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Testing of concrete —

Part 8: Determination of drying shrinkage of concrete for samples prepared in the field or in the laboratory

Essais du béton —

Partie 8: Détermination du retrait de séchage du béton d'échantillons préparés sur le terrain ou en laboratoire

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 1920-8 was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 1, *Test methods for concrete*.

ISO 1920 consists of the following parts, under the general title *Testing of concrete*:

— *Part 1: Sampling of fresh concrete*

— *Part 2: Properties of fresh concrete*

— *Part 3: Making and curing test specimens*

— *Part 4: Strength of hardened concrete*

— *Part 5: Properties of hardened concrete other than strength*

— *Part 6: Sampling, preparing and testing of concrete cores*

— *Part 7: Non-destructive tests on hardened concrete*

— *Part 8: Determination of drying shrinkage of concrete for samples prepared in the field or in the laboratory*

— *Part 9: Determination of creep of concrete cylinders in compression*

The following part is under preparation:

— *Part 10: Determination of static modulus of elasticity in compression*

Testing of concrete —

Part 8:
Determination of drying shrinkage of concrete for samples prepared in the field or in the laboratory

1 Scope

This part of ISO 1920 specifies a method for determining the length changes of concrete specimens due to drying in air, and the method of preparing and curing the concrete specimens to be tested.

It is applicable for the testing of specimens prepared in the laboratory or in the field, in which the maximum nominal size of aggregate in the concrete, in accordance with ISO 6274, does not exceed 25 mm.

The precision statement in Clause 10 does not apply to specimens that have had non-standard initial curing (normally field-prepared specimens). In addition, this part of ISO 1920 requires that field-prepared specimens be marked, recorded and reported as such.

NOTE 1 This test method is not always suitable for very low slump concrete (less than 20 mm), primarily due to the difficulties in obtaining adequate compaction. Provided adequate compaction is obtained, the method is applicable.

NOTE 2 The method is specifically developed for measurement of drying shrinkage of concrete, but it is capable of adaptation for measurement of length changes of specimens subjected to a variety of environmental conditions.

2 Normative references

The following referenced documents are essential for the application of this part of ISO 1920. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1920-1, *Testing of concrete — Part 1: Sampling of fresh concrete*

ISO 1920-2, *Testing of concrete — Part 2: Properties of fresh concrete*

ISO 1920-3:2004, *Testing of concrete — Part 3: Making and curing test specimens*

ISO 6274, *Concrete — Sieve analysis of aggregates*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
preparing laboratory
laboratory responsible for sampling of concrete, moulding of specimens, initial curing in moulds, demoulding, initial moist curing and transport to measuring laboratory (if required)

3.2
measuring laboratory
laboratory responsible for completion of initial moist curing, storage in drying room and measurement of specimens

NOTE In some instances, the preparing and measuring laboratories will be the same.

4 Principle

Specimens are cured and air dried for a specified time, and the change in length is measured.

5 Apparatus

5.1 Drying room, with suitably controlled temperature, humidity and air circulation, for storing specimens in air and for measuring their length.

The room shall meet the following requirements.

a) Air shall be circulated through the room in a uniform manner, so that the specified conditions are attained adjacent to all specimens under test.

b) The temperature in the drying room shall be maintained at (22 ± 2) °C.

c) The relative humidity in the drying room shall be maintained at (55 ± 5) % at all times.

d) The room shall be fitted with recording devices, capable of rapid response to changes in room conditions, which will continuously record the temperature and the relative humidity.

The recording detectors shall be verified against a standardized Assmann hygrometer at intervals of time that will assure compliance with the temperature and humidity requirements specified in 5.1, b) and c).

NOTE 1 A suitable rapid response device for recording temperature and humidity uses a combined detector with a thin-film capacitor for humidity and a platinum resistance thermocouple for temperature measurement. Response time for this type of detector is measured in seconds and is virtually instantaneous within the narrow range required for this test method.

NOTE 2 Most thermo hygrographs are unsuitable for the purpose, as the response is too slow to detect the full extent of fluctuations, particularly with the hair type of humidity detector.

e) The rate of air movement in the drying room shall be determined and controlled by sensors in order to maintain the rate of evaporation at (12 ± 5) ml per 24 h. The evaporation rates shall be determined by measuring the loss in weight of water in 400 ml low-form beakers of internal diameter (78 ± 5) mm, initially containing approximately 375 g of water at a temperature of (20 ± 2) °C. The weight of water in the beaker shall not fall below 325 g. Each beaker shall be placed midway between test specimens on the storage racks with the water level at approximately the same height as the top of the specimens.

Systematic checks shall be carried out on the sensors or on the evaporation rates by varying the location of the beakers within the drying room at least monthly, or where conditions have changed. The results shall be recorded.

f) The requirements for temperature, humidity and evaporation rate apply to each storage position. Only positions that conform to these requirements shall be used for storage of test specimens.

g) The drying room shall be fitted with suitable racks for storing specimens. The racks shall permit free circulation of air around specimens, except for necessary supports, and shall be so situated with respect to the nearest wall or other obstruction that air circulation is not restricted in the intervening

space. The horizontal supports shall consist of non-absorptive members having a total bearing width supporting the specimen of not more than 25 mm.

5.2 Moulds, made of non-absorbent material that does not react with cement paste and their internal surfaces; shall have a smooth finish.

The moulds shall be substantial enough to hold their form without distortion and shall be substantially leak proof. They shall meet the following requirements.

5.2.1 General

Each mould shall be provided with a base plate, two end plates and two side plates which are securely fastened to the end plates, and two partially loose end plates which act as gauge stud holders. Each gauge stud holder shall fit inside the end of the mould and shall locate and secure a gauge stud during the setting period of the concrete. Each gauge stud holder shall be held in position against the end plate by a retaining screw and shall be capable of release after compaction of the concrete. The opposite side plates shall be parallel.

The dimensions of the mould shall be one of the following.

a) For specimens having dimensions of 75 mm × 75 mm × 280 mm (see 6.2.2)

— the distance between the opposite side plates shall be (75 ± 1) mm, and

— the inside height shall be (75 ± 1) mm;

b) For specimens having dimensions of 100 mm × 100 mm × 400 mm

— the distance between the opposite side plates shall be (100 ± 1) mm, and

— the inside height shall be (100 ± 1) mm.

5.2.2 Construction of the mould

The mould shall be aligned coaxially along the central axis of the mould.

a) For specimens having dimensions of 75 mm × 75 mm × 280 mm:

— the distance between the inner ends of the two studs shall be (250 ± 0,5) mm;

— the distance between the outer ends of the gauge studs shall be (295 ± 1) mm;

— gauge studs shall protrude from the gauge stud holders to a distance of (15 ± 1) mm.

b) For specimens having dimensions of 100 mm × 100 mm × 400 mm:

— the distance between the inner ends of the two studs shall be (360 ± 0,5) mm;

— the distance between the outer ends of the gauge studs shall be (420 ± 1) mm;

— gauge studs shall protrude from the gauge stud holders to a distance of (20 ± 1) mm.

A suitable form of construction of the moulds is shown in Figure 1.

5.3 Gauge studs, made of stainless steel and conforming to the dimensions shown in Figure 2.

The radius of the gauge stud end shall be such as to assure compliance to the precision requirements for measuring length changes, as specified in 5.8.1.

Gauge studs for horizontal and vertical comparators shall not be interchanged.

5.4 Length gauge, for checking the nominal length between gauge studs (5.3).

The length gauge shall be made of metal, and the specifications shall be as follows.

a) For specimens having dimensions of 75 mm × 75 mm × 280 mm

— the diameter of the length gauge shall be not less than 6 mm, and

— the length of the length gauge shall be (250 ± 0,2) mm;

b) For specimens having dimensions of 100 mm × 100 mm × 400 mm

— the diameter of the length gauge shall be not less than 10 mm, and

— the length of the length gauge shall be (360 ± 0,2) mm.

The ends of the bar shall be flat and perpendicular to its length.

5.5 Means of compaction, consisting of the following.

5.5.1 Tamping bar, compacting bar, straight, made of steel having a rectangular shape of approximately 25 mm × 10 mm, a length of approximately 600 mm and with a ramming face square with the axis.

5.5.2 Tamping rod, compacting rod of circular cross-section, straight, made of steel, having a diameter of approximately 16 mm, a length of approximately 600 mm and with round ends.

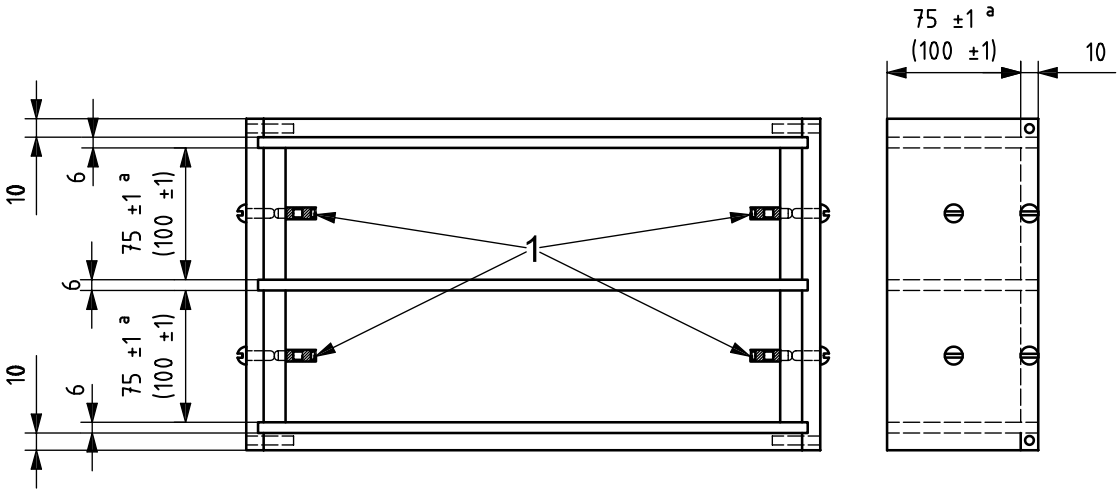
5.5.3 External vibrator, table type with provision for clamping of the mould (5.2), capable of compacting concrete in the moulds. Internal vibrators shall not be used.

NOTE A vibrating table with a nominal frequency of vibration of 50 Hz is usually suitable.

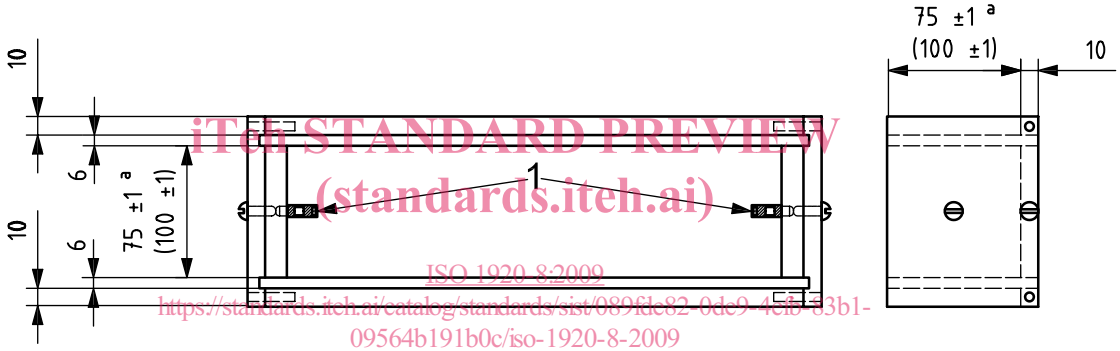
5.6 Mallet.

5.7 Balance, used to determine the mass of the concrete specimen and having an accuracy of at least 0,1 g.

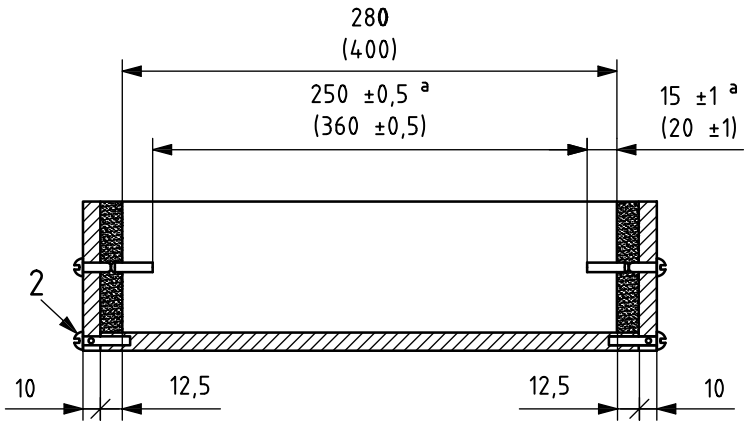
Dimensions in millimetres



a) Double mould

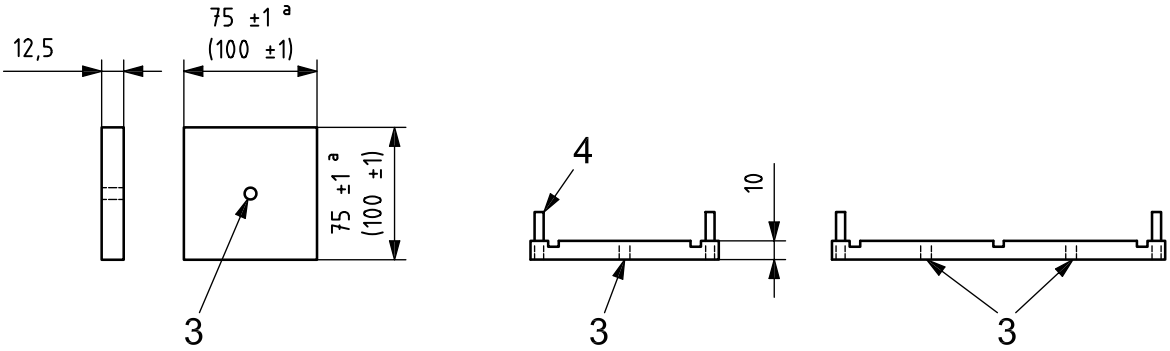


b) Single mould



c) Selection of mould

Figure 1 — Details of a typical mould (*continued*)



d) Gauge stud holder **e) End plate details**

Key

1 gauge stud holder retaining screw

2 drill and tap with an M6 × 1-6g thread (to take baseplate screw)

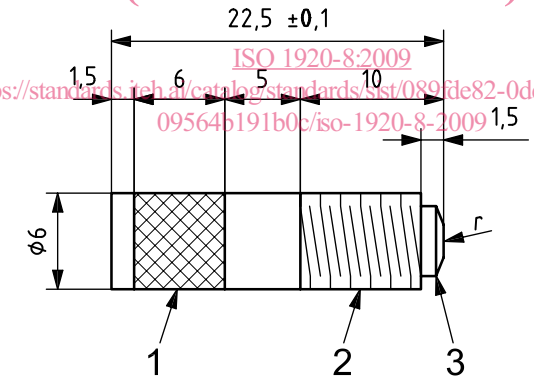
3 drill and tap centrally with an M6 × 1-6g thread (to take gauge stud and spacer screw)

4 dowel pin ∅5 press fitted in end plate

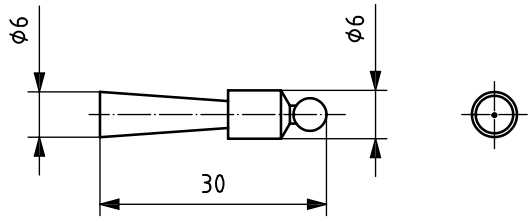
a The dimensions in Figure 1 refer to a mould suitable for casting specimens having dimensions of (75 × 75 × 280) mm. The dimensions in parentheses refer to a mould suitable for casting specimens having dimensions of (100 × 100 × 400) mm.

Figure 1 — Details of a typical mould

Dimensions in millimetres



a) Gauge stud for (75 × 75 × 280) mm specimen



b) Gauge stud for (100 × 100 × 400) mm specimen

Key

1 coarse knurl

2 thread M6 × 1-6g

3 buff tip to a polished finish

Figure 2 — Details for typical gauge studs

5.8 Length comparator, used for measuring changes in length.

5.8.1 General

The comparator shall be capable of measuring the length of specimens over a range of 290 mm to 300 mm for specimens of (75 × 75 × 280) mm, and over a range of 415 mm to 425 mm for specimens of (100 × 100 × 400) mm. The precision of the measurement shall be 0,001 mm.

It is recommended that, where a horizontal comparator is used, micrometers be of the digital read-out type. Details of a suitable horizontal length comparator are provided in Annex A.

5.8.2 Reference bar

A specific reference bar made of a material characterized by an extremely low coefficient of thermal expansion shall be used with each comparator.

a) For specimens having dimensions of 75 mm × 75 mm × 280 mm

   — the diameter of the reference bar shall be not less than 6 mm, and

   — the overall length of the reference bar shall be (295 ± 1,5) mm;

b) For specimens having dimensions of 100 mm × 100 mm × 400 mm

   — the diameter of the reference bar shall be not less than 10 mm, and

   — the overall length of the reference bar shall be (420 ± 1,5) mm.

Each end shall be reduced in diameter and the end 5 mm shall have approximately the same diameter and have the same end radius as the projecting end of the gauge stud (5.3) being used in the specimen. Each end of the reference bar shall be polished.

The central section of the reference bar shall be covered by a rubber tube, or equivalent, of length approximately 100 mm and wall thickness of at least 3 mm to minimize the effect of temperature change during handling. The reference bar shall be provided with a positioning mark and shall always be placed in the comparator in the same orientation.

5.8.3 Check of precision

The precision of the length comparator and the performance of the operator shall be checked by recording the difference in length between the reference bar and a typical specimen 20 times, replacing each in the comparator for each reading. The standard deviation of these 20 length differences shall not exceed 0,002 mm. When a check of precision fails to meet this requirement, further checks shall be made with another specimen or with another operator to ascertain whether the lack of precision is associated with the comparator or with the operator.

The frequency of the checking shall confirm with the quality management programme of the laboratory.

6 Test samples and specimens

6.1 Sampling

Specimens may be prepared either in the laboratory or in the field. Particular care should be taken to ensure that sampling and preparation are strictly in accordance with Clause 6, as these activities are crucial to the accuracy and repeatability of the test. Full records should also be kept for inclusion in the report (see Clause 9 and Clause 10).

For concrete sampled in the field, the test sample shall be obtained in accordance with ISO 1920-1.