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Geotextiles and geotextile-related products — Determination of water flow capacity in their plane —

Part 2: Performance test

Géotextiles et produits apparentés — Détermination de la capacité de débit dans leur plan —
Partie 2: Essai de performance

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of 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 www.iso.org/iso/foreword.html.

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 first edition of ISO 12958-2, together with ISO 12958-1, cancels and replaces ISO 12958:2010, which has been technically revised.

A list of all parts in the ISO 12958 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.

Introduction

The results obtained under this test procedure do not compare with those obtained under ISO 12958-1, even if some of the test conditions are similar.

Many geosynthetic products can creep under constant load, i.e. see their thickness diminish over time, which can influence their in-plane water flow capacity. Although a seating time typically greater than the one used in ISO 12958-1 is used, this test does not cover all creep-related issues for drainage geocomposites. Assessment of long-term flow capacity involves further considerations.

This procedure can be useful to assess the effect of geotextile intrusion into the drainage core on the transmissivity of a drainage product, using soil from a particular project as a stress-distribution layer in contact with the geotextile.

Other test methods can be more suitable for the characterization of particular drainage products, such as ISO 18325 for prefabricated vertical drains. It is the responsibility of the user to assess the limit of this test procedure and select the appropriate test method, test conditions or both that adequately reflect the particular needs for their project.

In this test method, the flow capacity of the product in a given direction is evaluated considering soil confinement, service load and service hydraulic gradient, as well as primary creep. However:

— For some products and designs, ensuring the product performance may require controlling the flow capacity of the product in both directions, for example for products with discrete draining elements, where the flow capacity significantly depends on the direction of flow. For these situations, the test shall be performed in both directions.

— Other field-related issues affect material long-term performance, such as secondary or tertiary creep, chemical or biological clogging, chemical resistance and durability, installation and backfilling. These issues are covered in separate standards and it is essential that they be considered while designing with geosynthetics.

Geotextiles and geotextile-related products — Determination of water flow capacity in their plane —

Part 2: Performance test

1 Scope

This document specifies a method for determining the constant-head water flow capacity within the plane of a geotextile or geotextile-related product, using boundary materials and test conditions of interest. A standard series of test conditions are proposed, involving soil confinement, low hydraulic gradients, seating times and an array of normal loads.

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 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances*

ISO 5813, *Water quality — Determination of dissolved oxygen — Iodometric method*

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

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

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

3 Terms and definitions

For the purposes of this document, terms and definitions in ISO 10318-1 and 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
normal compressive stress
σ
compressive stress normal to the plane of the geotextile or geotextile-related product, expressed in kilopascals [kPa]

3.2
in-plane flow
Q
fluid flow within the geotextile or geotextile-related product and parallel to its plane, expressed in litres per second [l/s]

3.3
performance in-plane water flow capacity
$q_{\mathrm{p\ perf}\ (\sigma,i,t,b)}$
volumetric flow rate of water per unit width of specimen at a defined normal compressive stress (σ), hydraulic gradient (i), seating time (t) and boundary conditions (b), expressed in litres per second per meter [(l/s)/m]

3.4
hydraulic gradient
i
ratio of the head loss in the geotextile or geotextile-related product specimen to the distance between two measuring points within the geotextile or geotextile-related product

Note 1 to entry: ISO/TR 18228-4[1)] provides information on the significance of the hydraulic gradient.

3.5
seating time
period of time during which the product is maintained under constant compressive stress before a measurement is made, expressed in hours (h)

3.6
boundary conditions
b
type of materials contacting the specimen on its external faces

Note 1 to entry: Materials may be soil or granular materials, concrete or rigid platen, or any material likely to be in contact with the geotextile or geotextile-related product.

3.7
geotextile intrusion
effect of the external loads pushing the geotextile into the draining core of the geocomposite, reducing the flow area, on a geocomposite where a geotextile is combined with a draining core

4 Principle

The flow of water within the plane of a geotextile or geotextile-related product is measured under normal compressive stresses, seating time, hydraulic gradients and boundary conditions (contact surfaces) which are representative of a particular field condition.

5 Apparatus and materials

5.1 Constant-head in-plane water flow apparatus, as follows:

a) The apparatus shall be capable of maintaining a constant head loss at different water levels, at least those corresponding to the selected hydraulic gradients, while maintaining a water head at the point of discharge not greater than 100 mm.

b) Reading of the water in open-tube piezometers or manometers is acceptable for hydraulic gradients of 0,1 or more (that is, applied head loss of 30 mm or more). For hydraulic gradients smaller than 0,1 (head loss of 30 mm or less), the use of water pressure transducers is necessary to achieve a maximum permissible measurement error of 5 % of the measured head loss. The water pressure transducers shall be located to capture the actual length of flow over which the water head is measured (effective flow length on Figure 1).

c) If the average water head above the specimen exceeds 100 mm, and the applied normal load is equal to or less than 20 kPa, the normal stress shall be corrected considering the average water head.

1) Under preparation. Stage at the time of publication: ISO/CD TR 18228-4:2020.

d) The apparatus shall include a loading mechanism capable of exerting a constant normal compressive stress on the geotextile or geotextile-related specimen to a maximum permissible measurement error of 1 % of the applied load or 1 kPa, whichever is greater, for a period of time exceeding the seating time.

e) The apparatus should have a minimum width of 0,2 m and a minimum net hydraulic length of 0,3 m. It shall be capable of testing specimens up to a thickness of 50 mm. It shall also be capable of accepting boundary materials to the thickness needed for the test.

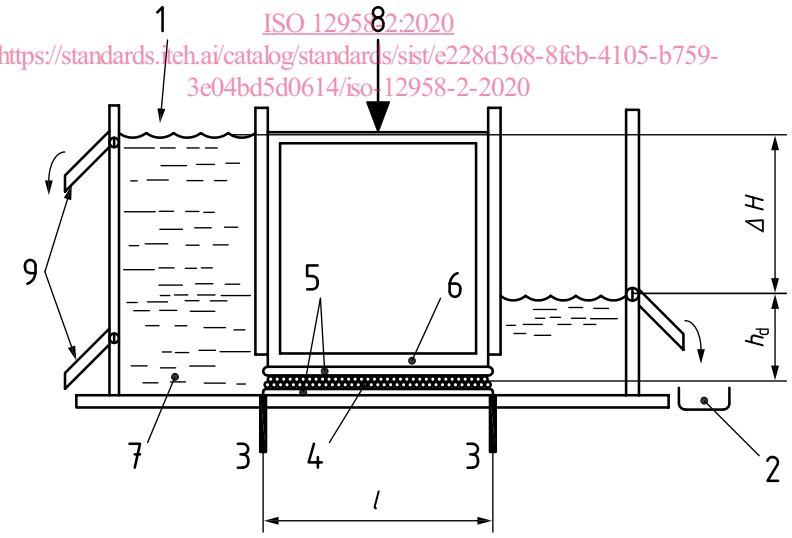
For a specimen length of 0,3 m, the use of test cells narrower than 0,3 m may affect the properties measured on products exhibiting a highly oriented structure, such as biplanar geonets.

The height of the cell shall be sufficient to accommodate installation of a thick layer of soil as per the requirements of 6.4.

f) Soils and other permeable materials used in the test setup to reproduce the boundaries conditions shall be confined in a membrane. The membrane shall not limit soil intrusion into the drain. Membranes with a thickness not exceeding 0,7 mm and a tensile elastic modulus not exceeding 1,12 kN/m were found satisfactory. The membrane shall be checked before each test for integrity. It shall not present any deformation nor puncture visible with the naked eye.

g) Leakage through the apparatus shall not exceed 5 % of the flow rate measured during the test. To verify the leak rate of the apparatus, a blank test shall be conducted periodically using a closed-cell foam in place of the geosynthetic, as well as sand wrapped in a plastic film above and below the closed-cell foam, and tested under the minimum and the maximum normal load which can be applied with the apparatus, as well as the average of these normal loads. The leak check shall be performed using the highest hydraulic gradient which can be applied.

An example of apparatus is shown in Figure 1.



Key

1	water supply	7	water reservoir
2	water collection	8	normal compressive load
3	upstream water head manometers/piezometers	9	overflow weirs
4	specimen	l	effective flow length (≥300 mm)
5	material used as boundary (e.g. soil)	ΔH	head loss
6	loading platen	h_d	downstream water head (≤100 mm)

Figure 1 — Typical example of apparatus

5.2 Water

For water flow rates up to 0,3 (l/s)/m, the water used shall be de-aerated or fed from a stilling tank. The water should be at a temperature between 18 °C and 22 °C and the water temperature should preferably be at or above the ambient temperature of the test laboratory. It is recommended that the oxygen content does not exceed 6 mg/kg, when measured in accordance with ISO 5813 at the point where the water enters the apparatus, to avoid air-clogging of the specimen due to the duration of the test.

For water flow rates greater than 0,3 (l/s)/m, water may be recirculated but care shall be given to avoid changes of temperature across the duration of the test. Water from the mains supply may be used only if its normal temperature is between 18 °C and 22 °C. Mixing hot and cold water to achieve a temperature between 18 and 22 °C is not acceptable as it will release the oxygen dissolved in the colder water because of the change of temperature.

As temperature correction relates only to laminar flow, it is advisable to work at temperatures as close as possible to 20 °C to minimize inaccuracies associated with inappropriate correction factors.

The water shall be filtered to avoid presence of suspended solids.

To avoid biological activity, the water in the stilling tank shall be periodically replaced and shall not be used for a long duration.

5.3 Dissolved-oxygen meter, or apparatus in accordance with ISO 5813.

5.4 Stopwatch, with a maximum permissible measurement error of 0,5 s.

5.5 Thermometer, with a maximum permissible measurement error of 0,5 °C.

5.6 Equipment for determining the water flow rate, to a maximum permissible measurement error of 2 %.

5.7 Measuring device for determining the applied hydraulic head, to a maximum permissible measurement error of 1 mm. For hydraulic gradients of less than 0,1, a manometer with a maximum permissible error of 5 % shall be used.

5.8 Measuring device for determining the applied normal stress, to a maximum permissible measurement error of 1 % or 1 kPa, whichever is greater.

6 Specimens and boundary conditions

6.1 Handling

In order to prevent disturbing its structure, samples of the geotextile or geotextile-related product shall be handled as infrequently as possible and shall not be folded. They shall be kept in a flat position without any load.

If soils or granular materials whose plasticity varies with water content are involved, they shall be maintained at a humidity similar to what can be expected during their installation and service or as agreed upon by parties.

6.2 Selection

Take specimens from the samples to be tested in accordance with ISO 9862.

6.3 Number and dimensions

6.3.1 Geotextile or geotextile-related product

Cut the number of test specimens agreed upon by the parties from the sample with the length parallel to each of the directions of the test (i.e. machine direction, transverse direction or both) so that their length is 0,35 m (−0 m /+0,01 m) in the direction of the test and their width equal to the interior width of the apparatus.

Although statistical representation should require at least three specimens to be tested, the current practice is often to limit this to one or two specimens. Where it is necessary to determine the results within a given confidence interval of the mean, determine the number of test specimens in accordance with ISO 2854.

For products with a regular shape, such as double-cuspated sheets, the width of the specimen shall be a multiple of the width of an elementary component of the product. The specimen shall be cut in a location where the structural integrity of the structure will not be affected. If this leads to the use of a specimen that is less than the width of the apparatus, the edges shall be sealed, for example with a block of closed-cell foam. The normal load and hydraulic gradient applied shall be corrected, taking into account dimensions of the specimen as well as foam properties should the specimen be narrower than the platen used to apply the normal load.

When the geocomposite includes an impermeable core (e.g. a double-cuspated sheet) and the flow to drain penetrates only from one face of the geosynthetic, the flow capacity test should be performed on a specimen purposely prepared in order to prevent the input flow along one of the two faces of the impermeable core. For example, a rubber or mastic strip may be added at the inlet of the specimen.

It is important that the specimen width is not undersized, i.e. that it shows a good push-tight fit. Die-cut specimens are recommended. Specimen length shall be sufficient to ensure the boundary materials will not seal the upstream or downstream edge of the tested product if they are expanding under the action of the normal load.

6.3.2 Other geosynthetic products

The test configuration may involve various types of products, such as geosynthetic barrier (polymeric, clay or bituminous) or geotextile. These products shall be prepared in a similar fashion to the product on which a flow measurement will be made.

6.4 Granular materials used as boundaries

When granular materials are used as a boundary or component of a boundary, their dry unit weight, particle size distribution and other relevant index properties shall be known and attached to the test report, as well as installation conditions used to perform the test.

Should the parties decide to use a soil that differs from the soil anticipated to act as a boundary condition, i.e. for research or to obtain generic information not related to any project in particular, it is recommended that the soil described in Annex C is used.

The minimum thickness of granular materials is determined by the nature of the geosynthetic product being evaluated. It should be greater than three times the distance between two load supports (i.e. cups of a cuspated structure or rib of geonet) and not less than 25 mm. Examples are proposed in Figure 2.