Testing coated fabrics

Part 34. Method 37. Method for determination of water vapour permeability index (WVPI)

IMPORTANT NOTE. It is recommended that this Part be read in conjunction with the information in Part 0 'Foreword and general introduction'.

STANDARDS

Foreword

This British Standard has been prepared under the direction of the Plastics and Rubber Standards Policy Committee.

The transmission of water vapour through textiles and polymer coated textiles is a feature of great significance to many end uses, additional to apparel, such as tentage and certain types of decorative awnings for example.

The present method compares the rate of water vapour transmission through the coated fabric under test with the rate of transmission through a standard woven polyester reference fabric under exactly the same circumstances, thus allowing comparisons to be made between different materials.

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

Contents

Method

1 Scope

This British Standard describes a method for determining the water vapour permeability of a coated fabric relative to that of a standard woven polyester monofilament fabric.

NOTE. The titles of the publications referred to in this standard are listed on the inside back page.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1 water vapour permeable

The ability of a coated fabric to transmit water vapour above a minimum index level when tested in accordance with this method of test prior to any previous chemical and/or physical testing.

NOTE 1. An alternative term in common usage is breathable.

NOTE 2. It is recommended that neither the term water vapour permeable nor breathable be applied to any coated fabric that exhibits a water vapour permeability index less than 40.

2.2 water vapour permeability index (WVPI)

The water vapour permeability of a material expressed as a percentage of a known reference standard.

3 Principle

A test specimen is sealed over the open mouth of a test dish which contains water, and the assembly placed in a controlled atmosphere. Following a period to establish equilibrium of the water vapour pressure gradient across the test specimen, successive weighings of the assembled dish are made and the rate of water vapour permeation through the specimen is determined.

The water vapour permeability index is calculated by expressing the water vapour permeability of the coated fabric as a percentage of the water vapour permeability of a reference woven fabric which is tested in a similar manner, concurrently and alongside the test specimen.

NOTE. The method used is based on that commonly known as the Turl dish or control dish method which is used to measure the resistance of materials to water vapour diffusion and is particularly suitable for clothing materials.

4 Apparatus

4.1 *Reference fabric.* A precision, high tenacity polyester woven monofilament mesh having the following characteristics:

mesh aperture	18 μm;
yarn diameter	32 μm;
threads per cm	196.1;
open area	12.5 % (approx)

NOTE. This fabric is tightly woven and constructed from synthetic fibres of low moisture regain to avoid sagging under conditions of high relative humidity.

4.2 *Test chamber.* Room or cabinet controlled at the standard temperate atmosphere for testing textiles as defined in BS 3424 : Part 2, i.e. a relative humidity of 65 ± 5 % and a temperature of 20 ± 2 °C. The chamber is of sufficient size to contain the turntable assembly and test dishes and to maintain them within the specified limits of temperature and humidity.

4.3 *A cutting device.* Capable of cutting circular specimens with a diameter not less than the outer diameter of the dish.

4.4 *Burette.* Conforming to class B, or better, of BS 846.

4.5 *Open dishes.* Dishes fitted with cover rings, of the approximate dimensions shown in figures 1 and 2 manufactured from a stable, lightweight, corrosion resistant material. The interior walls of the dishes are treated to reduce their wettability to ensure a uniform vertical gradient of water vapour pressure over the entire area of the dishes.

NOTE 1. Each dish and its corresponding covering should be numbered for identification purposes.

NOTE 2. To ensure accuracy in measuring water vapour loss, the dishes should be of low mass, e.g. manufactured from materials of low specific gravity. Aluminium alloy, e.g. material designation 6082 as specified in BS 1474, has been found to be a satisfactory material for the dishes.

NOTE 3. A baked-on silicone treatment has been found satisfactory for metal dishes.

4.6 *Sample support.* A means of supporting the specimen in the dish, to prevent it from sagging, which would alter the depth of the air layer between the specimen and the surface of the water.

NOTE. One type of support, shown in figure 1, is constructed from stainless steel wire (0.0914 mm diameter) and fits into three semi-circular depressions spaced 120 ° apart and cut into the rim of the lid. The depth of the depressions are such that, with the support in place, the covering just fits flush onto the dish rim.

4.7 *Sealing means.* For securing the sample to the lip of the dish and the sealing lid in such a manner as to prevent lateral leakage of water vapour.

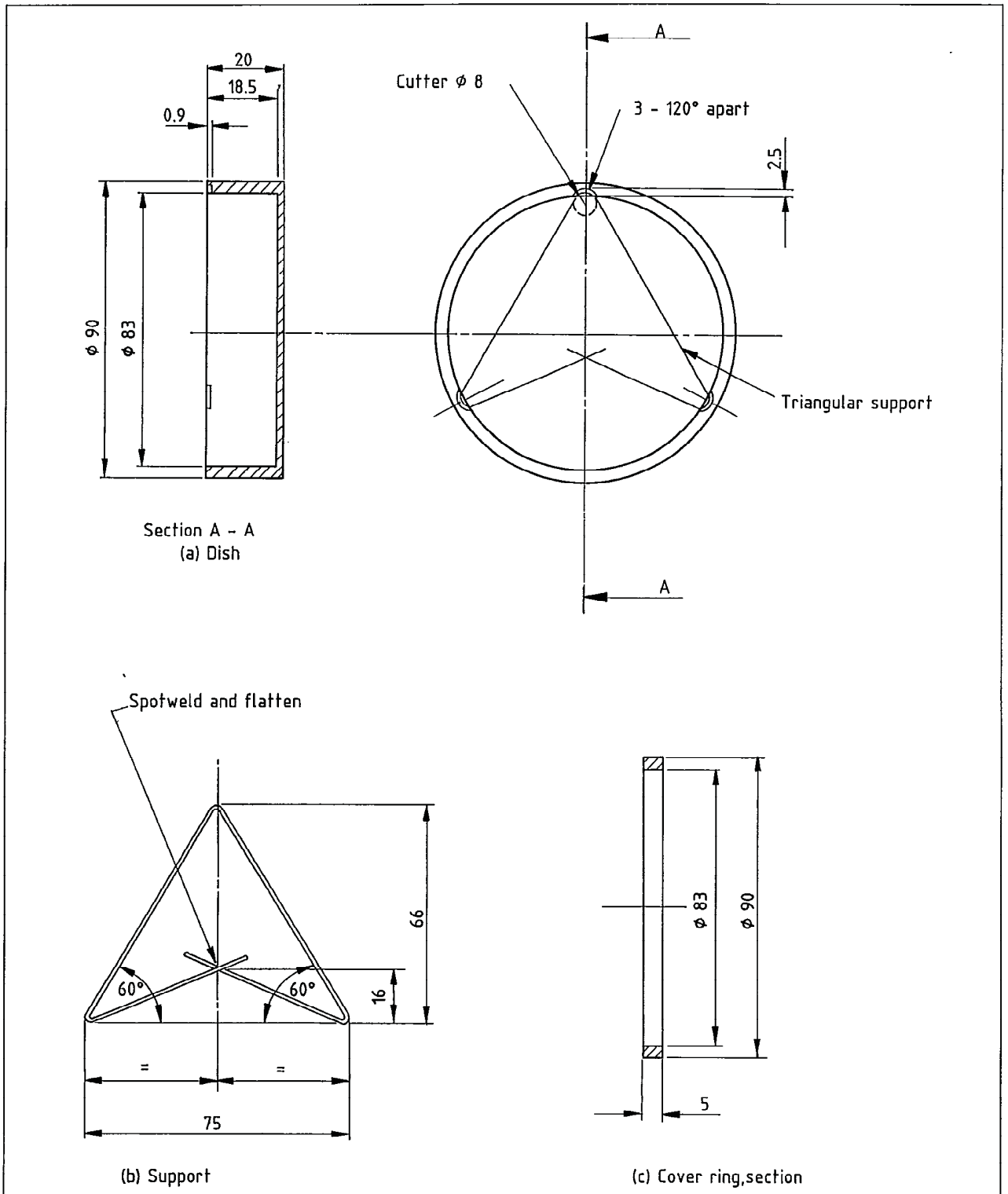
One such method is described in **5.4** which requires the following.

(a) Adhesive cement. A quick-drying adhesive cement for fixing test fabrics to the rim of the test dishes.

NOTE. The adhesive or its solvents should not react with or irreversibly alter any part of the test fabric. A general-purpose, clear PVC/nitrile contact adhesive has been found satisfactory for this purpose.

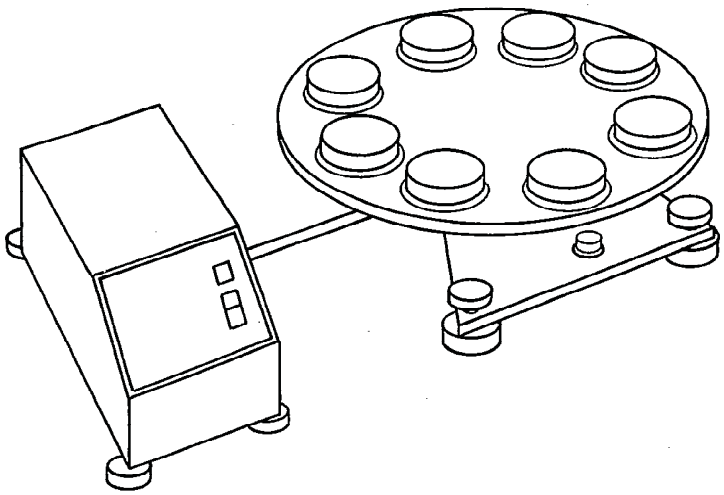
(b) Adhesive tape. Pressure sensitive, adhesive-backed polymer tape with negligible water vapour transmission properties for sealing the cover rings to the test dishes.

NOTE. PVC electrical insulating tape approximately 10 mm to 15 mm wide has been found satisfactory for this purpose.

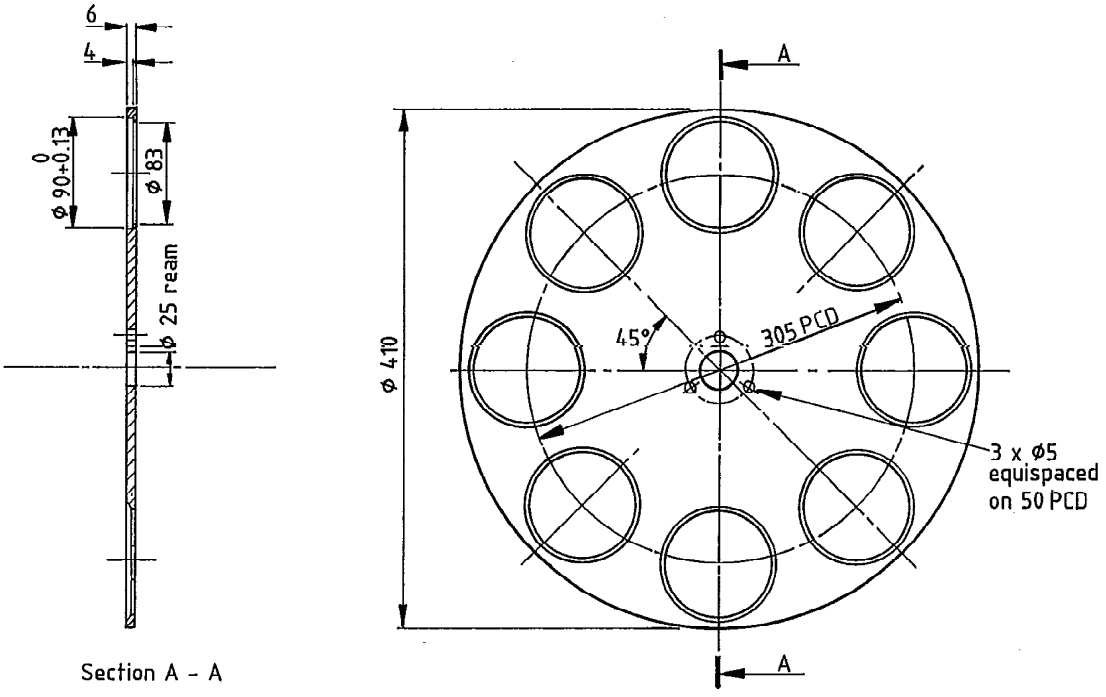


All linear dimensions are in millimetres.

Figure 1. Dish, support and cover ring



(a) Example of turntable and motor assembly



(b) Top view and section

Figure 2. Turntable

4.8 *Turntable.* A turntable, capable of carrying at least six test dishes, which rotates uniformly to avoid formation of still air layers above the test dishes. Movement of the dishes is not to exceed 6 m/min. Means of accurately levelling the turntable are provided to ensure a uniform still air layer within the test dishes. The turntable is isolated from any vibration of heat generated by its motor.

NOTE. A turntable of the dimensions shown in figure 2 and rotating at approximately 2 r/min has been found satisfactory. A turntable is more satisfactory than an electric fan for generating a slow air flow, evenly and consistently over all of the assembled dishes. Larger turntables carrying larger numbers of dishes can obviously be used. Providing the dishes are equidistant from the centre of the turntable, the air flow over each dish will be the same.

4.9 *Balance.* Balance capable of weighing to within 0.01 g.

NOTE. The balance is positioned close to or preferably inside the test chamber to minimize the fluctuation in atmospheric conditions on weighing the assembled test dishes.

4.10 *Timer.* Means for timing accurately to within ± 1 min the intervals between weighings over a period of at least 16 h.

4.11 *Reagents.* Water conforming with grade 3 of BS 3978.

5 Procedure

5.1 Take care throughout all handling operations to keep the assembled dishes level and to avoid splashing the inside surface of the test or reference fabric.

5.2 Condition the test fabric and reference fabric (**4.1**) for at least 1 h in the test chamber (**4.2**).

5.3 For each fabric to be tested, cut, by means of the cutting device (**4.3**), a minimum of 5 test specimens and a minimum of 2 specimens from the reference fabric, preferably without removing the specimens from the test chamber.

5.4 By means of the burette (**4.4**), transfer a volume of water (**4.11**) at 20 ± 2 °C to each open dish (**4.5**), predetermined from the dimensions of the dish to give a 10 ± 1 mm deep layer of air between the surface of the water and the underside of the supported specimen.

NOTE. 46 ml of water placed in a dish constructed to the dimensions shown in figure 2 creates an internal still air layer of 10 ± 1 mm.

Position the sample support (**4.6**) in the dish. If an adhesive method is to be employed for securing the sample, adopt the following procedure.

Apply a thin continuous layer of adhesive cement (item (a) of **4.7**) to the rim of the dish. Carefully place the fabric specimen onto the rim of the dish, avoiding contamination of the exposed test area of the fabric. Position the test fabric such that the surface which is intended to be on the outside of the clothing assembly is uppermost. Place the corresponding cover ring over the rim of the dish, now sealed by the test fabric, press firmly down and apply a strip of ahesive tape, (item (b) of **4.7**) around the full circumference, sealing the joint between the cover ring and the dish. Ensure that the edge of the adhesive tape does not project above the cover ring.

5.5 Place each assembly (i.e. dish, complete with specimen), in turn, on to its corresponding position on the turntable (**4.8**).

5.6 Rotate the turntable with assemblies in the test chamber for a period of not less than 1 h to establish equilibrium of the water vapour gradient for each assembly.

5.7 At the end of the equilibration period, weigh each assembly on the balance (**4.9**) to the nearest 0.01 g. Record the mass of each assembly and the time at which assembly was weighed. Replace the dishes on the turntable.

5.8 Rotate the turntable within the controlled atmosphere for a further period of at least 16 h.

Reweigh the assemblies and note the mass and time of weighing.

NOTE. If, for internal quality control purposes, the period of controlled exposure is less than 16 h (e.g. 8 h), the balance (**4.9**) needs to be accurate to within 0.001 g.

5.9 Determine the internal diameter of the test dish as the mean of two measurements taken at right angles.

5.10 The water vapour permeability index (WVPI) is given by means of the following equation:

$$\text{WVPI} = \frac{(\text{WVP})_f}{(\text{WVP})_r} \times 100$$

where

$(\text{WVP})_f$ is the mean water vapour permeability of the fabric under test, expressed in g/m^2 per 24 h;

$(\text{WVP})_r$ is the mean water vapour permeability of the reference fabric, expressed in g/m^2 per 24 h.

and

$$WVP = \frac{24\,M}{At}$$

(WVP can be $(WVP)_f$ or $(WVP)_r$ respectively)

where

M is the mass loss of the assembly over the time period t (in g);

t is the time between successive weighings of the assembly (in h);

A is the area of the exposed test fabric (equal to the internal area of the test dish) in m^2 and is given by the equation:

$$A = \frac{\pi\,d^2}{4} \times 10^{-6}$$

where

d is the internal diameter of the test dish (in mm).

NOTE. For all practical purposes:

$$WVPI = \frac{\text{Mean mass loss of test specimen}}{\text{Mean mass loss of reference fabric}} \times 100$$

Providing that the controlled exposure time, t, is identical for both the test specimen and the reference fabric.

6 Test report

The test report shall include all the following particulars.

(a) a full description of the coated fabric;

(b) the means used of securing the test piece to the top of the dish (see **4.7**);

(c) the period of exposure within the controlled atmosphere (see **5.8**);

(d) the mean water vapour permeability index (WVPI) calculated in accordance with **5.10**;

(e) any deviations from the standard test procedure.

Publication(s) referred to

BS 846	Specification for burettes
BS 1474	Specification for wrought aluminium and aluminium alloys for general engineering purposes: bars, extruded round tubes and sections
BS 3424	Testing coated fabrics Part 2 Method 4. Conditioning and selection of test specimens
BS 3978	Specification for water for laboratory use

Committees responsible for this British Standard

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British Nonwovens Manufacturers' Association
British Plastics Federation
British Railways Board
British Resin Manufacturers' Association
British Rubber Manufacturers' Association Ltd.
British Textile Confederation
British Textile Technology Group
Department of Health
Department of the Environment (Building Research Establishment)
Electricity Industry in United Kingdom
Furniture Industry Research Association
Home Office
Industrial Safety (Protective Equipment) Manufacturers' Association
London Regional Transport
Made-Up Textiles Association
Ministry of Defence
National Union of Dyers, Bleachers and Textile Workers (NUDBTW)
RAPRA Technology Ltd.
SATRA Footwear Technology Centre
Society of Motor Manufacturers and Traders Ltd.

The following body was also represented in the drafting of the standard, through subcommittees and panels:

Ministry of Defence

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