

# METHODS OF TEST FOR CONCRETE

## Part 2

## TESTS RELATING TO THE DETERMINATION OF STRENGTH OF CONCRETE

### AMENDMENT No. 2

July 2000

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#### REVISED TEXT

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#### EXPLANATORY NOTE

Amendment No. 2 provides for the use of a restrained rubber cap for compression testing of cylinders.

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#### APPROVAL

Amendment No. 2 was approved on 4 July 2000 by the Standards Council to be an amendment to NZS 3112: Part 2:1986.

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#### RELATED DOCUMENTS (page 3)

Add the following:

##### AUSTRALIAN STANDARD

AS 1523-1981                      Elastomeric bearings for use in structures

##### ISO STANDARD

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

(Amendment No. 2, July 2000)

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#### 3.4.2 (page 7)

Delete existing clause and **substitute** the following:

##### “3.4.2

Immediately after compaction, by rodding or vibration, use one of the following procedures:

- (a) *Hardened vertically.* For all concrete strengths, the specimen may be hardened vertically in the following manner. Strike off the surplus concrete with a trowel to produce a flat even surface that is level with the edge of the mould and that has no depressions or projections larger than 1 mm.
- (b) *Hardened horizontally.* For concrete strengths less than 50 MPa, the specimen may be hardened horizontally in the following manner. Work the top plates down on to the concrete with a sliding and rotary motion until they fit snugly against the top of the moulds. Then securely fasten the top plates to the moulds without distorting the plates. Immediately lay the moulds on their sides with their axes horizontal and maintain in this position until the specimens are removed from the moulds.

NOTE – The use of a restrained natural rubber capping system in accordance with 4.4.3 reduces the need to consider the use of horizontal hardening for concretes up to 50 MPa compressive strength. Vertical hardening gives a lower within test coefficient of variation at all strength levels.”

(Amendment No. 2, July 2000)

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## 3.5 (page 7)

Add non-mandatory note after the heading "Curing:"

"NOTE – The curing limits provided in clause 3.5, if utilized, may result in a scatter of results that is wider than can be attributed to variations in concrete quality. This applies particularly to higher strength concretes. Recommendations for concrete with strengths above 50 MPa that will give more consistent results are as follows:

Clause	Time limit given in clause	Recommended time for better result consistency
3.5.1	16 h 50 h	18 h 36 h
3.5.2.1	16 h 80 h (three places)	18 h 36 h (three places)
3.5.2.2	64 h	18 h
3.5.3.1	16 h 80 h	36 h 36 h

(Amendment No. 2, July 2000)

## 3.5.1 (page 8)

After the sentence ending "...top plates within 1 h of casting." **add:**

"A recessed top cover is beneficial in terms of reducing the formation of puddles of bleed water on top of the concrete and forming an airtight seal."

(Amendment No. 2, July 2000)

## 4.1 (page 9)

**Add** to the end of 4.1.1.

"Procedures are also specified for restrained natural rubber capping system for capping hardened concrete cylinders."

(Amendment No. 2, July 2000)

## 4.1 (page 9)

**Add** new clause 4.1.2.

**4.1.2**

The cylinder end preparation methods shall be in accordance with table 4.1 according to the expected concrete compression strength and capping method."

(Amendment No. 2, July 2000)

## 4.2 (page 9)

**Add** new subclause 4.2.2.

**4.2.2**

In the case of cylinders to be tested using a restrained natural rubber capping system in accordance with clause 4.4.3, end surfaces of the test cylinder shall be a plane within a tolerance of 3.0 mm and shall not depart from being perpendicular to the axis by more than 1.5°."

(Amendment No. 2, July 2000)

## 4.4.1 (page 9)

In the fourth line **delete** "20 MPa" and substitute "35 MPa".

(Amendment No. 2, July 2000)

## 4.4.1 (page 9)

**Add** the following to the end of the subclause.

"This material may be used for testing concretes within the strength ranges stated in table 4.1."

(Amendment No. 2, July 2000)

## 4.4.2 (page 9)

**Delete** subclause 4.4.2 (but not its Note) and **substitute**:

**"4.4.2*****Sulphur-based materials***

These materials are composed of sulphur with or without inert fillers. To be suitable for capping, these materials shall be capable of developing the strengths set out in table 4.1. Both end surfaces of the capped cylinders shall be plane within 0.05 mm."

(Amendment No. 2, July 2000)

## 4.4.3 (page 9)

**Add** new subclause 4.4.3 and subclauses 4.4.3.1 to 4.4.3.3.

**"4.4.3*****Restrained natural rubber capping system*****4.4.3.1*****Apparatus***

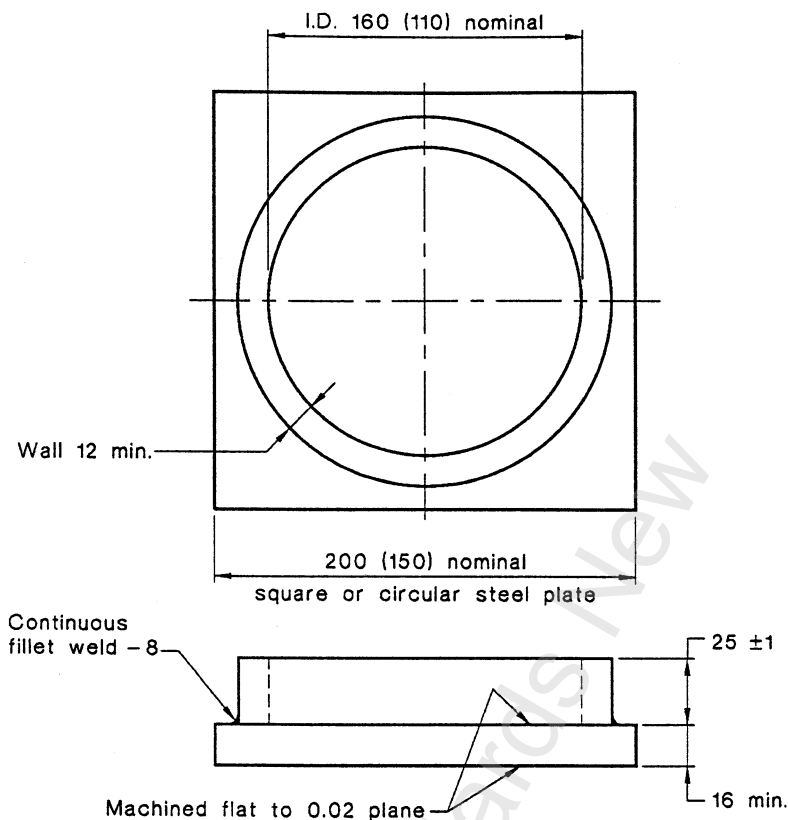
Moulded concrete cylinders of nominal 150 mm and 100 mm diameter may be capped and tested with a restrained natural rubber pad.

The capping system shall consist of a circular natural rubber pad inside a restraining device such as shown in figure 4.1. Other materials may be used for the restraining device provided they give equivalent results.

The pad shall be:

- (a) For a nominal 150 mm diameter cylinder — 160 mm nom. dia. (e.g. snug fit to the restraining device) and a uniform thickness between 12 mm and 15 mm; or
- (b) For a nominal 100 mm diameter cylinder — 110 mm nom. dia. (e.g. snug fit to the restraining device) and a uniform thickness between 12 mm and 15 mm; and
- (c) Natural rubber as described in AS 1523 with a nominal Shore A Durometer hardness of 50 to 65.

NOTE — Under certain conditions and with certain testing machines, there may be an increase of sudden failures when the rubber capping system is used.



DIMENSIONS IN MILLIMETRES

NOTE – Dimensions in brackets apply to nominal 100 mm diameter cylinders.

Figure 4.1 – Steel restraining device

#### 4.4.3.2

##### Procedure

Apply capping system immediately prior to testing. Ensure that the rubber pad, cylinder and steel restraining device are concentric. Ensure that the concrete cylinder is not in contact with the steel restraining device.

#### 4.4.3.3

##### Inspection

The capping system shall be inspected regularly for damage or wear. The initial use of pads will cause some deformation and flow of the rubber, however this shall not be a reason for rejecting the pad. The rubber pads may be reused provided that they are:

- (a) Not torn or split; and
- (b) Capable of providing contact over the whole area of the cylinder end."

(Amendment No. 2, July 2000)

#### 4.5.1 (page 9)

**Delete** the first sentence of 4.5.1(b) and **substitute:**

"(b) Make caps as thin as is practicable, and no more than 2 mm thick for concrete with a compressive strength greater than 80 MPa and no more than 4 mm thick for concrete with a compressive strength less than 80 MPa."

(Amendment No. 2, July 2000)

Section 4 (page 10)

Add the following new table at the end of section 4:

“Table 4.1 – CAPPING METHODS

Capping material	Capping method		
	Expected compressive strength MPa		
	≤ 50	> 50 ≤ 80	> 80
Filled sulphur mixtures	Cap shall be at least 1 h old and average compressive strength of the sulphur mixture shall exceed 35 Pa (Note 1)	Cap shall be at least 2 h old and the average compressive strength of the sulphur mixture shall exceed 35 MPa (Note 1)	Cap shall be at least 2 h old and average compressive strength of the sulphur mixture shall exceed 50 MPa (Note 1)
Special gypsum plasters	Cap shall be at least 1 h old and compressive strength of the plaster mixture shall exceed 35 MPa when tested in accordance with clause 4.4.1	Not permitted	Not permitted
Restrained natural rubber capping system (Note 2)	Permitted for > 10 MPa	Permitted	Not permitted

NOTE –

- (1) Sulphur mixture specimens shall be 50 mm to 75 mm cubes. To prepare a suitable cube specimen of sulphur mixture, it is advisable to place the molten mixture in thin layers (about 3 mm to 6 mm) in a mould that has been preheated to about 50 °C allowing each layer to partly solidify before the next layer is added. The average of 3 cube compressive strength results shall be used with testing carried out at least 2 hours after hardening.
- (2) A restrained natural rubber capping system shall be in accordance with clause 4.4.3.”

(Amendment No. 2, July 2000)

5.5.1 (page 11)

In the fifth line **delete** “not earlier than 16 h nor later than 50 h” and **substitute** “at approximately 48 h”

(Amendment No. 2, July 2000)

## 5.5.2 (page 11)

**Delete** the clause and its subclauses, 5.5.2.1, 5.5.2.2 and 5.5.2.3 and **substitute** the following:

**5.5.2**

*Specimens made in the field for quality control and acceptance tests*

**5.5.2.1**

Immediately after moulding the specimens, store the moulds in a suitable enclosure such that the temperature remains within the range 10 °C to 26 °C and leave undisturbed for at least 18 h. No later than 36 h after moulding, place the flexure specimens in their moulds at a temperature of  $21 \pm 2$  °C under moist conditions such that free water is maintained on the surface of the specimen at all times.

**5.5.2.2**

At approximately 48 h after moulding remove the specimens from the moulds and replace them into standard moist conditions at  $21 \pm 2$  °C as soon as possible, but not later than 3 h after demoulding and up to the time of testing.

**5.5.2.3**

When specimens are transported to a laboratory, they shall be carried in such a way that physical damage is avoided and loss of moisture and temperature extremes are prevented.

Transportation of the specimens to the laboratory may either be:

(a) Between 18 h and 36 h in their moulds.

(b) After 48 h from moulding where standard moist conditions are available on site.

NOTE – The curing time limits provided in clause 5.5.2, if utilized, may result in a scatter of results than is wider than can be attributed to variations in concrete quality. This applies particularly to higher strength concretes. Following recommendations similar to those given for clause 3.5 for concrete with strengths above 50 MPa will give more consistent results."

(Amendment No. 2, July 2000)

**6.2.1** (page 13)

**Delete** at the beginning of the clause the words "The machine shall comply as regards accuracy with the requirements of Grade B of NZS 1021, except ..." and **substitute**:

"The machine shall comply as regards accuracy with the requirements of Grade 2 of ISO 7500-1, except..."

(Amendment No. 2, July 2000)

**6.3.3** (page 13)

**Add** the following as a new paragraph to the end of 6.3.3.

"Where a restrained natural rubber capping system is used, the end surface of the test cylinder shall be a plane within a tolerance of 3.0 mm and shall not depart from being perpendicular to the axis by more than  $1.5^\circ$ ."

(Amendment No. 2, July 2000)



**6.3.4** (page 13)

Delete 6.3.4 and **substitute** the following:

**“6.3.4**

Where capping is required, use the procedures specified in section 4.”

(Amendment No. 2, July 2000)

**6.4.1(g)** (page 14)

Add new note at the end of the clause:

“NOTE – Individual results may be recorded to 0.1 MPa but the average results do not have a precision better than 0.5 MPa.”

(Amendment No. 2, July 2000)

**10.4** (page 21)

After the heading “Calculations” **add** a non-mandatory note:

“NOTE – Results may be calculated and recorded to a greater precision than that required by section 10 but the final results do not have a precision better than 0.5 MPa or 0.1 MPa in the case of the overall production standard deviation.”

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