British Standard

BRITISH STANDARD

BS 1881-5: 1970

Incorporating Amendment Nos. 1 and 2

Methods of

Testing concrete —

Part 5: Methods of testing hardened concrete for other than strength

UDC 666.972.01:691.32:620.1

Co-operating organizations

The Cement, Lime and Gypsum Products Industry Standards Committee, under whose supervision this standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Association of Consulting Engineers
British Granite and Whinstone Federation
British Precast Concrete Federation*
British Railways Board
British Ready Mixed Concrete Association*
British Slag Federation
British Steel Industry
Cement and Concrete Association*
Cement Makers' Federation*
Chalk Quarrying Association
Chemical Industries Association
Concrete Society Ltd.*
Federation of Civil Engineering Contractors*
Greater London Council*
Gypsum Plasterboard Development Association
Institution of Civil Engineers*
Institution of Municipal Engineers*
Institution of Structural Engineers*
Institution of Water Engineers
Limestone Federation*
London Transport Board*
Ministry of Housing and Local Government
Ministry of Public Building and Works*
Ministry of Public Building and Works — Building Research Station*
Ministry of Transport*
National Federation of Building Trades Employers
Royal Institute of British Architects*
Royal Institution of Chartered Surveyors
Sand and Gravel Association of Great Britain*
Society of Chemical Industry
Welwyn Hall Research Association

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committees entrusted with the preparation of this standard:

District Surveyors' Association
Incorporated Association of Architects and Surveyors
Ministry of Transport—Road Research Laboratory
National Paving and Kerb Association
Non-destructive Testing Society of Great Britain
Reinforcement Manufacturers' Association
Research Committee for the Cast Stone and Cast Concrete Products Industry
Scientific Instrument Manufacturers Association
Society of Non-destructive Examination
United Kingdom Atomic Energy Authority

This British Standard, having been approved by the Cement, Lime and Gypsum Products Industry Standards Committee, was published under the authority of the Executive Board on 26 January 1970

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The following BSI references relate to the work on this standard:
Committee references CEB/4, CEB/4/3 and CEB/4/4
Drafts for comment D65/10400, 66/10591 and 67/26699

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Amendments issued since publication

Amd. No.	Date of issue	Comments
4062	February 1983	
6267	March 1990	Indicated by a sideline in the margin

Contents

Foreword

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

BS 12, *Portland cement (ordinary and rapid-hardening).*

BS 604, *Graduated measuring cylinders.*

BS 915, *High alumina cement.*

BS 2028, BS 1364, *Precast concrete blocks.*

BS 2648, *Performance requirements for electrically-heated laboratory drying ovens.*

BS 3718, *Laboratory humidity ovens (non-injection type).*

BS 3846, *Methods for calibration and grading of extensometers for testing of metals.*

BS 3898, *Laboratory humidity ovens (injection type).*

The purpose of this British Standard is to provide suitable methods for testing concrete, both on site and in the laboratory, so that individual specifications can include references to this standard instead of giving test methods as appendices. The term "site" is used when samples are being taken from concrete to be used in the works and the term "laboratory", when most of the concrete is to be used in the samples. Thus it is possible to provide uniformity in the methods of making and recording the tests carried out on the concrete.

The tests do not apply to concrete whose nominal maximum aggregate size exceeds 40 mm.

The standard has been revised under the authority of the Cement, Lime and Gypsum Products Industry Standards Committee in the light of experience gained in carrying out the tests described in the first edition published in 1952 and in order to expand its scope to cover additional methods of testing concrete.

The standard has been largely revised, except clause **6** of Part 5 on the initial surface absorption test, into Parts dealing with individual tests. Parts 101 onward contain methods of test and Parts 201 onwards contain recommendations for non-destructive tests.

Clause **6** describes a method of determining the initial surface absorption of concrete which has been developed by the British Precast Concrete Federation. It has been found that the results are closely related to those obtained by the procedure given in BS 1881-122 for the water absorption test and to weight loss during freezing and thawing tests. The test has been included in the standard because it is non-destructive and has the particular advantage that measurements can be taken on the surface of site concrete by a procedure which incorporates specified modifications of the general requirements for testing oven dried specimens.

Information on any other methods of test that are thought to be suitable for extensive use, or suggestions for improvement on the specified methods, are welcomed and will be considered in the course of future revision of this standard.

In view of the need for standardization of temperature and humidity conditions for laboratories engaged in testing building materials, the standard has been brought into line with the international recommendation adopting a mid-point of 20 °C for the control of temperature conditions in testing laboratories situated in temperate climates. Consideration was given to adopting the associated recommendation for control of relative humidity about a mid-point of 65 %, but as a result of a long term investigation of the actual humidity conditions in various laboratories, it became evident that such an attempt would be premature. However, a first step in this direction has been taken by fixing a minimum relative humidity of 50 % for the laboratory mixing room in line with a requirement in various American Society for Testing and Materials (A.S.T.M.) standards.

For the control of temperature conditions in testing laboratories situated in tropical climates, a mid-point of 27 °C has been internationally recommended. When tests specified in this standard are carried out in such climates, therefore. It is suggested that a temperature mid-point of 27 °C should be adopted, subject to the same tolerances as those laid down in the relevant clauses of the standard for use in temperate climates, and the fact reported.

In view of the change to metric in industry, this standard is expressed in metric terms. There is no intention, however, of denying users the opportunity of getting an acceptable life from existing apparatus. Apparatus for tests included in the original edition is specified solely in terms of rounded metric values, although some of these dimensions will cover not only the preferred metric sizes coming into use, but also existing inch sizes where these are not critical as indicated by any tolerances specified.

Apparatus for tests which have not appeared previously in the standard are given in terms of rounded metric values which generally do not relate to any inch sizes.

Values of stress in this standard are given in terms of the MN/m^2, the preferred multiple of the basic unit. Values thus expressed are, however, numerically equal to values expressed in terms of the N/mm^2, which is often chosen for convenience of use (i.e. 1 MN/m^2 = 1 N/mm^2).

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 to iv, 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.

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1 Scope

Clause **6** specifies the method for determining the initial surface absorption of oven dried specimens and of concrete which cannot be oven dried.

Clause 2 *Text deleted*

Figure 1 — *Figure deleted*

Clause 3 *Text deleted*

Clause 4 *Text deleted*

Figure 2 — *Figure deleted*

Clause 5 *Text deleted*

Figure 3 — *Figure deleted*

Figure 4 — *Figure deleted*

Figure 5 — *Figure deleted*

6 Test for determining the initial surface absorption of concrete

NOTE 1 Tests on oven dried concrete give reasonably consistent results whereas concretes which have to be conditioned in the laboratory or on site give less accurate results.

NOTE 2 This method of test is not applicable to specimens having excessive porosity or honeycombing. It is, however, applicable to concretes with exposed aggregate or profiled finish.

NOTE 3 High alumina cement concrete should not be oven dried.

6.1 Definition. For the purposes of this clause, the following definition applies:

initial surface absorption

the rate of flow of water into concrete per unit area after a stated interval from the start of the test and at a constant applied head and temperature

6.2 Apparatus

6.2.1 *Cap*

6.2.1.1 The cap shall provide a minimum area of water contact with the surface to be tested of 5 000 mm^2.

6.2.1.2 An inlet and an outlet tube shall be fixed into the cap, the former connecting to the reservoir (**6.2.2**) and the latter to the capillary tube (**6.2.3**). The outlet shall be so positioned that it is at the highest part of the cap to allow all trapped air to escape.

6.2.1.3 The cap shall be made of any suitable impermeable material.

NOTE If plastics material is selected a clear acrylic, polyester or epoxy resin (reinforced if necessary) is preferable, as this allows the operator to observe the cap filling up with water and all the air being displaced.

6.2.1.4 A suitable cap for clamping horizontally onto concrete samples with a relatively smooth surface is illustrated in Figure 6 and a complete assembly in Figure 7.

NOTE This form of cap is difficult to clamp in position on samples larger than about 250 mm wide by 120 mm deep.

6.2.1.5 In cases where either the surface of the concrete is not smooth or the cap cannot be clamped onto the surface to be tested, the cap shall have a knife edge for contact with the concrete. The cap shall be fixed to the test position as described in **6.5.1**. A suitable cap for testing vertical surfaces is illustrated in Figure 8.

6.2.2 *Reservoir and connections to the cap.* The reservoir shall comply with the following requirements:

1) it shall be a funnel made of glass or plastics of about 100 mm diameter, and

2) it shall be provided with a connection to the inlet to the cap by flexible tubing into which a control tap or clip tap is fitted.

6.2.3 *Capillary tube and scale.* A length of precision bore glass capillary tubing, 100–1 000 mm long and with a bore of 0·4–1·0 mm radius, determined as laid down in **6.4.1**, shall be fixed to a scale calibrated according to the procedure laid down in **6.4.2**. One end of the capillary tube shall protrude beyond the end of the scale and this end shall be provided with a connection of flexible tubing to the outlet of the cap.

6.2.4 *Oven.* A well ventilated drying oven complying with BS 2648[1)], except that the internal space may exceed 0·085 m^3, in which the temperature is controlled at 105 ± 5 °C.

6.2.5 *Cooling cabinet.* A dry airtight vessel.

6.2.6 *Stop watch.* A stop watch or clock capable of being read to an accuracy of 0·5 s.

6.3 Selection and preparation of specimens. At least three separate specimens or locations shall be tested.

6.3.1 ***Oven dried samples.*** The sample shall be dried in a well ventilated oven at 105 ± 5 °C until constant weight is achieved. By constant weight is meant not more than 0·1 % weight change over any 24 h drying period. When the sample has reached constant weight it shall be placed in a suitable airtight cooling cabinet where it shall remain until the temperature in the cabinet falls to a temperature within 2 degC of that of the room. Each sample shall remain in the cabinet until required for testing.

[1)] BS 2648, "Performance requirements for electrically-heated laboratory drying ovens".

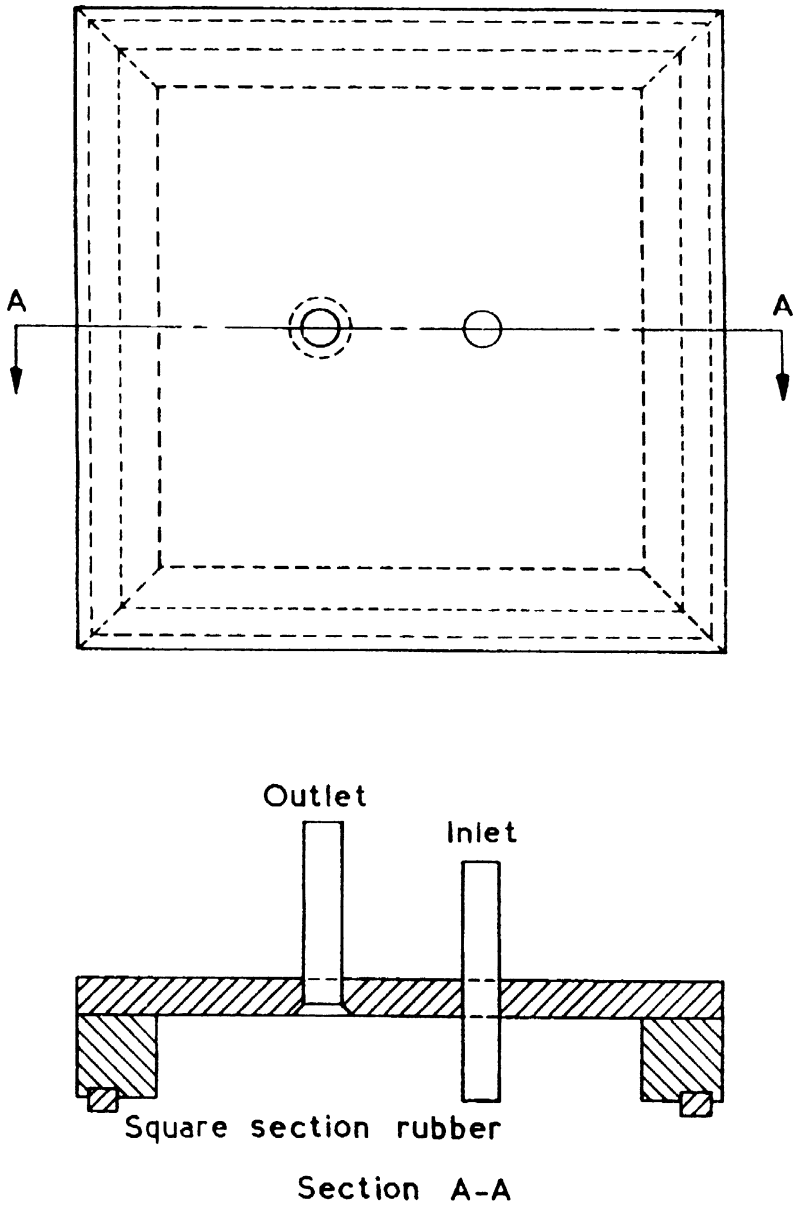

Figure 6 — Typical cap suitable for clamping onto smooth horizontal surface

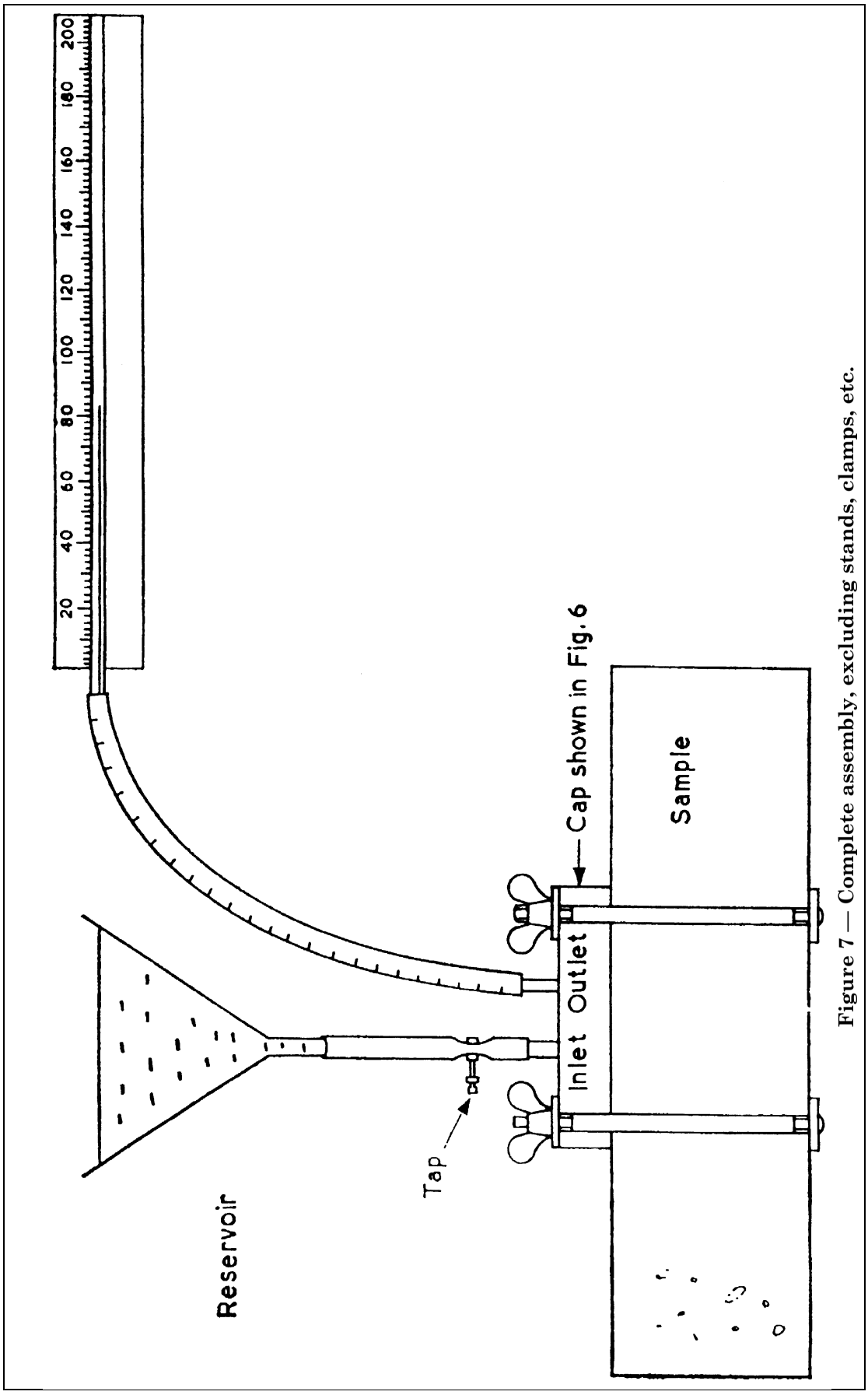

Figure 7 — Complete assembly, excluding stands, clamps, etc.

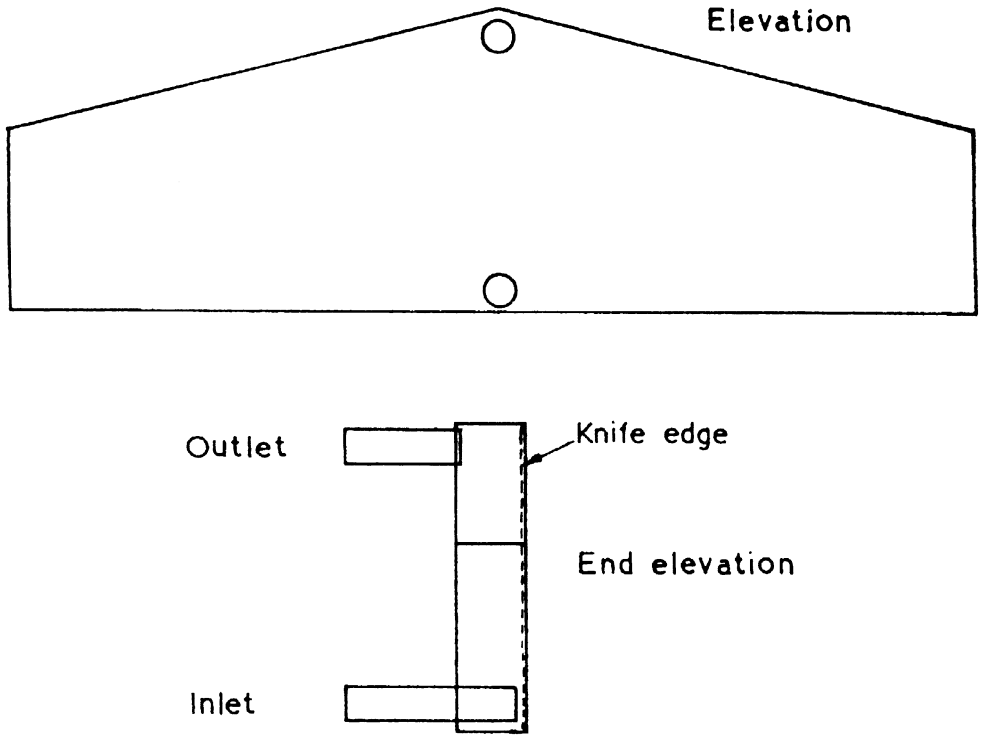

Figure 8 — Typical cap suitable for vertical surface

6.3.2 ***Non-oven dried samples***

6.3.2.1 *Conditioning for laboratory testing.* The concrete unit or sample shall remain in the laboratory for a minimum period of 48 h at a temperature of 20 ± 2 °C.

6.3.2.2 *Conditioning for site testing.* The surface shall be tested after a period of at least 48 h during which no water has fallen onto the test surface.

6.4 Calibration of apparatus

6.4.1 ***Radius of bore of capillary tube.*** The length of the capillary tube shall be measured and recorded to the nearest millimetre. The tube shall be flushed through with soap solution, followed by at least 25 ml of distilled or de-ionized water. The tube shall be clamped horizontally and connected to the reservoir by means of a flexible tube fitted with a tap. The reservoir shall be fixed such that a head of water of 200 ± 5 mm shall be maintained during the course of the calibration. A measuring cylinder of 10 ml capacity conforming to the requirements of BS 604[2)] shall be used for the purpose of collecting the water issuing from the open end of the capillary tube.

The tap shall be shut off and the reservoir filled with distilled or de-ionized water to the specified level. The temperature of the water shall be determined, using a thermometer accurate to ± 0 2 °C, and shall be at ambient ± 1 degC. The tap shall be opened and when a steady discharge occurs the measuring cylinder shall be placed under the open end and collection of the water begun. At the same instant the stop watch shall be started. The time required to collect 10 ml of water shall be recorded in seconds.

The procedure described in the previous paragraph shall be repeated twice more and the average of the three recordings shall be calculated.

The bore radius of the capillary tube, r, in millimetres, shall be calculated from the following equation:

$$r^4 = \frac{L}{20\mu t},$$

where:

L is the length of the capillary tube in millimetres,

t is the average time in seconds to collect 10 ml, and

[2)] BS 604, "Graduated measuring cylinders".

μ is the viscosity factor, which shall be obtained from the values below:

Water temp. (°C):	18	19	20	21	22
Factor μ:	3·73	3·82	3·91	4·00	4·09

6.4.2 ***Capillary scale.*** From the dimensions of the cap, the area of contact of the water with the specimen shall be calculated and recorded in square millimetres, A_1. The area of the bore of the capillary in square millimetres, A_2, shall be calculated from the equation $A_2 = \pi r^2$, using the value of r from **6.4.1**.

A scale shall now be prepared to mount behind the capillary tube and shall be marked off in units of 0·01, spaced $6 \times 10^{-4} \frac{A_1}{A_2}$ mm apart.

NOTE The scale and capillary are now prepared so that the movement of the water along the capillary over a one minute period is the initial surface absorption in millilitres per square metre per second at the time of the test.

6.5 Procedure

6.5.1 ***Fixing the cap.*** Where the cap has a solid rubber gasket this shall be slightly greased. Foamed rubber gaskets may or may not need greasing. In the case of knife edged caps a variety of materials may be used to build a dam round the outside of the cap and thereby prevent any loss of water from under the knife edge. The material shall be firmly applied to the concrete and the edges of the cap to build a wall capable of withstanding the pressure.

NOTE One of the best materials has been found to be modelling clay into which enough grease has been kneaded to enable the modelling clay to "wet" glass or metal. The colour may be selected to match the concrete.

The cap shall then be clamped into position or fixed into place and tested by blowing gently down one of the tubes whilst closing the other. If any leakage, which will reveal itself if a little soap solution is applied to the outside of the joint, is detected the joint shall be made good by tighter clamping or using more material round the edges of the cap.

6.5.2 ***Assembling the apparatus.*** The reservoir shall be set up so that when it is filled (see **6.5.4**) a head of 200 ± 20 mm of water shall be applied to the surface of the concrete. In the case of non-plane or vertical surfaces, the head of water shall be measured from mid-height of the concrete under the cap. The reservoir shall be connected to the inlet of the cap with the flexible tubing, which has the tap fitted to it.

The capillary tube shall be supported so that it can be fixed horizontally at the same level as the surface of the water in the reservoir and so that the open end of the capillary tube can be raised to avoid overflow of the water between taking readings (see **6.5.5**).

6.5.3 ***Temperature of water.*** In laboratory tests the temperature of the water shall be maintained at 20 ± 2 °C.

In site tests no limits can be laid down, but precautions shall be taken to avoid undue fluctuations in the temperature of the water during the test and, in any case, it is strongly recommended that the temperature of the water should not exceed 22 °C.

6.5.4 ***Starting the test.*** The tap from the reservoir shall be closed and the reservoir filled with water. The time of the start of the test shall be recorded and the tap opened to allow the water to run into the cap and out of the outlet tubing until no more air escapes. At all times care shall be taken that the reservoir does not empty itself. The outlet tubing shall be connected to the capillary tube and any additional trapped air shall be flushed out by allowing the capillary to overflow and, if necessary, by sharply pinching the flexible tubing. The reservoir shall be replenished to maintain the specified head of water.

6.5.5 ***Readings.*** Readings shall be taken after the following intervals from the start of the test:

10 min, 30 min, 1 h and 2 h.

Just before the specified intervals the position of the capillary tube shall be adjusted so that it is completely filled with water. It shall then be fixed in a horizontal position at the same level as the surface of the water in the reservoir.

At each of the specified test intervals the tap shall be closed and when water starts to flow along the capillary tube the stop watch shall be started. After 5 s the number of scale units the water has moved shall be noted and, by reference to Table 1, the period during which movement is noted shall be determined.

Table 1 — Determination of period of movement

Number of scale units moved in 5 s	Period during which movement is noted
Less than 3	2 minutes
3–9	1 minute
10–30	30 s
More than 30	Record initial surface absorption as more than 3·60 ml/m^2 per second

When readings are taken over a 2 min or 30 s period the measurement shall be multiplied by 0·5 or 2 respectively, and the number of scale units the water travels in one minute shall be recorded. If the movement over the 5 period exceeds 30 scale units the initial surface absorption shall be recorded as more than 3·60 ml/m^2 s.

Between test intervals the tap shall be left open and the level of the water in the reservoir shall be maintained at the specified head. The capillary tube may be tilled to prevent overflow of the water.

6.6 Report. The following information shall be included in the report on each specimen or each location:

1) date of test,

2) identification and description of test specimen or location,

3) age of sample,

4) description of the conditioning prior to test,

5) positions tested, where applicable,

6) detailed description of the surface of the concrete,

7) whether horizontal or vertical surface under test,

8) method of sealing cap,

9) area of water contact of cap, depth of cap and length of capillary, and

10) initial surface absorption test results in millilitres per square metre per second after the following intervals from the start of the test:

10 min,

30 min,

1 h,

2 h.

Clause 7 *Text deleted*

Figure 9 — *Figure deleted*

British Standards

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