

Testing coated fabrics

Part 26: Methods 29A, 29B, 29C and 29D. Methods for determination of resistance to water penetration and surface wetting

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

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Foreword

The method used for determination of resistance to water penetration or hydrostatic head testing will depend upon the type of coated fabric under test, the end use to which the material will be put, and the pressures to which it is considered most appropriate to subject the material under test. It is advisable to employ as large an area as possible in contact with the water, however, the availability of test equipment, economies of sampling and the limitations of commercial test equipment have to be taken into account.

Because of these considerations it has been decided to provide four methods which will cater for most foreseeable requirements in terms of the widely divergent coated fabric types encountered in the coated fabrics industry, as well as taking account of the commercial test equipment available in the industry and the dependancy of the coated fabrics industry on the textile industry proper.

Method 29A of BS 3424:1973 has been found to be, in the majority of cases, unwieldy, and takes up an unnecessary amount of laboratory space. This revision of method 29A is the preferred method, using as it does, a large specimen of greater statistical significance.

In BS 3424-26:1986 the approach adopted in method 29A and 29C was to subject the test specimens to a steadily increasing pressure (the pumping rate being specified as 10 mL/min or 60 mL/min) until penetration of the first drop of water occurred. The pressure of water exerted at that point was then recorded. One of the objectives of this approach to hydrostatic head testing, was that with some variability in the performance of the coated fabric, especially after flexing or accelerated ageing, it was possible to treat the results obtained statistically and assess the performance with some known level of confidence. Unfortunately the methods require constant attention by laboratory staff, and with the lower pumping rates and an extensive testing schedule such as that in BS 3546, the staff time is quite considerable. It become difficult, with multiple head instruments, for the operator to note accurately the penetration pressure on individual specimens. With such a wide variety of coatings; from lightweight polyurethane (PU) to double texture polychloroprene (CR) coated fabrics, the range of hydrostatic head performance values may be from approximately 5 kPa for crumple/flexed lightweight PU to over 80 kPa for most medium weight neoprenes. With pumping rates of 10 mL/min this represents penetration times of 5 min to nearly 1.5 h.

As a consequence of these considerations it has been decided to adopt an additional and more economic and practical approach to hydrostatic head testing in the form of pass/fail methods. There are, however, limitations to the pragmatic approach. Technologically justifiable times for the achievement of test pressure have been chosen so that the strains imposed on each group of fabrics are as closely aligned as possible.

This Part of BS 3424 supersedes BS 3424-26:1986 which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, 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 3424 describes three methods for the determination of the resistance of coated fabrics to water penetration and surface wetting (hydrostatic resistance), two of the methods each having two operational modes. A method for the assessment of the tendency to exhibit surface wetness is recommended as method 29D.

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

2 Method 29A. Low range (large specimen) method

2.1 Principle

A specimen of coated fabric is subjected to an increasing pressure of water on one face, under standard conditions, until a predetermined pressure specified in the coated fabric specification is obtained. The required pressure is maintained for a specified time or until penetration occurs, whichever is the lesser. The water pressure may be applied from below or from above the test specimen. The chosen alternative is specified in the test report.

2.2 Apparatus

2.2.1 A test rig

2.2.1.1 General. The apparatus consists of a well, fitted with a coaxial ring clamp to fasten the test specimen over the well. The apparatus introduces water at room temperature from above or below the test specimen over a circular area of 100 cm² (approximately 113 mm diameter).

The rubber tubing connecting the constant-level device and the well has an inside diameter of not less than 6 mm.

NOTE 1 If necessary soft rubber sealing gaskets may be employed between the coated fabric specimen and the surfaces of the coaxial ring clamps in order to reduce the risk of damage to the test specimen by the clamps and to facilitate the testing of seams. In this respect rubber of designation Z40 complying with BS 1154, having a hardness of approximately 40 IRHD (International Rubber Hardness Degree) and approximately 1 cm thick or 1 cm diameter has been found useful. Alternatively, a closed cell, cross-linked polyethylene foam having a density of 45 kg/m³ to 55 kg/m³ and approximately 1 cm thick has also been used.

NOTE 2 Results obtained using the two different modes of operation in 2.2.1.2 and 2.2.1.3 on different materials exhibiting similar values do not reflect similar performances.

NOTE 3 A test rig is shown in Figure 1.

2.2.1.2 Pass/fail mode pumping rate. When operating the test rig for pass/fail tests, the water pressure specified in the coated fabric specification is attained in 1 min ± 10 s for pressures less than 30 kPa¹⁾ or in 2 min ± 20 s for pressures greater than 30 kPa (305 cmH₂O).

NOTE This may readily be achieved by using mains water supply where suitable.

2.2.1.3 Index mode pumping rate. When operating the test rig for index mode, i.e. when subsequent statistical analysis is to be employed, water pressure is increased at the rate of 0.98 ± 0.049 kPa/min (10 ± 0.5 cmH₂O/min).

2.2.2 A means of measuring water pressure, such as either a manometer connected to the testing head(s), allowing water pressure up to 19.6 kPa (200 cmH₂O) to be read to an accuracy of ± 1 %, or a pressure gauge, graduated in centimetres head of water or in kilopascals and complying with BS 1780 with a maximum reading of at least 100 kPa (946 cmH₂O), is used as the means of measuring the water pressure applied to the test specimen.

2.3 Test specimens

At least five specimens of coated fabric of diameter 130 mm to 200 mm, randomly selected from the sample, shall be tested.

NOTE Where the appropriate equipment is available the coated fabric may be tested without cutting specimens from the sample.

2.4 Procedure

Wipe all surface water from the clamping surfaces. Clamp the test specimen in the test head so that the coated fabric is in a horizontal plane and in contact with the water, ensuring that no air is trapped between the coated fabric specimen and the water. The release valve shall be in the open position so that the clamping pressure does not exceed 0.196 kPa (2 cmH₂O). Ensure that there is no leakage of water at the clamps. Close the release valve.

Subject the test specimen immediately to increasing water pressure until the required operating pressure is obtained (see 2.2.1).

For pass/fail tests, maintain the hydrostatic pressure specified in the coated fabric specification for 2 min if the required pressure is below 30 kPa or, for 5 min if the required pressure is above 30 kPa. The total duration of the test, if below 30 kPa, shall be not less than 3 min, or, if above 30 kPa, not less than 7 min. If any water appears on the surface of the specimen record a failure.

For index methods, record the pressure at which water, if any, first appears on the surface of the specimen.

Do not take into account droplets which are formed at the clamping edge and touching the clamping edge.

¹⁾ 1 cmH₂O = 98.066 Pa.

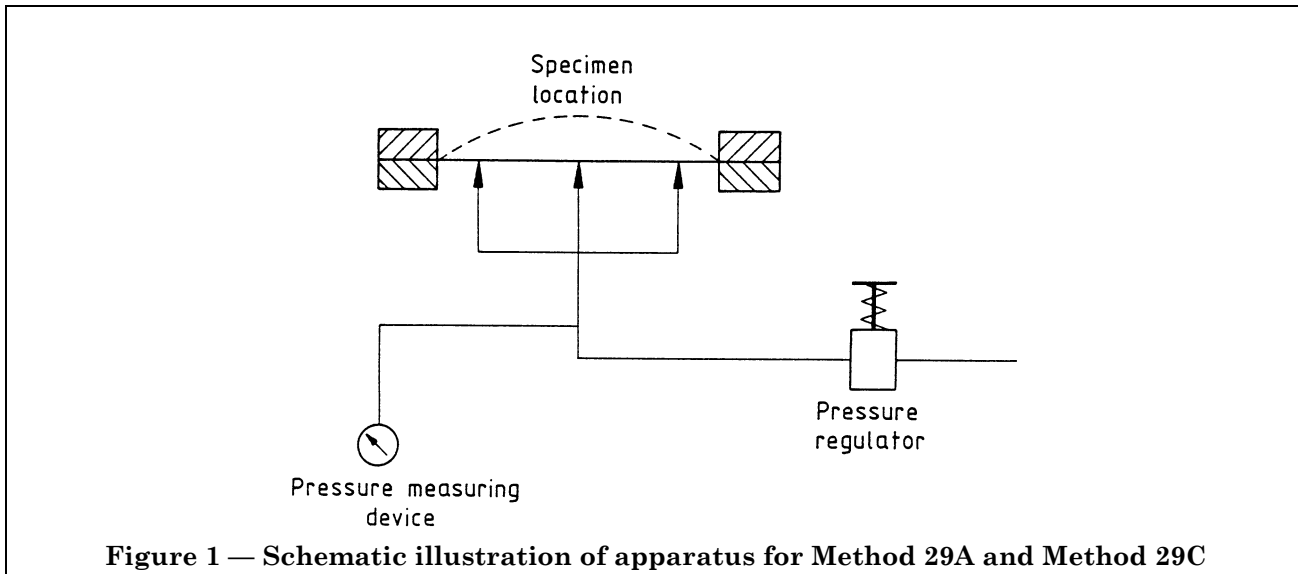


Figure 1 — Schematic illustration of apparatus for Method 29A and Method 29C

2.5 Test report

The test report shall include the following information:

- the description of the coated fabric;
- the rate of increase of water pressure;
- to which side of the coated fabric the water was applied;
- whether the water was applied from above or below the specimen;
- the individual test results;
- any deviation from the standard test procedure;
- reference to this method of test, i.e. method 29A of BS 3424-26:1990.

NOTE For information, the units are related as follows:

- 1 inH₂O = 249.089 Pa;
- 1 cmH₂O = 98.066 Pa;
- 1 psi = 6.894 × 10³ Pa;
- 1 psi = 70.307 cmH₂O.

3 Method 29B. High pressure method

3.1 Principle

A specimen of coated fabric is subjected to a predetermined pressure of water specified in the coated fabric specification on one face, under standard conditions for 10 min. The water pressure may be applied from below or from above the test specimen. The chosen alternative is specified in the test report.

3.2 Apparatus

3.2.1 A test rig, consisting of a well, fitted with a coaxial ring clamp to fasten the specimen over the well so that the specimen is clamped in a horizontal plane and such that it cannot slip in the clamps. The apparatus introduces water at room temperature to the test specimen over a circular area of 683.49 cm², i.e. 29.5 cm diameter at such a rate that the water pressure specified in the coated fabric specification is attained in 1 min ± 10 s.

NOTE 1 If necessary soft rubber sealing gaskets may be employed between the coated fabric specimen and the surfaces of the coaxial ring clamps in order to reduce the risk of damage to the test specimen by the clamps.

NOTE 2 A test rig is shown in Figure 2.

3.2.2 A pressure gauge, complying with BS 1780, graduated in kPa, with a maximum reading of at least 1 000 kPa, is used as the means of measuring the water pressure applied to the test specimen.

3.3 Test specimens

At least three specimens of coated fabric, randomly selected from the sample shall be tested.

NOTE The coated fabric may be tested without cutting specimens from the sample, but if specimens are to be cut, they should be not less than 350 mm diameter.

3.4 Procedure

Wipe all surface water from the clamping surfaces. Clamp the test specimen in the test head so that the coated fabric is in contact with the water, ensuring that no air is trapped between the coated fabric specimen and the water. Ensure there is no leakage of water at the clamps. In the case of single face coated fabrics the face in contact with the water shall be specified in the test report. Increase the water pressure to that specified in the coated fabric specification. Maintain the specified pressure for 10 min. Examine the surface of the test specimen in contact with the air for the presence of water globules or damp patches.

3.5 Test report

The test report shall include the following:

- a) the description of the coated fabric;
- b) the rate of increase of water pressure;
- c) information on which side of the coated fabric specimen the water was applied to;
- d) whether the water was applied from above or below the coated fabric specimen;
- e) the individual test results;
- f) any deviation from the test procedure;
- g) reference to this method of test, i.e. method 29B of BS 3424-26:1990.

4 Method 29C. Low range (small specimen) method

4.1 Principle

A specimen of coated fabric is subjected to an increasing pressure of water on one face, under standard conditions, until a predetermined pressure specified in the coated fabric specification is obtained. The required pressure is maintained for a specified time or until penetration occurs whichever is the lesser. The water pressure may be applied from below or from above the test specimen. The chosen alternative is specified in the test report.

4.2 Apparatus

4.2.1 A test rig

4.2.1.1 General. The apparatus consists of a well, fitted with a coaxial ring clamp to fasten the test specimen over the well. The apparatus introduces water at room temperature from above or below the test specimen over a circular area of approximately 19.63 cm^2 (50 mm diameter).

4.2.1.2 Pass/fail mode pumping rate. When operating the test rig for pass/fail tests, the water pressure specified in the coated fabric specification shall be attained in $1 \text{ min} \pm 10 \text{ s}$ for pressures less than 30 kPa (305 cmH₂O) or in $2 \text{ min} \pm 20 \text{ s}$ for pressures greater than 30 kPa (305 cmH₂O).

NOTE 1 This may readily be achieved by using mains water supply where suitable.

NOTE 2 If necessary soft rubber sealing gaskets may be employed between the coated fabric specimen and the surfaces of the coaxial ring clamps in order to reduce the risk of damage to the test specimen by the clamps and to facilitate the testing of seams. In this respect rubber of designation Z40 complying with BS 1154, having a hardness of approximately 40 IRHD and approximately 1 cm thick or 1 cm diameter has been found useful. Alternatively a closed cell, cross-linked polyethylene foam having a density of 45 kg/m^3 to 55 kg/m^3 and approximately 1 cm thick has also been used.

NOTE 3 Results obtained using the two different modes of operation in 4.2.1.2 and 4.2.1.3 on different materials exhibiting similar values do not reflect similar performance.

NOTE 4 A test rig is shown in Figure 1.

4.2.1.3 Index mode pumping rate. When operating the test rig for index mode, i.e. when subsequent statistical analysis is to be employed, water pressure should be increased at the rate of $0.98 \pm 0.049 \text{ kPa/min}$ ($10 \pm 0.5 \text{ cmH}_2\text{O/min}$).

4.2.2 A means of measuring water pressure, such as either a manometer connected to the testing head(s), allowing water pressure up to 19.6 kPa (200 cmH₂O) to be read to an accuracy of $\pm 1 \%$, or a pressure gauge, graduated in kilopascals or in centimetres head of water and complying with BS 1780 with a maximum reading of at least 100 kPa (946 cmH₂O), is used as the means of measuring the water pressure applied to the test specimen.

4.3 Test specimens

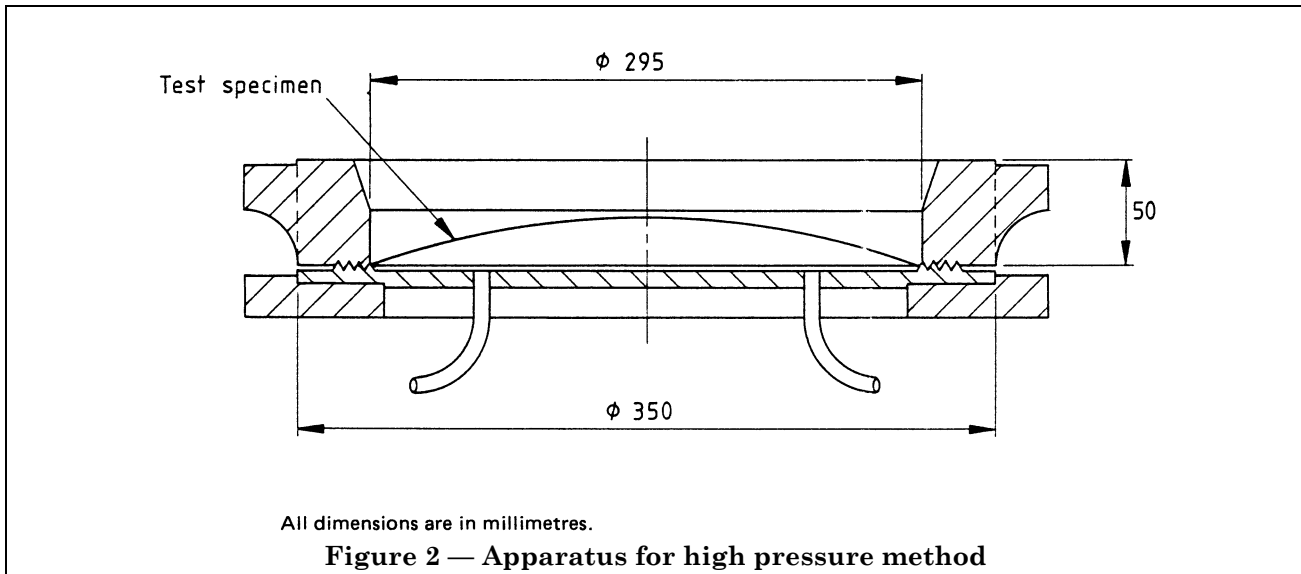
At least five specimens of coated fabric, of a size appropriate for the instrument in use, shall be tested.

NOTE Where the appropriate equipment is available the coated fabric may be tested without cutting specimens from the sample. Cut specimens however are commonly not less than 75 mm diameter.

4.4 Procedure

Wipe all surface water from the clamping surfaces. Clamp the test specimen in the test head so that the coated fabric is in a horizontal plane and in contact with the water, ensuring that no air is trapped between the coated fabric specimen and the water. The release valve shall be in the open position so that the clamping pressure does not exceed 0.196 kPa (2 cmH₂O). Ensure that there is no leakage of water at the clamps. Close the release valve.

Subject the test specimen immediately to increasing water pressure until the required operating pressure is obtained (see 4.2.1).



For pass/fail tests, maintain the required hydrostatic pressure specified in the coated fabric specification for 2 min if the required pressure is below 30 kPa, or for 5 min, if the required pressure is above 30 kPa. The total duration of the test, if below 30 kPa, shall be not less than 3 min, or, if above 30 kPa, not less than 7 min. If any water appears on the surface of the specimen record a failure.

For index methods, record the pressure at which water, if any, first appears on the surface of the specimen.

Do not take into account droplets which are formed at the clamping edge and touching the clamping edge.

4.5 Test report

The test report shall include the following:

- a) the description of the coated fabric;
- b) the rate of increase of water pressure;
- c) information on which side of the coated fabric specimen the water was applied to;
- d) whether the water was applied from above or below the specimen;
- e) each individual result;
- f) any deviation from the test procedure;
- g) reference to this method of test, i.e. method 29C of BS 3424-26:1990.

5 Method 29D. Surface wetting (spray test)

NOTE This method of test is technically equivalent to BS 3702:1982.

²⁾ For information on the availability of suitable metal nozzles, apply to Enquiry Section, BSI, Linford Wood, Milton Keynes, MK 14 6LE, enclosing a stamped addressed envelope for reply.

5.1 Principle

A specified volume of distilled or fully deionized water is sprayed on a test specimen which has been mounted on a ring and placed at an angle of 45° so that the centre of the specimen is at a specified distance below the spray nozzle. The spray rating is determined by comparing the appearance of the specimen with descriptive standards and photographs.

5.2 Apparatus and materials

5.2.1 Spray device (see Figure 3), consisting of a 150 mm funnel held vertically, with a metal nozzle (5.2.2) connected to the end of the stem by rubber tubing of 10 mm bore. The distance from the top of the funnel to the bottom of the nozzle is 190 mm.

5.2.2 Metal nozzle²⁾ (see Figure 4), having a convex face with 19 holes of 0.9 mm diameter. The holes are distributed over the face of the nozzle. The duration of flow for the specified volume of 250 mL of water poured into the funnel shall be between 25 s and 30 s.

5.2.3 Specimen holder, consisting of two wood or metal rings, which fit into each other, one of 150 mm inside diameter and one of 150 mm outside diameter (for example an embroidery hoop), into which the specimen can be secured. The rings should, when in position for a test, rest on a suitable support so that it is inclined at an angle of 45° with the centre of the test area 150 mm below the centre of the face of the spray nozzle.

5.2.4 Distilled or fully deionized water, at 20 ± 2 °C, or 27 ± 2 °C.

5.3 Test specimens

Take at least three test specimens, 180 mm square, from different places in the fabric so that they represent the material as fully as possible. Do not take test specimens from places with creases or fold marks.

5.4 Procedure

5.4.1 Condition the test specimens for at least 24 h under standard conditions.

5.4.2 After conditioning, mount the test specimen securely on the specimen holder (5.2.3) and place it with the face of the fabric uppermost on the hoop support. Unless otherwise stated in the material specification, the specimen shall be orientated so that the warp direction is parallel to the flow of water down the specimen.

Pour 250 mL of water (5.2.4) into the funnel (5.2.1) quickly, but steadily so that the spraying shall be continuous once it has commenced.

Immediately the spray has ceased, remove the holder with its specimen and tap smartly twice against a solid object (on diametrically opposite points of the frame). During this operation, the plane of the fabric shall be almost horizontal, with the fabric face down.

After tapping, with the specimen still on the holder, assign to the specimen the rating in the following descriptive scale or in the photographic scale (see Appendix A and Figure 5) which best describes the observed degree of wetting. Make no attempt to assign intermediate ratings.

NOTE Photographic standards are not entirely satisfactory for dark-coloured fabrics and for such fabrics more reliance should be placed on verbal descriptions.

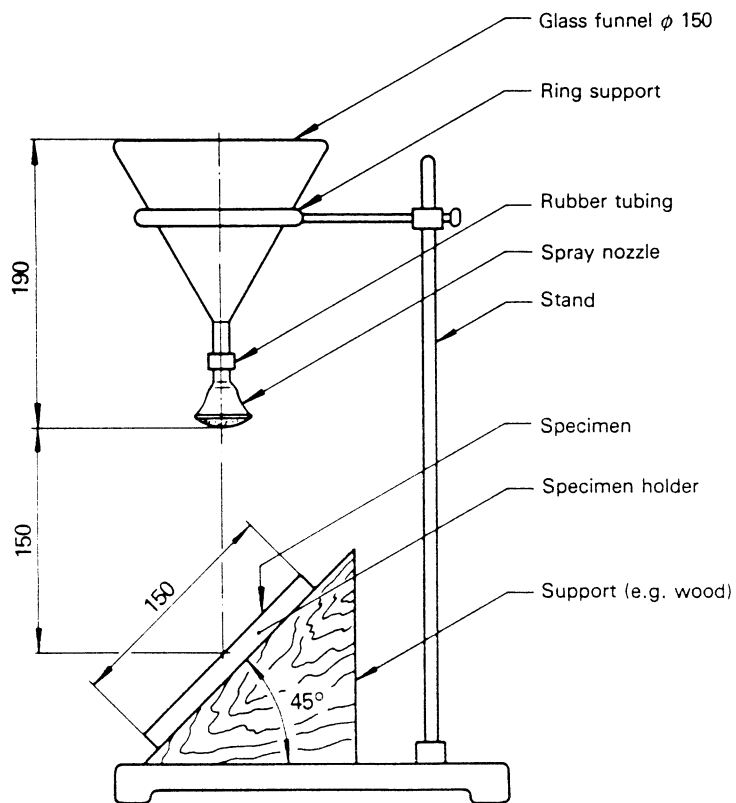
5.4.3 The spray rating is a measure of the resistance of the surface of a fabric to wetting and is rated as follows.

- a) 1 is the wetting of the whole of the sprayed surface.
- b) 2 is the wetting of half of the sprayed surface. This usually occurs through the merging of small discrete wetting areas.
- c) 3 is the wetting of the sprayed surface only at small discrete areas.
- d) 4 is the no wetting of, but adherence of small drops to, the sprayed surface.
- e) 5 is the no wetting of, and no adherence of small drops to, the sprayed surface.

5.5 Test report

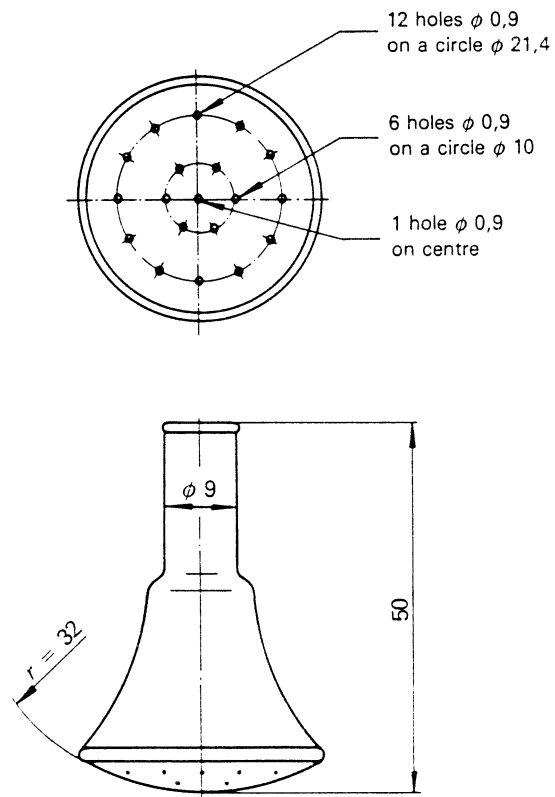
The test report shall include the following information:

- a) reference to this method of test, i.e. method 29D of BS 3424-26:1990;
- b) the atmosphere used (standard temperate or standard tropical or other atmosphere);
- c) the temperature of the water (20 °C or 27 °C or other temperature);
- d) the spray rating for each specimen tested.



All dimensions are in millimetres.

Figure 3 — Apparatus for spray test



All dimensions are in millimetres.

Figure 4 — Spray nozzle

Appendix A ISO photographic scale

The ISO descriptive rating scale corresponds to the AATCC photographic scale³⁾ as follows (see Figure 5):

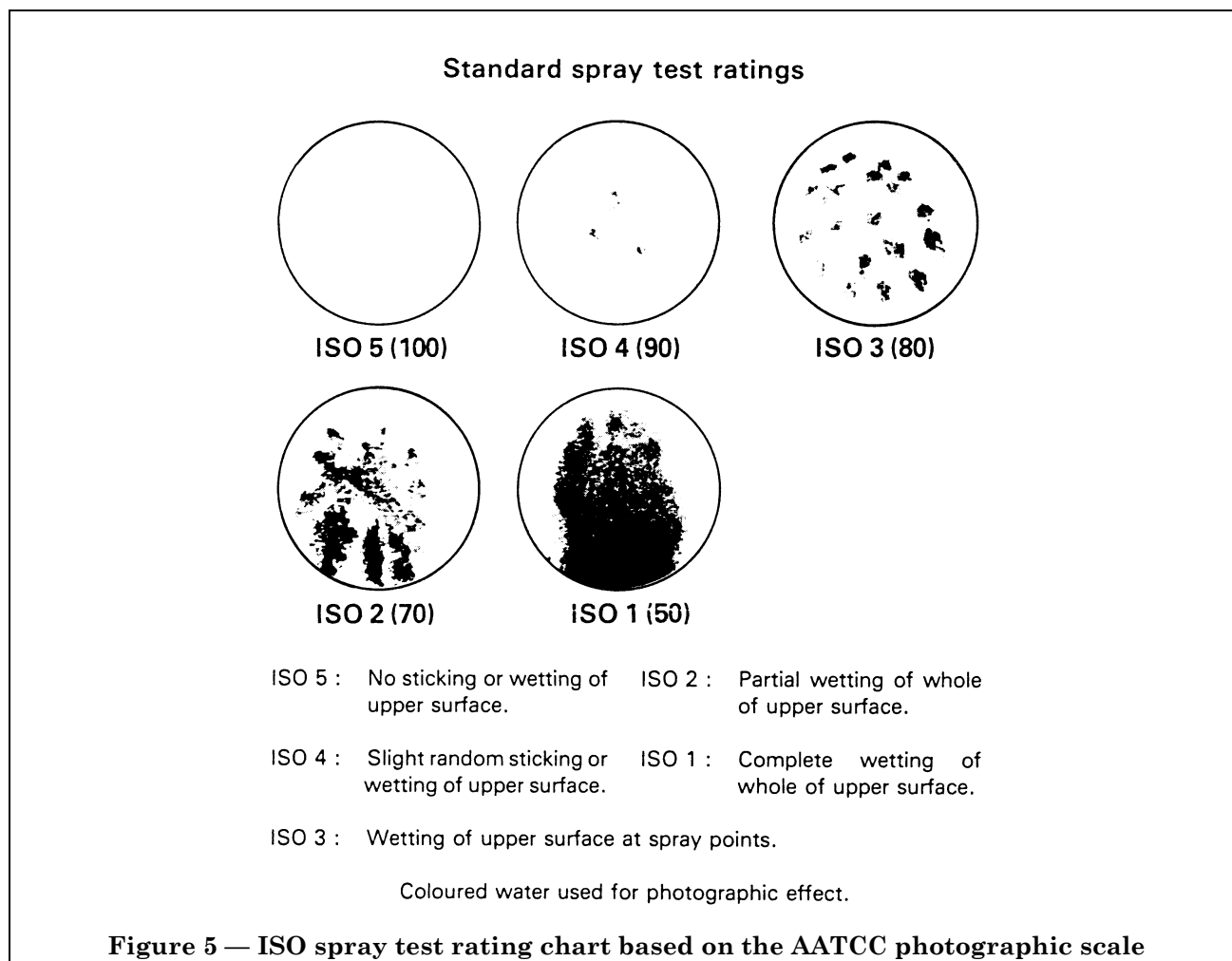
ISO 1 = AATCC 50

ISO 2 = AATCC 70

ISO 3 = AATCC 80

ISO 4 = AATCC 90

ISO 5 = AATCC 100



³⁾ The AATCC (American Association of Textile Chemists and Colorists) scale is available commercially. Details may be obtained from the ISO Central Secretariat or from the Secretariat of ISO/TC 38.

Publications referred to

BS 1154, *Specification for natural rubber compounds.*

BS 1780, *Specification for bourdon tube pressure and vacuum gauges.*

BS 3424, *Testing coated fabrics.*

BS 3424-2:Method 4, *Conditioning and selection of test specimens.*

BS 3546, *Coated fabrics for water resistant clothing*⁴⁾.

BS 3702, *Method of test for determination of resistance of textile fabrics to surface wetting (spray test).*

⁴⁾ Referred to in the foreword only.

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