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Geosynthetics — Determination of friction characteristics —

Part 1: Direct shear test

Géosynthétiques — Détermination des caractéristiques de frottement —

Partie 1: Essai de cisaillement direct

Reference number
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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 documents 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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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 221, *Geosynthetics*.

This second edition cancels and replaces the first edition (ISO 12957-1:2005), which has been technically revised. The main changes compared to the previous edition are as follows:

— introduction of the possibility to test the shear between two geosynthetics;

— introduction of the possibility to test soil different from the standard sand.

A list of all parts in the ISO 12957 series can be found on the ISO website.

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 friction characteristics —

Part 1: Direct shear test

1 Scope

This document specifies an index test method to determine the friction characteristics of geosynthetics in contact with a standard sand as described in EN 196-1, i.e. with a specified density and moisture content, under a normal stress and at a constant rate of displacement, using a direct shear apparatus.

The same testing procedure can be used with any type of soil with the density and moisture content that are required to evaluate the performance under specific conditions or with another geosynthetic under a normal stress and at a constant rate of displacement, using a direct shear apparatus.

The procedure can also be used for testing geosynthetic barriers.

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

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions 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 http://www.electropedia.org/

3.1
relative displacement
s
displacement of the sand, soil or other geosynthetic relative to the specimen during shearing

Note 1 to entry: Relative displacement is expressed in millimetres (mm).

3.2
normal force
N
constant vertical force applied to the specimen

Note 1 to entry: Normal force is expressed in kilonewtons (kN).

3.3
shear force
S
horizontal force measured during shearing at a constant rate of displacement

Note 1 to entry: Shear force is expressed in kilonewtons (kN).

3.4
normal stress
σ
normal force (3.2) divided by the contact area of the specimen

Note 1 to entry: Normal stress is expressed in kilopascals (kPa).

3.5
shear stress
τ
shear force (3.3) along the sand, soil or other geosynthetic /geosynthetic interface, divided by the contact area of the specimen

Note 1 to entry: Shear stress is expressed in kilopascals (kPa).

3.6
maximum shear stress
τ_{max}
maximum value of *shear stress* (3.5) developed in a shear test

Note 1 to entry: Maximum shear stress is expressed in kilopascals (kPa).

3.7
angle of friction
ϕ
slope of the "best fit regression straight line", through the plot of *maximum shear stress* (3.6)

Note 1 to entry: The angle of friction is expressed in degrees (°).

Note 2 to entry: In this document, ϕ_{sg} is used to refer to the angle of friction between geosynthetic and sand, or geosynthetics and specific soil, and ϕ_{gg} is used for the angle of friction between geosynthetic and geosynthetic.

3.8
apparent cohesion
c_{sg}
calculated value of the *shear stress* (3.5) on the "best fit regression straight line" corresponding to zero *normal stress* (3.4)

Note 1 to entry: Apparent cohesion is expressed in kilopascals (kPa).

Note 2 to entry: This term is used between geosynthetic and sand, or geosynthetics and specific soil.

3.9
maximum shear stress in sand or soil alone
$\tau_{max,s}$
maximum shear stress (3.6) developed during a shear test on sand or soil alone

Note 1 to entry: Maximum shear stress in sand or soil alone is expressed in kilopascals (kPa).

3.10
maximum shear stress sand or soil/support
$\tau_{max,sup}$
maximum shear stress (3.6) developed during the shearing along the sand or soil/support interface without geosynthetic

Note 1 to entry: Maximum shear stress sand or soil/support is expressed in kilopascals (kPa).

3.11
friction ratio
$f_g(\sigma)$
ratio of the *maximum shear stress*, τ_{max} (3.6) to the *maximum shear stress in sand or soil alone*, $\tau_{max,s}$ (3.9) for the same *normal stress* (3.4) σ

3.12
apparent adhesion
a_{gg}
calculated value of the *shear stress* (3.5) on the "best fit regression straight line" corresponding to zero *normal stress* (3.4)

Note 1 to entry: Apparent adhesion is expressed in kilopascals (kPa).

Note 2 to entry: This term is used between geosynthetic and geosynthetic.

4 Principle

A geosynthetic is submitted to direct shear at its contact surface with standard sand, specific soil or another geosynthetic in a shear apparatus or similar apparatus. The angle of friction at the sand/geosynthetic, soil/geosynthetic or geosynthetic/geosynthetic interface is determined.

When geogrids are tested in contact with soil with a rigid support, the results are dependent on the friction with the support and the results are not necessarily realistic. The accuracy of the test should be verified by calibration tests.

5 Test specimens

5.1 Sampling

Take specimens in accordance with ISO 9862.

5.2 Number and dimensions of test specimens

Cut four specimens from the test sample of geosynthetic for each direction to be tested for every sample. The size of the specimens shall suit the dimensions of the apparatus.

If the two faces of the sample are different, both faces shall be tested; four specimens shall be tested for each face.

6 Conditioning

Condition the test specimens and conduct the tests in the standard atmosphere for testing defined in ISO 554, i.e. at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 2) %, until the change in mass between successive readings made at intervals of not less than two hours does not exceed 0,25 % of the mass of the test specimens.

Conditioning and/or testing at a specified relative humidity may be omitted if it can be proven that the results are not affected by this omission.

7 Apparatus

7.1 Shearing apparatus

7.1.1 Constant contact area shear apparatus, schematically represented in Figure 1.

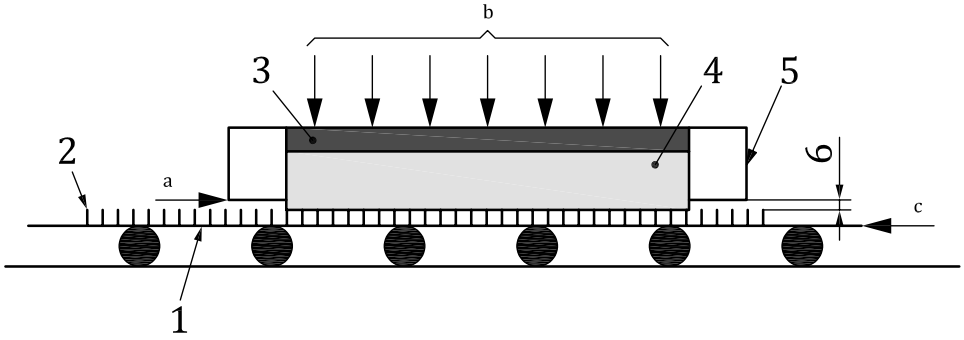
The shear apparatus shall be divided into upper and lower sections. The apparatus shall be sufficiently rigid to resist distortion under the loads applied. It shall be possible to lift the upper part of the shear apparatus from the lower part.

The upper part of the shear apparatus shall have internal dimensions of not less than 300 mm × 300 mm, the width of both parts being not less than 50 % of their length. The box shall be sufficiently deep to accommodate the sand layer and the loading system, or a rigid support to which the upper geosynthetic has to be fixed.

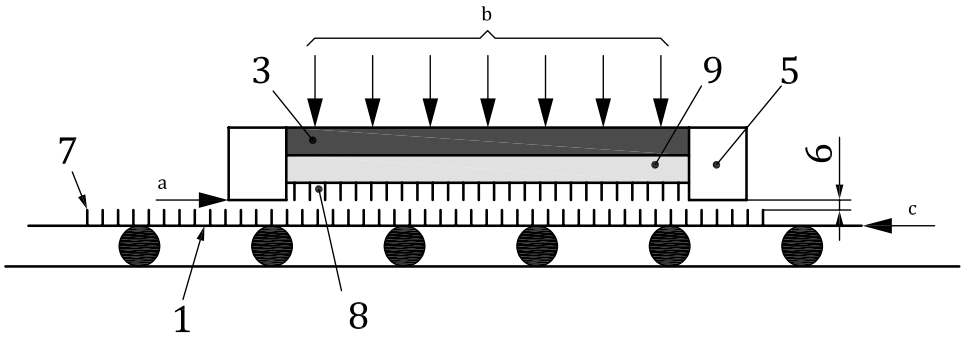
For the testing of geogrids, the minimum dimensions of the shear apparatus shall be such that at least two full longitudinal ribs and three transverse bars are contained within the length of both the upper and lower boxes throughout the test.

The lower part of the shear apparatus shall contain the support of the specimen and any clamping arrangements to prevent the specimen from slipping during the test.

The lower part of the shear apparatus shall be sufficiently long to maintain full contact between specimen and the open area of the upper part over a relative shear displacement of at least 16,5 % of the internal length of the top part.



a) Constant area direct shear test (typical layout) for sand/generic soil — Geosynthetic interface



b) Constant area direct shear test (typical layout) for geosynthetic — Geosynthetic interface

Key

1 rigid base
2 geosynthetic specimen
3 loading system
4 standard sand/generic soil
5 rigid shear box
6 appropriate gap
7 geosynthetic #1 specimen
8 geosynthetic #2 specimen
9 rigid specimen support
a Horizontal reaction.
b Normal load.
c Horizontal force.

Figure 1 — Constant area direct shear test