BRITISH STANDARD

BS EN
14406:2004

# Products and systems for the protection and repair of concrete structures — Test methods — Determination of the expansion ratio and expansion evolution

The European Standard EN 14406:2004 has the status of a British Standard

ICS 91.080.40

# National foreword

This British Standard is the official English language version of EN 14406:2004.

The UK participation in its preparation was entrusted by Technical Committee B/517, Concrete, to Subcommittee B/517/8, Protection and repair of concrete structures, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 7 and a back cover.

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EUROPEAN STANDARD

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# EN 14406

September 2004

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English version

# Products and systems for the protection and repair of concrete structures - Test methods - Determination of the expansion ratio and expansion evolution

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essai - Détermination du rapport d'expansion et de l'évolution de l'expansion

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung des Ausdehnungsverhältnisses und der Ausdehnungsentwicklung

This European Standard was approved by CEN on 16 April 2004.

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# Foreword

This document (EN 14406:2004) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

It has been drafted by Sub-Committee 8 "Products and systems for the protection and repair of concrete structures" (Secretariat AFNOR).

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of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

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## 1 Scope

This document describes a test method to determine the expansion ratio and rate of injection products intended for ductile filling of wet cracks, voids and interstices.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1504-1:1998, *Products and systems for the protection and repair of concrete structures - Definitions,requirements, quality control and evaluation of conformity - Part 1: Definitions*.

prEN 1504-5:2001, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 5: Concrete injection.*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1504-1:1998 and prEN 1504-5:2001 and the following apply.

**3.1**
**final expansion ratio**
ratio of the volume of reacted product and the initial volume of the unreacted injection products3.2

**expansion evolution**
ratio of the volume of reacting product and the initial volume of the unreacted injection products as a function of time

## 4 Test principle

Water is added at a ratio of 5 % by weight to the mixed injection products. The ensuing reaction is measured as a function of the unrestricted expansion of the reacting materials in one direction.

NOTE 1 For special purposes, the product can be tested with other water contents (e.g. 10 %, 15 % or even 50 %).

NOTE 2 The test can be used to indicate the expansion properties of a product, e.g. induction time, general behaviour of the product during the expansion, and end properties of the expanded product. The expansion ratio should not be considered as a quality evaluation and a performance related characteristic.

## 5 Apparatus

**5.1 Expansion measuring vessel,** consisting of:

— a clear acrylic pipe, inner diameter of (48 ± 2) mm. The height of the tube e.g. 400mm, shall be adjusted to the expansion of the material;

a tool (e.g. ruler) fixed to the pipe, for measuring the height of the (expanding) product, with an accuracy of ± 1 mm;a polymeric e.g. polyethylene, bottom provided with a hole (20 ± 1) mm depth, with a diameter slightly higher than the outer diameter of the pipe;

— a plastic film, to seal the inserted tube into the bottom.

**5.2 Stop watch** with an accuracy of ± 1 s.

**5.3 Mixing equipment.**

**5.4 Pipette,** which allows to add water with an accuracy of 5 % relative to the requested amount.

**5.5 Weighing device,** capable of weighing the expansion measuring vessel to the nearest 0,01 g.

## 6 Sampling and preparation

The temperature of the injection product and mixing water shall be (21 ± 2) °C.

If two component products have to be tested, the mixture of the two components (ratio of the components, mixing procedure) shall be in accordance with the manufacturer's instructions.

For catalysed products, the catalyst content shall be selected to be at the minimum of the range recommended by the manufacturer.

## 7 Procedure

— The standard conditions of test shall be (21 ± 2) °C and (60 ± 10) % relative humidity.

— Immediately after the mixing of the injection product, a quantity of product sufficient to achieve a height of (20 ± 1) mm is poured into the pipe.

— The quantity of water to be added is determined by weighing before and after adding the product, and by considering that the mixture shall contain 5 % of water in weight (i.e. 5 g for 100 g of product).

— The mixing equipment, mounted on a drilling machine, is placed in the pipe.

— The water is added with a pipette, assuming a specific weight of 1 000 kg x $m^{-3}$.

— The mixing starts immediately. The speed is chosen to approximately 400 rpm and the mixing time to 10 s.

The following measurements are to be made:

— initial height $H_i$ of the product;

— maximum height $H_m$ of the expanded product;

— at least 5 intermediate heights $H_t$ well spread over the period of expanding;

— final height $H_f$, which is the value of height measured 1 h after reaching the maximum height.

The heights are to be measured to the top of the foam.

— Furthermore, observations concerning the general behaviour of the product shall be made.. Visual observations and the homogeneity of the expanded product shall be recognised, such as large bubbles, asymmetrical rise of the expanding product, as well collapse (reduction of volume not related to drying and thermal shrinkage).

At least three tests shall be performed.

Expression of results

— The final expansion ratio $E_f$ of the product is expressed as follows:

$$E_f = \frac{H_f}{H_i}$$

where

$H_f$ is the final height of the product;

$H_i$ is the initial height of the product.

— The rate of expansion is presented in diagrams $E_t f(t)$ where $E_t$ is the expansion at time t, and is given by:

$$E_t = \frac{H_t}{H_i}$$

where

$H_t$ is the height of the product at time t (s);

$H_i$ is the initial height of the product.

— The induction time, which is the time from end of mixing until beginning of expansion.

— The period of time to reach maximum expansion, i.e. height $H_m$.

## 8 Report

The test report shall contain the following informations:

a) a reference to this document;

b) name and address of the test laboratory;

c) identification number of the test report;

d) name and address of the manufacturer or supplier of the product;

e) name and identification marks or batch number of the product;

f) date of supply of the product;

g) date of preparation of the test specimens and any deviation from the prescribed method of preparation; procedure of mixing of the product and mixing with water (ratio of the components and/or catalyst, description of mixing equipment, duration of mixing);

h) conditions of storage of prepared specimens prior to test;

i) date of test and details of the test equipment used, including the make, type and capacity and the calibrations details or the identification number of the apparatus;

j) the test results

- individual and average values of expansion ratio;
- rate of expansion, presented in diagrams;
- induction time, individual and average values;
- time to reach maximum expansion, individual and average values;
- observations concerning the general behaviour of the product;
- observations concerning the elasticity or brittleness of the expanded product;

k) accuracy data;

l) date of test report and signature.

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