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British Standard Specification for

Water vapour permeable apparel fabrics

Etoffes pour vêtements perméables à la vapeur d'eau

Wasserdampfdurchlässige Kleiderstoffe

British Standards Institution

Foreword

This British Standard has been prepared under the direction of the Textiles and Clothing Standards Policy Committee and specifies requirements for fabrics, suitable for the manufacture of water resistant clothing, which allow the permeation of water vapour. The fabrics were initially considered by the British Mountaineering Council as suitable for outdoor pursuits but it is now considered that their use can be extended to other areas.

The standard covers only the basic description of the fabrics and their construction and performance requirements. Purchasing authorities therefore may need to include additional information.

Many properties cannot be specified objectively and cannot therefore be included in the specification, examples of such properties include colour, handle, appearance and details of additional design features. Public sector purchasing authorities may be able to supply standard patterns which cover these properties and serve to resolve any ambiguities of description.

Appendix A gives a scheme for the selection of test specimens and appendix B gives the method for the determination of water vapour permeability index.

Appendices C, D and E give methods for the determination of the resistance to water penetration after cleaning, abrasion and flexing respectively, and appendix F gives a method for the determination of surface wetting after cleaning.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, attention is drawn to Statutory Instrument 1986 No. 26 Trade Descriptions, the Textile Products (Indications of Fibre Content) Regulations 1986.

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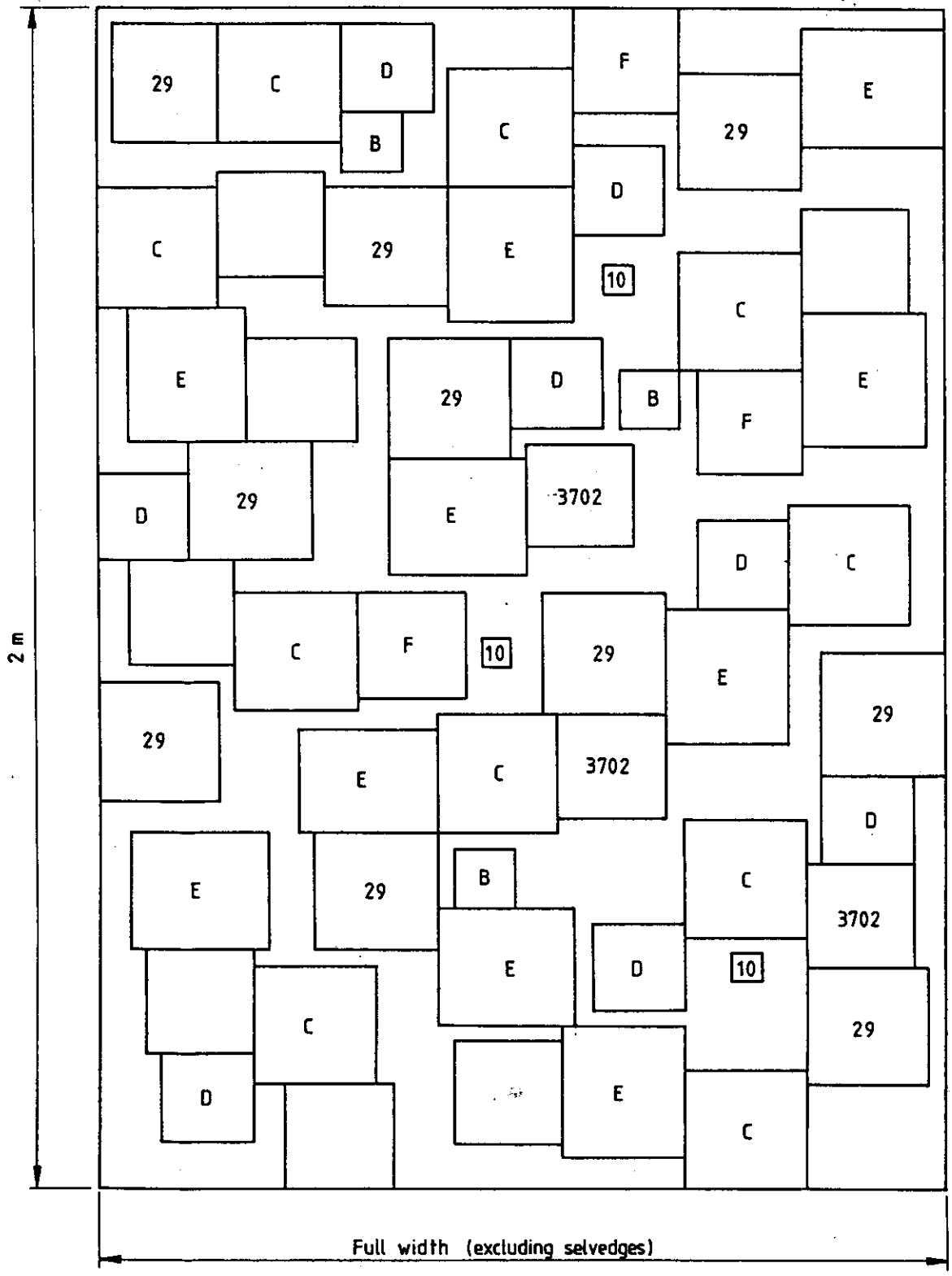


NOTE. The letters and numbers shown in the figure indicate the following:

(a) letters B to F, to the appendices B to F of this standard;
(b) 10 to BS 3424 : Part 8 : method 10A;
(c) 29 to BS 3424 : Part 26 : method 29A;
(d) 3702 to BS 3702.

Figure 1. Scheme for the selection of test specimens (not to scale)

Table 2. Colour fastness			
Agency	Minimum rating		Test method
	Colour change	Staining	
Light	5	–	BS 1006 : section B02
Washing: colour change staining of cotton	 4 – 5 –	 – 4 – 5	BS 1006 : section C06 : B2S*
Dry cleaning colour change discoloration of solvent	 4 – 5 –	 – 4 – 5	BS 1006 : section D01
Rubbing	4 – 5	–	BS 3424 : Part 14 : method 16

NOTE. Colour change assessments are to be carried out under the conditions specified in BS 950.

*Except where the fabric manufacturer recommends soap only for washing in which case the test method is BS 1006 : section C02.

4.3 Compliance

Samples shall be pre-conditioned for 4 h in a relative humidity not exceeding 10 % at a temperature not greater than 50 °C before being exposed to the standard temperate atmosphere for the conditioning and testing of textiles defined in BS 1051 for at least 24 h before testing.

In the event of dispute, if any of the specimens tested do not comply with any requirement, the tests that the specimens have failed shall be repeated twice. For this purpose two further samples shall be taken from the same source as the original sample and the same number of test specimens as for the original test shall be taken from each sample so that duplicate tests may be conducted. If all the retest results are in accordance with the requirements given, the bulk of the fabric that the samples represent shall be deemed to comply with the requirements of this standard. If any of the results of the retests do not comply with the requirements, the bulk of the fabric that the samples represented shall be deemed not to comply with the requirements of the standard.

5 Marking

Each roll of fabric shall bear the following information, e.g. on a label or swing ticket:

(a) the name, trademark or other means of identification of the manufacturer and the manufacturing batch number;

(b) the number and date of this British Standard, i.e. BS 7209 : 1990*;

(c) the fabric reference;

(d) the fibre type of the basic fabric, e.g. polyamide;

(e) any other marking as the contract or order may direct.

* Marking BS 7209 : 1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendices

Appendix A. Selection of test specimens

Select test specimens in accordance with the scheme for selection of test specimens shown in figure 1.

NOTE. Figure 1 gives a scheme for selection of test specimens for fabrics approximately 1 m wide. For other widths of fabric, the arrangement should be adjusted accordingly whilst still maintaining the shown symmetry of distribution of the test specimens.

The numbers and sizes of test specimens shall be as shown in table 3.

Table 3. Number and size of test specimens

Test	Number of specimens	Specimen size
Water vapour permeability as received	3	96 mm diameter
Resistance to water penetration		
(a) as received	10	200 mm diameter
(b) after cleaning	10	200 mm diameter
(c) after abrasion	8	130 mm to 200 mm diameter
(d) after flexing	10	220 mm x 190 mm
Cold cracking	3	32 mm x 6 mm
Surface wetting		
(a) as received	3	180 mm x 180 mm
(b) after cleaning	3	180 mm x 180 mm

Specification

1 Scope

This British Standard specifies requirements for two grades of fabric, which are suitable for the manufacture of water resistant clothing, and which allow the permeation of water vapour.

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

2 Definitions

For the purposes of this standard the definitions given in BS 3546 : Part 1 and BS 6189 apply together with the following.

2.1 batch. A definite quantity of some commodity manufactured or produced under conditions which are presumed uniform.

2.2 bulk. The total number of rolls of fabric included in any part delivery.

3 Performance

3.1 Physical requirements

The fabrics shall comply with table 1.

3.2 Colour fastness requirements

3.2.1 *General.* Except in the case of garments where fluorescent colours are specified, the fabrics shall comply with the requirements of table 2.

Colour fastness shall be tested on that surface of the fabric intended to be worn outermost, except that for colour fastness to rubbing, both surfaces of the fabric shall be tested.

NOTE. Colour selection may be made by reference to the colours in BS 381C.

3.2.2 *Fluorescent colours.* Where fluorescent colours are specified within the limits outlined in BS 6629, the colour fastness requirements shall be in accordance with that British Standard.

4 Sampling, selection of test specimens and compliance

4.1 Sampling

Sampling shall be carried out in such a manner that samples taken are representative of the manufacturing, processing, dyeing or finishing batch from which they are drawn and at a frequency of not less than one sample per kilometre of fabric.

4.2 Selection of test specimens

NOTE. Unless otherwise specified by the purchaser, samples should be taken not nearer than 20 m from the beginning or end of a batch.

The size of samples taken from each manufacturing batch shall be such that the aggregate size of the samples is sufficient to enable test specimens to be selected for the purposes of fulfilling the requirements in tables 1 and 2.

Test specimens shall be selected from the sample in accordance with appendix A.

In the case of multi-colour samples, all colours shall be represented by the specimens selected for colour fastness testing in accordance with table 2.

Table 1. Physical properties

Fabric reference		LA	HA	Method of test
Water vapour permeability index (%)	min.	50	80	Appendix B
Resistance to water penetration (kPa)*				
(a) as received	min.	15	50	BS 3424 : Part 26 : method 29A†
(b) after cleaning	min.	10	35	Appendix C†
(c) after abrasion	min.	10	35	Appendix D†
(d) after flexing	min.	10	35	Appendix E†
Cold crack temperature (°C)	max.	-20	-40	BS 3424 : Part 8 : method 10A
Surface wetting (spray rating)				
(a) as received	min.	4	4	BS 3702†‡
(b) after cleaning	min.	3	3	Appendix F†‡

* 1 kPa = 102 mm H_2O.

† Applying the water to that surface of the fabric intended to be used outermost.

‡ Using water conforming to grade 3 of BS 3978 at a temperature of 20 ± 2 ° C.

Appendix B. Determination of water vapour permeability index

B.1 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 sample, 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 fabric as a rcentage 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.

B.2 Apparatus

B.2.1 *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.

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

.2.2 *Test chamber.* Room or cabinet controlled at the standard temperate atmosphere for testing textiles as defined in BS 1051, i.e. a relative humidity of 65 ± 2 % 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.

B.2.3 *A cutting device*, capable of cutting circular specimens with a diameter not less than the outer diameter of the dish.

B.2.4 *Burette*, conforming to class B, or better, of BS 846.

B.2.5 *Open dishes.* Dishes fitted with cover rings, of the approximate dimensions shown in figure 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 cover ring should be numbered for identification purposes.

NOTE 2. In order 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. Dishes with cover rings, constructed from aluminium alloy, assembled with specimens and containing water ready for testing, weigh 120 g to 150 g each.

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

B.2.6 *Sample support.* A means of supporting the specimen in the dish, to prevent it from sagging, thereby altering the depth of the air layer between the specimen and the surface of the water.

NOTE. One type of support, shown in figure 2, 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 is such that, with the support in place, the cover ring just fits onto the dish rim.

B.2.7 *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.2.8 *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.

B.2.9 *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 or heat generated by its motor.

NOTE. A turntable of the dimensions shown in figure 3 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

* For details of the source of supply of a suitable reference fabric, apply to Enquiry Section, BSI, Linford Wood, Milton Keynes MK14 6LE, enclosing a stamped addressed envelope for reply.

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.

B.2.10 *Balance.* Balance capable of weighing to within 0.001 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.

B.2.11 *Timer.* Means for timing the intervals between weighings to within 1.0 min.

B.3 Reagents

B.3.1 *Water,* complying with grade 3 of BS 3978.

B.4 Procedure

B.4.1 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.

B.4.2 Condition the test fabric and reference fabric (B.2.1) for at least 1 h in the test chamber (B.2.2).

B.4.3 For each fabric to be tested, cut, by means of the cutting device (B.2.3), three test specimens and one specimen from the reference fabric, preferably without removing the specimens from the test chamber.

B.4.4 By means of the burette (B.2.4), transfer a volume of water (B.3.1) at 20 ± 2 °C to each open dish (B.2.5), 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 cm^3 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 (B.2.6) in the dish. Apply a thin continuous layer of adhesive cement (B.2.7) 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 adhesive tape (B.2.8) around the full circumference, sealing the join between the cover ring and the dish. Ensure that the edge of the adhesive tape does not project above the cover ring.

B.4.5 Place each assembly (i.e. dish, complete with specimen), in turn, onto its corresponding position on the turntable (B.2.9), e.g. on an eight station turntable, arrange triplicate specimens from each of two test fabrics (A and B) and the reference fabric clockwise in the following dish sequence: A1, A2, A3, reference; B1, B2, B3, reference.

B.4.6 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.

B.4.7 At the end of the equilibration period, weigh each assembly on the balance (B.2.10) to the nearest 0.001 g. Note the mass of each assembly and the time at which each assembly was weighed. Replace the dishes on the turntable.

B.4.8 Rotate the turntable within the controlled atmosphere for a further period of at least 5 h.

NOTE. An overnight period of 16 h is often convenient.

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

B.4.9 Determine the internal diameter of the test dish as the mean of two measurements taken at right angles.

B.4.10 The water vapour permeability (*WVP*) in $g/m^2/day$ is given by the equation:

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

where

M is the loss in mass 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);

where

A is given by the equation:

$$A = \left(\frac{\pi d^2}{4}\right) \times 10^{-6}$$

where

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

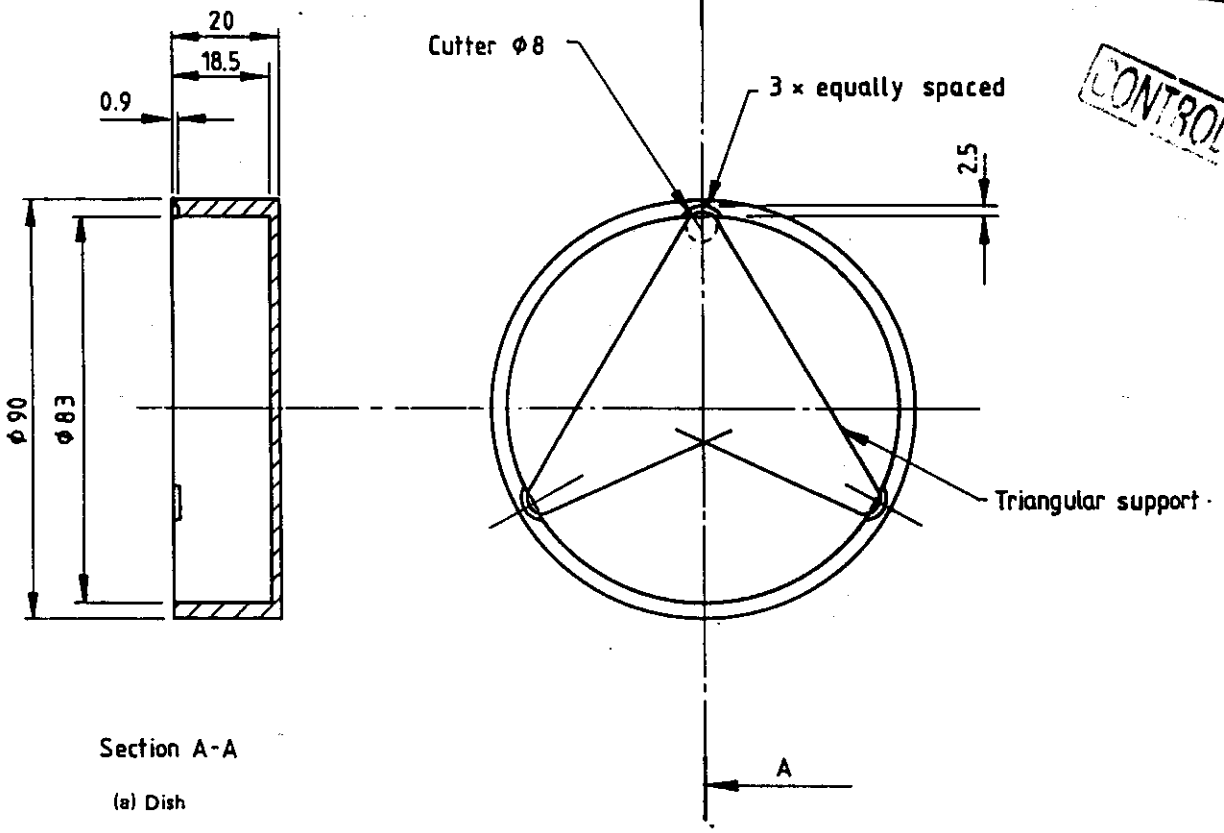
B.4.11 The water vapour permeability index (I) is given by means of the following equation:

$$I = \left\{\frac{(WVP)_f}{(WVP)_r}\right\} \times 100$$

where

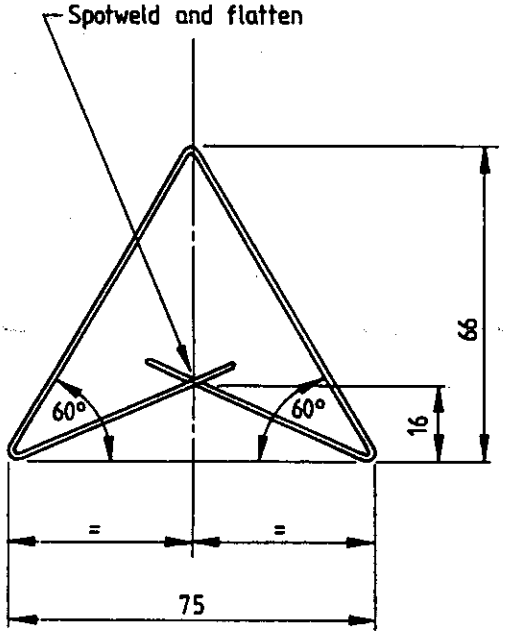
$(WVP)_f$ is the mean water vapour permeability of the fabric under test;

$(WVP)_r$ is the water vapour permeability of the reference fabric.

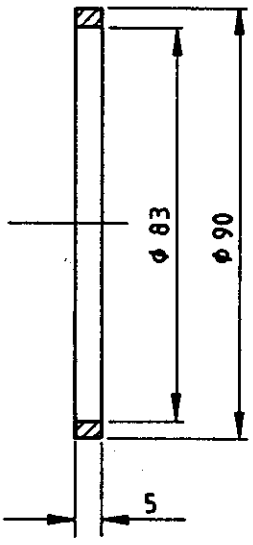


Section A-A

(a) Dish



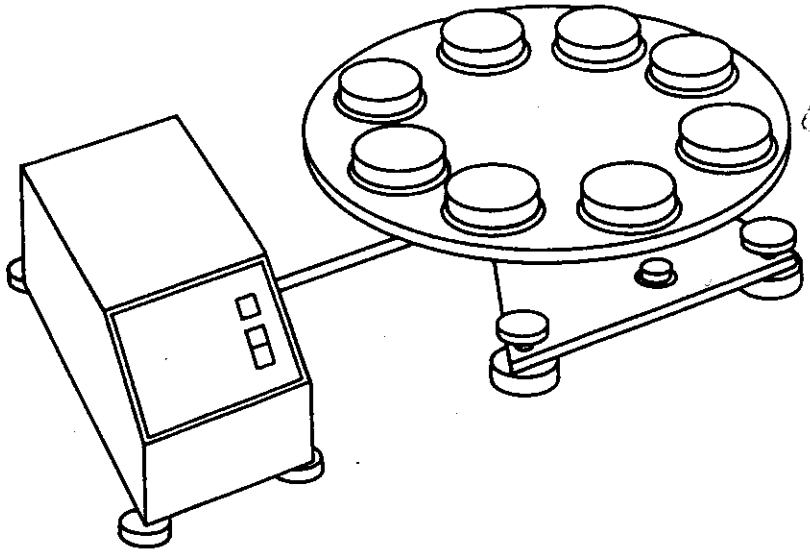
(b) Support



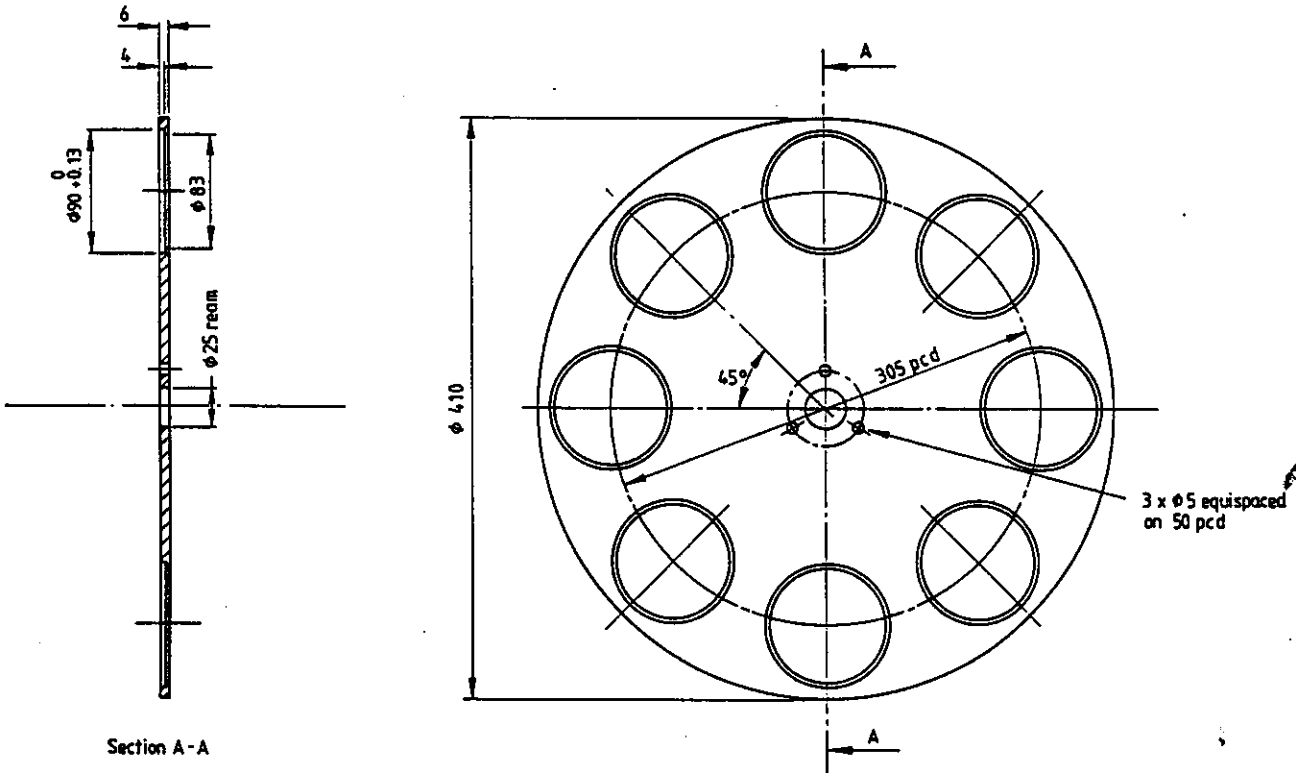
2(c) Cover ring, section

All linear dimensions are in millimetres.

Figure 2. Dish, support and cover ring



(a) Example of turntable and motor assembly



(b) Top view and section

All linear dimensions are in millimetres.

Figure 3. Turntable

Appendix C. Determination of resistance to water penetration after cleaning

Subject 10 specimens, each measuring 200 mm diameter, to the appropriate cleaning procedure for the fabric, i.e. washing or dry cleaning, whichever is specified by the manufacturer. Where washing is specified, wash in accordance with procedure 6A of BS 4923 and dry in accordance with procedure A of that standard. Where dry cleaning is specified, treat the specimens in accordance with section D01 of BS 1006.

Test each specimen for resistance to water penetration in accordance with method 29A of BS 3424 : Part 26.

Appendix D. Determination of resistance to water penetration after abrasion

Subject eight specimens to 5000 abrasion cycles in accordance with BS 5690 with a pressure on the specimen of 9 ± 0.2 kPa and with the following exceptions:

(a) the specimen size is 130 mm to 200 mm diameter;

(b) to permit subsequent hydrostatic head testing, fix the specimen, backed by the felt, to the bottom abradant tables, and fix the reference abradant to the specimen holders. Carry out the abrasion on that surface of the fabric intended to be worn innermost.

After abrading, test each specimen for resistance to water penetration in accordance with method 29A of BS 3424 : Part 26.

Clamp the test specimen so that the abraded area (of approximately 90 mm x 90 mm) is located concentrically with the well and ring clamp of the apparatus.

Appendix E. Determination of resistance to water penetration after flexing

Expose 10 specimens, each measuring 220 mm x 190 mm, to a temperature maintained at 70 ± 2 °C in a relative humidity of 100 % for 24 h. Upon removal from this atmosphere expose the specimens to the standard temperate atmosphere for conditioning and testing of textiles defined in BS 1051 (i.e. a temperature of 20 ± 2 °C and relative humidity of 65 ± 2 %) for 24 h and then flex each specimen for 9000 cycles in accordance with method 11D of BS 3424 : Part 9.

After flexing, test each specimen for resistance to water penetration in accordance with method 29A of BS 3424 : Part 26.

Appendix F. Determination of surface wetting after cleaning

Subject three specimens, each measuring 180 mm x 180 mm, to the cleaning procedure described in appendix C, after which, test the specimens for surface wetting in accordance with BS 3702 using water complying with grade 3 of BS 3978 at a temperature of 20 ± 2 °C.

Publications referred to

BS 381C Specification for colours for identification, coding and special purposes
BS 846 Specification for burettes
BS 950 Specification for artificial daylight for the assessment of colour
BS 1006 Methods of test for colour fastness of textiles and leather
BS 1051 Glossary of terms relating to the conditioning, testing and mass determination of textiles
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 8 Methods 10A, 10B and 10C. Methods for determination of low temperature performance
Part 9 Methods 11A, 11B, 11C and 11D. Methods for determination of resistance to damage by flexing
Part 14 Method 16. Methods for determination of colour fastness to wet and dry rubbing and determination of resistance to printwear
Part 26 Methods 29A, 29B and 29C. Methods for determination of resistance to penetration by water
BS 3546 Coated fabrics for water resistant clothing
Part 1 Specification for polyurethane and silicone elastomer coated fabrics
BS 3702 Method of test for determination of resistance of textile fabrics to surface wetting (spray test)
BS 3978 Specification for water for laboratory use
BS 4923 Schedule of domestic washing and drying procedures for textile testing
BS 5690 Method for determination of the abrasion resistance of fabrics
BS 6189 Glossary of terms relating to fabrics and associated fibres, yarns and processes
BS 6629 Specification for optical performance of high-visibility garments and accessories for use on the highway

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 31 May 1990

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Committee reference TCM/18 Draft for comment 87/44065 DC

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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/18, upon which the following bodies were represented:

Assistant Masters and Mistresses Association
British Clothing Industry Association
British Railways Board
British Textile Employers' Association
Confederation of British Wool Textiles Limited
Department of Health
Home Office
International Wool Secretariat
Local Authority Organizations
Mail Order Traders' Association
Man-made Fibres Producers' Committee
Ministry of Defence
National Association of Head Teachers
National Children's Wear Association
Textile and Clothing Contractors' Association
Textile Research Council (FCRA)

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Marine Industries Federation
British Plastics Federation

Amendments issued since publication

Amd. No.	Date of issue	Text affected