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Methods of test for

Coated fabrics

British Standards Institution

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The following BSI references relate to the work on this standard:

Committee reference M/31 Draft for comment 72/70309

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The Textile Divisional Council, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

*British Railways Board	*Ministry of Defence
Consumers' Association	Ropes and Cordage Industry Standards Committee
Consumer Standards Advisory Committee of BSI	Silk Industry Standards Committee
Cotton Industry Standards Committee	Society of Dyers and Colourists
Jute Industry Standards Committee	Textile Institute
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*London Transport Executive	Trades Union Congress
Man-made Fibres Industry Standards Committee	Wool Industry Standards Committee

The Government department and organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

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British Nonwovens Manufacturers' Association	Leathercloth and Coated Fabric Manufacturers' Association
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Department of Trade and Industry — Joint Fire Research Station	Society of Motor Manufacturers and Traders
Electricity Council, the Central Electricity Generating Board, and the Area Boards in England and Wales	



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Contents

	Page		Page
Co-operating organizations	Inside front cover	27. Method 27: determination of abrasion resistance of coated fabrics in which an expanded layer is included in the coating	48
Foreword	3	28. Method 28: determination of coating thickness	50
Method		29. Method 29: resistance to penetration by water	53
0. Scope	4	30. Method 30: determination of soil resistance of coated fabrics	58
1. Method 1: determination of width of roll	4	Appendix	
2. Method 2: determination of length of roll	5	A. Methods of test specifically for Government department use	59
3. Method 3: determination of mass of roll	6	B. Conversion factors	66
4. Method 4: conditioning and selection of test specimens	7	Figures	
5. Method 5: determination of mass per unit area	8	1. Specimen for methods 7A and 7B	14
6. Method 6: determination of breaking load and breaking extension	11	2. Specimen for method 7C	15
7. Method 7: determination of tear strength	13	3. Method of clamping specimen	15
8. Method 8: determination of bursting strength	16	4. Bursting pressure apparatus test head (method 8)	16
9. Method 9: determination of coating adhesion	17	5. Apparatus for testing cold crack temperature	21
10. Method 10: determination of cold crack temperature	20	6. Specimen holder for method 12	26
11. Method 11: determination of resistance to damage by flexing	23	7. Apparatus for method 12	26
12. Method 12: determination of surface drag	26	8. Apparatus for heat ageing PVC-coated fabrics	29
13. Method 13: blocking test	28	9. Details of abrading member A	33
14. Method 14: accelerated ageing	29	10. Apparatus for determining fastness of colour to rubbing	33
15. Method 15: determination of colour fastness to light and weathering	33	11. Apparatus for testing resistance to flame	35
16. Method 16: determination of fastness of colour to wet and dry rubbing	33	12. Air permeability specimen holder	37
17. Method 17: determination of resistance to flame	35	13. Fabric specimen prepared for resistance to wicking test	41
18. Method 18: determination of air permeability	37	14. Resistance to wicking test	42
19. Method 19: determination of resistance to penetration by liquids	39	15. Cutting blocks	50
20. Method 20: determination of the effect of water immersion on dimensional stability	40	16. Mounting stand	50
21. Method 21: determination of resistance to wicking	41	17. Preparation of fabric strip for embedding	51
22. Method 22: determination of resistance to discoloration by sulphur or its compounds	43	18. Waterproofness test, low pressure	54
23. Method 23: determination of dimensional stability	44	19. Alternative apparatus for waterproof test	55
24. Method 24: determination of elongation and tension set under constant mass	45	20. Waterproofness test, high pressure	56
25. Method 25: determination of degree of fusion of PVC coatings	46	21. Apparatus for crumpling	59
26. Method 26: determination of thickness of coated fabrics in which an expanded layer is included in the coating	47	22. Test jig: resistance to acids and alkalis	61
		23. 'U'-cell assembly and thermostatically controlled bath	63
		24. Bending jig	65

Foreword

This edition differs from the preceding ones in that some tests are also applicable to rubber coated fabrics which were previously the subject of BS 903, 'Methods of testing vulcanized rubber', Parts G1 to G9, 'Methods of testing rubber proofed fabric'.

Included in appendices in this edition are methods of test requested by the Ministry of Defence and specifically for the use of Government departments, and some imperial equivalents of the metric units which are used in the present edition of this standard.

The attention of users of this standard is drawn to the following standards which may be of use in assessing properties which are not covered by tests in this publication:

- BS 1006: Methods for the determination of the colour fastness of textiles to light and weathering.
- BS 3144: Methods of sampling and physical testing of leather.
- BS 3266: Methods for the determination of conductivity, pH, water-soluble matter, chloride and sulphate in aqueous extracts of textile materials.
- BS 4724: Method of test for resistance of air-impermeable clothing materials to penetration by harmful liquids.

BS 3424 : 1973

British Standard Methods of test for Coated fabrics

0. Scope

The methods described in this standard are intended for use with all types of coating, whether on one, or both sides of a base fabric. All the tests are applicable to fabrics on a woven base and many of the tests are also applicable to products with a base fabric of other than woven construction.

Appendix A gives methods of test specifically for the use of Government departments.

Appendix B gives some imperial equivalents of the metric units which are used in the present edition of this standard.

NOTE. The titles of British Standards and special publication referred to in this standard are listed on the inside back cover.

1. Method 1: determination of width of roll

1.1 Apparatus

A flat table not less than 2 m long and at least as wide as the roll to be tested. A metal scale, of length greater than the width of the fabric to be measured, graduated in mm.

1.2 Procedure

Unroll the material along the table with the face side of the fabric upwards. Measure and record the usable width of the material at intervals of 10 m and while it is free from tension. For rolls less than 20 m long, measure the width at three positions, near the two ends and the middle of the roll.

Make all measurements of width at right angles to the longitudinal direction of the roll and to the nearest cm.

NOTE. The term 'usable width' means that width of material which is coated and finished uniformly and in such a manner that the cloth backing is not visible through the coating unless the coating is intended to be translucent or discontinuous.

1.3 Calculation and expression of results

Calculate the mean of the recorded widths to the nearest cm below and report the value obtained as the average usable width. Report also the minimum usable width recorded.

Clause 1. Method 1: determination of width of roll

Text deleted. Superseded by Method 1 of BS 3424 : Part 1 : 1982.

Clause 2. Method 2: determination of length of roll

Text deleted. Superseded by Method 1 of BS 3424 : Part 1 : 1982.

Clause 3. Method 3: determination of mass of roll

Text deleted. Superseded by Method 1 of BS 3424 : Part 1 : 1982.

Clause 4. Method 4: conditioning and selection of test specimens

Text deleted. Superseded by Method 4 of BS 3424 : Part 2 : 1982.

Clause 5. Method 5: determination of mass per unit area

Text deleted. Superseded by Methods 5A, 5B and 5C of BS 3424 : Part 3 : 1982.

Clause 6. Method 6: determination of breaking load and breaking extension

Text deleted. Superseded by Method 6 of BS 3424 : Part 4 : 1982.

Clause 7. Method 7: determination of tear strength

Text deleted. Superseded by Methods 7A, 7B and 7C of BS 3424 : Part 5 : 1982.

Clause 8. Method 8: determination of bursting strength

Text deleted. Superseded by Methods 8A and 8B of BS 3424 : Part 6 : 1982.

Clause 9. Method 9: determination of coating adhesion

Text deleted. Superseded by Method 9 of BS 3424 : Part 7 : 1982.

Clause 10. Method 10: determination of cold crack temperature

Text deleted. Superseded by Methods 10A, 10B and 10C of BS 3424 : Part 8 : 1982.

Clause 11. Method 11: determination of resistance to damage by flexing

Text deleted. Superseded by Methods 11A, 11B, 11C and 11D of BS 3424 : Part 9 : 1984.

BS 3424 : 1973

12. Method 12: determination of surface drag

12.1 General

The method described gives a measure of the coefficient of friction between the surface of the test material and a standard woollen fabric which is representative of clothing fabrics.

The woollen fabric is used to face a flat surface on which is placed a standard sledge, carrying the test material on its under surface. The method involves determining the minimum angle of inclination of the flat surface at which the sledge will slide down the slope under its own mass.

12.2 Apparatus

A rigid platform approximately 300 mm long and not less than 100 mm wide is hinged at one end to a baseboard provided with levelling screws. The rigid platform is provided with a spirit level and means for measuring the angle of inclination with an accuracy of $\pm \frac{1}{2}^\circ$. An electric motor suitably geared is provided to tilt the plane mechanically at a rate of $15^\circ \pm 2^\circ$ per minute. A piece of woollen melton cloth conforming to BS 1771, CW5 and measuring approximately 250 mm long and 100 mm wide with its length in the cross direction is fixed to the platform under slight tension.

The specimen carrier, which is of metal, has dimensions as illustrated in Fig. 6. The total mass of the carrier including the clamping screw is adjusted to 300 g by balanced boring out of the upper section of the carrier.

A microswitch (see BS 9562) is included in the circuit in series with the electric motor. This is so positioned at the top end of the platform that the actuating lever of the switch may be depressed by the back edge of the specimen carrier resting on the melton cloth. A suitable stop is provided such that the distance of travel of the carrier between the stop and the contact breaking position of the switch is 4.5 ± 0.5 mm. The force required to depress the actuating lever of the microswitch is between 40 and 80 mN.

A suitable apparatus is shown schematically in Fig. 7.

NOTE. The melton cloth should be covered when the apparatus is not in use. It should be replaced at intervals, or if contaminated through use.

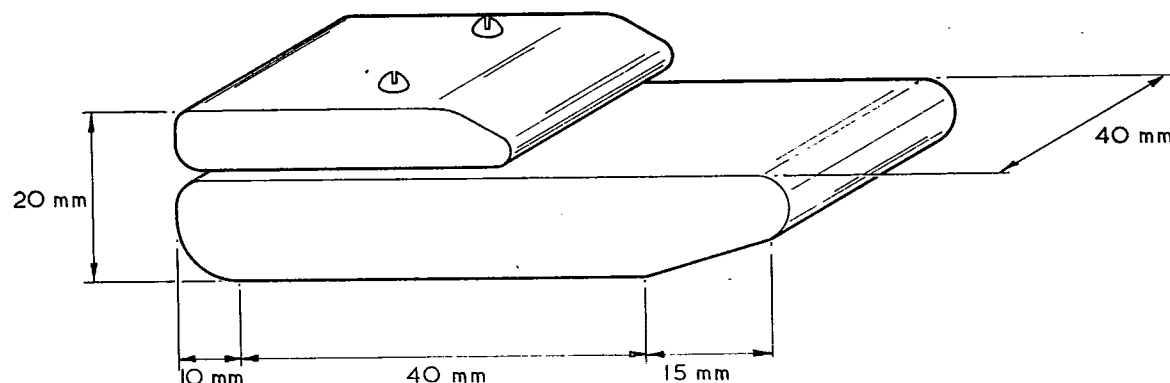


Fig. 6. Specimen holder for method 12

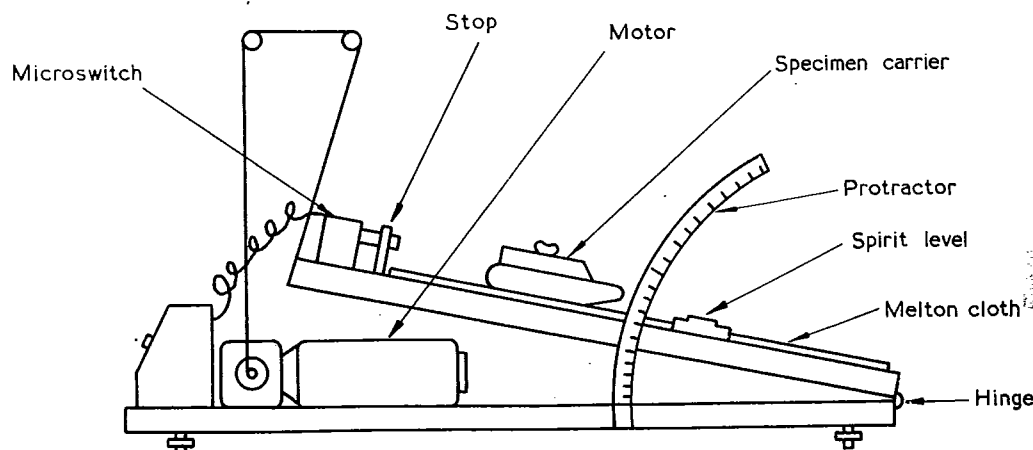


Fig. 7. Apparatus for method 12

12.3 Test specimens

Cut three specimens each 40 mm wide and 120 mm long with their length in the cross direction from positions equally spaced across the width of the material but not within 50 mm of an edge.

12.4 Procedure

Condition the specimens and the melton cloth in accordance with method 4, unless otherwise stated, and carry out the tests in an atmosphere similar to that used for conditioning. Set the platform to 0° on the protractor scale and level the platform using the levelling screws on the baseboard.

Wrap a specimen around the carrier and clamp it in position under slight tension. Place the specimen carrier on the platform with the specimen in contact with the melton cloth and with the back of the carrier against the stop, thus actuating the microswitch. Switch on the motor. When the inclination of the platform is sufficient to cause the specimen and carrier to slide over the melton cloth, the microswitch actuating lever is released, stopping the motor. Record the angle of inclination of the platform to the nearest $\frac{1}{2}^\circ$.

Repeat the procedure with the remaining specimens.

12.5 Calculation and expression of results

Calculate the mean of the three results to the nearest degree as the surface drag.



Clause 13. Method 13: locking test

Text deleted. Superseded by Method 13 of BS 3424 : Part 11 : 1982.

14. Method 14: accelerated ageing

14.1 Method 14A: loss of volatile matter on heating of PVC types

14.1.1 General. As a result of natural ageing PVC-coated fabrics may lose plasticizer by volatilization, and in time this will have an adverse effect on the flexibility of the coating. The extent to which a particular material will be so affected will depend on the formulation of the coating, so it is desirable to be able to assess this property. The method described is designed to accelerate the loss of volatiles by exposing test specimens to an elevated temperature, followed by determination of the loss of mass. The effect of this on flexibility can then be estimated when the original plasticizer content of the coating is known; direct determination of the loss of flexibility by means of the flexing test is not practicable because the latter is not sufficiently precise.

14.1.2 Apparatus. The apparatus (Fig. 8) consists of:

- (1) A container 150 mm diameter and 165 mm high into which an annular cage arrangement is fitted. The cage consists of two cylindrical tubes made of 500 μ m bronze gauze, one being 100 mm diameter and the other 112.5 mm diameter, secured in position by means of six 5 mm diameter copper rods mounted on a copper or brass ring. The cage is maintained in a central position in the container by some convenient method, such as three positioning rivets. The cage is provided with a loose lid in the centre of which is a 35 mm diameter hole. The loose lid of the main container has a hole in the centre through which a thermometer can be inserted.
- (2) Means for maintaining the container at a temperature of $100 \pm 1^\circ\text{C}$.
- (3) A balance capable of measuring to an accuracy of 0.2 % of the mass of the test specimen.

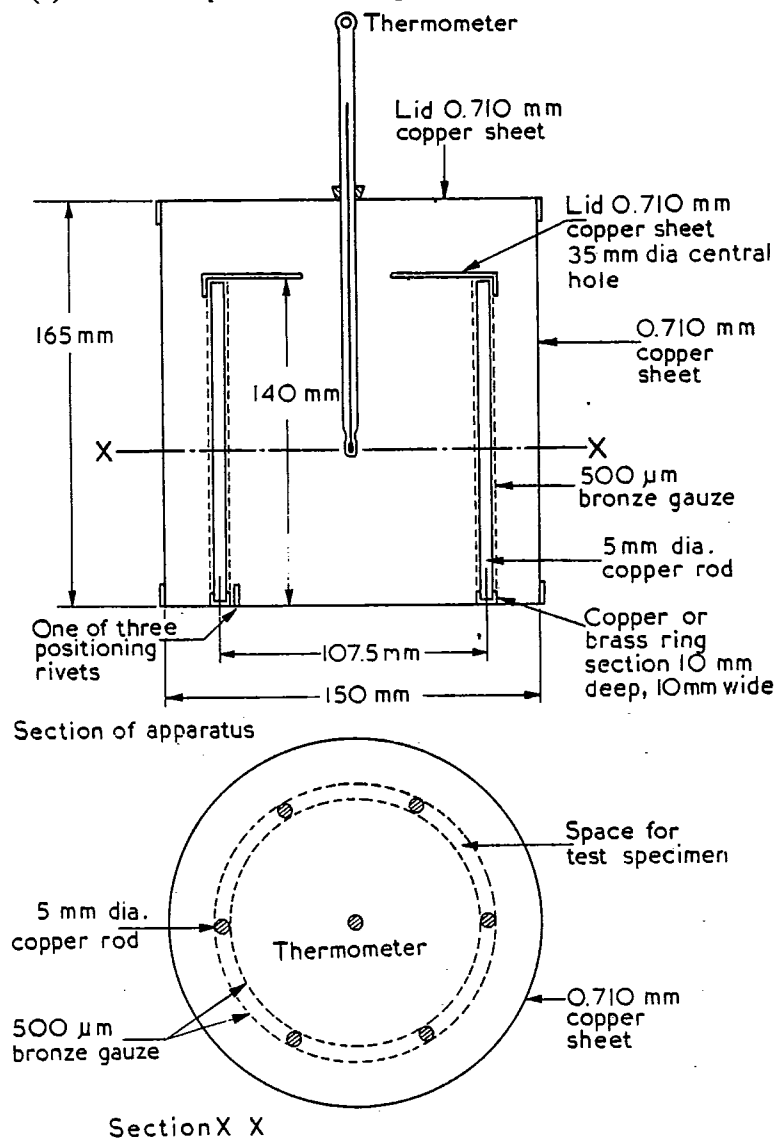


Fig. 8. Apparatus for heat ageing PVC-coated fabrics

BS 3424 : 1973

14.1.3 Test specimens. Cut three test specimens each 125 mm × 37.5 mm selected so that, as far as possible, they are evenly spaced across the sample and with their length in the longitudinal or cross direction.

14.1.4 Procedure. Condition the test specimens in accordance with method 4. After conditioning, determine the mass of each test specimen to an accuracy of 0.2 % (M_1).

Suspend the three test specimens, each in a space of the annular cage, and in such a manner that the coated side is toward the centre of the container. Place activated coconut shell carbon of surface area 1000 m²/g and particle size 3.35 mm to 1.20 mm in the container until it is filled level with the top of each side of the annular cage. Place the lid of the cage in position and add activated carbon until the container is filled completely. Place the lid of the container in position and introduce a thermometer in such a manner that the bulb coincides with the centre point of the container.

Introduce the container into a heating unit maintained at 100 ± 1 °C. If the heating unit is a liquid bath, immerse the container in the liquid to within 25 mm from the top. Ensure that both the heating medium and the centre point of the container reach the prescribed temperature of 100 ± 1 °C within 1 hour of the introduction of the container and maintain this temperature for 16 h.

After the prescribed time of heating, remove the container from the heating medium, take out the test specimens and wipe the surfaces to remove dust. Condition the specimens in accordance with method 4 and determine the mass of each specimen to an accuracy of 0.2 % (M_2).

14.1.5 Expression of results. Report the loss in mass of each specimen as a percentage of the coating mass of the material under test (as determined by method 5C) according to the following formula:

$$\text{Percentage mass loss on coating mass} = \frac{M_1 - M_2}{M_1} \times \frac{\text{total mass}^*}{\text{coating mass}^*} \times 100$$

14.2 Method 14B: oven method

14.2.1 General. This ageing test consists of subjecting test specimens to air at an elevated temperature and atmospheric pressure, after which the condition of the coating is assessed by hand. In the oven test the oxygen concentration is comparatively low and, if oxidation is rapid, oxygen may not diffuse into the coating quickly enough to maintain uniform oxidation. The test is therefore liable to give misleading results with poor-ageing coatings unless the coatings are very thin.

If desired, selected samples may be aged for periods considerably in excess of those specified, in order to ensure that decomposition will occur; such samples are then used to illustrate the effects of bad ageing.

14.2.2 Apparatus. The apparatus consists of the following.

- (1) An oven of such a size that the total volume of the test specimens does not exceed 10 % of the free air space of the oven.
- (2) Means for suspending test specimens so that they are not within 6 mm of each other or the sides of the oven.
- (3) Means for maintaining the temperature of the oven at 70 ± 1 °C, or at the temperature otherwise specified.
- (4) A thermometer placed near the centre of the ageing test specimens, to record the actual ageing temperature.

14.2.3 Test specimens. Cut three test specimens each at least 100 mm × 60 mm so that, as far as possible, they are evenly spaced across the sample and with their length in the longitudinal or cross direction.

14.2.4 Procedure. After pre-heating the oven to the operating temperature, place the test specimens in it so that they are free from strain, freely exposed to air on all sides and not exposed to light.

Make provision for a slow circulation of air through the oven, taking care that incoming air is heated to the temperature of the oven before coming in contact with the test specimens.

Simultaneous ageing of different types of compound should be avoided in order that migration of sulphur or antioxidant shall not occur.

Remove the test specimens from the oven after 168 h and examine as follows after conditioning for 24 h at 20 ± 2 °C in the dark.

Examine the exposed coated parts of the test specimens for any signs of softening, stiffening, tackiness, brittleness or other loss of properties found in the unaged material.

The assessment is carried out mainly by a series of hand tests, as follows:

* As determined by method 5.

- 1) Fold the exposed coated face(s) of the specimen through 180° and report any sign of cracking or sticking in the immediate vicinity of the fold.
- 2) Indent and scratch the exposed coated face(s) with the finger nail and observe the degree of firmness and resistance to disturbance of the film; it should be particularly noticed whether the coating is so soft that it can easily be scraped away.

E. When carrying out these tests it is advised that a comparison be made with the unaged material. This procedure greatly assists in assessing the changes which have occurred.

1.5 Report. Give a description of the results of the hand tests detailed in 14.2.4 as compared with similar tests on the unaged coated fabric.

3 Method 14C: oxygen pressure method

3.1 General. In this ageing test, test specimens are exposed to an elevated temperature and elevated oxygen pressure, after which the condition of the coating is assessed by hand in comparison with an unaged specimen. In the oxygen pressure test the increased oxygen concentration promotes rapid diffusion, and so helps to give uniform oxidation. On the other hand, the artificial promotion of oxidation may over-emphasize oxidative changes so that the total effect may not resemble that of natural ageing.

3.2 Apparatus. The oxygen pressure chamber consists of a stainless steel vessel with a bolted-down head designed to retain an internal atmosphere of oxygen under pressure, with provision for placing test specimens within it and subjecting them to a controlled uniform temperature.

The size of the vessel is optional, but is such that the total volume of the test specimens does not exceed 10 % of the free gas space in the vessel. No copper or brass parts are used within the ageing chamber.

The bath which surrounds the vessel is thermostatically controlled and a thermometer is immersed in the ageing fluid.

The pressure chamber is equipped with a reliable safety valve set at 3500 kN/m^2 .

3.3 Test specimens. Cut three test specimens each at least $75 \text{ mm} \times 25 \text{ mm}$ so that, as far as possible, they are evenly spaced across the sample and with their length in the longitudinal or cross direction.

3.4 Procedure. Suspend the specimens vertically in the pressure chamber after it has been dried and heated to the operating temperature. Before commencing the test flush the air out of the vessel by releasing the oxygen pressure and re-filling. Ensure that the test specimens in the vessel are stationary, free from strain, and freely exposed to the oxygen on all sides.

Pass oxygen into the pressure chamber until a pressure of 2000 kN/m^2 is obtained. Without opening the chamber, maintain a constant pressure at a temperature of $70 \pm 1^\circ \text{C}$, for the specified time.

Simultaneous ageing of different types of coating should be avoided in order that migration of antioxidant does not occur.

When the ageing period is complete, release the pressure completely in a slow and uniform manner over a period of at least 5 min. Remove the test specimens from the pressure chamber and examine as follows after conditioning for 24 h at $20 \pm 2^\circ \text{C}$ in the dark.

Examine the exposed coatings of the specimens for any signs of softening, stiffening, tackiness, brittleness or other loss of properties in comparison with an unaged specimen.

The assessment is carried out mainly by a series of hand tests, as follows:

(1) Fold the exposed coated face(s) of the specimens through 180° , and report any sign of cracking or sticking in the immediate vicinity of the fold.

(2) Indent and scratch the exposed coating with the finger nail, and observe the degree of firmness and resistance to disturbance of the film; it should be particularly noticed whether the coating is so soft that it can easily be scraped away.

4.3.5 Report. Give a description of the results of the hand tests detailed in 14.3.4 as compared with similar tests on unaged coated fabrics.

14.4 Method 14D: Nitro-cellulose types

14.4.1 Apparatus. The apparatus required is the following:

- (1) Three boiling tubes, $150 \text{ mm} \times 25 \text{ mm}$
- (2) Three clean corks to fit tubes
- (3) Means for maintaining the tubes at a temperature of $70 \pm 1^\circ \text{C}$.

14.4.2 Test specimens. Cut three test specimens, each $150 \text{ mm} \times 75 \text{ mm}$, selected so that as far as possible they are evenly spaced across the sample and with their length in the longitudinal or cross direction.

14.4.3 Procedure. Roll each test specimen along its length with the coating outermost and insert into a 150 mm X 25 mm boiling tube. Place a clean fresh cork lightly into the mouth of each boiling tube and place the assembly in an oven, maintained at 70 ± 1 °C. After 168 h at this temperature remove the assembly from the oven, remove the test specimens and condition them in accordance with method 4. While still in the standard atmosphere fold each specimen sharply along its length between the fingers, with the coating outermost. Examine the specimen and report any cracks in the coating.

15. Method 15: Determination of colour fastness to light and weathering

The procedures described in BS 1006 are appropriate.

2

Clause 16. Method 16: determination of fastness of colours to wet and dry rubbing

Text deleted. Superseded by Methods 16A and 16B of BS 3424 : Part 14 : 1985.

17. Method 17: determination of resistance to flame

17.1 General

The method described here is based on that described in BS 3119 and omits reference to any pre-treatment specified in BS 3120.

A conditioned strip of material is suspended vertically and the lower end is ignited. The duration of flaming and afterglow, after the removal of the igniting flame, are timed.

17.2 Apparatus

The apparatus (see Fig. 11) consists of the following.

- (1) A suitable clip for suspending the test specimen above the flame.
- (2) A shield in the form of an incombustible box 305 mm X 305 mm X 762 mm high, open at the top, and provided with a vertical transparent front. An opening 25 mm deep and 127 mm long is left at the bottom of the front, to allow manipulation of the gas burner.

- (3) A Bunsen burner with internal diameter 9 mm.

- (4) Plain or serrated spring clips or small clamps.

NOTE. With smooth materials it may be necessary to insert emery paper to increase the friction.

- (5) A suitable range of weight-pieces.

- (6) Two stenter pin plates, each consisting of a flat plate carrying pointed pins attached to one side of its broad surface to prevent movement of the lower end of the test specimen during the application of the test flame. Each plate is secured at one end to the side of the shield in the horizontal position.

- (7) A supply of commercial butane.

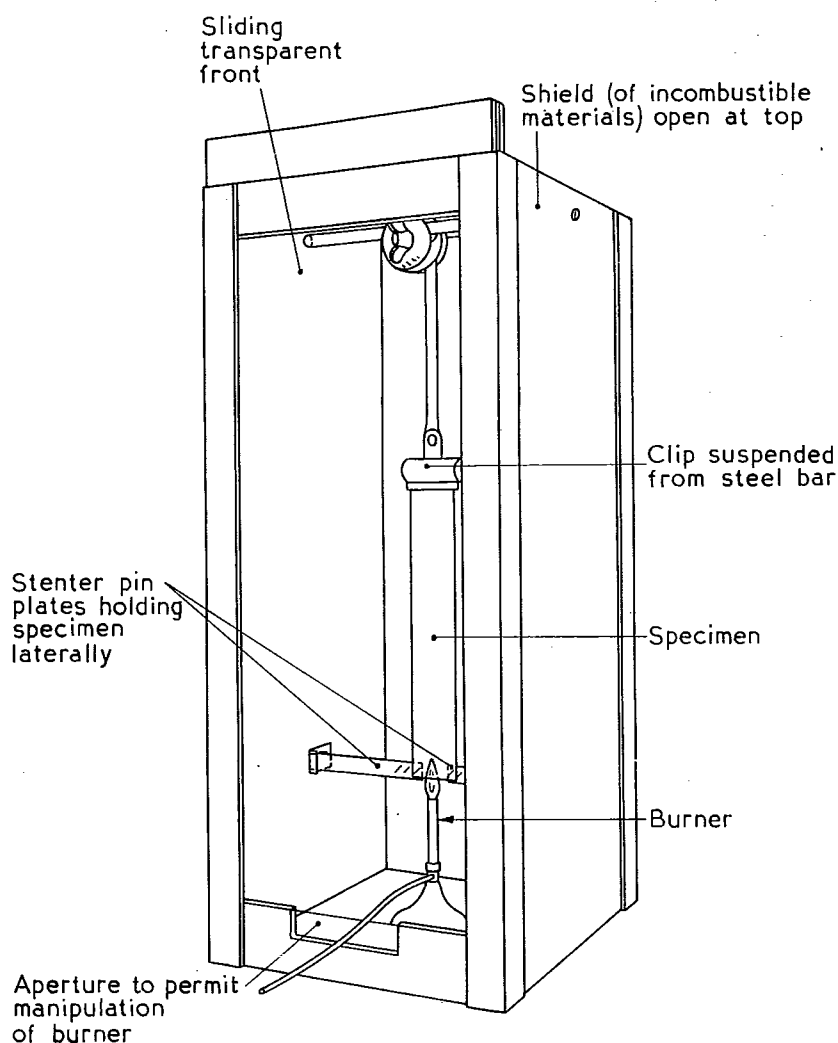


Fig. 11. Apparatus for testing resistance to flame

BS 3424 : 1973

17.3 Test specimens

Cut from three widely separated sections of the sample six test specimens, each 318 mm × 51 mm. Where appropriate cut three test specimens in the warp or longitudinal direction and three in the weft or cross direction, or at right angles to one another. Do not include a selvage.

17.4 Procedure

Condition the test specimens in accordance with method 4, unless otherwise stated. Set up the apparatus in a substantially draught free room or enclosure, having an atmosphere of relative humidity between 20 % and 80 % and a temperature between 15 °C and 30 °C. Suspend the test specimen from the clip so that it hangs vertically, with its lower end held by the horizontal stenter pin plates in such a way that the bottom 6 mm of the specimen is attached to the horizontal stenter pins thereon. Fix the plates so that no more than 9 mm of the specimen on either side is covered by them and so that the specimen is held in slight tension both vertically and horizontally.

Shut off completely the air supply to the gas burner, and adjust the burner to give a luminous flame 38 mm in length. Place the gas burner in such a position that the base of the flame is 19 mm below the middle of the lower edge of the specimen. Apply the flame for a period of 12 s and then withdraw it.

Record separately by stop-watch the times during which flaming and afterglow continue on the test specimen.

When any afterglow has ceased, remove the test specimen from the clip and stenter pin plates and attach clamps to the lower extremities of the unburned material, one on each side of the charred area. Attach a weight-piece to one clamp so that the combined mass is approximately equal to 25 % of that required to tear the unburned material. Apply the weight-piece to the test specimen gently without impact, by raising the other clamp. Measure the distance from the exposed end of the test specimen to the end of the tear made on the specimen by the applied load. Determine the difference between this length and the original length of the test specimen and record it as the length of char or melt.

NOTE. If a material under test is based on fabrics made from a thermoplastic fibre, it may be necessary to make a small cut vertically (with a pair of scissors or a razor blade) through the area of resolidified polymer which extends round the charred area. The clamps are then attached and the material tested by the method described above.

In order to determine the load required to tear the unburned material, lay an unburned specimen on a table and make a cut about 5 mm long in the middle of one end. Attach a clamp to the material on each side of the cut and attach a weight piece to the clamp on one side. Lift the material gently by the other clamp, and observe the cut. Repeat the process, if necessary, until the minimum load required to tear the material is found. Report the combined mass of the clamp and attached weight pieces as the load required to tear the material.

17.5 Calculation and expression of results

For each specimen calculate the following.

- (1) Duration of flaming, i.e. the period which elapses between the removal of the igniting flame and the time that the specimen ceases to flame (in s).
- (2) Duration of the afterglow, i.e. after flaming has ceased (in s).
- (3) The length of material which chars or melts (in mm).
- (4) Whether pieces of the test specimen fall and remain burning.
- (5) The length of char or melt.