INTERNATIONAL STANDARD

ISO 12958

First edition
1999-02-15

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

Géotextiles et produits apparentés — Détermination de la capacité de débit dans leur plan

r
ISO 12958:199(E)

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.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12958 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 21, *Geotextiles*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "..this European Standard..." to mean "...this International Standard...".

Annexes A and B of this International Standard are for information only.

Annex ZZ provides a list of corresponding International and European Standards for which equivalents are not given in the text.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Foreword

The text of EN ISO 12958:1999 has been prepared by Technical Committee CEN/TC 189 "Geotextiles and geotextile-related products", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 38 "Textiles".

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 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

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

1 Scope

This European standard specifies a method for determining the constant-head water flow capacity within the plane of a geotextile or geotextile-related product.

> NOTE : If the full water flow capacity characteristics of the geotextile or geotextile-related product have previously been established, then for control purposes it can be sufficient to determine the water flow capacity at two loads and both gradients.

> NOTE 2: The compressibility of the product over time will substantially influence the in-plane water flow capacity. A test method for assessing compressive creep behaviour of geotextiles or geotextile-related products is described in ENV 1897.

The test report is judged in conjunction with the long-term compressive creep behaviour in order to assess the long-term flow capacity.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 963	Geotextiles and geotextile-related products - Sampling and preparation of test specimens
EN 964-1	Geotextiles and geotextile-related product - Determination of thickness at specified pressures : Part 1 : Single layers
ENV 1897	Geotextiles and geotextile-related products - Determination of the compressive creep properties
EN 30320	Geotextiles - Identification on site (ISO 10320 : 1991)
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.

3 Definitions

For the purposes of this European Standard the following definitions apply:

3.1 normal compressive stress: Compressive stress components, (expressed in kilopascals) normal to the plane of the geotextile or geotextile-related product.

3.2 in-plane flow: Fluid flow within the geotextile or geotextile-related product and parallel to its plane.

3.3 in-plane water flow capacity: Volumetric flow rate of water per unit width of specimen at a defined gradient and load.

NOTE: The term transmissivity is related to laminar flow conditions only and equals the water flow capacity at a hydraulic gradient equal to unity. As non laminar flow may occur, the term water flow capacity is preferred.

3.4 hydraulic gradient: Ratio of the head loss in the geotextile or geotextile-related product specimen to the distance between the measuring points.

4 Principle

The flow of water within the plane of a geotextile or geotextile-related product is measured under varying normal compressive stresses, typical hydraulic gradients and defined contact surfaces.

5 Apparatus and materials

5.1 Constant-head in-plane water flow apparatus, satisfying the following requirements:

a) The apparatus shall be capable of maintaining a constant head loss at different water levels, at least those corresponding to hydraulic gradients of 0,1 and 1,0, while maintaining a water head at the point of discharge of not greater than 100 mm.

NOTE 1: If the water head exceeds 100 mm, the normal stress should be corrected for the excess.

b) The apparatus shall be capable of maintaining the proposed normal compressive stress on the specimen without deformation which would influence the test results.

c) A loading mechanism, capable of sustaining a constant normal compressive stress on the geotextile specimen of 20 kPa, 100 kPa and 200 kPa to an accuracy of ± 5%.

d) The surfaces contacting the specimen shall be closed-cell foam rubber whose properties satisfy the compression-deflection envelope, illustrated in figure 1, when tested in accordance with EN 964-1.

For specimens with a thickness up to 10 mm, a foam rubber with a nominal thickness of 10 mm shall be used on each face.

For specimens with a thickness between 10 mm and 25 mm, a foam rubber with a nominal thickness of 1 to 1,25 times the specimen thickness shall be used on each face.

For specimens with a thickness over 25 mm, the foam rubber on each face shall have a nominal thickness of 25 mm.

NOTE 2: Two layers of foam rubber may be combined to achieve the desired thickness.

The width of the foam shall be the same as that of the loading platen. The length of the foam should normally be the same as the loading platen. However, to avoid obstruction at both the inlet and outlet due to compression of the foam, it is recommended, where necessary, to reduce its length by 0,4 times its nominal thickness.

NOTE 3: When the geotextile-related products to be tested have been designed to perform their hydraulic functions against rigid boundaries, the foam rubber membranes should not be used, but should be replaced with the adequate boundary, e.g. stiff high density polyethylene liner or concrete panel. Products for such applications can be identified typically by the fact that they have no geotextile layers to prevent soil intrusion, and in fact are not placed directly against a soil boundary.

When foam rubber layers have not been used, the test report should include the specific boundary used.

e) The apparatus shall 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 a foam rubber with a thickness of 25 mm in contact with both faces of the material to be tested.

f) The apparatus shall be essentially leaktight. At the lowest normal compressive stress and the highest hydraulic gradient, when the platen or pressure membranes with the contact surfaces are seated in the unit without the test specimen, the leakage shall not exceed 0, 2 ml/s.

Some examples of apparatus are shown in figure 2.

NOTE 4: For determination of the hydraulic head loss, it is recommended to provide the apparatus in figures 2b and 2c with two manometers at a spacing of at least 0,3 m within the specimen.

For very low flows, the leakage shall not exceed 10% of the flow value.

5.2 Water

For water flow rate values up to 0,3 l/m.s, the water used shall be de-aerated or fed from a stilling tank. The water shall be at a temperature between 18°C and 22°C and should be equal to or above that of the ambient temperature of the testing laboratory. The water shall not be continuously recycled. The oxygen content shall not exceed 10 mg/kg, when measured at the point where the water enters the apparatus.

For water flow rates greater than 300 $mls^{-1}m^{-1}$, water from the mains supply may be used. The temperature shall be noted and all necessary measures shall be taken to avoid air inclusion in the tap water.

> NOTE: 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, should the flow be non laminar.

The water shall be filtered if suspended solids are visible to the naked eye or if solids accumulate on or in the specimen thus inhibiting flow.

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

5.4 Stopwatch, for measuring time to an accuracy of 0,1 s.

5.5 Thermometer, for measuring temperature to an accuracy of 0,2°C.

5.6 Measuring vessel, for determining volume of water to an accuracy of 10 ml.

Alternatively, when small flow rate measurements are taken, the mass of water shall be determined with a balance for determining the mass to an accuracy of 1%.

Where direct discharge measurements are taken, the flow gauge shall be calibrated to an accuracy of 5% of the reading.

5.7 Measuring device to determine the applied head, to an accuracy of 1 mm.

5.8 Measuring device to determine the applied normal stress, with an accuracy of 1%.

6 Specimens

6.1 Handling

The sample shall be handled as infrequently as possible and shall not be folded, in order to prevent disturbing its structure. Keep the sample in a flat position without any load.

6.2 Selection

Take specimens from the sample in accordance with EN 963.

6.3 Number and dimensions

Cut three test specimens from the sample with the length parallel to the machine direction, and three specimens with the length parallel to the cross-machine direction so that the specimens measure at least 0,3 m in the length, or flow, direction, and at least 0,2 m in the cross-machine direction. When the width of the product is less than 0,2 m, the full width of the product shall be tested, by modifying the apparatus.

For an apparatus with rigid platen loading (see figure 2a), the length of the specimen shall be equal to the length of the loading platen taking into account 5.1 d); for an apparatus with pressure-membrane loading (see figures 2b and 2c) the length of the specimen may exceed the loaded length.

For products without integrated flow to both sides of the core and that are to be used for single sided drainage, six specimens shall be taken to enable testing of each of the two sides after one of them has been sealed.

It is important that the specimen width is not undersized, i.e. it shows a good push-tight fit.

Where it is necessary to determine the results to within a given confidence interval of the mean, determine the number of test specimens in accordance with ISO 2854.

6.4 Specimen conditions

The specimens shall be clean, free from surface deposits and without visible damage or fold marks.

7 Test procedure

7.1 Measure the nominal thickness of the test specimen under a pressure of 2 kPa in accordance with EN 964-1.

7.2 Place the specimens under water containing a wetting agent at laboratory temperature, gently stir to remove air bubbles and leave to saturate for at least 12 h. The wetting agent is an aryl alkyl sodium sulfonate at 0,1 % V/V content.

7.3 Define the thickness of the foam contact surface in relation to the nominal thickness of the test specimen.

7.4 Place the lower foam contact surface material on the base of the apparatus and then place the test specimen on top. Place the upper foam contact surface material over the specimen in a similar manner. Lower the loading platen or pressure membrane on to the test specimen.

7.5 Place a seating stress of 2 kPa (including the loading platen) on the test specimen and fill the apparatus inlet reservoir with water to allow the water to flow through the test specimen in order to remove air. Take all necessary precautions to avoid preferential flow paths along the boundaries of the specimen. If such flows are observed, re-seat or discard the specimen as required.

7.6 Adjust the normal stress to 20 kPa and hold this pressure for 360 s.

7.7 Fill the inlet reservoir to the level corresponding to the hydraulic rate gradient 0,1. Use de-aerated water or water from a stilling tank for flow rate values up to 0,3 l/m.s and properties in accordance with 5.2.

NOTE: Water direct from the mains supply may be used for water flow rate greater than 0,3 l/m.s. No temperature correction is required; however, the temperature should be noted and reported.

7.8 Allow water to flow through the specimen under the above conditions for 120 s.

For some materials, especially those exhibiting compression creep, the stress may tend to decay during the test, if e.g. a hydraulic jack is employed to apply the stress. In this case, continual readjustment of the stress will be necessary to maintain a constant value during the test period.

7.9 In the measuring vessel collect the water passing through the system over a fixed period of time. The volume of water collected shall be a minimum of 0,5 l and for very high flow materials the collection time shall be a minimum of 5 s. Record the volume of water collected. For products with very low water flow capacity, the collection time may be limited to 600 s and the collected water shall be weighed to an accuracy of 1%. Note the water temperature. Repeat this procedure two more times, i.e. three flow readings in all, and take the average of the volume of water collected.

If a discharge gauge is used then the discharge shall be the average of three consecutive readings with a minimum time interval between readings of 15 s.

7.10 Increase the hydraulic gradient to 1,0 while maintaining the stress value. Repeat the procedure given in 7.9.

7.11 Reduce the hydraulic gradient to 0,1, increase the normal compressive stress to the next highest value (100 kPa) and hold for 120 s prior to flow. Repeat the procedure given in 7.9 and 7.10.

7.12 Continue in this way until the specimen has been tested at each hydraulic gradient and stress.

7.13 Repeat the entire sequence of operations given in 7.4 to 7.12 for the remaining test specimens.

8 Calculations and expressions of result

8.1 Calculate the in-plane water flow capacity $q_{stress/gradient}$ at 20°C when using water from a stilling tank, for each given hydraulic gradient and normal stress, using the following equation:

$$q_{stress/gradient} = \frac{VR_T}{Wt}$$

where :

$q_{stress/gradient}$	is the in-plane water flow capacity per unit width at a defined stress and gradient, in square metres per second
V	is the average volume measured in cubic metres;
R_T	is the correction factor to a water temperature of 20°C (see annex A);
W	is the width of the specimen, in metres;
t	is the time, in seconds.

Where the discharge Q has been measured directly, a temperature correction is accordingly necessary and the in-plane water flow capacity $q_{stress/gradient}$ is then given by:

$$q_{stress/gradient} = \frac{QR_T}{W}$$

where Q is the discharge, in cubic metres per second.

Express the in-plane water flow capacity $q_{stress/gradient}$ to two significant figures.

For water from the mains supply, carry out a temperature correction if the temperature falls within the range of 18°C to 22°C; if not, the temperature is only noted and no correction is applied.

8.2 Results can be expressed as a plot of in-plane water flow capacity versus normal compressive stress for the two hydraulic gradients used (see figure 3).