INTERNATIONAL STANDARD

ISO
12958-2

First edition
2020-10

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
$q_{\text{p perf }(\sigma,i,t,b)}$
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.

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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.
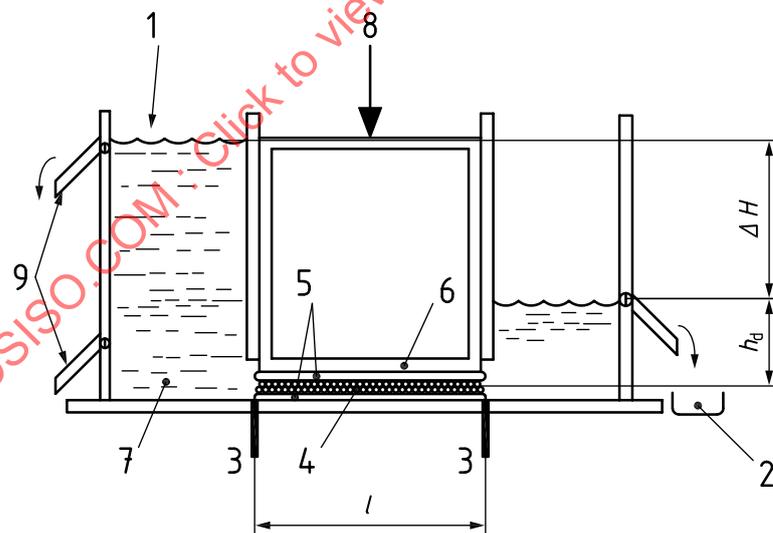
Key

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.
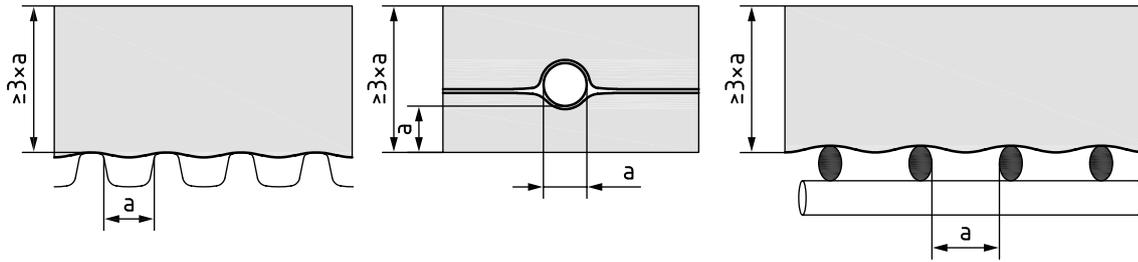
Key

a   width across which soil arching will develop

Figure 2 — Examples of test setups showing the minimum thickness of soil installed over the tested geosynthetic

The minimum thickness of a granular material should also be determined following the granulometry of the material. Most relevant soil conditions should be identified and/or agreed by all the parties and then considered for testing.

Installation of a layer of soil slimmer than three times the distance between two load supports can change the load distribution on the product by limiting the possibility of arching effect to develop in the soil, on top of the structural component of the product. This can increase geotextile intrusion and generate lower flow measurement. Should a slimmer layer of soil be installed on top of the product, the report shall indicate that the minimum soil thickness requirement was not met.

6.5   Specimen condition

Geotextile or geotextile-related specimens shall be clean, free from surface deposits and without visible damage or fold marks at the time of installation.

Soil specimens shall be prepared to the water content which is expected to be observed on-site at the time of installation or the conditions agreed upon by the parties.

7   Test procedure

7.1   Measure the thickness of the test specimens at a pressure of 20 kPa in general accordance with ISO 9863-1.

7.2   Place the specimens under water containing a 0,1 % volume non-ionic surfactant at laboratory temperature, gently stir to remove air bubbles and leave to saturate for at least 12 h.

7.3   Prepare each granular material to be used as a boundary, making sure there will be a sufficient quantity to obtain the thickness required in 6.4.

7.4   Install the system to be tested, from the bottom to the top. This may involve geosynthetic materials as well as soil wrapped in the membrane described in 5.1 g). The weight of soil shall be determined considering the volume needed to meet the minimum requirements specified in 6.4, taking into account potential compaction of the soil during the test. The soil shall then be hand-tapped to create a smooth, flat surface to receive the loading platen and other components of the apparatus. Install a quantity of soil that will lead to a thickness of soil at the end of the test meeting the requirement of 6.4.

7.5   Apply a seating stress of between 2 kPa and 10 kPa (including the loading platen) to the test specimen and fill the inlet reservoir with water. 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, reseat or discard the specimen as necessary.

7.6   Adjust the normal stress to the smallest agreed normal stress.

The normal stress shall be maintained throughout the test with a precision of ± 1 % or 1 kPa, whichever is greater.

Should this stress be 50 % or more of the compression resistance of the tested product, creep be anticipated to take place during the test or both, a particular loading strategy shall be defined by the parties.

7.7   Maintain the normal load for the seating time agreed upon by the parties. Should several seating times need to be tested on the same system, start with the shortest seating time, i.e. if the behaviour of the system needs to be observed after 1 h, 24 h and 100 h, perform the test using a 1 h seating time first, followed by an additional 23 h, and so on.

Selection of a seating time should be done with consideration of further usage of the test result. If a creep reduction factor is to be applied to the property measured per this test method, the seating time should be selected in order to reflect the hypothesis considered in the definition of this creep reduction factor.

7.8   Fill the inlet reservoir to the level corresponding to the target hydraulic gradient. Use hydraulic gradients of 0,02, 0,1, 0,5 and 1,0 or other values as agreed upon by the parties.

The hydraulic gradient shall be determined considering a flow length equal to the length of product where the flow of water is controlled by the product. This decision shall be justified by the testing laboratory as it can vary depending on the type of product tested and apparatus used. It can be either or both of the following:

— the length of specimen confined in soil, which can exceed the length of the box should the soil layer expand upstream and downstream under normal stress;

— the length of the flow element for products including discrete draining elements.

7.9   Allow water to flow through the specimen under the above conditions for at least 120 s.

NOTE   It is good practice to flush out air bubbles potentially trapped in the specimen by applying a much higher hydraulic gradient, such as 1,0 or more, before proceeding with the measurement under the selected gradient.

7.10 Collect the water passing through the system over a fixed period of time in the measuring vessel. The volume of water collected shall be at least 0,5 l. The collection time shall be at least 5 s. Record the volume of water collected. For products with a very low water flow capacity, the collection time may be limited to 600 s. Record the water temperature. Repeat this procedure two more times, i.e. take three flow readings in total. Determine the average of volume of water collected per unit time.

Should the three flow measurements show a decrease over time of 5 % between two consecutive measurements, the first value (e.g. the highest flow measurement) should be retained for further calculation and reporting.

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

The time needed to perform all flow measurements should not exceed 10 % of the seating time corresponding to the measurement being made.

The exact seating time associated to a given measurement shall be reported to reflect the time at which each measurement was actually made.

7.11 Increase the hydraulic gradient to the next specified value, if any, while maintaining the stress value. Repeat the procedure given in 7.10.

7.12 Repeat 7.7 to 7.11 for the remaining seating times.

7.13 Increase the stress to the next specified value, if any, and repeat steps 7.6 to 7.12 for all requested normal stresses and hydraulic gradients, starting with the smaller stress and finishing with the higher stress.

7.14 Repeat 7.1 to 7.12 for the remaining test specimens, if more than one test specimen is to be tested.

8   Calculations and expression of results

8.1   Products with a continuous structure (i.e. with no discrete draining elements)

Calculate the in-plane water flow capacity per unit width at a defined stress σ, gradient i, seating time t and boundary condition b, in litres per metre second [(l/s)/m], $q_{\text{p perf}(\sigma,i,t,b)}$, at 20 °C, for each given hydraulic gradient, normal stress and seating time, using Formula (1):

$$q_{\text{p perf}(\sigma,i,t,b)} = \frac{Q}{W} \times R_T \tag{1}$$

where

    Q is the in-plane flow, in litres per second. If the in-plane flow is determined using volumetric or weight determination, calculate the in-plane flow, using Formula (2).

    R_T is the correction factor for converting to a water temperature of 20 °C (see Annex A);

    W is the width of the specimen, in metres.

$$Q = \frac{V}{t} \tag{2}$$

where

    V is the average volume measured, in litres;

    t is the collection time, in seconds.

Express the performance in-plane water flow capacity, $q_{\text{p perf}(\sigma,i,t,b)}$, to two significant figures.

For products with a regular shape, such as cuspated sheets, the in-plane flow capacity calculation shall be made using the actual width of the specimen if different from the width of the cell (see 6.3.1).

8.2   Products with discrete draining elements

For products with discrete draining elements, the contribution of the main layer (i.e. geotextile) and the spacing of the discrete draining elements (i.e. pipe) shall be considered in the determination of an equivalent in-plane water flow capacity per unit width of the geocomposite. To do so, six specimens shall be taken on the laboratory sample to enable testing of all parts of the product contributing to the water flow:

— three specimens including one single draining element;

— three specimens located between draining elements, identified "carrier".

Both series of tests shall be performed on the same test width.

The discharge rate in l/s shall be determined on each specimen for each test condition, for both configurations. The average of three measurements is identified as $Q_{\sigma,i,t,b\,(C+L)}$ for the discharge rate of the carrier with one draining element and $Q_{\sigma,i,t,b\,(C)}$ for the discharge rate of the carrier alone.

The discharge rate in l/s passing through a single draining element under these tests conditions $Q_{\sigma,i,t,b\,(L)}$ is then determined according to Formula (3).

$$Q_{\sigma,i,t,b\,(L)} = Q_{\sigma,i,t,b\,(C+L)} - Q_{\sigma,i,t,b\,(C)} \tag{3}$$

The performance in-plane water flow of the product can then be determined by adding up the contributions of the draining elements and the carrier, considering the distance between two draining elements, D, as shown in Formula (4).

$$q_{p\,perf\,(D)(\sigma,i,t,b)} = \left[\frac{Q_{\sigma,i,t,b(C)}}{W} + \frac{Q_{\sigma,i,t,b(L)}}{D} \right] \times R_T \tag{4}$$

where

- W is the test width, in metres;
- D is the distance between two draining elements, in metres.

The configuration considered to determine the equivalent discharge rate shall be attached to the reported value. For example, for a product including one draining element per metre, tested under a normal stress of 200 kPa, a hydraulic gradient of 0,1 and soil used as boundary conditions on both sides, the discharge capacity shall be expressed as follows: $q_{(\sigma\,=\,200\,kPa,\,i\,=\,0,1,\,t\,=\,100\,h,\,soil/soil)\,(1\,drain\,per\,metre)}$.

Neglecting the contribution of the carrier leads to conservative values and may thus be an acceptable alternate. If this solution is preferred by the parties, only three specimens, including a single draining element, can be tested. The width of the carrier installed in the test apparatus shall then be smaller than the distance between two draining elements considered in the calculations. The performance in-plane flow capacity is then determined using Formula (5).

$$q_{p\,perf\,(D)(\sigma,i,t,b)} = \left[\frac{Q_{\sigma,i,t,b(carrier+drain)}}{D} \right] \times R_T \tag{5}$$

8.3 Graphical representation

Results can be expressed as a plot of in-plane water flow capacity versus normal compressive stress for the different test conditions used (see Figure 3).
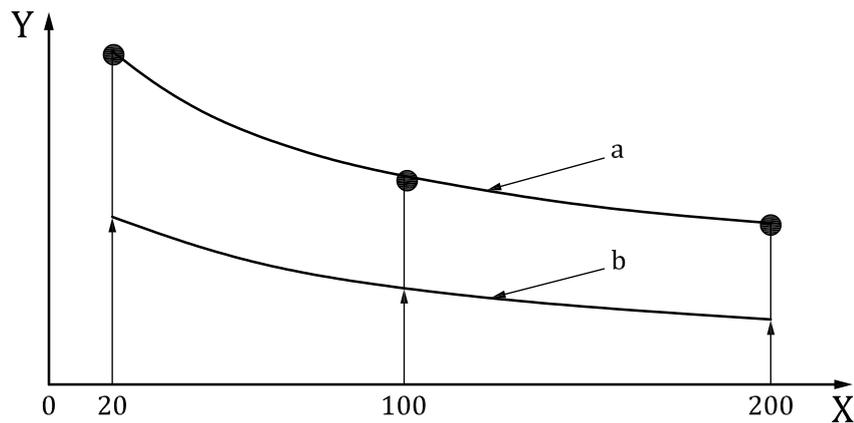
Key

X   normal compressive stress, in kilopascals

Y   in-plane water flow capacity, in litres per metre second [(l/s)/m]

a   Hydraulic gradient 1,0.

b   Hydraulic gradient 0,1.

Figure 3 — Typical examples of in-plane water flow capacity curves

9 Test report

The test report shall include the following information:

a)   reference to this document, i.e. ISO 12958-2:2020;

b)   test laboratory;

c)   description of the tested system, i.e.

   1)   geosynthetic drainage product being evaluated;

   2)   other geosynthetic products, when applicable;

   3)   soil properties, when applicable, for example dry unit weight, particle size distribution and water content used for installation;

   4)   description of the structure as installed: order of installation of the layers from bottom to top, thickness(es) of soil layer(s);

   5)   direction of the test, usually machine direction, transverse direction or both. If only one direction was tested, a statement that the other direction was not tested, for example 'the transverse direction was not evaluated';

d)   test conditions: normal load (σ), hydraulic gradient (i), seating time (t), boundary conditions (b);

e)   details of the apparatus used, in particular width and length of the cell, details of the loading system and flow measuring technique;

f)   width and length of the specimen(s);

g)   if required, table giving the experimental data and the calculations for each specimen (see Annex B);

h)   if required, plot of in-plane water flow capacity for each normal compressive stress, applied hydraulic gradient (see Figure 3), seating time and boundary condition;

i) individual measurements and mean value of in-plane water flow capacity for each hydraulic gradient, normal stress, seating time and boundary condition for each measurement;

j) water temperature range prevailing during the test. If required, report the water temperature for each reported result;

k) water type (de-aerated or stilled). Indicate the oxygen content if greater than 6 ppm;

l) any deviation from the procedure described in this document;

m) any anomaly in the hydraulic behaviour of the geotextile or geotextile-related product under test;

n) date of the test.

Annex A
(informative)

Determination of the correction factor R_T for conversionto a water temperature of 20 °C

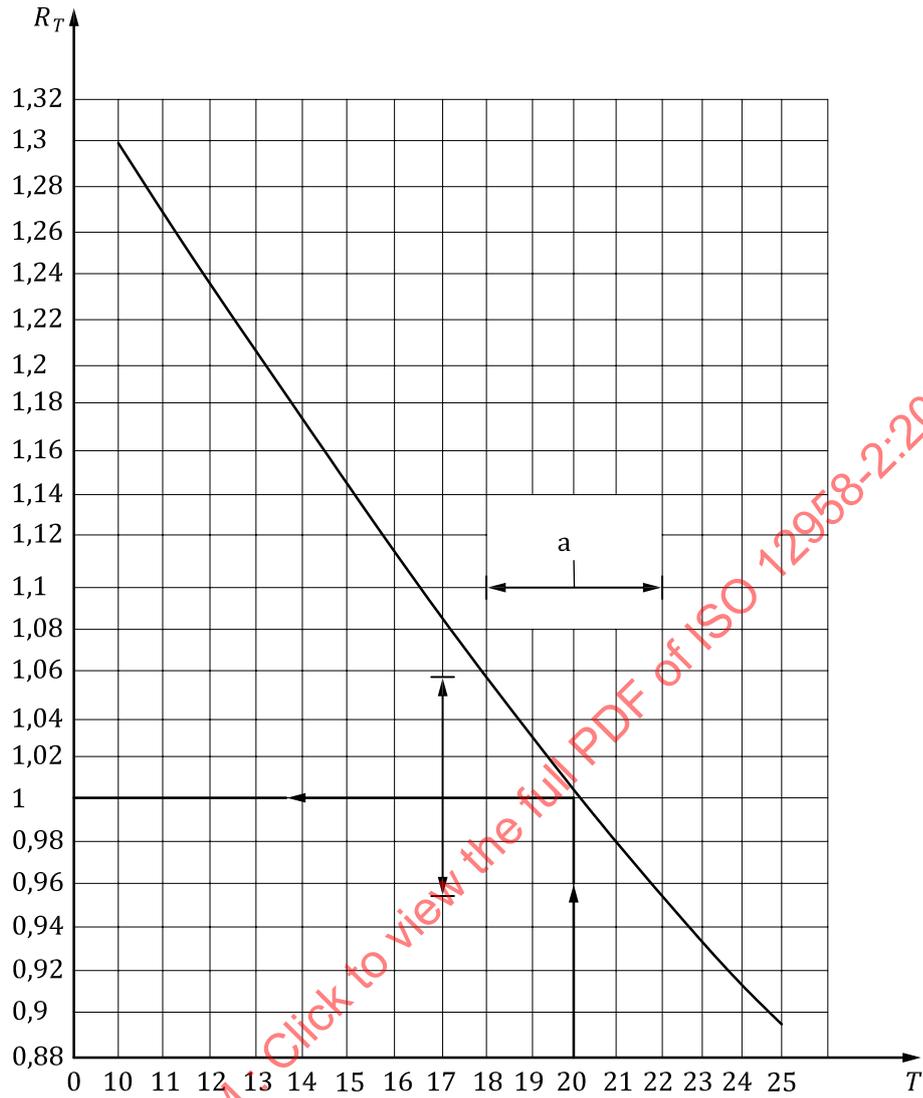$$R_T = \frac{T}{20} = \frac{1,762}{1+0,033\,7T+0,000\,22T^2}$$

where

R_T is the correction factor for converting to a water temperature of 20 °C;

T is the water temperature, in degrees Celsius.

A graphical representation of R_T versus T is given in Figure A.1.

Key

T test temperature, in degrees Celsius

R_T correction factor

a   Temperature range 18 °C to 22 °C (see 5.2).

Figure A.1 — Graphical presentation of the correction factor R_T