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Geosynthetics — Determination of the protection efficiency of a geosynthetic against impact damage

Géosynthétiques — Détermination de l'efficacité de protection d'un géosynthétique contre l'effet d'un impact

Reference number
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Foreword

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ISO 13428 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 189, *Geosynthetics*, in collaboration with Technical Committee ISO/TC 221, *Geosynthetics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Geosynthetics — Determination of the protection efficiency of a geosynthetic against impact damage

1 Scope

This International Standard describes an index test for the determination of the protection efficiency of a geosynthetic on a hard surface, exposed to the impact load of a hemispherical object.

The index test measures the change in thickness of a thin lead plate lying between the geosynthetic and a rigid support.

It can also be used as a performance test, by using the real rigid surface to protect and the real sequence of geosynthetics.

The test is applicable to all geosynthetics with apertures smaller than 15 mm (maximum size).

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.

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

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

ISO 9863-1, *Geosynthetics — Determination of thickness at specified pressure — Part 1: Single layers*

ISO 9864, *Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products*

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

3 Terms and definitions

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

3.1
plate thickness
s
thickness of the thin lead plate

NOTE Plate thickness is expressed in millimetres.

3.2
initial plate thickness
s_i
plate thickness under an applied pressure of 2 kPa

NOTE Initial plate thickness is expressed in millimetres.

3.3
residual plate thickness
s_r
plate thickness after an impact, in the centre of the impact area

NOTE Residual plate thickness is expressed in millimetres.

3.4
probe
hemispherical mass used to produce the impact on the geosynthetic specimen

NOTE The probe is shown in Figure 3.

3.5
nominal specimen thickness
t_n
thickness of the specimen when subjected to an applied normal stress of 2 kPa, when measured in accordance with ISO 9863-1

NOTE Nominal specimen thickness is expressed in millimetres.

4 Principle

A geosynthetic test specimen is subjected to an impact load produced by a rigid probe with a hemispherical head. The probe hits the specimen with a known energy.

The specimen lies on a rigid support, consisting of a thick steel plate of set characteristics and dimensions. A thin lead plate is placed between the steel plate and the specimen.

The five specimens are each subjected to one impact. A single lead plate can be used for all five specimens.

The residual thickness of the lead plate is measured in the impacted areas and the average residual thickness is calculated.

The impact energy is given by:

$$E = F \times h \tag{1}$$

where

E is the impact energy, in joules;

F is the weight of the probe, in newtons;

h is the distance between top surface of the specimen and bottom point of the probe, in metres.

5 Test specimens

5.1 Sampling

Take specimens in accordance with ISO 9862.

5.2 Number and dimensions of test specimens

Cut five specimens for each face from the test sample. A new set of specimens is required for each test.

Specimens shall meet the following criteria:

— the shape of the specimen shall be square (see Figure 2);

— the minimum size of the specimen shall be 100 mm × 100 mm (see Figure 2).

5.3 Conditioning

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

The specimens can be considered to be conditioned when the change in mass in successive weighings 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 the 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. This information shall be included in the test report.

6 Apparatus (see Figure 1)

6.1 Probe

The probe is made of a steel cylinder with a hemispherical head of 20 mm diameter. It is fixed to a trigger (Figure 3).

NOTE The probe may move inside a large tube, e.g. acrylic glass, to provide protection for the operator. For performance tests, weight and diameter of the probe and the falling height can be varied in order to model the real situation.

For index tests, the falling height shall be (1 ± 0,01) m and the mass of the probe shall be (1 000 ± 2) g.

6.2 Specimen support

The specimen support with all the relevant dimensions is shown in Figure 2.

It consists of a 40 mm thick steel plate, as shown in Figure 2. The steel plate shall have minimum dimensions equal to or exceeding those of the specimens.

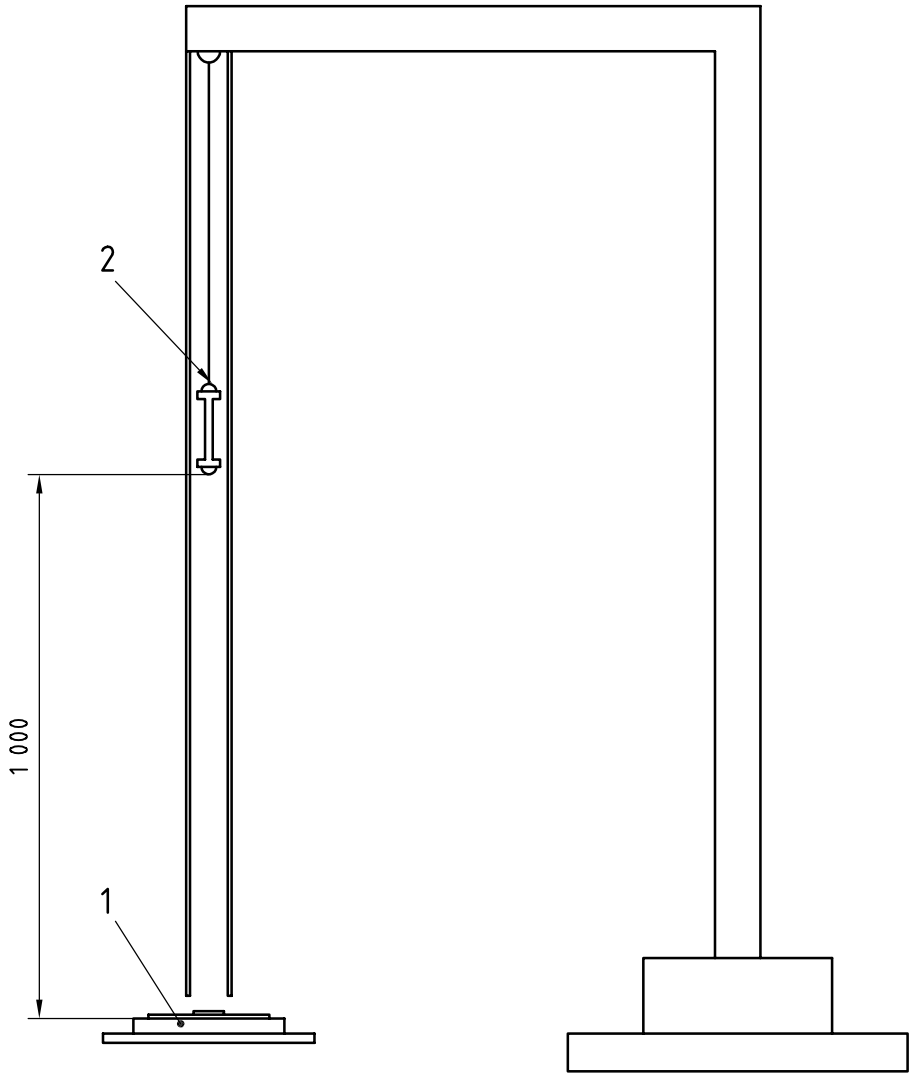
The steel plate shall be put on a flat rigid support, like a concrete floor, which will not bend or settle during the impact. No soft or deformable base shall be used. Before starting the test, it shall be checked that the steel plate lays perfectly on the support and that no vibration occurs when the probe impacts the specimens.

NOTE For this test, the same tube and trigger system as for the cone drop test (EN 918) may be used.

6.3 Lead plate

A soft lead plate, grade 3 according to EN 12588, is placed on the top slab. The lead plate shall have a nominal thickness of 1,8 mm. Since the actual thickness of the lead plates can have local variations of up to 20 % compared to its nominal thickness, the initial thickness in each impact area shall be measured and reported. If the initial thickness of the plate is outside the limits of (1,8 ± 0,2) mm, the plate shall be discarded. The lead plate shall have minimum dimensions of 60 mm × 60 mm. When the specimen is larger then 60 mm, the lead plate's size shall be increased accordingly. Then the specimen shall be placed on the metal plate as shown in Figure 2.

Dimensions in millimetres



Key

1 specimen support

2 probe

Figure 1 — Scheme of the testing apparatus

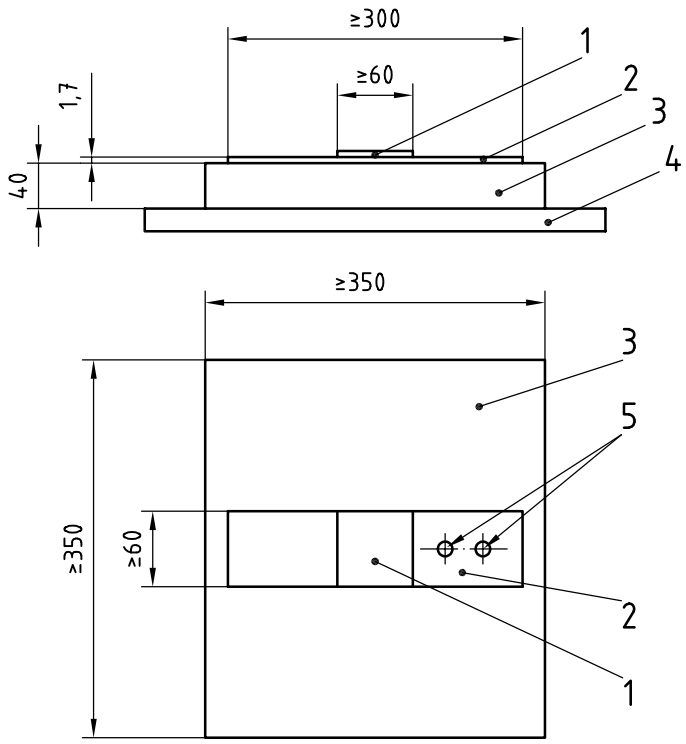
6.4 Thickness gauge

The thickness gauge can be a comparator, or any device able to measure the thickness of a locally deformed metal plate with an accuracy of ± 0,01 mm.

The device shall be capable of measuring under an applied pressure of 2 kPa.

The contact element of the thickness gauge shall have rounded tips with a diameter of 0,50 mm.

Dimensions in millimetres



Key

1 specimen
2 lead plate
3 steel platen
4 rigid base or floor
5 previous impacts

Figure 2 — Specimen support

7 Test procedure

Measure the probe head diameter and the falling height of the probe from its lowest point when mounted in the guide tube.

Measure the initial thickness s_i of the lead plate, the nominal thickness t_n of each specimen, in accordance with ISO 9863-1, and mass per unit area ρ of each specimen in accordance with ISO 9864.

Assemble the steel plate, the lead plate and the first specimen.

Load the probe in the starting position and release the trigger.

Remove the specimen.

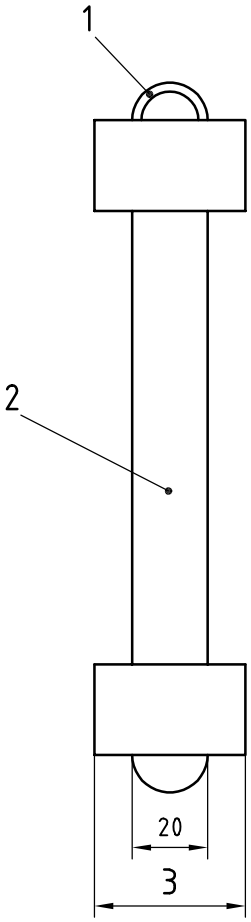
Place a new lead plate and a new specimen on the lead plate.

Impact the specimen with the probe.

Repeat for all specimens of the same face. Repeat for the specimens of the other face.

Measure the minimum residual thickness t_r of the lead plates in the impact areas with the thickness gauge.

Dimensions in millimetres



Key

1 support matching the triggering system

2 probe body (indicative shape only)

3 probe width fitting the guide tube diameter

Figure 3 — Probe

8 Calculation

Calculate the average mass per unit area ρ_A and the average nominal thickness $\overline{t}_n$ of the specimens.

Calculate, for each specimen, the residual thickness of the lead plate s_{rk}* corrected versus the mass per unit area ρ_{Ak}:

$$s_{rk}{}^{*} = s_{rk} \cdot \frac{\rho_{Ak}}{\rho_A} \tag{2}$$

where

s_{rk}* is the residual thickness of the lead plate, in millimetres, corrected versus the mass per unit area, for the kth specimen;

s_{rk} is the residual thickness of the lead plate for the kth specimen;

ρ_{Ak} is the average mass per unit area of the kth specimen.

For each face, calculate the percent residual thickness [S_r (%)] of the lead plates in the impact areas

$$S_r(\%) = \frac{\sum_{k=1}^{n} s_{rk}^{*} / s_{ik}}{n} \times 100 = \frac{100}{n} \times \sum_{k=1}^{n} \frac{s_{rk}}{s_{ik}} \times \frac{\rho_{Ak}}{\rho_A} = \frac{100}{n \cdot \rho_A} \times \sum_{k=1}^{n} \frac{s_{rk} \cdot \rho_{Ak}}{s_{ik}} \quad (3)$$

9 Test report

The test report shall include the following information:

a) number and date of this International Standard;

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

c) conditioning atmosphere;

d) the type of apparatus used with a complete description, in particular, the probe head diameter, probe weight and falling height;

e) the specimen support, with a detailed description of each element and the floor on which it lies;

f) the description of the lead plates and their dimensions;

g) the initial thickness s_{ik} of the lead plates, the nominal thickness t_{nk} and mass per unit area ρ_{Ak} of each specimen, plus the size of the specimens;

h) a list of the residual thickness values s_{rk} of the lead plate in the impact areas, for each specimen;

i) the average nominal thickness $\bar{t}_n$ and average mass per unit area ρ_A of the specimens;

j) for each face, the average percent residual thickness of the lead plates;

k) any agreed departure from the procedure;

l) any unusual behaviour observed during the test.

Annex A
(informative)

Performance testing

This Annex describes modifications to the standard index-test procedures which can then be used for a performance test, as follows:

a) the specimen may be composed of the real protected surface and the real protecting geosynthetic;

b) the specimen support may be made up of a piece of the real support;

c) the impact energy may be increased or decreased to simulate real conditions;

d) the result of the test may be evaluated by visual observation of the protected surface or by any other suitable means.

Bibliography

[1] EN 918, *Geotextiles and geotextile-related products — Dynamic perforation test (cone drop test)*

[2] NF P 84-506, *Géomembranes — Dispositifs d'étanchéité pour géomembranes (DEG) — Determination de la résistance au poinçonnement dynamique — Cas d'un support rigide — Méthode du pendule*

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