

Testing concrete —

Part 112: Methods of accelerated curing of test cubes

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Committees responsible for this British Standard

This British Standard was published under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee CAB/-. Its preparation was entrusted to Technical Committee CAB/4 upon which the following bodies were represented:

British Aggregate Construction Materials Industries
 British Precast Concrete Federation Ltd.
 British Ready Mixed Concrete Association
 Cement Admixtures Association
 Cement and Concrete Association
 Cement Makers' Federation
 Concrete Society Limited
 County Surveyors' Society
 Department of the Environment (Building Research Establishment)
 Department of the Environment (PSA)
 Department of the Environment (Transport and Road Research Laboratory)
 Department of Transport
 Electricity Supply Industry in England and Wales
 Federation of Civil Engineering Contractors
 Greater London Council
 Institute of Concrete Technology
 Institution of Civil Engineers
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 Institution of Structural Engineers
 Institution of Water Engineers and Scientists
 National Federation of Building Trades Employers
 Royal Institute of British Architects
 Royal Institution of Chartered Surveyors
 Sand and Gravel Association Limited
 Society of Chemical industry

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

British Civil Engineering Test Equipment Manufacturers' Association
 Coopted members

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, was published under the authority of the Board of BSI and comes into effect on 29 July 1983.

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The following BSI references relate to the work on this standard:
 Committee reference CAB/4
 Draft for comment 81/12319 DC

Amendments issued since publication

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Foreword

This Part of this British Standard, prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, is a revision of clause 6 of BS 1881-3:1970. Together with Parts 108, 109, 110, 111 and 113, this Part of BS 1881 supersedes BS 1881-3:1970, which is withdrawn.

Two of the methods given in this Part use relatively high curing temperatures, 55 °C and 82 °C, and the third a moderate temperature, 35 °C. All methods enable strengths to be determined the day after the specimens are made. Of the three methods of curing given, those at 55 °C and 82 °C were previously included in BS 1881-3:1970; the method of curing at 35 °C has been introduced in this Part as it is simpler and more convenient than curing at the higher temperatures.

Strength test results from cubes that have been subjected to accelerated curing can be used for control purposes and it is also possible to use a regime of accelerated strength testing to judge compliance. In addition, the strength of normally cured concrete at later ages can be predicted by the use of correlations appropriate to the method, materials and mix used. While the 35 °C method is the simplest and most convenient of the three the correlations for a range of different concretes may be somewhat more widely dispersed than for the 55 °C and 82 °C methods.

Experience of accelerated curing of concrete has largely been gained from cubes made with ordinary or rapid hardening Portland cement and without admixtures. If other mixes are used caution is required when interpreting accelerated strength test results.

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 4, 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 this British Standard describes the methods of accelerated curing of concrete test cubes at 35 °C, 55 °C and 82 °C.

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 Part of this British Standard, the definitions given in BS 5328 and BS 1881-101 apply together with the following:

2.1

specimen

the test cube complete with its mould and cover plate

3 35 °C method

3.1 Apparatus

3.1.1 Cover plate. A rigid plate, such as a base plate, to cover each mould (see BS 1881-108) to isolate the concrete from the water of the curing tank (see 3.1.2). The material for this cover plate shall be such that it does not react with the concrete or the mould.

3.1.2 Curing tank. A curing tank constructed from any material which is of adequate strength and corrosion resistant, provided with a lid and instruments for continuous recording of the water temperature. The internal dimensions of the tank shall be appropriate for the number and size of the test specimens to be accommodated, shall permit adequate circulation of the water and shall be such that the specimens can be removed easily. In order to provide adequate circulation of the water there shall be at least 30 mm of water above, below and around each specimen and in addition the specimens shall be at least 30 mm above the heating element. The curing tank shall be capable of holding sufficient water and of being controlled so that the temperature of the water at any point within the tank is maintained at 35 ± 2 °C at all times.

NOTE 1 For a convection circulating tank a volume of water at least 15 times the volume of concrete to be cured has been found to be satisfactory. If the tank is provided with forced circulation a volume of water at least 10 times the volume of concrete to be cured has been found to be satisfactory.

NOTE 2 It is advantageous to provide the tank and its lid with suitable thermal insulation.

NOTE 3 The power input required will be dependent on various factors including:

- a) the surrounding air temperature;
- b) the degree of tank insulation;
- c) the volume of concrete placed in the tank;
- d) the volume of water in the tank.

NOTE 4 Attention is drawn to the need for electrical safety both in the construction of the tank and in its installation and use (see CP 1017).

3.1.3 Thermometer, suitable for measuring maximum and minimum curing temperatures.

3.1.4 Temperature recorder [optional see 6.2.2 f)]. Recording thermograph and probe or similar arrangement fitted in the curing tank to provide a continuous record of the temperature in the curing tank for the whole of the curing cycle (see Figure 1).

3.2 Making test cubes. Make the test cubes by the method described in BS 1881-108. Finish the upper surface of the concrete level with the top of the mould and then wipe the mould clean.

3.3 Procedure. Thinly coat the cover plate with release agent to prevent adhesion of the concrete and place it in position to form a watertight seal; then immediately lower the specimens gently into the filled curing tank, ensuring that they are spaced in accordance with 3.1.2. Totally immerse the specimens for a period of $24 \text{ h} \pm 15 \text{ min}$, continuously recording the water temperature which shall be maintained at 35 ± 2 °C at all times except for a period not exceeding 15 min immediately after immersion of the specimens. Remove the specimens from the curing tank, demould the cubes and clearly and indelibly mark each one with an identification number or code. Test the cubes (see BS 1881-116) as soon as possible after removal from the curing tank.

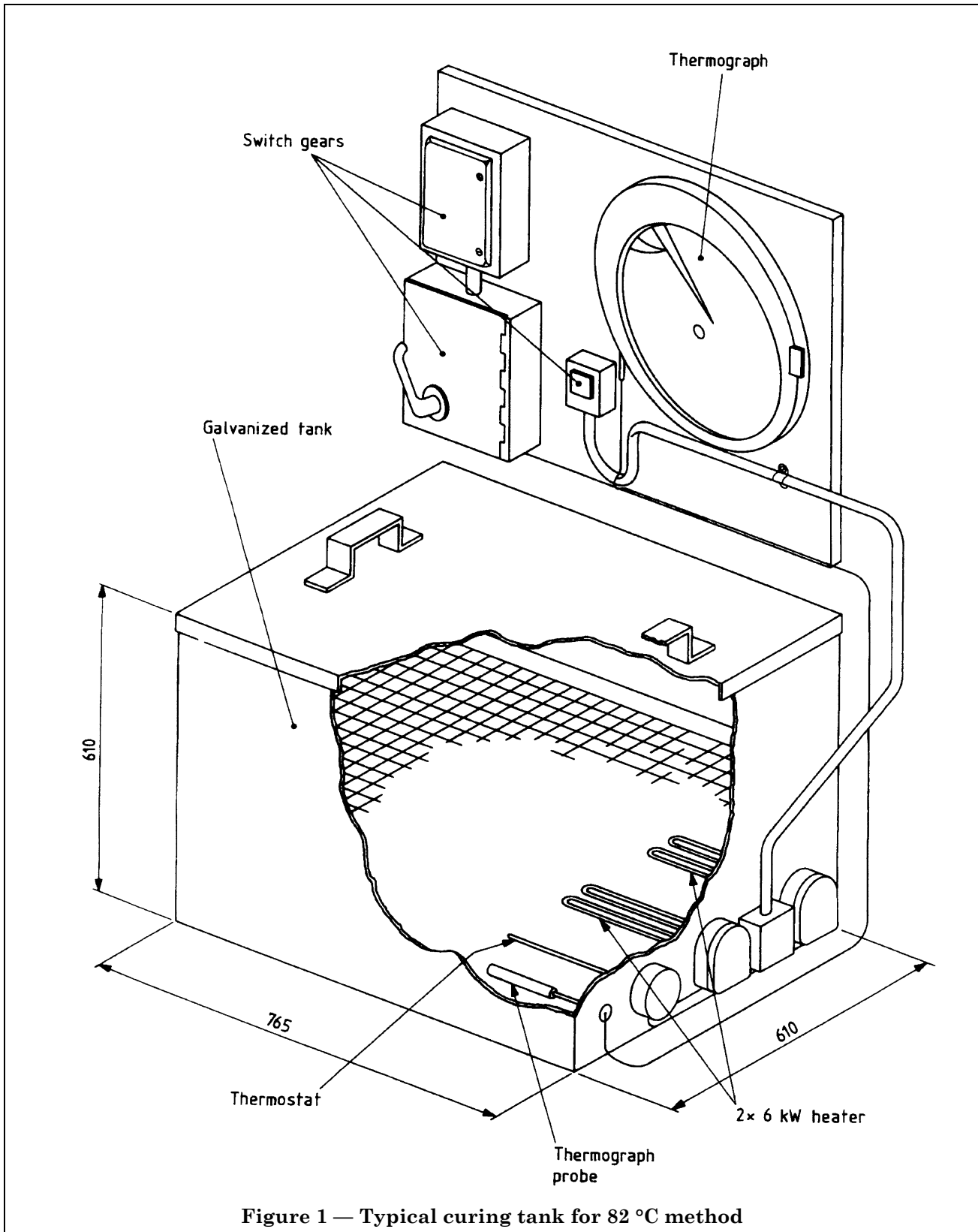
4 55 °C method

4.1 Apparatus

4.1.1 Cover plate, as described in 3.1.1.

4.1.2 Curing tank, as described in 3.1.2 but maintained at 55 ± 2 °C.

4.1.3 Cooling tank, A cooling tank constructed from any material which is of adequate strength and corrosion resistant. The internal dimensions of the tank shall be appropriate for the number and size of cubes to be accommodated, shall permit adequate circulation of water and shall be such that the cubes can be removed easily. The tank shall contain clean water which shall be renewed at least once a month and be controlled so that the temperature of the water at any point in the tank shall be maintained at 20 ± 5 °C during the period that cubes are being cooled.



4.1.4 Thermometer, as described in 3.1.3.

4.1.5 Temperature recorder [optional, see 6.2.2 f)], as described in 3.1.4.

4.2 Making test cubes. Test cubes shall be made in accordance with 3.2.

4.3 Procedure. Place the cover plate in position after being thinly coated with release agent to prevent adhesion of the concrete and leave the specimens to stand undisturbed in a place free from vibration at a temperature of 20 ± 5 °C for at least 1 h. Lower the specimens gently into the filled curing tank not less than 1 h 30 min or more than 3 h 30 min after the addition of the water to the other materials in the concrete mix, ensuring that the specimens are spaced in accordance with 3.1.2.

Totally immerse the specimens for a period of not less than 19 h 50 min, continuously recording the water temperature which shall be maintained at 55 ± 2 °C at all times except for a period not exceeding 15 min immediately after immersion of the specimens. Remove the specimens from the water, demould the cubes and clearly and indelibly mark each one with an identification number or code. Immerse the cubes in the cooling tank not more than 20 h 10 min after their time of immersion in the curing tank. Leave the cubes in the cooling tank for a period of between 1 h and 2 h and then test (see BS 1881-116) as soon as possible after removal from the cooling tank.

NOTE To minimize the difficulties in handling and the risk of injury to the operator, it is recommended that suitable gloves or other aids should be used.

5 82 °C method

5.1 Apparatus

5.1.1 Cover plate, as described in 3.1.1.

5.1.2 Curing tank, as described in 3.1.2 but maintained at 82 ± 2 °C. Additionally, the tank shall be fitted with a tap to enable the tank to be drained at the end of the curing period.

NOTE 1 A typical tank is shown in Figure 1.

NOTE 2 For the tank shown in Figure 1, two 6 kW electric immersion heaters have been found to be adequate.

5.1.3 Temperature recorder, as described in 3.1.4.

5.2 Making test cubes. Test cubes shall be made in accordance with 3.2.

5.3 Procedure. Place the cover plate in position after being thinly coated with release agent to prevent adhesion of the concrete and then leave the specimens to stand undisturbed in a place free from vibration at a temperature of 20 ± 5 °C for at least 1 h and not more than 12 h. Place the specimens in the empty curing tank and fill with water at a temperature of between 5 °C and 20 °C until the specimens are totally immersed. Ensure that the specimens are spaced in accordance with 3.1.2. Raise the temperature of the water to 82 ± 2 °C in $2 \text{ h} \pm 15 \text{ min}$ and maintain it for a further $14 \text{ h} \pm 15 \text{ min}$. Discharge the water from the tank within 5 min and remove the specimens from the tank. Demould the cubes and mark clearly and indelibly with an identification number or code. Test the cubes (see BS 1881-116) whilst they are still hot, as soon as possible after removal from their moulds and not later than 1 h after the discharge of the curing water.

NOTE To minimize the difficulties in handling and the risk of injury to the operator, it is recommended that suitable gloves or other aids should be used.

6 Report

6.1 General. The report shall affirm that the cubes were cured in accordance with this Part of this British Standard. The report shall state whether or not a certificate of sampling and specimen preparation is available. If available, a copy of the certificate shall be provided.

6.2 Information to be included in the report

6.2.1 Mandatory information. The following information shall be included in the test report:

- a) identification number or codes of specimens;
- b) method of curing (35 °C, 55 °C or 82 °C method);
- c) maximum and minimum curing temperatures;
- d) certificate that curing has been carried out in accordance with this Part of this standard.

6.2.2 Optional information. If requested the following information shall be included in the test report:

- a) time of adding water to the other materials in the concrete mix;
- b) time of making cubes;
- c) time of immersion of cubes into curing tank;
- d) time of removal of cubes from curing tank;
- e) time when cubes placed in and removed from cooling tank (55 °C method only);
- f) temperature record during curing.

Publications referred to

BS 1881, *Testing concrete.*

BS 1881-101, *Method of sampling fresh concrete on site.*

BS 1881-108, *Method for making test cubes from fresh concrete.*

BS 1881-109, *Method for making test beams from fresh concrete¹⁾.*

BS 1881-110, *Method for making test cylinders from fresh concrete¹⁾.*

BS 1881-111, *Method of normal curing of test specimens (20 °C method)¹⁾.*

BS 1881-113, *Method for making and curing no-fines test cubes¹⁾.*

BS 1881-116, *Method for determination of compressive strength of concrete cubes.*

BS 5328, *Methods for specifying concrete, including ready-mixed concrete.*

CP 1017, *Distribution of electricity on construction and building sites.*

¹⁾ Referred to in the foreword only.

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