BRITISH STANDARD

BS 7542:1992

Method of test for

Curing compounds for concrete

Confirmed
January 2012

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Technical Sector Board for Building and Civil Engineering (B/-) to Technical Committee CAB/3, upon which the following bodies were represented:

Brick Development Association
British Aggregate Construction Materials Industries
British Cement Association
British Ceramic Research Ltd.
British Precast Concrete Federation
British Ready Mixed Concrete Association
Building Employers Confederation
Cement Admixtures Association
Concrete Society
County Surveyors' Society
Department of the Environment (Building Research Establishment)
Department of the Environment (Property Services Agency)
Department of Transport
Electricity Industry in United Kingdom
Federation of Civil Engineering Contractors
Institute of Concrete Technology
Institution of Civil Engineers
Institution of Structural Engineers
Mortar Producers Association
Plasterers' Craft Guild
Society of Chemical Industry

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

Association of Consulting Engineers
Association of Consulting Scientists
Department of Transport (Transport and Road Research Laboratory)
Institution of Highways and Transportation

This British Standard, having been prepared under the direction of the Technical Sector Board for Building and Civil Engineering was published under the authority of the Standards Board and comes into effect on 31 January 1992

The following BSI references relate to the work on this standard:
Committee references CAB/3
Draft for comment DDI/17

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Contents

Foreword

This British Standard has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering and supersedes DD 147:1987 which is withdrawn.

Concrete has to be prevented from drying out after placing so that the cement can hydrate and form a dense structure that will be strong and impermeable. Moisture loss from concrete cast into moulds or formwork can be controlled by delaying demoulding or stripping, but this practice cannot be applied to large horizontal surfaces such as those of roads. These surfaces have to be covered as soon as possible and one method is to apply a curing membrane.

Curing compounds are materials sprayed in solution onto the surface of freshly placed concrete from which the solvent evaporates to leave a membrane which prevents loss of water. This membrane has to form on a wet and rough surface and yet be continuous and impermeable. A test to assess the effectiveness of curing compounds by simulating their performance in use was introduced a few years ago. The reproducibility of test results was found to be poor resulting in contractual problems for both the supplier and the user.

The original test has now been refined following considerable development work by the Cement Admixtures Association, which included investigating other test methods. The method applies specifically to curing compounds dissolved in organic solvents. It enables comparative tests to be made under standardized conditions to obtain good repeatability and reproducibility. The curing compound is therefore applied to a particular mortar having a finely brushed and level surface. The performance of curing compounds applied to a concrete may, in practice, be expected to be significantly affected by the concrete's constituents, composition, properties in the fresh state, texture and slope. The time of application of the curing compound and the prevailing ambient conditions will also be significant. In addition to laboratory tests, trials under site conditions are therefore essential to determine the application rate and subsequent performance of curing compounds for each intended use.

For water-based emulsions, a modification of this method has been suggested, involving a short period of pre-drying before application of the curing compound. Insufficient test data currently exist for its inclusion in this standard.

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 and ii, 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.

1 Scope

This British Standard describes a method for the laboratory determination of the water retention efficiency of organic solvent based, membrane-forming curing compounds for concrete.

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 British Standard the following definitions apply.

2.1
curing

maintenance of a sufficient moisture content in freshly placed concrete to ensure hydration of the binder and hence development of strength

2.2
curing compound

liquid applied as a coating which dries to form a curing membrane

2.3
curing membrane

film formed on the surface of freshly placed concrete to assist curing

3 Principle

The curing compound to be tested is applied as a uniform coating, usually by spraying, to the levelled surface of freshly mixed mortar in a metal mould. The coated specimen and an uncoated control specimen are then transferred to a warm curing cabinet in which dry air is circulated. The specimens are kept in the cabinet for 3 days and then weighed. The efficiency of the curing compound in forming a membrane which reduces moisture loss is calculated from the measured loss in mass of the specimens, after correction for the loss of solvent from the coated specimen.

4 Materials

4.1 *Portland cement*, complying with BS 12 that has been specially selected for the purpose of testing admixtures. It shall be identified as "CAA Reference Cement" and shall be stored in an airtight container.

NOTE BCA Specification Cement, meeting the requirements of the Cement Admixtures Association Reference Cement (CAA Reference Cement), and its specification can be obtained from Wexham Developments Limited, Wexham Springs, Slough SL3 6PL.

4.2 *Natural silica sand*, oven dry with a rounded particle shape complying with BS 882, except that the grading shall be as given in Table 1[1)].

Table 1 — Grading of sand

Sieve size	Proportion retained
	%
1.18 mm	None
600 µm	0 to 10
300 µm	60 to 88
150 µm	94 to 100

4.3 *Mould release agent*, comprising petroleum jelly, mineral oil or a similar commercial mould release agent.

5 Apparatus

5.1 *Moulds*, that are of corrosion resistant metal, do not distort, are watertight and of the following size (see Figure 1).

a) Top, internal: 150^{+5}_{0} mm × 300^{+5}_{0} mm.

b) Depth: (50 ± 2) mm.

c) Top flange: width at least 12 mm.

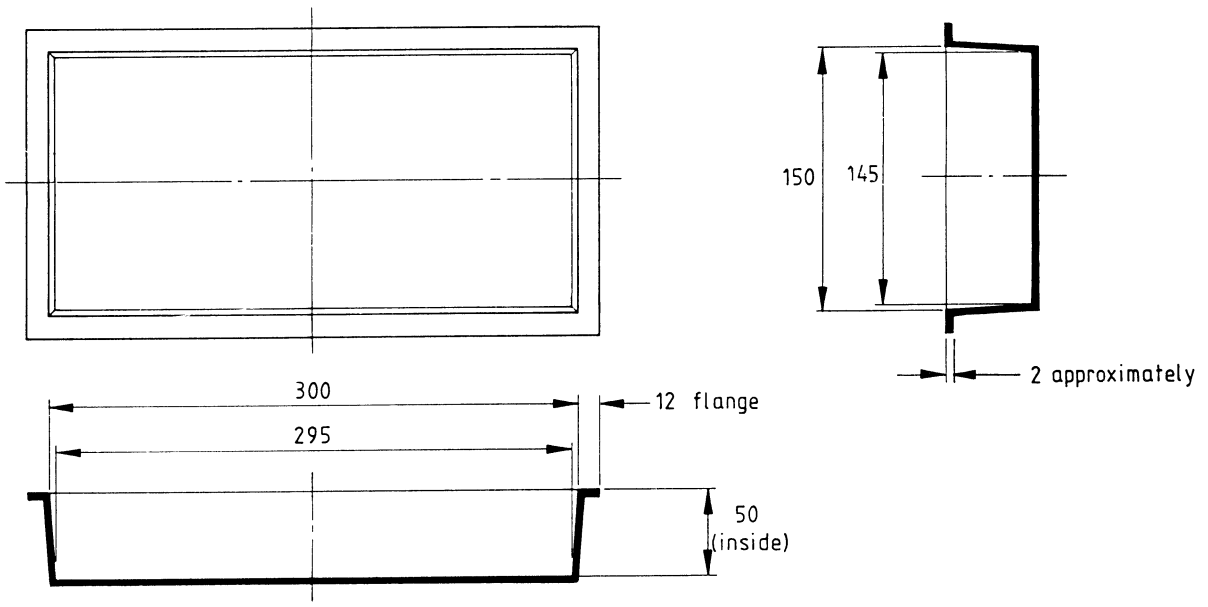
5.2 *Balance*, capable of weighing the filled moulds (each weighing about 6.5 kg) and readable to the nearest 0.1 g.

5.3 *Cabinet*, complying with BS 2648, for storing specimens at a temperature of (38 ± 1) °C and at a relative humidity of (35 ± 5) %. It shall have three perforated or mesh shelves each capable of supporting two specimens during testing so as to ensure a clear space of at least 40 mm on all sides of the individual specimen and between specimens and the side walls of the cabinet[2)]. The cabinet shall be equipped to circulate air over the specimens at an approximate rate of 0.5 m/s.

NOTE A relative humidity of (35 ± 5) % can be produced by placing a large open vessel containing a saturated aqueous solution of magnesium chloride in the bottom of the cabinet during the test.

5.4 *Spray equipment*, designed to permit the curing compound to be aspirated and applied evenly to the surface of the test specimen[2)].

[1)] For information on the availability of suitable sands, write to Customer Information, BSI, Linford Wood, Milton Keynes MK14 6LE.
[2)] For information on the suppliers of suitable cabinets and spray equipment, write to Customer Information, BSI, Linford Wood, Milton Keynes MK14 6LE.



Dimensions are in millimetres.
For tolerances see **5.1**.

Figure 1 — Mortar mould for specimens

5.5 *Mixer*, as described in **8.3** of BS 4551:1980, electrically driven and of nominal capacity 12 kg.

5.6 *Compacting equipment*, either a vibrating table or a vibrating hammer with a foot 40 mm square, or a compacting bar made from a non-absorbent material, approximately 200 mm long and with a foot 40 mm square.

5.7 *Metal screed*, (148 ± 1) mm long, of L-shaped cross section approximately 50 mm × 25 mm, the shorter side having a sharpened leading edge. The screed shall be supported across the top of the mould by a 200 mm long rigid member that can slide on the flanges while holding the screed horizontal. The height of the screed shall be adjustable to give a uniformly flat surface finish to the mortar (7 ± 1) mm from the top of the mould (see Figure 2).

5.8 *Metal tray*, with sides at least 3 mm high and having an area approximately equal to that of the surface of the test specimen (see Figure 3).

5.9 *Hydrometer*, complying with BS 718.

5.10 *Pain brush,* 50 mm wide, medium soft.

6 Preparation of mortar

6.1 Number of specimens

Prepare at least three pairs, each comprising a test specimen and a control specimen, for each curing compound to be tested.

6.2 Batching and mixing

The mortar shall contain one part by mass of cement (**4.1**), three parts by mass of sand (**4.2**) and 0.44 parts by mass of water.

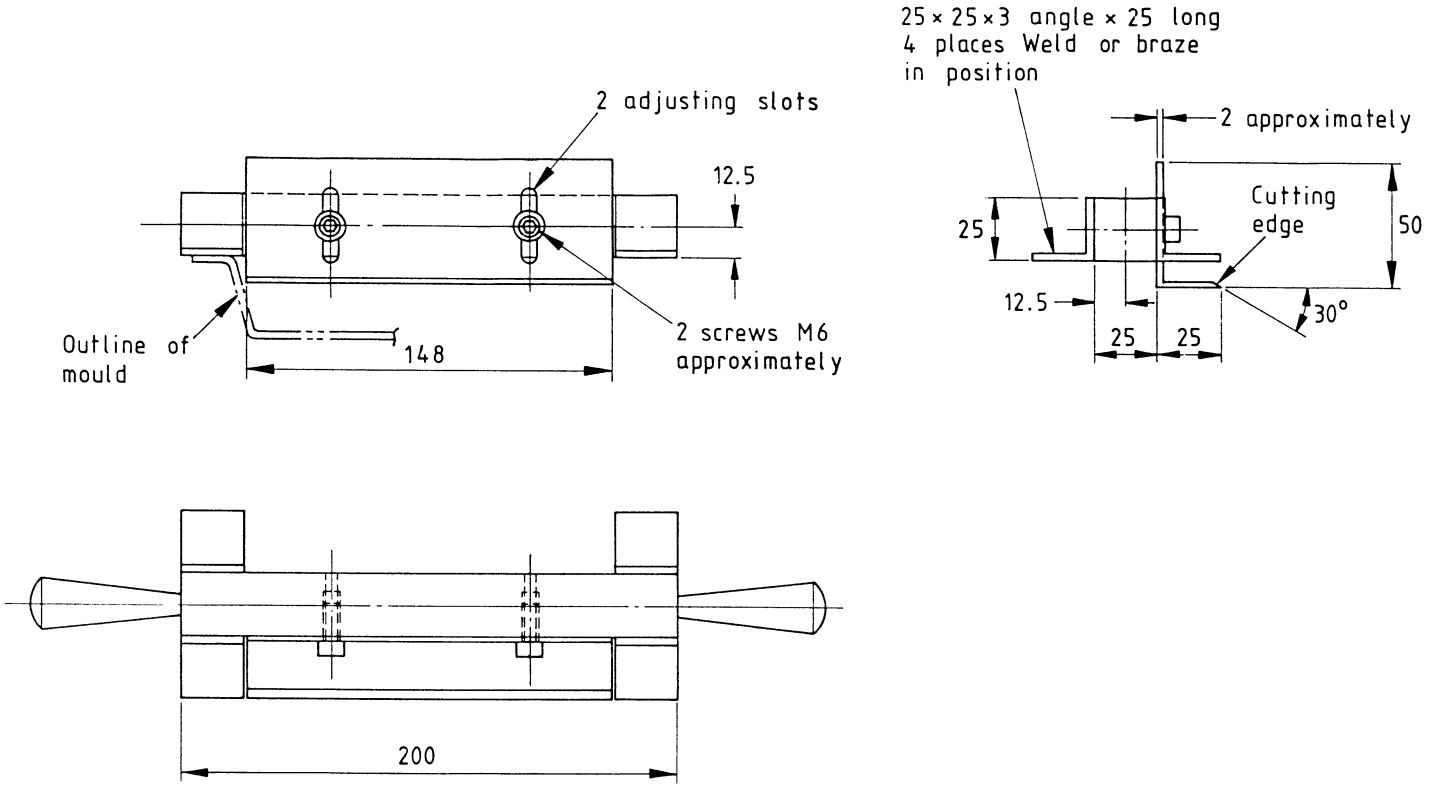
The mortar batch size shall be just sufficient to prepare two specimens, i.e. one test specimen and its corresponding control specimen.

Bring all the materials to a temperature of (20 ± 5) °C before starting the mixing and carry out the mixing in a room at this temperature.

Place the sand and cement in the mixing bowl and mix dry for 1 min. Add the water and continue mixing for a further 2 min. Stop the mixer and scrape any unmixed material from the bottom and sides of the bowl. Restart the mixer and mix for a further 2 min.

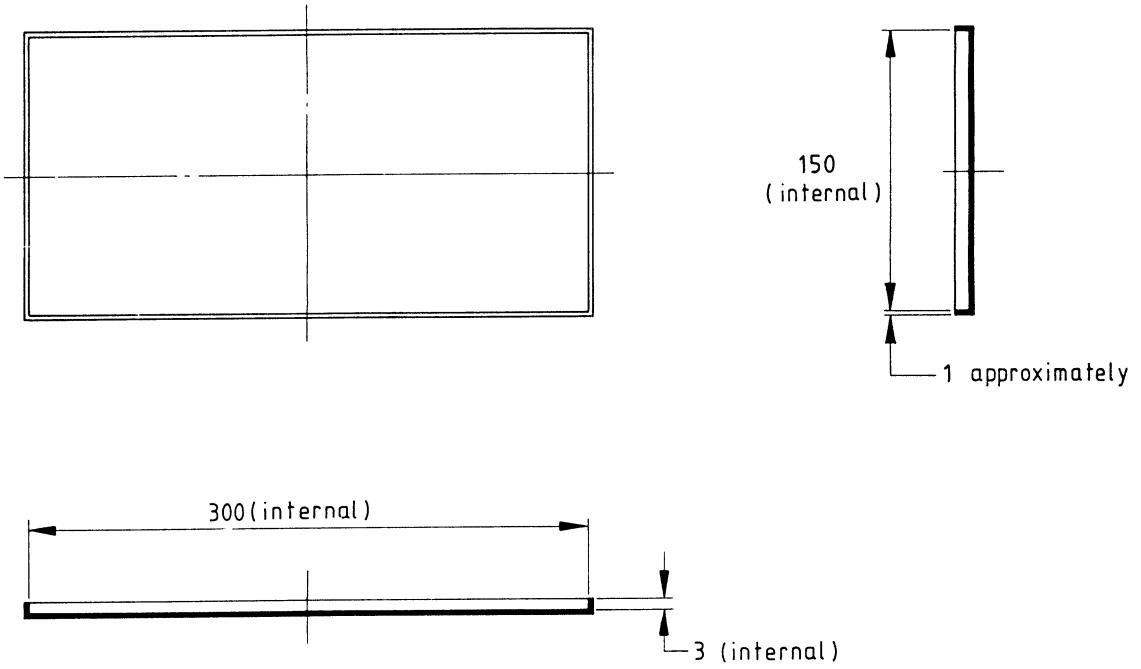
6.3 Moulding specimens

Prepare each pair of specimens within 20 min after the completion of mixing.



Dimensions are in millimetres.
For tolerances see **5.7**.

Figure 2 — Metal screed



Approximate dimensions are in millimetres.

Figure 3 — Metal tray

Thoroughly clean two moulds (**5.1**), lightly coat them with mould release agent (**4.3**), weigh them to the nearest 0.1 g and record the masses as m_1 and m_2. Then place a layer of mortar approximately 25 mm deep in each of the moulds. Compact this layer and a second layer as described in a) or b).

a) Tamp the mortar 50 times with the compacting bar (**5.6**). Place a second layer of mortar, sufficient to overfill the moulds slightly and compact it in a similar manner. Fill indentations formed by tamping and approximately level the surface using a vigorous compactive effort (slapping action) with the palms of the hands.

NOTE Rubber gloves should be worn to prevent contact of the hands with the wet mortar, which is alkaline and can cause skin irritation.

b) Compact the layer using the vibrating table or the vibrating hammer (**5.6**), place a second layer to overfill the moulds slightly and compact it by the same means.

Level the mortar (7 ± 1) mm from the top of the mould by a shaving action using the metal screed (**5.7**). Make the minimum number of passes of the screed, working along the length of the mould in both directions, to produce a uniform surface, free from undulations and surface defects.

NOTE The screed should not be pulled backwards across the mortar surface in such a way as to produce a floated finish.

Finally, brush the surface lightly with the paint brush (**5.10**) to remove small defects and produce a uniform matt finish.

Weigh each filled mould and record the masses, m_3 and m_4, to the nearest 0.1 g immediately prior to the application of the curing compound (see **7.1.3**).

7 Procedure

7.1 Application of the curing compound

7.1.1 *Sampling and preparation*

Take a representative sample of the curing compound by the appropriate method described in Appendix A of BS 5075-1:1982. Stir it thoroughly and determine its relative density at room temperature by means of the hydrometer (**5.9**). Calculate from the relative density the mass required to give the coverage rate in **7.1.2**. The mass of the material applied shall be within ± 0.5 g of that required to give the specified coverage rate.

7.1.2 *Coverage rate*

Apply the curing compound at the coverage rate recommended by the manufacturer. Where no rate has been recommended, apply at a rate of (0.20 ± 0.01) L/m^2.

7.1.3 *Method of application*

Immediately after weighing, apply the curing compound to the test specimen with the spray equipment (**5.4**), or in the manner recommended by the manufacturer. If spraying is not used, record the method used.

Agitate pigmented materials well during application to ensure that a representative sample is applied to the test specimen.

Hold the spray gun so that its nozzle is pointing downwards as near to the vertical as possible and at the height required to produce a fine mist spray that will give uniform application and minimum over-spray. Coat the test specimen uniformly by applying several layers over the whole surface until the coverage rate given in **7.1.2** is reached. Check the coverage rate by repeated weighing and complete the whole application procedure in not more than 2 min.

NOTE Adequate ventilation should be maintained during spraying, to limit exposure to the solvent vapour.

7.1.4 *Storing in the cabinet*

After applying the curing compound, wipe the flange of the mould, weigh the test specimen, m_5, and then immediately place it and its control specimen on the lowest shelf of the cabinet (**5.3**). When the second pair of specimens has been prepared and weighed, move the first pair up one shelf and place the second pair on the lowest shelf. Repeat the same procedure for the third pair of specimens. The total time for making the specimens, coating the test specimen and placing the pair in the cabinet shall not exceed 2 h.

NOTE Precautions should be taken to avoid any concentration of flammable solvent vapour, as it evaporates from the coated specimens, in and around the cabinet.

7.2 Determination of loss in mass

Keep the specimens in the cabinet for 72 h ± 15 min after applying the curing compound. Weigh the specimens to the nearest 0.1 g and record their masses, m_6 and m_7, at 72 h ± 15 min.

7.3 Correction for the mass of evaporated solvent

Determine the proportion by mass of solvent in the curing compound by coating the weighed metal tray (**5.8**), m_8, with the same quantity of material to within ± 0.5 g as that applied to the test specimen. Weigh the coated tray to the nearest 0.1 g before placing it in the cabinet and again at 72 h ± 15 min. Record these two masses as m_9 and m_{10}.

8 Calculation of results

For each pair of test specimens calculate the curing efficiency index, E, of the curing compound at 72 h as a percentage from the equation:

$$E = \frac{E_c - W_t}{W_c} \times 100 \qquad (1)$$

where

W_c is the loss of water from a control specimen calculated from equation (2) (in %);

W_t is the loss of water from its accompanying test specimen calculated from equation (3) (in %).

Then calculate, to the nearest 0.1 %, and record the mean value of E for the three pairs of specimens.

For each pair of specimens, calculate the loss of water from the test specimen (W_t) and from the control specimen (W_c), expressed as percentages from the equations:

$$W_c = \frac{(m_3 - m_7)}{(m_3 - m_1)} \times 100 \qquad (2)$$

$$W_t = \frac{(m_5 - m_6) - V(m_5 - m_4)}{(m_4 - m_2)} \times 100 \qquad (3)$$

Where V, the proportion of solvent lost during the test period, is given by the equation:

$$V = \frac{(m_9 - m_{10})}{(m_9 - m_8)} \qquad (4)$$

and

m_1 is the mass of the mould to contain the control mortar (in g);

m_2 is the mass of the mould to contain the test mortar (in g);

m_3 is the mass of the mould and control mortar (in g);

m_4 is the mass of the mould and test mortar (in g);

m_5 is the mass of the mould and test mortar after coating (in g);

m_6 is the mass of the mould and test mortar after 72 h in the cabinet (in g);

m_7 is the mass of the mould and control mortar after 72 h in the cabinet (in g);

m_8 is the mass of the tray (in g);

m_9 is the mass of the tray after coating (in g);

m_{10} is the mass of the coated tray after 72 h in the cabinet (in g).

9 Report

The report shall affirm that the test was carried out in accordance with this British Standard and shall contain the following information:

a) the identification of the sample of curing compound;

b) the source of the sample;

c) the volume of the sample;

d) the date on which the sample was received;

e) the date of the test;

f) the method of compacting the mortar;

g) the method of applying the curing compound;

h) the rate of application in L/m^2, i.e. the coverage rate;

i) the mean curing efficiency index at 72 h, expressed as a percentage, and the individual values of the curing efficiency index from which it was calculated;

j) the temperature and relative humidity of the room in which the test was carried out at the start and end of the test period.

Publication(s) referred to

BS 12, *Specification for Portland cements.*

BS 718, *Specification for density hydrometers.*

BS 882, *Specification for aggregates from natural sources for concrete.*

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

BS 4551, *Methods of testing mortars, screeds and plasters.*

BS 5075, *Concrete admixtures.*

BS 5075-1, *Specification for accelerating admixtures, retarding admixtures and water reducing admixtures.*

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