British Standard

BRITISH STANDARD

BS 6906-3: 1989

Methods of test for

Geotextiles —

Part 3: Determination of water flow normal to the plane of the geotextile under a constant head

UDC 677.01–032.2:532.5:620.1

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Textiles and Clothing Standards Policy Committee (TCM/-) to Technical Committee TCM/35, upon which the following bodies were represented:

Association of Consulting Engineers
British Polyolefin Textiles Association
British Railways Board
Chemical Industries Association
Department of Transport
Department of Transport (Transport and Road Research Laboratory)
ERA Technology Ltd.
Federation of Civil Engineering Contractors
Institution of Civil Engineers
Man-made Fibres Producers' Committee
Ministry of Agriculture, Fisheries and Food
Ministry of Defence
Textile Research Council

This British Standard, having been prepared under the direction of the Textiles and Clothing Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 30 November 1989

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Contents

Foreword

This Part of BS 6906 has been prepared under the direction of the Textiles and Clothing Standards Policy Committee.

The water flow through a geotextile is dependent upon its thickness, number and size of pores and the water flow path. The method described in this standard is a procedure for determining water flow normal to the plane of the geotextile. Determination of water flow through the plane of the geotextile will be covered in a subsequent Part of BS 6906.

The test described in this standard is basically an index test which gives values which are primarily of use when comparing one geotextile with another. Inevitably where a geotextile is to be used in structures where the system permeability is of importance then some derivation of effective hydraulic conductivity will be made from the flow rate through the geotextile. It is of paramount importance that designers are aware that the flow rate quoted is likely to be significantly greater than the system permeability incorporating the geotextile, for which reasons factor of safety of the order of 10 have been suggested when interpreting flow rates/permeability of geotextiles.

It is further evident that the hydraulic conditions in which a geotextile is placed have a profound effect upon the permeability of that material. The necessary ideal laboratory test conditions are unlikely to be repeated in the field. Care should therefore be taken when attempting to apply the results of this test to the field performance of a geotextile, particularly as the test is performed on geotextiles in isolation.

Some geotextiles wet up readily when exposed to water whereas others wet up only slowly and can support an appreciable head of water before "breakthrough" occurs. The procedure described in this method has been written with these characteristics in mind.

Other Parts of BS 6906 are as follows.

— *Part 1: Determination of the tensile properties using a wide width strip;*

— *Part 2: Determination of the apparent pore size distribution by dry sieving;*

— *Part 4: Determination of puncture resistance (CBR puncture test).*

At the time of publication of this Part of BS 6906 no corresponding international standards exist.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 6906 describes a procedure for determining water flow through geotextiles under conditions of a constant head with uni-directional flow with the geotextile uncompressed and isolated. The test is applicable to all types of geotextile with an anticipated water flow of less than 300 $L \cdot s^{-1} \cdot m^{-2}$ at a head of 100 mm.

NOTE 1 Information on the accuracy of the test is given in Appendix A.
NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Principle

The flow of water through a single layer of geotextile normal to the plane of the geotextile is measured under specified conditions.

3 Apparatus

3.1 *Water permeability apparatus,* complying with the following.

a) It shall be capable of applying various heads in the range 50 mm to 300 mm across the specimen and maintaining a constant head for the duration of one test with water on both sides of the specimen.

b) The specimen area exposed to testing shall be circular with a minimum diameter of 40 mm. The diameter shall be measured to the nearest millimetre.

c) The apparatus shall allow at least 1 L of water to be collected in a collection time of 10 s.

d) There is no head when the test is performed with no test specimen.

NOTE Examples of apparatus for determining water flow are shown in Figure 1.

3.2 *Water,* at a temperature of between 10 °C and 25 °C.

NOTE Due to problems caused by the release of air bubbles, the water should not be fed into the apparatus direct from a mains supply. The water should be de-aired or fed from a still tank but should not be recycled. The water should be filtered if suspended solids are visible to the naked eye or if solids accumulate on or in the specimen thus invalidating the test.

3.3 *Stopwatch,* having an accuracy of 0.1 s.

3.4 *Thermometer,* having an accuracy of 0.1 °C.

3.5 *Measuring vessel,* for determining volume to an accuracy of 10 mL.

3.6 *Balance,* capable of determining mass to an accuracy of 1 mg.

3.7 *Means of measuring dimensions of test specimens,* to an accuracy of at least 1 mm.

4 Test specimens

4.1 Selection

Take specimens at random from the sample. Unless otherwise agreed between the interested parties, do not take specimens from within 100 mm of the selvedge of the geotextile.

4.2 Number and dimensions

Unless otherwise agreed between interested parties, cut five test specimens from the sample, each of suitable dimensions for the water permeability apparatus to be used (**3.1**).

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 BS 2846-2.

4.3 Specimen condition

The specimens shall be clean and dry.

4.4 Mass per unit area

Determine the dimensions (**3.7**) and mass (**3.6**) of the test specimens, and calculate the mass per unit area.

5 Procedure

5.1 Assemble the water permeability apparatus (**3.1**) with the test specimen (clause **4**) in place. Ensure that all joints are watertight.

5.2 Introduce an increasing head of water (**3.2**) on one side of the test specimen while the other side remains exposed to air [i.e. the head of water is above the specimen in the apparatus shown in Figure 1(a) and below the specimen in the apparatus shown in Figure 1(b)]. Record the head of water achieved before flow is initiated as the breakthrough head.

5.3 Continue increasing the head to 150 mm to wet out the specimen.

5.4 Fill the apparatus with water [i.e. from the bottom upwards when using the apparatus in Figure 1(a)] through the specimen until there is a minimum 50 mm depth of water above the specimen with zero head (i.e. no flow through the specimen).

NOTE This stage may not be necessary if the apparatus fills during the procedure described in **5.3**.

5.5 The water level should equalize very quickly. If it does not equalize within 5 min remove any trapped air from under the specimen by suction and reapply a 150 mm head.

5.6 Commence flow, adjusting the inlet to give a constant head of 100 ± 2 mm.

5.7 When the head has been steady for a minimum of 30 s collect the water passing through the system in a measuring vessel (**3.5**) over a fixed period of time.

5.8 Record the volume collected to the nearest 10 mL, the time to the nearest 0.1 s (**3.3**) and the water temperature to the nearest 0.1 °C (**3.4**).

NOTE The volume collected should be a minimum of 1 L; the collection time should be a minimum of 10 s.

5.9 Readjust if necessary to give a 100 ± 2 mm head and repeat the procedure detailed in **5.6** to **5.8** two more times.

5.10 If agreed between the interested parties, repeat the procedures detailed in **5.6** to **5.8** but with a head of 50 ± 2 mm.

5.11 If agreed between the interested parties, repeat the procedures detailed in **5.6** to **5.8** but with a head of 150 ± 2 mm.

5.12 Repeat the whole procedure with each of the four remaining specimens.

6 Calculation and expression of results

Calculate the flow rate (F) in L $\cdot s^{-1}$ $\cdot m^{-2}$ and correct to 20 °C using the following equation:

$$F = \frac{QR_t}{At}$$

where

Q is the recorded flow volume (in L);

A is the tested area (in m^2);

t is the recorded time of test (in s);

R_t is the temperature correction factor from Figure 2.

Calculate the mean flow rate (in L $\cdot s^{-1}$ $\cdot m^{-2}$) for each specimen and the coefficient of variation between the means at 100 mm head (and, if agreed between the interested parties, at 50 mm and 150 mm heads).

7 Test report

The test report shall include the following information:

a) the number and date of this British Standard, i.e. BS 6906-3:1989;

b) a description of the geotextile tested;

c) the area of specimen tested (in mm^2);

d) the mass per unit area (in g/m^2) of the specimens (see **4.4**);

e) the breakthrough head (in mm);

f) details of apparatus used including specimen area exposed;

g) temperature of the water used (in °C);

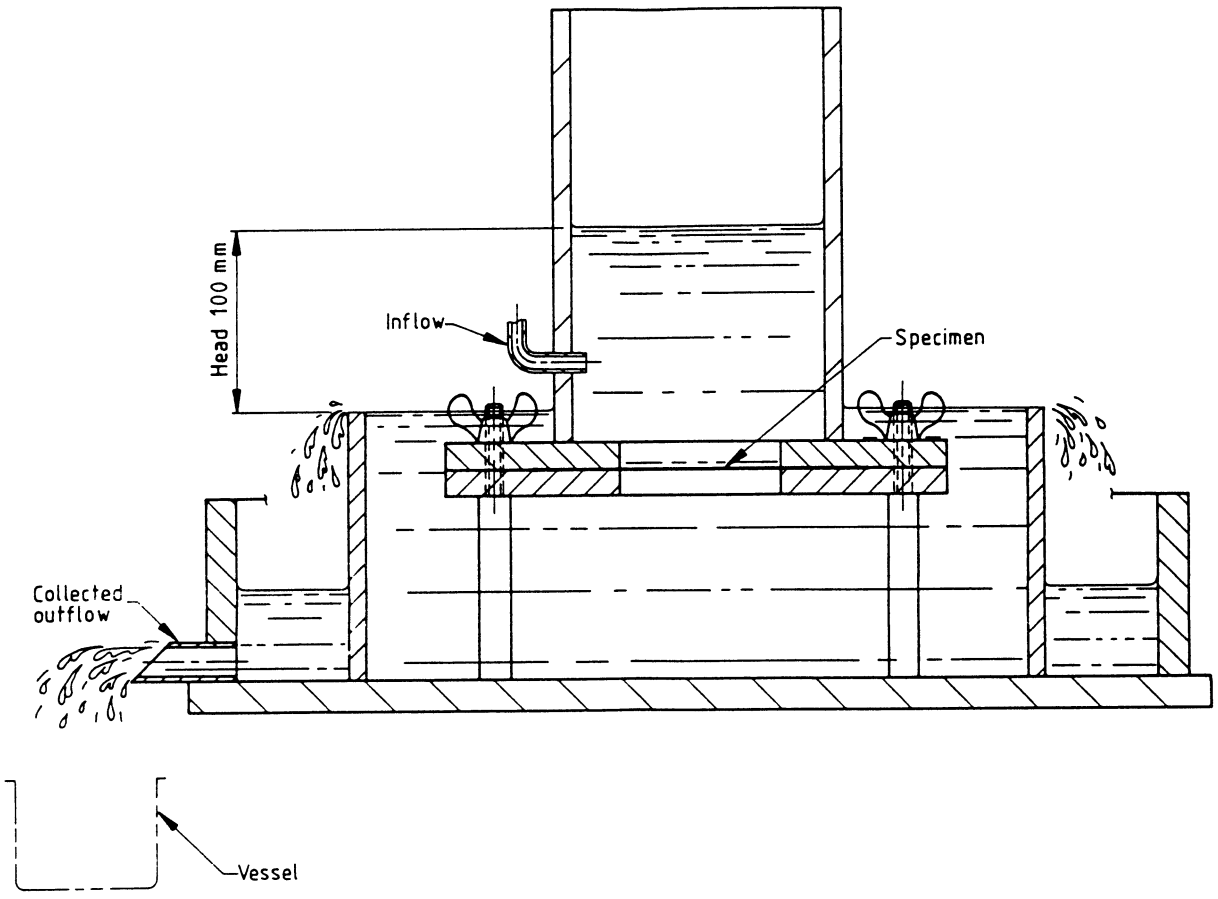
h) the results obtained, expressed as in clause **6**, for 100 mm head;

i) if agreed between the interested parties, the results obtained, expressed as in clause **6**, for 50 mm and 150 mm heads.

Appendix A Accuracy

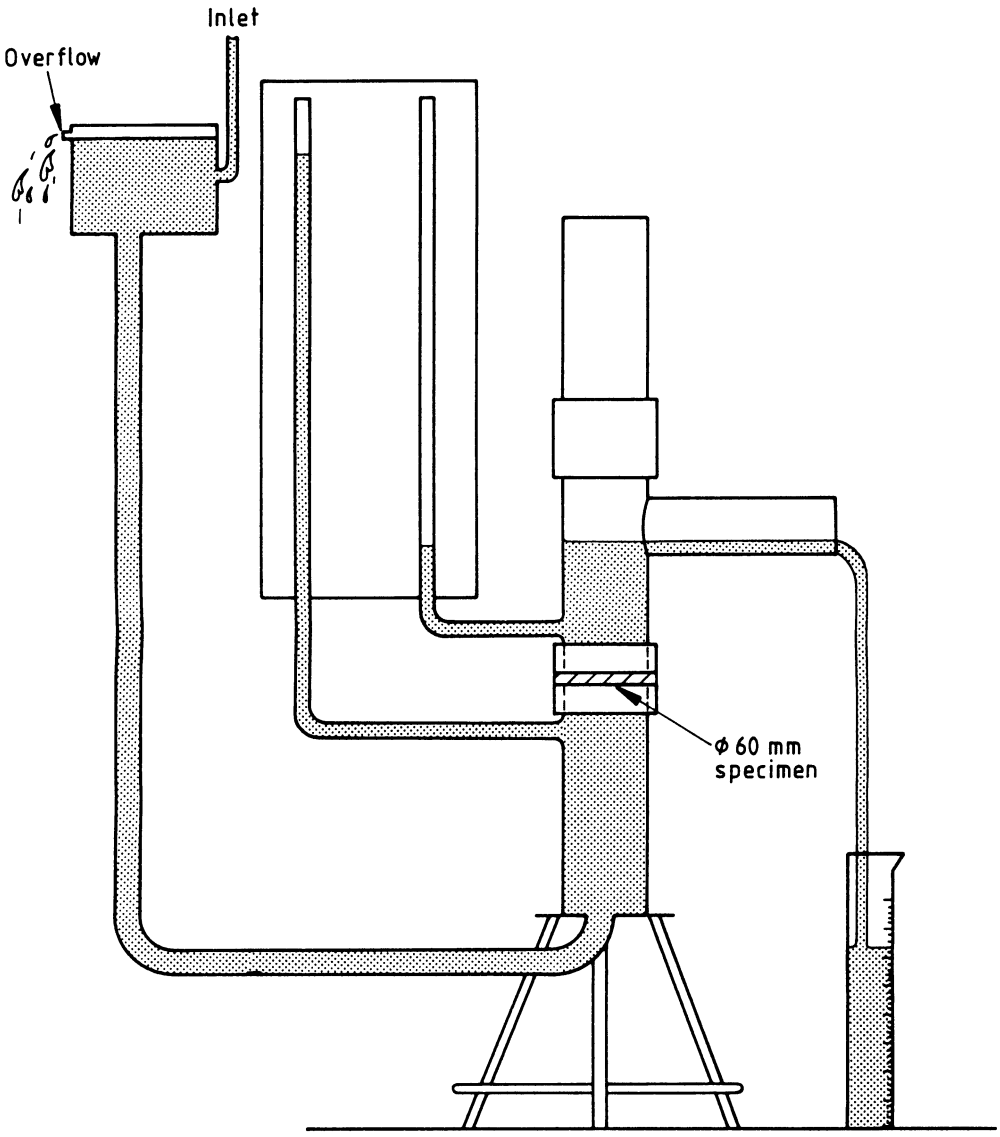
Based on the results of interlaboratory trials the coefficient of variation of repeat tests on the same specimen is less than 5 %.

The coefficient of variation of measurements from different specimens depends on the intrinsic variability of the geotextile. Typical geotextiles give coefficients of variation of up to 20 %.



(a) Open apparatus

Figure 1 — Examples of apparatus for determining water flow



(b) Closed apparatus

Figure 1 — Examples of apparatus for determining water flow *(concluded)*

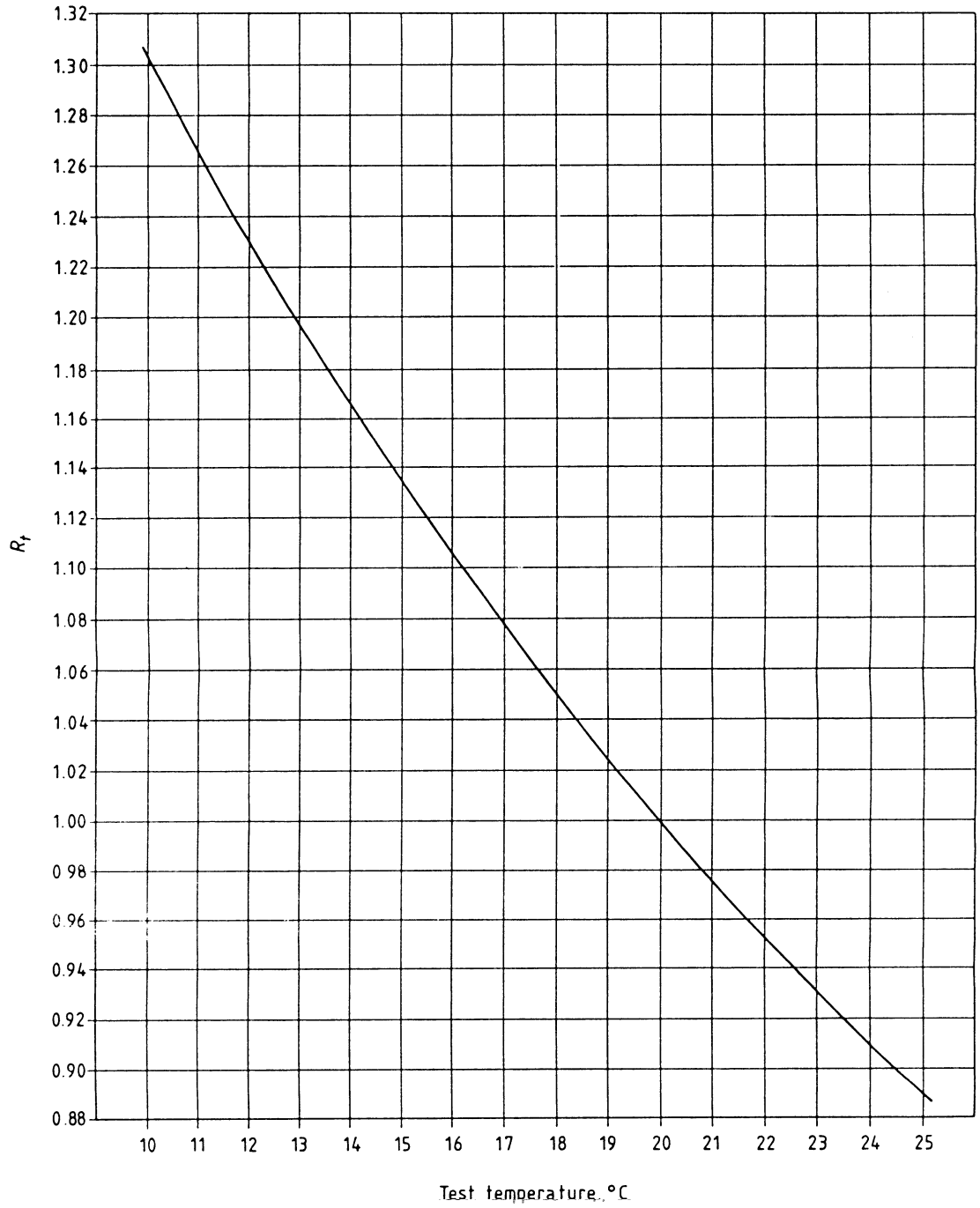


Figure 2 — Water viscosity correction factor R_t

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Publications referred to

BS 2846, *Guide to statistical interpretation of data.*
BS 2846-2, *Estimation of the mean: confidence interval.*
BS 6906, *Methods of test for geotextiles.*
BS 6906-1, *Determination of the tensile properties using a wide width strip*[1)].
BS 6906-2, *Determination of the apparent pore size distribution by dry sieving*[1)].
BS 6906-4, *Determination of puncture resistance (CBR puncture test)*[1)].

[1)] Referred to in the foreword only.

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