BSI

Document 98/109542 DC

# Draft for Public Comment

**Latest date for receipt of comments**

26 FEBRUARY 1999

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| **Project No.** | 91 7812 |
| **Committee ref** | B/517/8 |
| **Date** | 20 November 1998 |

Products and systems for the protection and repair of concrete structures - Test methods - Measurement of chloride ion ingress

(prEN 13396)

This draft is now available for public comment and your views and technical comments on it would be appreciated. If you have no specific comments to make but find it generally acceptable it would be helpful if you would notify us accordingly. Suggestions entailing revision of the text should indicate the preferred wording. **Please quote the relevant clause number against any comment.**

The co-ordination of the requirements of this draft with those of any related standards is of particular importance and you are invited to point out any areas where this may be necessary.

**All comments should be sent to the Committee Secretary** Mr. M K Greenley at the address below . The comments received will be passed to the committee concerned for its consideration; no acknowledgment will normally be sent.

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## NOTES ABOUT THIS DRAFT

This draft standard, prepared by Committee B/517/8, Protection and repair of concrete structures, has been submitted for CEN enquiry. The draft has been produced as a result of international discussions in which the committee has taken an active part.

It should be noted that BSI has an obligation to implement all European standards as British Standards and to withdraw any conflicting British Standards. This applies even if the UK voted against the draft European Standard.

Your comments on this draft standard, either editorial or technical, will assist the UK technical committee in deciding its response to this draft. They will also assist further participation by the UK in this work. Comments should be submitted to the committee secretary (whose name is given on the front cover) by post (on paper or disc), fax or e-mail, and should be clear, concise and in identified ascending clause number.

Please note that:

a) the BSI postal address is on the front of this document.
b) the fax number of the committee secretary is 0181 996 7065.
c) the e-mail address for the committee secretary is: malcolm_greenley@bsi.org.uk
d) if comments are submitted on computer disc (particularly useful if you wish to offer extensive comments) Microsoft Word 6.0 format is preferred.

The British Standards which implement the International or European publications referred to in this draft may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

Contents



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## 0 Foreword

This European Standard is under the responsibility of the technical committee CEN/TC 104 "Concrete - Performance, production, placing and compliance" (Secretariat DIN).

It has been prepared by sub-committee 8 "Products and systems for the protection and repair of concrete structures" (Secretariat AFNOR).

This Document has been submitted to CEN enquiry and the comments obtained therefrom have been incorporated into this draft.

This European Standard is one of a series dealing with products and systems for the protection and repair of concrete structures. It contains a method for determining the resistance to chloride ion penetration of hardened HC, PCC or PC repair products and systems.

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## 1 Scope

This European Standard specifies a method for determining the ingress of chloride ions into hardened HC, PCC or PC repair products and systems for the protection and repair of concrete, as defined in EN 1504-3.

The provisions of the standard are applicable to cementitious grouts, mortars and concretes with a maximum aggregate size of 20 mm.

## 2. Normative References

This European Standard incorporates by dated or undated reference, provisions from other publications. Normative references are cited at the appropriate places in the text and the relevant 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 this European Standard refers to the latest edition of the publication.

EN 1504-1 Products and systems for the protection and repair of concrete structures - Part 1 : General scope and definitions.

EN 1504-3[1)] Products and systems for the protection and repair of concrete structures - Part 3 : Structural and non-structural repair.

EN 1015-17[1)] Methods of test for mortar for masonry - Part 17 : Determination of soluble chloride content of fresh and hardened mortars.

EN 196-1 Methods of testing cement - Part 1: Determination of strength.

EN 1542[1)] Products and systems for the protection and repair of concrete structures - Test Methods - Pull-off Test.

## 3 Definitions

The definitions contained in prEN 1504-1 apply.

## 4 Principle

The test is carried out on cylindrical specimens with a diameter of 100 mm. The specimens may be cut from a larger block of the repair product or system or from cylinders cast in the laboratory. The specimens are pre-treated by saturation under a vacuum to minimise chloride uptake by absorption. The test procedure is designed to promote the ingress of chloride ions into the trowelled face of the cylinder, accelerated by immersion in a concentrated chloride solution at a temperature of 40 °C.

After the test period, the chloride ion content in the repair product or system is determined at three depths from the exposed surface.

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[1] At present at the draft stage

## 5 Equipment

**5.1 Cylindrical moulds** for producing specimens manufactured from non-absorbent rigid material, not attacked by cement paste or polymers, of (100 ± 2) mm internal diameter and at least 150 mm depth.

**Or**

**5.2 Formwork** for producing blocks of material from which a full set of test specimens can be obtained, produced from rigid non-absorbent material, not attacked by cement paste or polymers and at least 150 mm in depth.

**5.3 Diamond core drill and barrel** that enable the drilling of a (100 ± 2) mm cylindrical specimen through the repair product and system.

**5.4 Demineralised water** conductivity approximately 0,5 μS/mm.

**5.5 Electronic balance** with a minimum accuracy of 0,001 g.

**5.6 Vibrating table** to compact the mortar or concrete.

**5.7 Two water baths** with tightly-fitting lids to reduce evaporation, into which the specimens are placed. The volume of the bath should be 1.5 times the volume of the specimens and allow free circulation of test solution around them, made of rigid non-corroding material, filled as follows:

1. Distilled water maintained at (40 ± 2) °C, suitable for vacuum saturation,
2. 3 % NaCl solution (99.9 % pure NaCl) in distilled water, maintained at (40 ± 2) °C.

**5.8 Concrete cutting equipment** capable of trimming or grinding-away the concrete to an accuracy of 0.5 mm.

NOTE: suitable equipment includes a milling machine and dust collection system, operating a horizontally mounted diamond edged grinding wheel, or a vertically mounted diamond coated milling tool, or a petrographic (thin-bladed) concrete saw.

**5.9 Concrete grinding equipment** suitable for crushing concrete slices into a fine powder, in accordance with EN 1015-17.

**5.10 Potentiometric titration equipment** in accordance with prEN 1015-17.

**5.11 Hard bristled brushes** for wet scrubbing or cleaning dust from the specimens.

**5.12 Standard laboratory climate** in accordance with the requirements of Annex 1.

**5.13 Mortar mixer**, in accordance with EN 196-1, or **concrete mixer**, (forced action pan mixer).

**5.14 Compaction Tools and Equipment** for repair grouts, mortars and concretes according to EN 196-1.

NOTE: The compaction method shall be in accordance with the manufacturer's instructions.

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## 6 Test Procedure

Seven specimens are required for determining the ingress of chloride ions, as follows:

2 for testing at 28 days
2 for testing at 3 months
2 for testing at 6 months
1 control specimen

### 6.1 Preparation

All materials shall be conditioned in the standard laboratory climate (**5.12**) for a period of not less than 24-hours prior to mixing.

Unless otherwise instructed by the manufacturer, use the following mixing technique for preparing the specimens.

For PCC and cementitious mortar, use the mortar mixer (**5.13**) set to a low speed, pouring the gauging liquid to the bowl and adding the dry ingredients, mixing for a total period of two minutes.

Where manufacturer's instructions preclude use of part bags of material, a concrete mixer (**5.13**) or other method recommended by the manufacturer shall be used.

NOTE: It has been found that certain types of repair mortar can foam excessively under the action of the mortar mixer specified in EN 196-1. An alternative is to use a concrete mixer (**5.13**). The air content, strength and density of the HC and PCC mixes should normally be determined to characterise the mortar under test.

The mixed material shall be placed carefully into cylindrical moulds or formwork, tamping or vibrating (**5.14**) to achieve adequate compaction. The top surface shall be trowelled smooth and flat and protected from contamination. Release of the repair material may be helped by use of a light smearing of mould oil on the sides of the mould.

The specimens shall be demoulded 24 hours after casting, cured according to the manufacturers recommendations and then stored as defined in Annex 1 to an age of 28 days. The specimens shall be clearly labelled with the mix number or reference, the specimen number on the upper and lower faces.

After the 28 day curing period, the specimens shall be fully saturated by immersing them in demineralised water at 40 ± 2 °C under vacuum (**5.7-1**) until the change in weight over a 24 hour period of vacuum saturation is less than 0.5 g per kg of specimen weight. If full saturation is not achieved after 72 hours under vacuum, the specimens shall not be tested and a report prepared which gives the weight change.

### 6.2 Conditioning

After completion of the vacuum saturation period, the fully saturated specimens shall be blotted dry with a clean damp cloth, weighed and then immersed in the following solutions:

6 specimens in a 3 % NaCl solution using distilled water maintained at 40 ± 2 °C (**5.7-2**),

1 control specimen in distilled water maintained at 40 ± 2 °C (**5.7-1**).

The specimens shall be laid on their sides with a minimum of 100 mm between them, leaving the trowelled faces freely exposed to water movement.

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### 6.3 Test method

After 28 days, 3-months and 6-months conditioning, two specimens shall be removed from the NaCl bath (**5.7-2**), blotted dry with a clean, damp cloth and weighed. Each specimen shall be scrubbed lightly with the hard bristled brush and rinsed with distilled water to remove saline solution from the surface.

The specimen shall be prepared immediately (i.e concrete sampling shall be completed within 15 minutes of removal from the NaCl bath).

The trowelled face of the specimen shall be either trimmed to remove any edge concrete or ground in such a way as to leave an outer annulus, thereby excluding concrete that will have been affected by multidirectional diffusion (see Figure 1).

NOTE : Ignoring the outer 20 mm is usually sufficient to eliminate these effects for products and systems intended to be resistant to chloride ion penetration.

Three depth increments of the concrete shall be collected, of between 0 mm and 2 mm, 4 mm and 6 mm and 8 mm and 10 mm from the trowelled face.

The samples of concrete shall then be ground to a powder in accordance with the requirements of EN 1015-17. The powder shall be dried in an oven to a constant weight at (105 ± 5) °C and then allowed to cool to room temperature in a desiccator. It may be stored in a desiccator until the specimen is analysed. The chloride ion content of the powder shall then be determined by the Potentiometric method of titration according to prEN 1015-17. The titration apparatus shall be calibrated before and after each set of measurements by determining the chloride content of control solutions.

### 6.4 Control specimen

The control specimen shall be analysed following completion of the testing at 28 days. The control specimen shall be broken in half, and a sample of concrete taken from the centre of the specimen. The dust shall be analysed to establish the background chloride level by the method of prEN 1015-17.

## 7 Test Report

The test report shall include the following:

a) A reference to this Standard;

b) The name and address of the testing laboratory;

c) The name and address of the company ordering the work;

d) The name and address of the manufacturer or supplier of the product/material under test;

e) The name and identification marks on the product/material and the date of supply;

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f) The date of manufacture and type (cast cylinder/cored block) of the specimens, the maximum aggregate size and dimensions of the specimens;

g) The date of sampling (where appropriate), the date of commencement of vacuum saturation and the dates of immersion in and removal from the test solution;

h) The method of sampling (grinding or cutting) and any deviation from the thickness requirements of this Standard;

i) The test results for the chloride ion content of the samples at each depth and at each age, including the individual results and the mean value;

j) The background chloride ion content of the control specimen after 28 days immersion.

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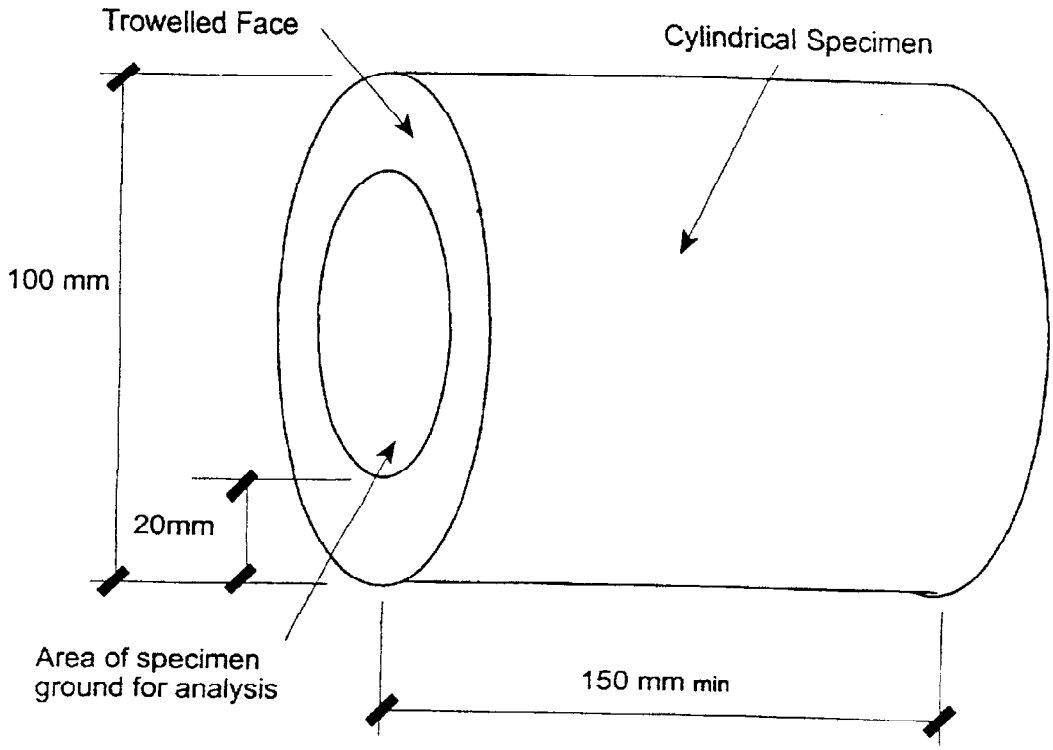


**Figure 1 : Specimen dimensions**

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# Annex A

**Summary of temperatures and humidities for the Curing, Conditioning and Testing of Repair Products and Systems.**

## A.1 Curing

### A.1.1 HC (grouts, mortars and concretes)

- Prepare as EN 196, cover in film for 24 h.
- Demould after 24 h.
- Cure under water at (21 ± 2) °C for 27 days.

### A.1.2 PCC (grouts, mortars and concretes)

- Prepare as EN 196, cover in film for 24 h.
- Demould after 24 h and wrap in film for 48 h.
- Unwrap and cure for 25 days in a standard laboratory climate of (21 ± 2) °C and (60 ± 10) % RH.

### A.1.3 PC (grouts, mortars and concretes)

- Cure for 7 days at (21±2) °C and (60±10) % RH.

## A.2 Conditioning and Testing

For specific applications, the following definitions apply:

### A.2.1 Standard laboratory climate (Dry conditioning):

- Take from the curing/storage environment and condition for 7 days in a standard laboratory climate of (21 ± 2) °C and (60 ± 10) % RH.

### A.2.2 Wet Conditioning:

- Immerse for 7 days at (21 ± 2) °C, or for HC take directly for test after 28 days of immersion,
- Remove all surface water by standing upright for 30 min before using for tests.

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