for openings for entrance and exit, commonly at each end

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3.1.7**moisture barrier**

barrier used to prevent the ingress of liquids and water vapours, without external hydrostatic pressure, to a tunnel or underground structure [SIST EN 16994:2018](https://standards.iteh.ai/catalog/standards/sist/859f0ad3-e710-4732-bd2c-7088a2f91449/sist-en-16994-2018)

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3.1.8**pressure water barrier**

barrier used to prevent or reduce the ingress of water to an underground structure (which is not associated with a tunnel) when subject to external hydrostatic pressure

3.1.9**fluid barrier**

barrier used to prevent or reduce the ingress of fluids underground structures (not associated with tunnels) when subject to differential pressure

3.1.10**fluid**

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

[SOURCE: EN 764-1:2015-04, 3.1.5]

3.1.11**rework material****RWM**

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

[SOURCE: EN 13249:2016-10, 3.1.3]

EN 16994:2018 (E)**3.1.12****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 13249:2016-10, 3.1.4]

3.1.13**post-industrial material****PIM**

material diverted from the waste stream during a manufacturing process

[SOURCE: EN 13249:2016-10, 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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4 Characteristics and corresponding methods of test**4.1 General**

The main function of clay geosynthetic barriers used in the construction of underground structures (other than tunnels and associated structures) is to prevent or reduce the flow of fluid through the structure. Damage during installation has not been addressed in this document.

NOTE In this document “underground structures not associated with tunnels” will be referred to as “underground structures”.

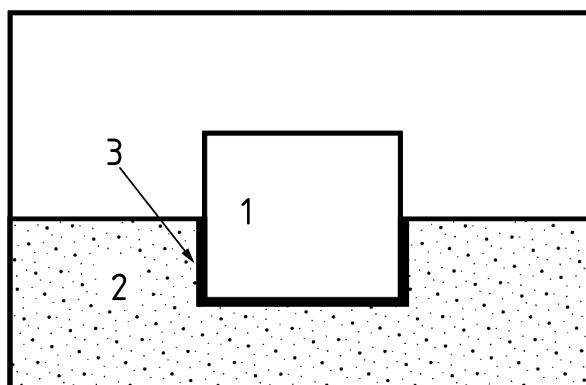
4.2 Type of application

4.2.1 General

The main function of geosynthetic barriers used in the construction of underground structures (other than tunnels and associated structures) is to prevent or reduce the flow of fluid through the structure wall. Damage during installation has not been addressed in this document.

4.2.2 .Application 1: “Moisture and fluid barrier”

Application where the GBR is used as a stand-alone barrier, Figure 1 shows a typical cross-section.



Key

- 1 underground structure
- 2 subgrade
- 3 clay geosynthetic barrier

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Figure 1 — Geosynthetic barrier in an underground structure as moisture and fluid barrier

4.3 Relevant characteristics

The characteristics, their relevance to the conditions of use, and the test methods to be used, are specified in Table 1. The list of characteristics in Table 1 includes those relevant to all conditions of use (A) (essential characteristics are listed in Table ZA.1), and those relevant to specific conditions of use (S). The indication “-” means that the characteristic is not relevant for that function.

Where, for the same property, data for more than one function shall be provided, the following ranking order shall be observed: A overrules S, and S overrules “-”.

The functions and conditions of use, corresponding with the S-coded characteristics in Table 1, are specified in 4.4.

The performances of the characteristics are given on basis of the results of tests specified in this document and, where relevant, in accordance with 5.1.

Information on how functioning joints can be made should be provided. Where products are jointed in the factory the liquid tightness and if relevant the strength of the joints shall be tested and data presented.

Prehydrated GBR-C should not be stored or installed when the ambient temperature is below 0 °C.

Table 1 — Clay geosynthetic barriers used in the construction of underground structures (other than tunnels and associated structures) – Functions, function-related characteristics and test methods to be used

		Geosynthetic barrier	Test methods	Remarks
No	Property to be tested ^a	GBR-C	GBR-C	
Physical properties				
1	Thickness	A	EN ISO 9863-1	
2	Mass per unit area	A	EN 14196	
Hydraulic properties				
3	Liquid tightness ^a	A	EN 16416	Test liquid is water. Report value index flux for GBR-C
4	Swell Index	A	ASTM D5890	
Mechanical properties				
6	Tensile strength	A	EN ISO 10319	Report in all cases the tensile strength at break measured according to the test method
7	Elongation	A	EN ISO 10319	
8	Static Puncture	A	EN ISO 12236	
9	Burst strength and elongation	S	EN 14151	This test applies to GBR-C only if they contain a polymeric or bituminous barrier element.
10	Tear strength	—	—	
Thermal properties				
11	Low temperature behaviour (flexure)	—	—	
12	Thermal expansion	—	—	
Durability				
13	Weathering	—	—	In accordance with Annex A
14	Microorganisms	S	EN 12225	In accordance with Annex A
15	Oxidation	A	EN ISO 13438	In accordance with Annex A EN ISO 13438 is applicable for the geotextile elements and reinforcement yarns of GBR-C
16	Environmental stress cracking	S	EN 14576	In accordance with Annex A EN 14576 is applicable to GBR-P with a semi-crystalline structure. If GBR-P is between 0,5 mm and 1,0 mm the test EN 14576 shall be

		Geosynthetic barrier	Test methods	Remarks
				performed with the same composition at a thickness greater than 1,0 mm.
17	Chemical resistance	S	EN 14414	In accordance with Annex A Chemical resistance testing should be conducted in line with site specific circumstances. This should be restricted to a consideration of the substrate onto which the material is laid and/or chemicals contained.
18	Wetting/drying	S	CEN/TS 14417	In accordance with Annex A To determine the property of wetting/drying the test method EN 16416 is required.
19	Freezing/thawing	S	CEN/TS 14418	In accordance with Annex A To determine the property of freezing/thawing the test method EN 16416 is required.

^a NOTE The 95 % confidence level corresponds to the mean value minus (and/or plus) a tolerance value (see Annex ZA, Table ZA.1 column Notes). Both the mean value and the tolerance value are defined by the manufacturer to be representative of the performance of the product for the corresponding characteristic (these two values are not necessarily based on a statistical calculation).

Relevance of codes:

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A: relevant to all conditions of use <https://www.sist.it/catalog/standards/sist/859f0ad3-e710-4732-bd2c-f08e-291449/sist-en-16994-2018>

S: relevant to specific conditions of use <https://www.sist.it/catalog/standards/sist/859f0ad3-e710-4732-bd2c-f08e-291449/sist-en-16994-2018>

“—”: indicates that the characteristic is not relevant for that product

Particular site-specific application cases may contain requirements for 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.

4.4 Characteristics relevant to specific conditions of use

4.4.1 General

The necessary data based on the test requirements and test methods described in this document for the functions and conditions of use described as relevant (see Table 1) in the project specification shall be provided.

The list of characteristics in Table 1 includes those relevant to all conditions of use (A) (essential characteristics are listed in Table ZA.1), and those relevant to specific conditions of use (S). These specific conditions of use (S) are listed from 4.4.2 to 4.4.5.

If the product under consideration is a multicomponent barrier, the performance of the claimed GBR shall dictate the characteristics listed in Table 1.