SLOVENSKI STANDARD
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Preskušanje strjenega betona - 4. del: Tlačna trdnost - Specifikacija za stiskalnice

Testing hardened concrete - Part 4: Compressive strength - Specification for testing machines

Prüfung von Festbeton - Teil 4: Bestimmung der Druckfestigkeit - Anforderungen an Prüfmaschinen

Essais pour béton durci - Partie 4: Résistance en compression - Caractéristiques des machines d'essai

Ta slovenski standard je istoveten z: **EN 12390-4:2000**

ICS:

91.100.30	Beton in betonski izdelki	Concrete and concrete products

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EUROPEAN STANDARD
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English version

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This European Standard was approved by CEN on 1 November 1999.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Forword

This European Standard has been prepared by Technical Committee CEN/TC 104 "Concrete (performance, production, placing and compliance criteria)", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2000, and conflicting national standards shall be withdrawn at the latest by December 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This Standard is one of a series concerned with testing concrete.

During the 1980s a number of countries found it necessary to introduce standards to specify more precisely the performance of compression machines for testing concrete specimens. This standard has been written to continue this movement and to overcome the present lack of a European Standard.

A draft for this standard was published in 1996 for CEN enquiry as prEN 12390. It was one of a series of individually numbered test methods for fresh or hardened concrete. For convenience it has now been decided to combine these separate draft standards into three new standards with separate parts for each method, as follows:

- Testing fresh concrete (EN 12350)
- Testing hardened concrete (EN 12390)
- Testing concrete in structures (EN 12504)

This series EN 12390 includes the following parts where the brackets give the numbers under which particular test methods were published for CEN enquiry:

Part 1: Shape, dimensions and other requirements of specimens and moulds (former prEN 12356:1996)
Part 2: Making and curing specimens for strength tests (former prEN 12379:1996)
Part 3: Compressive strength of test specimens (former prEN 12394:1996)

Part 4: Compressive strangth - Specification for testing machines (former prEN 12390:1996)
Part 5: Flexural strength of test specimens (former prEN 12359:1996)
Part 6: Tensile splitting strength of test specimens (former prEN 12362:1996)
Part 7: Density of hardened concrete (former prEN 12363:1996)
Part 8: Depth of penetration of water under pressure (former prEN 12364:1996)

Three classes of testing machine are currently recognized, corresponding to scale accuracies of 1 %, 2 % and 3 %. It is evident that these accuracy classes have a direct impact upon the accuracy of the test result and it is a matter for each country to decide whether to limit the range of machine classes to, for example, 1 % and 2 %.

The requirement in this standard for the manner of force transfer is also important with regard to the effect upon measured compressive strength. However, the requirement can be difficult to satisfy on some older testing machines. It is therefore a matter for each country to decide whether, at present, this requirement shall apply only to new machines as written in this standard or whether it shall apply immediately to all machines.

The requirements for testing machines set out in this standard have been formulated to satisfy the needs of those compressive tests on concrete specimens which are specified in EN 206. Machines conforming to this standard can be suitable for other uses, but this needs to be carefully considered on an individual test basis. Particular care needs to be taken before using machines conforming to this standard for compressive tests on small specimens e.g. these with lateral dimensions significantly less than 100 mm. The main concern is that the ball-seating fitted to the upper platen can be too large to align satisfactorily on the top of such small specimens and special adaptations can be required. Another concern is the ability to accurately determine the failure load of small or low strength specimens.

1 Scope

This Standard specifies the requirements for the performance of compression testing machines for the measurement of the compressive strength of concrete.

2 References

This European Standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 7500-1: 1999
Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines; verification and calibration of the force-measuring system (ISO 7500-1:1999)

EN 10002-3
Metallic materials - Tensile testing - Part 3: Calibration of force proving instruments for the verification of uniaxial testing machines.

prEN 12390-1:1999
Testing hardened concrete - Part 1: Shape, dimensions and other requirements of specimens and moulds

ISO 6507-1
Metallic materials - Vickers hardness test - Part 1: Test method.

ISO 4287: 1997
Geometrical Product Specification (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters

3 Definitions

For the purposes of this standard the following definitions apply:

3.1 auxiliary platen:
separate platen used to protect the machine platens, usually of a size equal to the designated size of the specimen being tested

3.2 contact area:
the part of the platen that comes into contact with the specimen

3.3 indicated force:
the force indicated on the machine scale(s) or display

3.4 indication range:
the total force range, from zero to maximum, displayed on the machine

3.5 machine platens:
lower platen and upper platen with spherical seating both centred on the central vertical axis of the machine

3.6 measuring range:
that part of an indication range over which the machine conforms with the accuracy values specified in this standard

3.7 relative accuracy error of:

3.7.1 true force:
the difference between the average indicated force and the true force expressed as a percentage of the true force

3.7.2 indicated force:
the difference between the average true force and the indicated force expressed as a percentage of the indicated force

3.8 relative repeatability error of:

3.8.1 true force:
the greatest difference between the indicated forces corresponding to repeated applications of a true force expressed as a percentage of the true force

3.8.2 indicated force:
the greatest difference between the true forces corresponding to repeated applications of an indicated force expressed as a percentage of the indicated force

3.9 resolution of force:
the smallest increment of force that can be assessed, estimated, or read on any force indication range (see annex B).

3.10 spacing block:
metal block used to adjust the space available to test specimens

3.11 true force:
the force indicated on a calibrated force proving device

4 Construction of machines

4.1 Machine platens, auxiliary platens and spacing blocks

NOTE 1: The use of auxiliary platens is optional.

4.1.1 Machine and auxiliary platens shall be made of a material which shall not deform irreversibly when the machine is used.

4.1.2 Machine and auxiliary platens shall have a hardness value of at least 550 HV 30 (HRC 53) when tested in accordance with ISO 6507 - 1.

4.1.3 The flatness tolerance for machine platens and auxiliary platens shall be 0,03 mm for the area in contact with the specimen.

NOTE 2: For the purpose of this European Standard, flatness can be assessed by the measurement of straightness in four positions. [see Annex B of prEN 12390-1:1999]

4.1.4 The roughness value (R_a) for the surface texture of machine and auxiliary platens shall be in the range 0,4 µm to 3,2 µm, when assessed in accordance with ISO/R468, for the area in contact with the specimens.

4.1.5 The area of machine platens in contact with the specimen shall be at least as great as the area of the specimen being tested.

4.1.6 The distance between either pair of opposite edges of a square auxiliary platen, or the diameter of a circular auxiliary platen, shall be not less than the designated size of the specimen.

4.1.7 The two contact faces of an auxiliary platen shall be parallel to a tolerance of 0,05 mm.

4.1.8 Auxiliary platens shall be at least 23 mm thick.

4.1.9 If there is a requirement to reduce the distance between the machine platens, up to four spacing blocks may be used.

4.1.10 A spacing block may be either circular or square in section and shall be adequately supported from below.

NOTE 3: A minimum diameter or length of side of 200 mm is recommended for spacing blocks.

4.1.11 Spacing blocks shall comply with the flatness and parallelism tolerances required for auxiliary platens. (see clauses 4.1.3 and 4.1.7

4.1.12 Spacing blocks shall not be placed in contact with the specimen.

4.1.13 Spacing blocks shall be positively located, centrally on the vertical machine axis.

4.2 Force measurement

4.2.1 Force indicator

The machine shall be provided with:

- dials or digital displays which allow the force to be read to the required accuracy. [see B1.2];
- a system which allows the maximum force sustained to be read after completion of the test, until reset;
- displays readable from the operating position.

The lowest verifiable value (see B1.4) of each measuring range shall be less than or equal to 20 % of the maximum value of the range. If the machine is equipped with several indication ranges the above requirement shall apply to each range.

The machine force indication system shall not be affected by explosive failure of the specimen.

4.2.2 Force indicator calibration

Force indicators shall be verified and shall conform to the requirements of Table 1 for the particular class of testing machine.

Table 1: Force scale tolerances

Machine class	Relative accuracy error %[2)]	Relative repeatability error %[2)]	Relative zero error (% of scale maximum) %[2)]	Machine resolution[1)] %[2)]
1	± 1,0	1,0	± 0,2	0,5
2	± 2,0	2,0	± 0,4	1,0
3	± 3,0	3,0	± 0,6	1,5

[1)] see definition in 5.3 of EN 10002 - 2:1998
[2)] The tabulated percentages are the maximum permitted for the related machine classes

4.2.3 Force indicator repeatability

The requirements of Table 1, appropriate to a machine's class, shall apply to each measuring range.

4.2.4 Accuracy of force indication

The accuracy of force indication shall be maintained under any or all of the following circumstances:

- mains voltage fluctuations of -14 % to +10 %;
- at a temperature of (20 ± 10) °C;
- at a relative humidity of up to 80 %.

NOTE: Where electrical or other interference exists this can affect the accuracy of force indication and special provisions to overcome this interference can be necessary.

4.2.5 Deviation in linearity

If a DC output, proportionate to the indicated force is provided, the linearity deviation of the output voltage - expressed as a percentage of the maximum output voltage - shall not exceed the value shown in Table 2.

Table 2: Deviation in the linearity of the output voltage

Maximum permissible deviation in linearity in relation to the maximum output voltage	
Machine class	%
1	± 0,1
2	± 0,2
3	± 0,3

4.3 Force control

4.3.1 The compression testing machine shall be provided with a control system. The control system shall enable the machine to be verified and to allow force to be applied smoothly and without shock. It shall also allow the force to be applied at prescribed constant rates.

4.3.2 The control system may be operated either by manual or automatic means.

4.3.3 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 ± 5 % of the specified rate.

4.4 Force transfer

4.4.1 Unless national provisions state otherwise, clauses 4.4.5 to 4.4.8 shall apply only to new machines delivered after this standard is implemented.

4.4.2 The upper platen shall incorporate a ball seating. The upper platen and the ball seating may be constructed separately or in one piece.

4.4.3 At the design stage, the manufacturer shall ensure that the centre of rotation of the ball seating shall coincide with the centre of the contact area of the machine platen and permit a rotation of at least three degrees.

4.4.4 At the start of a test, the upper platen shall align itself with the surface of the specimen, or an auxiliary platen, when the initial contact is made, before locking into position for the remainder of the test.

4.4.5 The design shall ensure that the requirements of Table 3 shall be met.

4.4.6 The force transfer shall be evaluated by means of a strain-gauged column as described in Annex A, or by an equivalent device.

4.4.7 The machine shall be designed to enable devices as set out in Annexes A and B, or similar, to be used for verifying:

- accuracy of force indication;
- self alignment of the upper machine plate;
- alignment of component parts of the machine;
- restraint of movement of the upper plate.

4.4.8 When tested in accordance with Annex A, or equivalent method, the machine shall conform to Table 3.

Table 3: Maximum permissible values for the mean strain ratio, the greatest difference in the strain ratio, and the strain ratio per mm of displacement

Force kN	Self alignment of upper machine plate	Alignment of machine components	Restraint on movement of upper plate
	Maximum permissible difference in the strain ratio	Maximum permissible mean strain ratio	Maximum permissible strain ratio per mm of displacement
200	0,10	± 0,10	0,06
2000	N/A	N/A	0,04

NOTE: The highest force (used only in the examination of restraint of movement of the upper platen) shall be the maximum capacity of the machine or 2000 kN whichever is the lesser.

4.5 Specimen location

4.5.1 To ensure correct positioning of the specimen in relation to the loading axis, the lower machine platen shall be provided with centring lines, locating cams or other fixtures for centring specimens.

4.5.2 If positive physical location is used for positioning specimens or auxiliary platens, then any locating device shall not restrict the deformation of the specimen during the test.

4.5.3 Centring lines, if provided, shall be no more than 0,5 mm wide and no more than 1,0 mm deep.