
Testing of concrete —

Part 6:

**Sampling, preparing and testing of
concrete cores**

Essais du béton —

*Partie 6: Échantillonnage, préparation et essais sur des carottes de
béton*

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Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Apparatus	1
5 Taking of cores	2
5.1 Age of concrete	2
5.2 Location	2
5.3 Drilling	3
5.4 Number of cores	3
5.5 Diameter of cores	3
5.6 Length of cores	3
5.7 Length-to-diameter (l/d) ratio	4
5.8 Marking and identification	4
5.9 Reinforcement	4
6 Examination	4
6.1 Visual inspection	4
6.2 Measurements and calculations of drilled core specimens	4
7 Preparation of cores	4
7.1 General	4
8 Compression test	5
8.1 Storage	5
8.2 Testing	5
9 Test results	5
10 Test report	5
Annex A (informative) Example of a test report of core strength	7

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and prestressed concrete*, Subcommittee SC 1, *Test methods for concrete*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This second edition cancels and replaces the first edition (ISO 1920-6:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

- requirements of compressive testing machine have been included and defined;
- [Clause 5](#) has been redrafted;
- accuracy requirements at the time of measuring core diameter, core length have been redefined;
- tolerances of the prepared test specimen have been redefined;
- the curing of test specimens under tropical climate has been included and defined.

A list of all parts in the ISO 1920 series can be found on the ISO website.

Testing of concrete —

Part 6:

Sampling, preparing and testing of concrete cores

1 Scope

This document specifies a method for taking cores from hardened concrete, their examination, preparation for testing and determination of compressive strength.

This document does not give guidance on the decision to drill cores or on the locations for drilling and does not provide procedures for interpreting the core strength results.

It is recommended that before coring, full agreement should be reached by all parties on the need for core testing and how the results should be interpreted.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1920-4, *Testing of concrete — Part 4: Strength of hardened concrete*

ISO 1920-5, *Testing of concrete — Part 5: Density and water penetration depth*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

core strength

compressive strength of the cored specimen, as determined by the test defined in this document

4 Apparatus

4.1 Core drill, capable of extracting cores from the hardened concrete to the dimensions specified in [5.3](#) with the tolerances specified in [Clause 7](#).

4.2 Compression testing machine

4.2.1 The test shall be carried out using a compression-testing machine which shall be robust, related to the size of specimen and capable of providing rate of loading with minimum desired specifications the place of testing.

4.2.1.1 Accuracy of the test machine shall be such that the percentage error for the loads within proposed range of use of the machine and shall not exceed $\pm 1,0$ % of the indicated load.

4.2.1.2 The compression testing machine shall be provided with a control system. The control system can be operated either by manual or automatic means. If the machine is not equipped with automatic application of force, a pacer shall be fitted to enable the operator to maintain the specified rate. The pacer shall indicate a rate within $\pm 5,0$ % of the specified rate.

4.2.1.3 Machine platens and auxiliary platens shall have a hardness value at least 550 HV (Vickers Hardness).

4.2.1.4 The thickness of the auxiliary platens shall be at least 23 mm with roughness value, R_a , for the surface texture of the contact faces of the auxiliary platen shall be in the range 0,4 μm to 3,2 μm .

4.2.2 The test machine shall be in calibration at the time of test. The calibration shall be carried out at least once per year.

4.3 **Balance** or **scale**, capable of determining the mass of the core, as tested, to within an accuracy of 0,1 % of the mass.

4.4 **Callipers** and/or **rules**, capable of measuring the dimensions of the core and the steel reinforcement to a tolerance of $\pm 0,01$ mm.

4.5 **Gauge**, capable of establishing that the relevant flatness of the specimen is within the requirements of [Clause 7](#).

4.6 **Squares** and **gauges**, capable of establishing that the perpendicularity and parallelism of specimens and moulds are within the requirements of [Clause 7](#).

5 Taking of cores

5.1 Age of concrete

Core to be tested for strength shall not be removed from the structure until the concrete has become hard enough to permit its removal without disturbing the bond between the mortar and the coarse aggregate. As a general guideline, concrete with specified or characteristics compressive strength up to 25 MPa, such concrete can be at least 14 days old before the cores are taken. For higher grades, cores may be taken at an earlier age.

5.2 Location

Possible structural implications resulting from taking a core shall be considered prior to drilling and the location where the cores are to be taken specified.

Cores shall preferably be taken at points not near to joints or edges of the concrete element to avoid as far as possible any reinforcement.

Cores shall be taken preferably from the middle part of the member leaving top and bottom parts where variation can be greater. While taking cores vertically from top, like from slab or from foundation top, the test length of core shall not contain concrete from the top 15 % to 20 % depth as top part of the core can contain non-uniform distribution of aggregates (maximum up to 60 mm). In case of cores which are not across full depth of member, about 10 % to 15 % portion of the bottom side of core may be trimmed off as the portion near to the broken end can contain some micro cracks/fractures.

Locations where there can be micro cracks due to tension shall be avoided and cores shall preferably be taken from compression zone.

5.3 Drilling

Unless otherwise specified, the cores shall be drilled perpendicular to the surface in such a manner as not to damage the cores. The drilling of the core should be carried out by an experienced operator using a diamond-impregnated bit attached to the core barrel. The drilling apparatus shall be rigidly anchored to the member to avoid bit wobble, which can result in a specimen with a variable cross-section. The drill bit shall be lubricated with water and shall be resurfaced periodically. Cores that show abnormal defects or that have been damaged in removal shall not be used.

The cores are preferably extracted from a location where there is no interference of reinforcement.

In case of cores to be taken from the removed slab, a sufficiently large portion of the slab shall be removed so that the desired test specimens can be secured without the inclusion of any concrete which has been cracked, spalled, undercut, or otherwise damaged.

5.4 Number of cores

Numbers and locations of cores shall be specified.

The points from which cores are to be taken and the number of cores required shall be representative of the whole of concrete concerned.

5.5 Diameter of cores

The diameter of the cores to be taken shall be specified.

The ratio of diameter to the maximum aggregate size should generally be greater than 3. The core diameter should generally be 100 mm $\pm$ 10 mm or 125 mm $\pm$ 10 mm or 150 mm $\pm$ 10 mm, with the preferred diameter being 100 mm for nominal maximum aggregate size up to 19 mm.

Other smaller diameters (not less than 3 times the nominal maximum aggregate size), which make drilling easier and reduce the damage to the element, may be used, provided the effect this has on the accuracy of the result is taken into account.

5.6 Length of cores

The length of core to be taken, and the length the core has to be cut to, shall be specified.

In deciding the length of cores for strength testing, take the following into account:

- a) the diameter of the core;
- b) the possible method of adjustment;
- c) whether comparison will be made with cube strength or cylinder strength (see [Clause 7](#) for preferred diameter/length ratios).

5.7 Length-to-diameter (l/d) ratio

The preferred length-to-diameter ratios are as follows:

- a) if the strength result is to be compared to cylinder strength: 2,0 (± 5 %);
- b) if the strength result is to be compared to cube strength: 1,0 (± 5 %).

In the case of using a specimen with a length-to-diameter ratio smaller than 2,0, it is permissible to convert, by an appropriate method, the test value of the compressive strength corresponding to a value for a length-to diameter ratio of 2,0.

5.8 Marking and identification

Immediately after drilling, mark each core clearly and indelibly. Record its location and orientation within the element from which it was drilled. If a core is subsequently cut to produce a number of specimens, mark each specimen to indicate its position and orientation within the original core.

5.9 Reinforcement

Drilling through reinforcement shall be avoided. The core shall not contain any reinforcement bars along or near its longitudinal axis. Cores containing cross reinforcement shall be trimmed off to obtain cores free from reinforcement.

6 Examination

6.1 Visual inspection

Carry out visual examination of the cored specimen to identify abnormalities.

6.2 Measurements and calculations of drilled core specimens

Take the following measurements:

- a) core diameter: Take pairs of measurements at right angles, at the half and quarter points of the length of the core to an accuracy of $\pm 0,1$ mm. Determine the average diameter, d_m .
- b) core length: Measure the maximum and minimum lengths after completion of the end preparation in accordance with [Clause 7](#) (excluding capping material) to an accuracy of $\pm 0,1$ mm. Determine the average length.
- c) mass: Where specified, each specimen shall be weighed as received and/or saturated. The mass shall be recorded to the nearest 0,1 % of the mass of the specimen.
- d) density: Where specified, the density of each specimen shall be determined as received and/or saturated in accordance with ISO 1920-5 and the result recorded to the nearest 10 kg/m^3 .

All measurements shall be recorded.

7 Preparation of cores

7.1 General

The ends of cores for compression tests shall be prepared in accordance with ISO 1920-4:2005, Annex B.

NOTE The preferred method of preparing the ends of cores is by grinding.

Tolerances

Prepare the specimen to within the following tolerances:

- a) flatness: The tolerance on flatness of the prepared end surfaces shall be $\pm 0,05$ mm;
- b) perpendicularity: The tolerance on perpendicularity of the prepared end, with respect to the axis of the specimen as datum, shall be $\pm 0,5$ mm;
- c) parallelism: The tolerance on parallelism of the prepared top surface, with respect to the bottom surface of the specimen as datum, shall be $\pm 0,6$ mm;
- d) straightness: The tolerance on straightness of any surface parallel to the centre line of the core shall be ± 3 % of the average core diameter, d_m .

If cores with diameters less than the values recommended in 5.5, the tolerances above should be considered with regard to their adequacy and narrowed if necessary, for example, reduced in proportion to the actual specimen diameter of 100 mm.

8 Compression test

8.1 Storage

Record the storage condition(s) of the specimen.

Cores shall be tested generally in saturated condition except if specifically required to be tested in air-dry condition. For the saturated condition, soak in water at $20\text{ °C} \pm 2\text{ °C}$ ($27\text{ °C} \pm 3\text{ °C}$ for tropical climate) for a minimum of 40 h and maximum up to 48 h before testing. Core shall be removed from the water and tested while it is still wet but remove all excess surface grit and water by wiping off. If it is required to test the core specimen in air-dry conditions, store in laboratory air for a minimum of 40 h and maximum up to 48 h prior to testing, record the storage time, ambient temperature and relative humidity of the storage conditions during air-dry storage of the specimens.

8.2 Testing

Carry out the testing in accordance with ISO 1920-4 using a calibrated compression-testing machine. Do not test cores with cracked, hollow or loose caps. All the measuring apparatus shall be in calibration at the time of the test.

Remove any loose sand or other material on the surface of the specimen.

If the specimen is to be tested while it is still wet, remove any surface water.

Record the surface moisture condition (wet/dry) of the specimen at the time of test.

9 Test results

Determine the compressive strength of each specimen by dividing the maximum load by the cross-sectional area, calculated from the average diameter and express the results to the nearest 0,1 MPa.

10 Test report

The report shall include:

- a) description and identification of the test specimen;
- b) date and time of test;