British Standard

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Testing concrete —

Part 110: Method for making test cylinders from fresh concrete

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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
Institution of Highway Engineers
Institution of Municipal Engineers
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

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

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 **5.1**, **5.2**, **5.3**, **5.4**, **5.5**, **5.7**, **5.8** and **5.9** of BS 1881-3:1970. Together with Parts 108, 109, 111, 112 and 113, this Part of BS 1881 supersedes BS 1881-3:1970, which is withdrawn.

The dimensions and tolerances specified in this Part of this standard comply with ISO 1920.

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 Part of this British Standard describes a method for making test cylinders of nominal diameter 100 mm and 150 mm out of fresh concrete. The method applies to plain and air-entrained concrete made with lightweight, normal weight and heavy aggregates having a nominal maximum size not exceeding 20 mm for 100 mm cylinders and 40 mm for 150 mm cylinders.

NOTE 1 A cylinder produced for determining tensile splitting strength should preferably be of 150 mm diameter with a length of 150 mm. A cylinder produced for determining the static modulus of elasticity should preferably be of 150 mm diameter with a length of 300 mm. See BS 1881-117 and BS 1881-121.

This method does not apply to aerated concrete, very stiff concrete, which cannot be compacted by vibration alone, and no-fines concrete.

NOTE 2 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.

3 Apparatus

3.1 Mould

3.1.1 *Construction and assembly.* The mould shall comprise a cylindrical former and a base plate both of ferrous metal having a hardness value of at least 90 Rockwell (scale B) when determined in accordance with BS 891. The cylindrical former shall be capable of being split longitudinally to facilitate removal of the concrete cylinder. All parts of the mould shall be robust enough to prevent distortion. Before assembly for use, the joints between the two sections of the cylindrical former and between them and the base plate shall be thinly coated with oil or grease to prevent loss of water. When the mould is assembled, the sections of the cylindrical former shall be positively located and the whole assembly rigidly held together in such a manner as to prevent leakage from the mould. The internal faces of the assembled mould shall be thinly coated with release agent to prevent adhesion of the concrete.

The sections of the cylindrical former shall be clearly marked before use with a reference code to enable each mould to be correctly assembled and, where appropriate, the cylinder to be marked for identification.

3.1.2 *Tolerances on dimensional deviations of new or refurbished moulds.* A new or refurbished mould shall be accurate within the following limits.

a) *Dimensions.* The internal diameter of the mould when assembled, based on the mean of three pairs of measurements at right angles to each other, symmetrically placed along the length of the mould, shall be 100 ± 0.15 mm or 150 ± 0.15 mm. The length, based on the mean of four symmetrically placed measurements, shall be the nominal size ± 0.5 mm.

b) *Flatness.* Excluding any indentations resulting from the hardness test, the flatness tolerance (see BS 308-3) for the top surface of the base plate shall be 0.03 mm wide. The flatness tolerance for the top and bottom surfaces of the cylindrical former, when assembled, shall be 0.06 mm wide and for the longitudinal joint faces shall be 0.06 mm per 150 mm length and 0.15 mm for each entire surface.

NOTE The flatness of the top surface of the base plate and of the longitudinal joint faces can be checked by using a straightedge complying with grade A of BS 5204-2 and feeler gauges complying with BS 957.

c) *Squareness.* When assembled, the squareness tolerance (squareness 3 of BS 308-3) for the axis of the mould with respect to the top surface of the base plate as datum face shall be a cylinder of diameter 1.0 mm perpendicular to the datum face.

d) *Parallelism.* When assembled, the parallelism tolerance (parallelism 4 of BS 308-3) for the top surface of the mould with respect to the top surface of the base plate as datum face shall be 1.0 mm wide.

e) *Cylindricity.* The cylindricity tolerance (see BS 308-3) for the inner cylindrical surface shall be 0.5 mm.

3.1.3 *Tolerances on dimensions and flatness of moulds in use.* A mould shall be refurbished or discarded when any dimensional deviation given in **3.1.2** exceeds twice the tolerance specified for a new mould.

NOTE Compliance with the tolerances for dimensions and flatness applicable to moulds in use should be checked at least once a year and when there is any cause to suspect that the dimensions of the mould may not be within the specified limits. The flatness over the top surface of the base plate can be checked using either:

a) a straightedge complying with grade A of BS 5204-2 and feeler gauges complying with BS 957, or

b) an assembly comprising two fixed reference points and a central movable reference point, all three of which can be placed in contact with the surface. The central reference point should be linked to a calibrated dial gauge, complying with BS 907, which indicates the distance of the third point from the line joining the two fixed reference points.

Checks should be made in several directions to ensure that the flatness is within the required tolerance in any direction.

If the dial gauge assembly is used, suitable spacings between the fixed reference points are 80 mm and 120 mm for 100 mm and 150 mm diameter moulds respectively. In such cases, the flatness requirement of 0.06 mm for the top surface of the base plate is equivalent to a deviation of the movable reference point from the straight line joining the two fixed reference points of 0.04 mm.

The corresponding value when checking the flatness of the joint faces, or the top surface of the base plate with a dial gauge assembly is 0.08 mm.

3.1.4 *Surface texture of the base plate.* The surface texture of the top surface of the base plate shall not exceed 3.2 μm R_a when determined in accordance with with BS 1134.

NOTE The top surface of the base plate of a mould usually becomes smoother with use but the surface should be checked annually and at any time that it appears to have been roughened or damaged. "(Accurate examples of different surface textures complying with BS 2634-1 permit tactile estimation of the surface texture.)"

3.2 *Scoop*, approximately 100 mm wide.

3.3 *Compacting bar or vibrator.* Compacting bar made from iron or steel weighing 1.8 ± 0.1 kg, at least 380 mm long and having a ramming face 25.0 ± 0.5 mm square, or a vibrating hammer or table suitable for compacting the concrete in accordance with **6.2** or **6.3**.

3.4 *Plasterer's steel float.*

3.5 *Sampling tray,* minimum dimensions 900 mm × 900 mm × 50 mm deep of rigid construction and made from a non-absorbent material not readily attacked by cement paste.

3.6 *Square mouthed shovel,* size 2 in accordance with BS 3388.

3.7 *Glass capping plate* (required if capping in accordance

3.8 *Top plate* (required if capping in accordance with **7.1.3.3**), at least 8 mm thick, which can be clamped to one end of the mould. The surface clamped to the mould shall comply with the tolerances specified in **3.1.2** b) and f) and shall have a Rockwell (scale B) Hardness Value[1)] of at least 95 when tested in accordance with BS 891-1.

3.9 *Grinding equipment* (required if grinding in accordance with **7.1.3.4**), capable of producing a surface in accordance with the tolerance specified in **7.2**.

3.10 *Steel collar* (required if capping in accordance with **7.1.3.5**), with a machined edge suitable for use when capping in accordance with **7.1.3.5**.

3.11 *Steel plate* (required if capping in accordance with **7.1.3.6**), with the working surface complying with the tolerances specified in **3.1.2**b) and f) and with a Rockwell (scale B) Hardness Value[1)] of at least 95 when tested in accordance with BS 891-1.

4 Sampling

Obtain the sample of fresh concrete by the procedure given in Part 101 or Part 125 of this British Standard. Commence making the cylinder as soon as possible after sampling.

5 Preparing the sample

Empty the sample from the container(s) on to the sampling tray. Ensure that no more than a light covering of slurry is left adhering to the container(s).

Thoroughly mix the sample by shovelling it to form a cone on the sampling tray and turning this over with the shovel to form a new cone, the operation being carried out three times. When forming the cones deposit each shovelful of the material on the apex of the cone so that the portions which slide down the sides are distributed as evenly as possible and so that the centre of the cone is not displaced. Flatten the third cone by repeated vertical insertion of the shovel across the apex of the cone, lifting the shovel clear of the concrete after each insertion.

NOTE The following modifications to the mixing procedures may be necessary when preparing samples of very high workability concrete (e.g. superplasticized concrete) for test.

a) *Sampling tray.* The vertical lips on the edges of the tray may have to be larger to contain the sample without spillage during mixing.

b) *Mixing the sample.* The coning procedure is not suitable for very high workability concrete and the following alternative method of mixing is recommended. Having poured the concrete on to the sampling tray, use the shovel to turn the concrete from the outside toward the centre, working progressively once round all sides of the sampling tray.

CAUTION. When cement is mixed with water, alkali is released. Take precautions to avoid dry cement entering the eyes, mouth and nose when mixing concrete. Prevent skin contact with wet cement or concrete by wearing suitable protective clothing. If cement or concrete enters the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash wet concrete off the skin immediately.

[1)] Indentations on the face resulting from the hardness test are acceptable.

6 Procedure

6.1 Filling the mould. Place the mould on a rigid horizontal surface or on the vibrating table and fill with concrete in such a way as to remove as much entrapped air as possible (without significantly reducing the amount of entrained air, if present) and to produce full compaction of the concrete with neither excessive segregation nor laitance. For this purpose, by means of the scoop place the concrete in the mould in layers approximately 50 mm deep and compact each layer by using either the compacting bar or the vibrator in the manner described in **6.2** or **6.3**. After the top layer has been compacted, smooth it level with the top of the mould, using the plasterer's float, and wipe clean the outside of the mould.

6.2 Compacting with compacting bar. When compacting each layer with the compacting bar distribute the strokes of the compacting bar in a uniform manner over the cross-section of the mould, and ensure that the compacting bar does not penetrate significantly any previous layer nor forcibly strike the bottom of the mould when compacting the first layer. The number of strokes per layer required to produce full compaction will depend upon the workability of the concrete but in no case shall the concrete be subjected to less than 30 strokes per layer for 150 mm cylinders or 20 strokes per layer for 100 mm cylinders, except in the case of very high workability concrete. Record the number of strokes.

6.3 Compacting with vibrator. When compacting each layer by means of the hammer or vibrating table use applied vibration of the minimum duration necessary to achieve full compaction of the concrete. Over-vibration may cause excessive segregation and laitance or loss of entrained air, if present. The required duration of vibration will depend upon the workability of the concrete and the effectiveness of the vibrator and vibration shall cease as soon as the surface of the concrete becomes relatively smooth and has a glazed appearance. Record the duration of vibration.

7 Preparation of upper surface of cylinder

7.1 Method of preparation

7.1.1 *General.* Prepare the upper surface of the cylinder in accordance with either **7.1.2** or **7.1.3** depending upon the method by which the cylinder will be tested.

7.1.2 *Preparation for tensile splitting strength test.* Using the float, finish the upper surface of the cylinder level with the top of the mould.

7.1.3 ***Preparation for static modulus of elasticity test***

7.1.3.1 *General.* If practicable, prepare the upper surface of the cylinder whilst it is still workable by one of the two methods given in **7.1.3.2** or **7.1.3.3**. If this is not possible, allow the concrete to harden and grind the upper surface by the method given in **7.1.3.4**; if this is impracticable, use one of the two methods given in **7.1.3.5** and **7.1.3.6**.

7.1.3.2 *Mortar capping of newly-cast cylinder.* Fill the mould to within 3 mm to 6 mm of the top, leaving the surface rough to provide a key for the capping material. As soon as possible after the mould is filled, prepare a mortar using a cement similar to that used in the concrete and fine sand not less than 90 % of which passes a 300 μm BS 410 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve. Ensure that the water/cement ratio of the mortar does not exceed that of the concrete and that the mortar is of a stiff workability. Remove any free water which has collected on the upper surface of the concrete with a sponge, blotting paper or other suitable material before applying the mortar. Using the float, apply the mortar firmly and compact it in such a manner as to leave a slightly convex surface above the edge of the mould. Coat the glass capping plate with a thin film of release agent and press it on to the cap with a rotary motion until it makes complete contact with the rim of the mould. Leave the plate in position until the cylinder is removed from the mould.

7.1.3.3 *Finishing of newly-cast cylinder by use of the steel top plate.* Using the float, finish the upper surface of the cylinder level with the top of the mould. Coat the steel top plate with a thin film of release agent and press it on to the concrete with a rotary motion until it makes complete contact with the rim of the mould. Clamp the top plate firmly to the top of the mould and place the mould, complete with top and base plates, with its axis horizontal on supports which will prevent any movement. Lightly tap the capping plate to ensure good contact with the surface of the concrete. Allow the cylinder to harden in a horizontal position until it is removed from the mould.

7.1.3.4 *Grinding of hardened cylinder.* Using the float, finish the upper surface of the cylinder level with the top of the mould. When the concrete has hardened, grind the surface until it complies with **7.2**. Water only shall be used as a coolant during grinding.

7.1.3.5 *Mortar capping of soaked hardened cylinder.* Roughen the upper surface of the cylinder by wire brushing or hacking. Place the cylinder, with its roughened surface uppermost, on a horizontal surface. Clamp the steel collar to the cylinder in such a way that the upper edge is horizontal and just extends above the highest part of the concrete surface. Fill the collar with a mortar of stiff workability composed of three parts by mass of high alumina cement complying with BS 915 to one part by mass of fine sand, not less than 90 % of which passes a 300 μm BS 410 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve. Using the float, apply the mortar firmly and compact it in such a manner as to leave a slightly convex surface above the edge of the collar. Coat the glass capping plate with a thin film of release agent and press it on to the cap with a rotary motion until it makes complete contact with the edge of the collar. Immediately place the cylinder, with the collar and plate, in moist air of at least 90 % humidity and at a temperature of 20 ± 5 °C. Remove the plate and collar when the mortar is sufficiently hard to permit this to be done without damaging the cap.

7.1.3.6 *Sulphur capping of dry hardened cylinder.* Prepare the capping material by mixing equal parts of sulphur and fine siliceous sand, not less than 90 % of which passes a 300 μm BS 410 woven wire sieve and is retained on a 150 μm BS 410 woven wire sieve, with a small proportion (1 % to 2 %) of carbon black. Alternatively, use a mixture[2)] of sulphur and pulverized-fuel ash in suitable proportions to provide a higher strength than that of the concrete. Heat the capping material to a temperature of approximately 130 °C to 150 °C and allow to cool slightly whilst stirring continuously. Pour the mixture on to the horizontal steel plate which has been slightly warmed and thinly coated with paraffin. Place the cylinder into the layer of capping material, in such a manner that the cap is as thin as practicable using a guide to ensure that the axis is vertical.

After a few seconds, cut the surplus capping material from the cylinder and remove the cylinder from the supporting surface.

When testing the cylinder, check that the cap does not flow or fracture before the concrete fails. After the test, check to ensure that no air was entrapped between the cylinder and the cap.

7.2 Tolerances. If the upper end is ground or capped when hardened, check to ensure the end complies with the following limits.

a) *Flatness.* The flatness tolerance (see BS 308-3) for the prepared surface is 0.06 mm wide.

b) *Parallelism.* The parallelism tolerance (parallelism 4 of BS 308-3) for the prepared surface with respect to the lower surface of the cylinder as datum face is 2.0 mm wide.

Any slight protrusion on a capped surface may be removed by scraping.

8 Conditioning of prepared cylinder

Cylinders prepared by capping as in **7.1.3.5** shall, after the caps have hardened, be further cured in accordance with BS 1881-111 for a minimum of 48 h before testing.

Similarly, cylinders whose ends have been prepared by grinding as in **7.1.3.4** shall also be further cured for a minimum of 48 h.

All cylinders may be removed from the water for not more than 1 h for measuring dimensions but shall be re-immersed for at least 1 h before testing.

9 Report

9.1 General. The report shall affirm that the cylinders were made in accordance with this Part of this British Standard. The report shall state whether or not a certificate of sampling is available. If available a copy of the certificate shall be provided.

9.2 Information to be included in the test report

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

a) date, time and place of sampling and sample identity number;

b) time and place of making cylinders;

c) number and nominal size of cylinders;

d) method of compaction (hand or vibration) including type of equipment used and the number of strokes of the compacting bar or duration of the vibration;

e) method of end preparation;

f) identification numbers or codes of cylinders;

g) name of person making cylinders;

h) certificate that the cylinders were made in accordance with this Part of this standard.

[2)] A granular mixture ready for use is available and for information on its supply apply to Enquiry Section, BSI, Linford Wood, Milton Keynes MK14 6LE, enclosing a stamped addressed envelope for reply.

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

a) name of project and place where concrete used;

b) name of supplier and source of concrete;

c) date and time of production of concrete or delivery to site;

d) specification of concrete mix (e.g. strength grade);

e) workability of concrete;

f) air content of concrete (if air-entrained);

g) lengths and weights of cylinder after end preparation;

h) age(s) at which cylinders are to be tested.

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Publications referred to

BS 308, *Engineering drawing practice.*

BS 308-3*, Geometrical tolerancing.*

BS 410, *Specification for test sieves.*

BS 891, *Methods for hardness test (Rockwell method) and for verification of hardness testing machines (Rockwell method).*

BS 907, *Specification for dial gauges for linear measurement.*

BS 915, *High alumina cement.*

BS 957, *Specification for feeler gauges.*

BS 1134, *Method for the assessment of surface texture.*

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*[3)].

BS 1881-109*, Method for making test beams from fresh concrete*[3)].

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

BS 1881-112*, Methods of accelerated curing of test cubes*[3)].

BS 1881-113*, Method for making and airing no-fines test cubes*[3)].

BS 1881-117*, Method for determination of tensile splitting strength.*

BS 1881-121*, Method for determination of static modulus of elasticity in compression.*

BS 1881-125*, Methods for mixing and sampling fresh concrete in the laboratory.*

BS 2634, *Specification for roughness comparison specimens.*

BS 2634-1*, Specification for turned, ground, bored, milled, shaped and planed specimens.*

BS 3388, *Forks, shovels and spades.*

BS 5204, *Specification for straightedges.*

BS 5204-2*, Steel or granite straightedges of rectangular section.*

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

ISO 1920, *Concrete tests — Dimensions, tolerances and applicability of test specimens*[3)].

[3)] Referred to in the foreword only.

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