Geosynthetics — Determination of burst strength

ICS 59.080.70; 91.100.50

British Standards

National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/553, Geotextiles and geomembranes.

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Geosynthetics - Determination of burst strength

Géosynthétiques - Détermination de la résistance à l'éclatement

Geokunststoffe - Bestimmung der Berstdruckfestigkeit

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Foreword

This document (EN 14151:2010) 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of an identical text or by endorsement, at the latest by December 2010, and conflicting national standards shall be withdrawn at the latest by December 2010.

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1 Scope

This European Standard specifies a method for the determination of bi-axial properties (burst strength) of geosynthetics.

This method applies to geotextiles, geosynthetic barriers and their related products. It applies to clay geosynthetic barriers only when tested in dry conditions.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN ISO 10318:2005, *Geosynthetics — Terms and definitions (ISO 10318:2005)*

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 10318:2005 apply.

4 Principle

A circular specimen, clamped around its edge, is subjected to a gradually increasing normal hydraulic stress, with a constant rate of increase of volume, until rupture occurs.

The main parameters measured during the test are the hydraulic pressure under the specimen and the deflection of the specimen.

For geotextiles, dry clay geosynthetic barriers and products with apertures, e.g. geogrids, it is necessary to use an appropriately thin, impermeable and deformable membrane (diaphragm) under the specimen. If any composite material comprises an impermeable layer it is not necessary to use a diaphragm in the tests.

5 Apparatus

5.1 General

The equipment is composed of:

— a test cell with two parts;

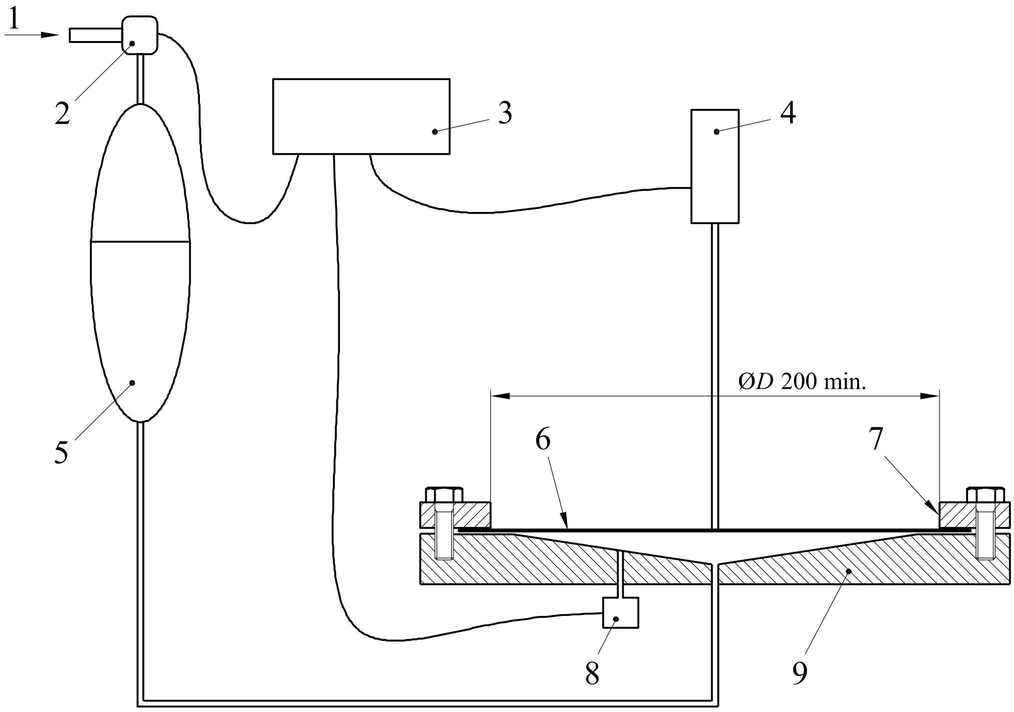
— a deflection measuring device;

— a pressure measuring device;

— a means of controlling flow rate

An example is shown in Figure 1.

Dimensions in millimetres



Key

1 air

2 pneumatic servovalve

3 computer

4 displacement sensor

5 water vessel

6 specimen

7 clamping ring

8 pressure transducer

9 base

Figure 1 — Example of testing apparatus

5.2 Cell

The cell is composed of a base and a clamping ring. The inner diameter (*D*) of the ring, shall be (200 ± 2) mm. This diameter is the effective diameter of the tested specimen. The lower inner edge of the clamping ring shall be rounded (approximately a 3 mm radius). The bottom (base) of the cell, maintained horizontally, can be either flat or recessed with a liquid inlet at its centre.

The cell shall be designed so that no essential deformation occurs under the applied pressure. The clamping device shall be designed in order to avoid any slippage of the specimen during the test. Clamping shall not damage the specimen.

5.3 Deflection measurement

The deflection of the centre of the specimen is measured with a deflection measuring device. Any measuring method meeting the following criteria is acceptable:

— ability to measure deflection up to the diameter of the cell;

— an accuracy of ± 0,5 mm;

— creation of negligible stress on the specimen.

This measurement is used to calculate the deformation of the specimen.

5.4 Pressure measurement

A pressure measuring device with an accuracy of ± 1 % shall be used to measure the liquid pressure in the cell. The temperature of the liquid shall be (20 ± 2) °C and shall be maintained constant during the test.

5.5 Volume control

The equipment shall allow control of the incoming liquid flow.

6 Specimens

Five specimens shall be cut from the test sample. They shall be clean and without any visible defects. Clay geosynthetic barriers may only be tested in dry condition.

NOTE If the surface of the specimen is rough, it can be necessary to smooth the clamping area in order to ensure a perfect seal.

7 Conditioning

The test specimens shall be conditioned and the test performed in the standard atmosphere for testing as defined in ISO 554 ((20 ± 2) °C and (65 ± 5) % relative humidity).

The specimens can be considered to have been conditioned when the change in mass in successive weightings made at intervals of not less than 2 h does not exceed 0,25 % of the mass of the test specimen.

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

8 Procedure

8.1 General

If the cell is not flat, fill the base up to its flange with liquid.

Put the specimen on the base of the cell and, if necessary, put the thin membrane (diaphragm) under it.

NOTE The mechanical properties of the thin membrane in theory should not affect the measurements. Its bi-axial mechanical strength should be negligible compared with the tested geosynthetic. However, the influence of the membrane should be taken into account for calculations.

If the cell is flat, apply a little vacuum under the specimen before clamping. Place the deflection measuring device in the centre of the specimen. If the specimen is not flat, the zero deflection is determined by the level of the lower face of the clamping ring.

Non-spherical or non-symmetrical deformation, e.g. as it occurs with anisotropic materials, shall be reported.

The test is not valid if the specimen breaks at the edge of the clamping ring.

8.2 Volume control

The test is conducted with an incoming liquid flow rate of 3 cm^3/s.

Ensure no slippage or fluid leakage has occurred around the perimeter of the clamp.

8.3 Diaphragm correction

With the same rate of liquid flow as employed in the tests, distend the diaphragm (without the presence of the specimen) and note the pressure required to distend it by an amount equal to the average distension of the specimens. This pressure is the “diaphragm correction”.

9 Calculations

Strain and stress calculations are based on the following assumptions (see also Figure 2):

— spherical deformation;

— constant and uniform thickness of the specimen.

Geometrical considerations lead to:

$$R = \frac{H^2 + \frac{D^2}{4}}{2H} \quad (1)$$

where

D is the inner diameter of the cell (in m);

H is the deflection of the specimen at the centre (in m);

R is the radius of the sphere (in m);

$$\alpha = Arc\cos\left[\frac{R-H}{R}\right] \quad (2)$$

where

H is the deflection of the specimen at the centre point (in m);

R is the radius of the sphere (in m);

α is the half-angle of the portion of circle (in radians).

The strain is:

$$\varepsilon = 100\left(\frac{R\alpha}{\left(\frac{D}{2}\right)} - 1\right) \quad (3)$$

where

ε is the strain (in %);

D is the inner diameter of the cell (in m);

R is the radius of the sphere (in m);

α is the half-angle of the portion of circle (in radians).

The stress in the specimen is:

$$\sigma = \frac{PR}{2e} \quad (4)$$

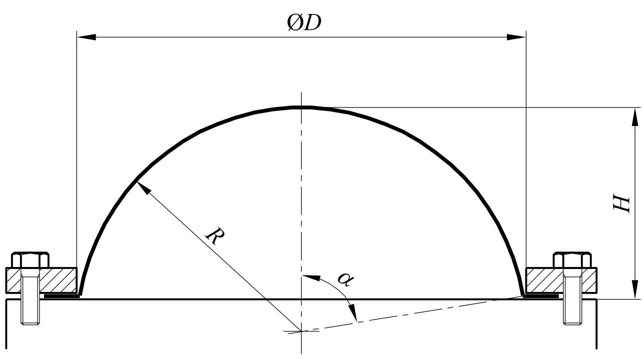
where

σ is the stress (in kPa);

e is the initial thickness of the specimen (in m);

P is the pressure under the specimen (kPa).

NOTE Where a diaphragm has been used in the tests, *P* should be the recorded pressure minus the diaphragm correction.



Key

H deflection of the centre point, in metres

α half-angle of the position o f circle, in radians

R radius of the sphere, in metres

D inner diameter of the cell, in metres

Figure 2 — Measurements and geometrical considerations

10 Test report

The test report shall include the following information:

a) the number and year of publication of this European Standard;

b) if applicable, the description of the impermeable material (diaphragm) used, and the diaphragm correction;

c) the identification of the sample, date of receipt and date of testing;

d) the thickness of the specimen;

e) the side placed in contact with the fluid (if any visible difference);

f) the fluid temperature;

g) mean values and standard deviations of stress and strain at rupture;

h) any observations made during the test (such as shape of the deformation);

i) any deviation from this procedure.

Bibliography

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

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

[3] EN ISO 9863-1, *Geosynthetics — Determination of thickness at specified pressures — Part 1: Single layers (ISO 9863-1:2005)*

[4] EN ISO 9863-2, *Geotextiles and geotextile-related products — Determination of thickness at specified pressures — Part 2: Procedure for determination of thickness of single layers of multilayer products (ISO 9863-2:1996)*

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