
**Geosynthetics — Determination of
friction characteristics —**

**Part 1:
Direct shear test**

*Géosynthétiques — Détermination des caractéristiques de
frottement —*
Partie 1: Essai de cisaillement direct

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12957-1 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 221, *Geosynthetics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read “...this European Standard...” to mean “...this International Standard...”.

ISO 12957 consists of the following parts, under the general title *Geosynthetics — Determination of friction characteristics*:

- Part 1: *Direct shear test*
- Part 2: *Inclined plane test*

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Foreword

This document (EN ISO 12957-1:2005) has been prepared by Technical Committee CEN/TC 189 "Geosynthetics", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 221 "Geosynthetics".

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of an identical text or by endorsement, at the latest by August 2005, and conflicting national standards shall be withdrawn at the latest by August 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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1 Scope

This document describes an index test method to determine the friction characteristics of geotextiles and geotextile-related products in contact with a standard sand, 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 procedure can also be used for testing geosynthetic barriers.

When geogrids are tested 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.

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 6344-2, *Coated abrasives — Grain size analysis — Part 2: Determination of grain size distribution of macrogrits P 12 to P 220*.

EN ISO 9862, *Geotextiles — Sampling and preparation of test specimens (ISO 9862:2005)*.

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3 Terms and definitions (standards.iteh.ai)

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

3.1

relative displacement (s)

displacement of the sand relative to the specimen during shearing, in millimetres

3.2

normal force (N)

constant vertical force applied to the specimen, in kilonewtons

3.3

shear force (S)

horizontal force, measured during shearing at a constant rate of displacement, in kilonewtons

3.4

normal stress (σ)

normal force divided by the contact area of the specimen, in kilopascals

3.5

shear stress (τ)

shear force along the sand/geotextile interface, divided by the contact area of the specimen, in kilopascals

3.6

maximum shear stress (τ^{\max})

maximum value of shear stress developed in a shear test, in kilopascals

3.7

angle of friction (ϕ_{sg}) (between geosynthetic and sand)

slope of the "best fit straight line", through the plot of maximum shear stress, in degrees

3.8

apparent cohesion (c_{sg}) (between geosynthetic and sand)

calculated value of the shear stress on the "best fit straight line" corresponding to zero normal stress, in kilopascals

3.9

maximum shear stress in sand (τ_s^{max})

maximum shear stress developed during a shear test on sand alone, in kilopascals

3.10

maximum shear stress sand/support (τ_{sup}^{max})

maximum shear stress developed during the shearing along the sand/support interface (without geosynthetic), in kilopascals

3.11

friction ratio ($f_g(\sigma)$)

ratio of the maximum shear stress τ^{max} (friction test sand/geosynthetic) to the maximum shear stress τ_s^{max} (shear test on sand alone) for the same normal stress σ

4 Principle

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

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5 Test specimens

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5.1 Sampling

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Take specimens in accordance with EN ISO 9862.

5.2 Number and dimensions of test specimens

Cut four specimens from the test sample for each direction to be tested. 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.

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

7 Apparatus

7.1 Shearing apparatus

7.1.1 Constant contact area shear box (schematically represented in Figure 1)

The shear box 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 box from the lower part.

The upper part of the shear box shall have internal dimensions of not less than 300 mm × 300 mm, the width of both boxes being not less than 50 % of their length. The box shall be sufficiently deep to accommodate the sand layer and the loading system.

For the testing of geogrids the minimum dimensions of the shear box 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 box throughout the test.

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

7.1.2 Reducing contact area shear box (schematically represented in Figure 2)

Alternatively a standard soil shear box with equally sized (300 mm × 300 mm minimum) upper and lower halves can be used.

7.2 Specimen support

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The specimen shall be placed on a rigid, horizontal support in the lower part of the shear box. The specimen shall be fixed to prevent, as far as possible, any relative displacement between the specimen and the support. The geosynthetic should be clamped at the front part outside the shear area. Inside the friction area, it should be fixed by gluing or with a standard friction support, e.g. an aluminium oxide abrasive sheet (P 80 type in accordance with ISO 6344-2).

When using a rigid plate as support for geogrids (or geotextiles) with a high percentage of openings, friction tests between sand and the support shall be performed and the maximum shear stress (τ_{sup}^{max}) related to every normal stress shall be evaluated.

NOTE For geogrids with large apertures (> 15 mm) and a high percentage of openings (> 50 % of the overall surface of the specimen), a sand support may be used, i.e. by filling the lower box with standard sand at the specified density.

7.3 Rigid carriage

The shear box shall be supported on the machine bed on low friction bearings, which allow movement in the longitudinal direction.

7.4 Loading device

The loading device shall be capable of applying a horizontal shear force to the shear box at a constant rate of displacement of (1 ± 0,2) mm/min.