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BSI Standards Publication

Geosynthetics — Determination of the long term protection efficiency of geosynthetics in contact with geosynthetic barriers

National foreword

This British Standard is the UK implementation of EN 13719:2016. It supersedes BS EN 13719:2002 which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Geosynthetics - Determination of the long term protection efficiency of geosynthetics in contact with geosynthetic barriers

Géosynthétiques - Détermination de l'efficacité de protection à long terme des géosynthétiques en contact avec les géomembranes

Geokunststoffe - Bestimmung der langfristigen Schutzwirksamkeit von Geokunststoffen im Kontakt mit geosynthetischen Dichtungsbahnen

This European Standard was approved by CEN on 20 February 2016.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 13719:2016) 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of an identical text or by endorsement, at the latest by October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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1 Scope

This European Standard is an index test used to determine the efficiency with which a geosynthetic product will protect a geosynthetic barrier or other contact surface against the mechanical long term effects of static point loads.

The test is performed on the geosynthetic product in isolation. It measures the strains experienced by a geosynthetic product in contact with a deformable pad.

NOTE Other properties relevant to the protection of geosynthetic barriers against differing actions are covered by other standards, e.g. dynamic perforation is covered in EN ISO 13433.

A related performance test simulating specific site conditions is described in Annex B (informative).

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 12588, *Lead and lead alloys — Rolled lead sheet for building purposes*

EN ISO 139, *Textiles — Standard atmospheres for conditioning and testing (ISO 139)*

EN ISO 9862, *Geosynthetics — Sampling and preparation of test specimens (ISO 9862)*

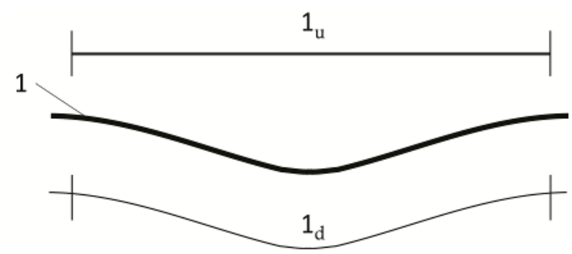
EN ISO 10320, *Geotextiles and geotextile-related products — Identification on site (ISO 10320)*

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
local strain
difference between the deformed length (l_d) of a straight line between two points on either side of a deformation and the undeformed length (l_u) between the same two points divided by the undeformed length (see Figure 1)



Key

1 – limit of deformation

Figure 1 — Local strain measurement of a single deformation

4 Principle

Load is applied through a simulated standard aggregate on to the geosynthetic specimen, which is supported on a simulated standard subgrade for a standard time. The local strain in the lower surface of the geosynthetic is measured and used to determine the protection efficiency.

5 Apparatus

5.1 Cylinder

A smooth sided steel cylinder having an internal diameter between 300 mm and 500 mm.

NOTE The cylinder can be in sections bolted together at flanged joints to facilitate setting up and dismantling.

5.2 Lower steel plate

20 mm minimum thickness mild steel plate with a diameter 4 mm less than that of the cylinder with a tolerance of ± 1 mm to allow it to vertically move freely within the cylinder. The lower steel plate shall be supported in a way that the effective normal stress can be measured to an accuracy of 1 %.

5.3 Dense rubber pad

A (25 ± 1) mm thickness rubber pad having a diameter similar to the lower steel plate and a hardness of (50 ± 5) Shore A, determined in accordance with ISO 7619-1. The rubber pad should be checked for hardness on a grid no greater than 20 mm at intervals not exceeding 12 months. If the pad is outside the hardness tolerance at any location or exhibits signs of permanent mechanical damage, it shall not be used.

5.4 Lead sheet

A circular lead disc shall be used. It shall have a thickness of (1,3 ± 0,1) mm, grade 3 lead to EN 12588 or similar, with deformation characteristics and thickness in accordance with the requirements of Annex A and with a diameter similar to that of the lower steel plate.

Prior to incorporation in the test the lead disc shall have a flatness such that a gauge of 0,05 mm cannot be inserted between the disc and a straight edge placed across any diameter.

5.5 Simulated standard aggregate

20 mm diameter steel balls to a minimum depth of 150 mm. The balls shall not show any visible signs of damage.

5.6 Applied stress

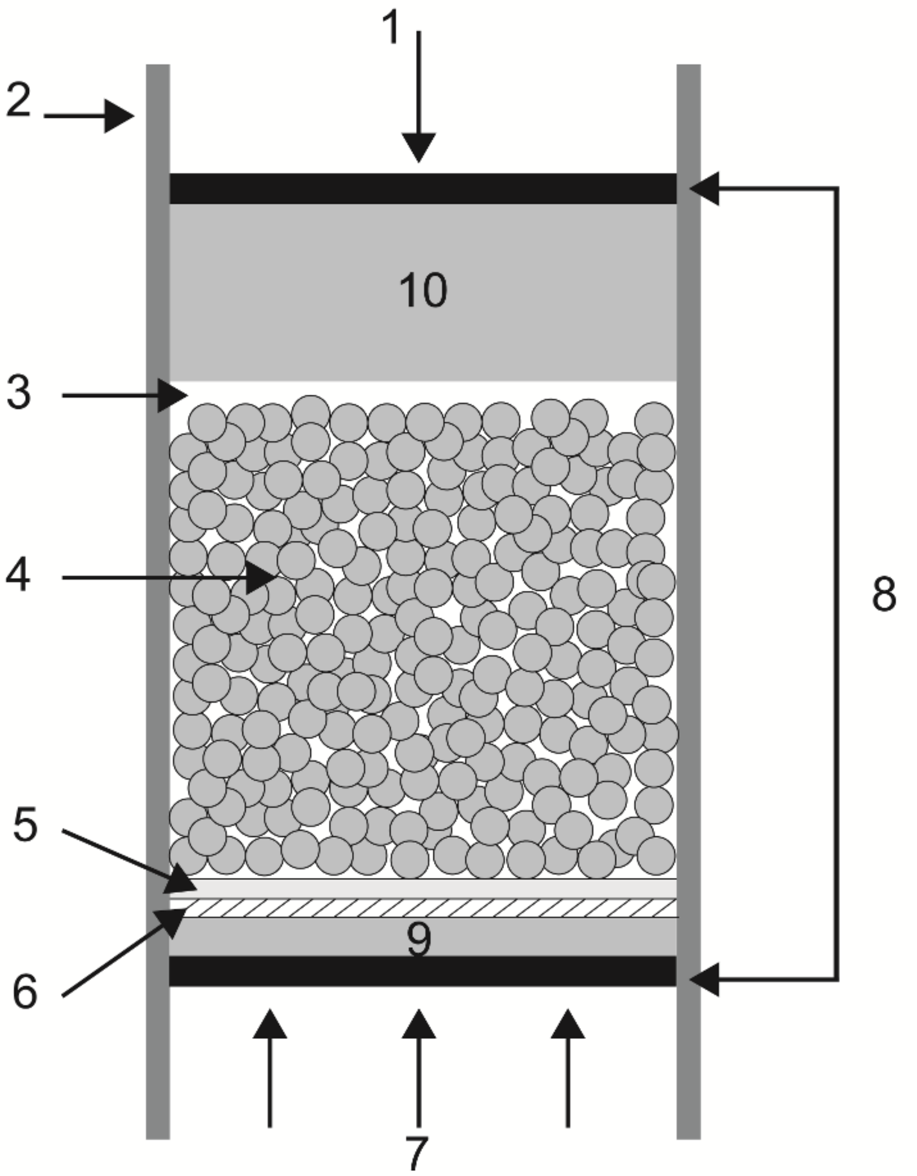
Means of constantly applying the required uniform normal stresses to an accuracy of ± 5 % as registered by the load cells or pressure gauges beneath the lower steel plate over a period of up to 1000 h.

5.7 Timing device

Means of timing the duration of the test accurate to ± 1 % of the test duration.

5.8 Deformation measurement

Means of measuring the deformed length and undeformed length of a depression in the lead plate. Simultaneous measurement horizontally and vertically to an accuracy of 0,01 mm. If a dial gauge is to be used the tip in contact with the metal sheet shall have a diameter of (2,0 ± 0,2) mm.



Key

1 applied load
2 cylinder
3 geotextile separator
4 simulated standard aggregate
5 geosynthetic test specimen
6 lead sheet
7 load cells
8 upper and lower steel plates
9 dense rubber pad
10 sand

Figure 2 — Test apparatus

6 Specimen

6.1 Sampling

Take samples of the geosynthetic in accordance with EN ISO 9862.

6.2 Number and dimensions of specimens

Cut three specimens from the sample each with a circular diameter similar to that of the lower steel plate.

If the material is known to have different characteristics on each face (e.g. physical characteristics as a result of the manufacturing process) then select the face to be placed uppermost and record in the test report.

7 Conditioning

Condition and test the geosynthetic specimens in the standard atmosphere of (20 ± 2) °C and (65 ± 5) % relative humidity, as defined in EN ISO 139. The specimens can be considered to have been conditioned when the change in mass of the specimen in successive weighings made at intervals of not less than 2 h does not exceed 0,25 % of the mass of the test specimens.

Conditioning and/or testing in the standard atmosphere may be omitted when it can be shown that results obtained for the same type of product (both structure and polymer type) are not affected by changes in temperature and humidity exceeding the limits.

8 Procedure

8.1 Assemble the apparatus and build up the layers as shown in Figure 2. The simulated aggregate should be placed en masse on the specimen. Placing the pieces of the simulated aggregate individually is not permitted.

8.2 Gradually apply increasing stress over a maximum period of 1 h up to 300 kN/m^2, as registered by the load cells or pressure gauges beneath the lower steel plate. Start timing and maintain the registered stress at (300 ± 15) kN/m^2, recording stress and temperature for (100 ± 1) h, at intervals of (1,0 ± 0,1) h for the first 6 h and then every (24 ± 1) h for the duration of the test, then dismantle the apparatus and carefully recover the geosynthetic and the lead sheet.

8.3 Examine the geosynthetic and record the number of holes if any through the geosynthetic together with any significant physical damage.

8.4 Examine the lead sheet and select the three deformations with the greatest strains. Do not select any deformation with any part closer than 25 mm to the edge of the sheet. For each deformation, select two axes at right angles and on each axis mark the limit of the deformation.

Defining the limit of the deformation should be done accurately because the difference between the deformed axis length and the undeformed axis length is small.

Using the deformation measuring device start at one edge of the deformation and work along one of the axes. Determine the vertical displacement correct to 0,01 mm at (3,0 ± 0,20) mm horizontal intervals to the edge of the deformation. The edge of the deformation is defined as the point where two consecutive readings 3 mm apart have a vertical height difference of less than or equal to 0,06 mm.

8.5. Repeat the measuring procedure along the second axis and then repeat the whole measuring procedure on both axes of the remaining two deformations.

Alternatively direct local strain measurements may be made using calibrated laser or optical scanning instruments.

Deformation measurement should be completed within 24 h of removing the test load.

8.6 Using a new specimen and a new lead sheet repeat steps 8.1 to 8.5, but at a registered stress of 600 kN/m^2.

8.7 Using a new specimen and a new lead sheet repeat steps 8.1 to 8.5, but at a registered stress of 1 200 kN/m^2.

9 Calculation

9.1 From the measurements determined in 8.4 and 8.5 calculate the undeformed length l_u (which may be a slope length if the edges of the deformation at opposite ends of an axis are at differing levels) and the deformed length l_d using a series of Pythagorean calculations.

9.2 For each axis calculate (to 0,01) the local strain, as defined in 3.1, i.e. $\{(l_d - l_u)/l_u\}$

NOTE This can be determined directly from the scanning device.

9.3 Calculate the arithmetic mean of the six local strains (two from each depression) determined for each lead plate.

10 Test report

The test report shall include at least the following information:

a) number and date of this standard, EN 13719:2016;

b) identification of the sample tested according to EN ISO 10320;

c) date of receipt;

d) conditioning atmosphere for each of the specimens; note of the side of the geosynthetic tested if the two sides of the sample were different;

e) confirmation that the lead sheet deformation characteristics comply with the requirements of Annex A;

f) date of commencing each test and temperature record over test periods;

g) any significant physical damage to the geosynthetic;

h) the six individual strain values and the mean at each normal pressure;

i) any deviations from the procedure.

Annex A
(normative)

Determination of the deformation characteristics of the lead sheet used for recording local strains

A.1 Principle

Load is applied through a spherical steel ball on to a sample of the lead sheet supported on a rubber pad as used in the main test. The depth of the indentation produced is measured and used to determine acceptability.

A.2 Apparatus

A.2.1 Dense rubber pad

A circular rubber pad of (100 ± 2) mm complying with the requirements of 5.3 as used in the main test apparatus.

A.2.2 Steel ball

A (25 ± 0,01) mm diameter spherical steel ball.

A.2.3 Applied load

Means of applying a steadily increasing vertical load up to (250 ± 5) N at a constant rate of travel. A standard laboratory compression apparatus should be acceptable.

A.2.4 Thickness measurement

Means of measuring the thickness of the lead sheet to an accuracy of 0,01 mm.

A.2.5 Indentation measurement

Means of measuring the depth of the indentation in the lead sheet to an accuracy of 0,01 mm.

A.3 Specimens

A.3.1 Sampling

Take a sample of minimum dimensions 220 mm x 220 mm from the same lead sheet as that proposed for use in the main test.

A.3.2 Specimens

Cut three specimens from the sample of lead sheet, each with a circular diameter of (100 ± 2) mm.

A.4 Procedure

A.4.1 This test shall be carried out under the same conditions of temperature and humidity as the main test.

A.4.2 Measure the thickness of the lead sheet to an accuracy of 0,01 mm.

A.4.3 Place the lead sheet specimen on the rubber pad.

A.4.4 Apply load through the steel ball on to the upper surface of the lead sheet specimen at a vertical movement rate of 1 mm per minute until a load of 250 N is reached.

A.4.5 Determine the maximum depth of the indentation in the lead sheet to an accuracy of 0,01mm within 2 h of the load application.

A.4.6 Repeat the procedure for the remaining two lead sheet specimens.

A.4.7 Calculate the arithmetic mean thickness corrected to 0,01 mm.

A.5 Acceptance criteria

A.5.1 The depth of the indentation measured in each specimen shall be between 2,50 mm and 3,50 mm for the lead sheet to be acceptable for use in the main test.

A.5.2 The thickness of the lead sheet disc to be used in the main test is to be within 0,02 mm of the mean value from A.4.7.

A.6 Test report

The test report should include at the least the following information:

a) reference to this standard, EN 13719:2016, Annex A;

b) test conditions of temperature and humidity;

c) date of test;

d) indentation depths and lead sheet thickness;

e) any deviations from the procedure.

Annex B
(informative)

Performance Test

B.1 Scope

This annex describes the variations to the index test together with additional requirements for it to be used as a performance test. The performance test will simulate as closely as possible the specific conditions expected in a particular application.

B.2 Definition

B.2.1
incremental strain
strain for each 3 mm segment of the measurement axes through the indentations

B.3 Principle

Load is applied through the proposed cover material eg drainage aggregate, and through the proposed geosynthetic product to the proposed geosynthetic barrier or other contact surface which is supported on a simulated standard subgrade. The local strains and incremental strains experienced by the geosynthetic barrier or other contact surface are recorded in a lead sheet and measured.

B.4 Apparatus

The arrangement remains as Figure 2 with the simulated standard aggregate, item 4, replaced by the proposed cover material and the geosynthetic barrier or other contact surface placed between the geosynthetic material, item 5, and the lead sheet, item 6.

A representative sample of the proposed aggregate or cover material placed to the depth proposed. The maximum particle size to be used in a 300 mm diameter cylinder shall be 75 mm on any axis.

A cylinder liner may be used to reduce sidewall friction.

B.5 Specimens

Take samples of the geosynthetic product and the geosynthetic barrier or other contact surface in accordance with relevant standards e.g. EN ISO 9862 for geosynthetics.

Examine the specimens and note any marks, tears, nicks, scratches or other signs of distress.

B.6 Conditioning

The aggregate and the specimens shall be left for a minimum of 24 h in the same conditions as required in the test.

B.7 Procedure

Follow the procedure described in Clause 8 of this standard with the following modifications:

— To 8.1:

Assemble the apparatus and build up the layers as shown in Figure 2 including the geosynthetic barrier or other contact surface between the lead sheet and geosynthetic product and replacing the simulated aggregate with the proposed cover material.

Thoroughly mix the whole of the aggregate supplied. Build up the aggregate in three layers in the cylinder, the minimum depth should normally be 150mm. Placing of the aggregate can influence the result of the test. There should be no compaction of material into the cylinder, the placing of three layers is intended to avoid any potential for bridging or voids.

— To 8.2:

Gradually apply increasing stress over a maximum period of 1 h up to the required stress as registered by the load cells or pressure gauges beneath the lower steel plate.

Start timing and maintain the registered stress at the required value ± 5 %, recording the registered stress at intervals of maximum 12 h, for the required test duration.

The required test stress and test duration should be specified by the client. This will normally be calculated from the anticipated loading conditions with applied factors of safety to allow for the use of a short-term test and differing test temperatures. For example where an HDPE geosynthetic barrier is to be used in a landfill waste containment the applied stress is calculated from the final depth of waste and its density. The usual factors of safety are:

— 1,5 for tests of 1 000 h at 40 °C;

— 2,25 for tests of 1 000 h at 20 °C;

— 2,5 for tests of 100 h at 20 °C;

Calculate the expected maximum overburden pressure due to the depth of waste. That is, depth x the waste density x acceleration due to gravity. Multiply the result of this calculation using the relevant factor from above. These factors have been experimentally derived from simplified extrapolations of the deformation behaviour of HDPE materials.

For example for a landfill with 20 m of waste and a waste density 1 000 kg/m^3 and a 100 h test at 20 °C the test pressure would be calculated as follows: $20 \times 1\,000 \times (9{,}81 \times 10^{-3}) \times 2{,}5$, giving a test pressure of 490,5 kN/m^2.

Dismantle the apparatus and carefully recover the geosynthetic product, the geosynthetic barrier or other contact surface and the lead sheet. Record any change in the condition of the cover material.

— To 8.3:

Visually examine the geosynthetic product and the geosynthetic barrier or other contact surface and record the number of holes or other significant damage.

— To 8.4

Select the five indentations which have the greatest deformation lengths, taking into account both the depth and the steepness of the sides.

B.8 Calculation

See Clause 9 of this standard. For each axis calculate correct to 0,01 the local strain (see 3.1) and the incremental strains (see B.2.1).

The strain results for the three indentations with the highest mean strain values of both axes are the values which should be included in the final report.

B.9 Test report

See Clause 10 of this standard with following modifications:

— replace item h) with: "report the six local strain values and their arithmetic mean together with the incremental strains";

— add j): report any significant change in the condition of the cover material;

— add k): report any significant damage to the geosynthetic barrier.

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