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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

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Contents

Page

Foreword ..... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Principle **2**

5 Test specimens **3**
5.1 Sampling 3
5.2 Number and dimensions of test specimens 3
5.3 Conditioning 3

6 Apparatus **3**
6.1 General 3
6.2 Probe 3
6.3 Specimen support 3
6.4 Lead plate 4
6.5 Thickness gauge 5

7 Test procedure **5**

8 Calculation **6**

9 Test report **7**

Annex A (informative) **Performance testing** **8**

Bibliography **9**

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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

This second edition cancels and replaces the first edition (ISO 13428:2005), which has been technically revised.

The main changes are as follows:

— the normative references have been updated;

— Figure 1 has been corrected;

— the thickness of lead plate has been modified to 2,0 mm.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

1 Scope

This document 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 is also 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 pressures — Part 1: Single layers*

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

ISO 10318-1, *Geosynthetics — Part 1: Terms and definitions*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
lead plate thickness
s
thickness of the thin plate used to assess the effect of impact

Note 1 to entry: Plate thickness is expressed in millimeters.

3.2
initial lead plate thickness
s_i
lead plate thickness (3.1) under an applied pressure of 2 kPa

Note 1 to entry: Initial plate thickness is expressed in millimetres.

3.3
residual lead plate thickness
s_r
lead plate thickness (3.1) after an impact, in the centre of the impact area

Note 1 to entry: Residual lead plate thickness is expressed in millimetres.

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

Note 1 to entry: The probe is shown in Figure 3.

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

Note 1 to entry: Nominal 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.

This test is relevant for applications like geonets protecting the coating of steel pipelines and geocomposites or geospacers protecting the geomembrane placed on the back face of a concrete retaining wall, where stones dumped during backfilling can cause an impact of the same type that is simulated in the test.

The standard index-test procedures may be modified to be used for a performance test, as described in Annex A.

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

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

The impact energy is given by Formula (1):

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

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 before releasing the trigger, 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 60 mm × 60 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 in accordance with ISO 554.

The specimens may 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.

Either conditioning or testing, or both, 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

6.1 General

NOTE See Figure 1.

6.2 Probe

The probe is made of a steel cylinder with a hemispherical head of (20 ± 0,5 mm) diameter. It is fixed to a triggering system (Figure 3).

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

For index tests, the falling height shall be (1 000 ± 10) mm and the mass of the probe shall be (1 000 ± 2) g.

6.3 Specimen support

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

It consists of a (40 mm ± 0,5 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 (ISO 13433) are used.

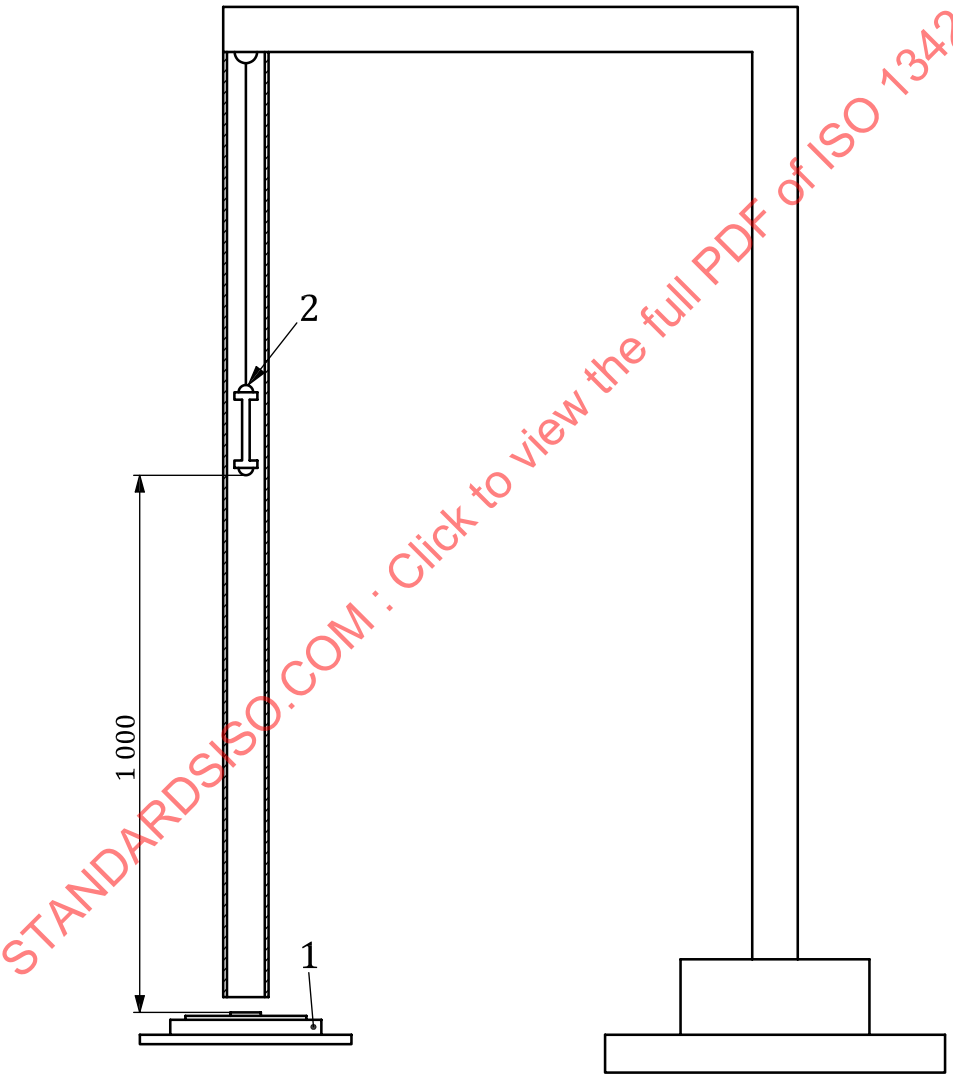
6.4 Lead plate

A soft lead plate, grade 3 in accordance with EN 12588, shall be placed on the steel plate. The lead plate shall have a nominal thickness of (2,0 ± 0,2) 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 (2,0 ± 0,2) mm, the plate shall be discarded. The lead plate shall have minimum dimensions of 60 mm × 60 mm for each specimen. It is possible to use a single lead plate with minimum dimensions of 60 mm × 300 mm, divided in 5 square areas, as shown in Figure 2. When the specimen is larger than 60 mm, the size of the lead plate shall be increased accordingly. Then the specimen shall be placed on the metal plate as shown in Figure 2. Lead plates shall be handled with precaution, by wearing gloves and breath masks.

NOTE 1 Lead can have potential effects on the health of occupants of the testing laboratory.

NOTE 2 Other soft metal plates, like copper and tin conforming to EN 506 and EN 611-2, are substitutes of the lead plate.

Dimensions in millimetres



Key

1 specimen support

2 probe

Figure 1 — Scheme of the testing apparatus

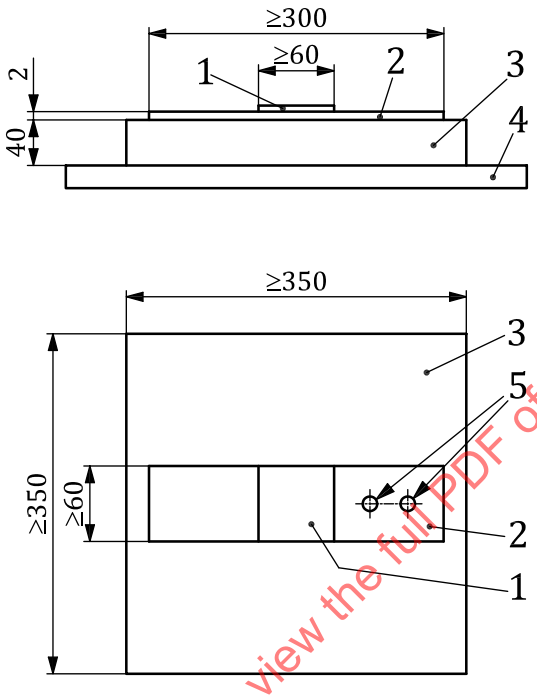
6.5 Thickness gauge

The thickness gauge may 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 ± 0,01) mm.

Dimensions in millimetres



Key

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

Figure 2 — Specimen support

7 Test procedure

The test procedure shall be as follows:

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

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

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

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

e) Remove the specimen.

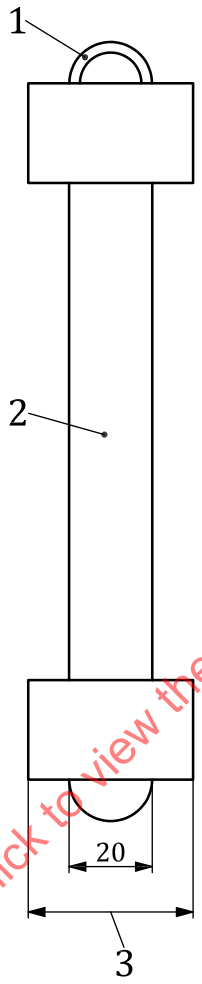
f) Place a new lead plate and a new specimen on the lead plate.

g) Impact the specimen with the probe.

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

i) 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 $\bar{t}_n$ 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} according to Formula (2):

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

where

ρ_A is the average mass per unit area;

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

s_{rk} is the residual lead plate thickness 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 according to Formula (3):

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

where

ρ_A is the average mass per unit area;

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

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

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

s_{ik} is the initial lead plate thickness of the plate used for the kth specimen.

9 Test report

The test report shall include the following information:

a) a reference to this document, including the date of publication, i.e. ISO 13428:2024;

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.