SLOVENSKI STANDARD
SIST EN 1770:2000

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Proizvodi in sistemi za zaģl ito in popravilo betonskih konstrukcij - Preskusne metode - Dololļ evanje toplotnega razteznostnega koeficienta

Products and systems for the protection and repair of concrete structures - Test methods - Determination of the coefficient of thermal expansion

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung des Wärmeausdehnungskoeffizienten

Produits et systemes pour la protection et la réparation des structures en béton - Méthodes d'essais - Détermination du coefficient de dilatation thermique

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ICS:

91.080.40	Betonske konstrukcije	Concrete structures

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English version

Products and systems for the protection and repair of concrete structures - Test methods - Determination of the coefficient of thermal expansion

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essais - Détermination du coefficient de dilatation thermique

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This European Standard was approved by CEN on 22 February 1998.

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

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Foreword

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.

NOTE : This European standard should be read together with EN 1504-1.

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of an identical text or by endorsement, at the latest by September 1998, and conflicting national standards shall be withdrawn at the latest by September 1998.

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.

1 Scope

This European Standard specifies methods for the determination of the coefficient of thermal expansion of hardened structural bonding agents. The first method provides a continuous measurement of linear thermal expansion using thermomechanical analysis techniques. This method may also be used for surface protection systems. The alternative method uses prisms of 40 mm x 40 mm x 160 mm. This method may also be used for repair mortar. Both methods are suitable for bonding agents formulated with fillers of up to 4 mm.

2 Normative references

This European Standard incorporates by dated or 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.

prEN 12190 Products and systems for the protection and repair of concrete structures - Test methods - Determination of compressive strength

3 Thermomechanical analysis

3.1 Principle

The coefficient of thermal expansion of resinous materials is to be measured at an age of 7 days (storage at (21 ± 2) °C and (60 ± 10) % relative humidity).

Once hardened the bonding agent is subjected to a constant heating rate. This method uses a thermomechanical analyser to determine the changes in length, which is electronically recorded as a function of temperature. The coefficient of linear thermal expansion can be calculated from the recorded data.

3.2 Apparatus

3.2.1 Thermomechanical analyser, or similar device, consisting of :

a) specimen holder and probe, (constructed from low-expansion materials such as fused quartz) that transmits changes in the length of the specimen to the transducer. The shape and size of the probe shall be such that the load applied shall not cause indentation of the specimen, during testing ;

b) transducer, for sensing movement of the probe resulting from changes in length of the specimen and for translating these movements into an electrical signal suitable for input to a recording system ;

c) temperature sensing element, for measuring the temperature of the test specimen ;

d) a recording system to record the changes in specimen length as a function of specimen temperature. The combination of transducer and recorder shall have sufficient sensitivity to produce a minimum of 1 mm of chart deflection per 100 nm of probe movement with provision for less sensitive ranges, where needed.

3.2.2 Furnace, for uniformly heating the specimen (preferably at 2 °C/min), at a predetermined rate over the testing temperature range with provision for cooling the specimen when sub-ambient temperature measurements are to be made.

3.2.3 Means of purging the specimen environment with a dry inert gas such as nitrogen or helium (for temperatures > 100 °C).

3.2.4 Callipers, capable of measuring linear dimensions to an accuracy of not less than 25 µm.

3.3 Test procedure

3.3.1 Sampling material

The bonding agent to be tested shall be taken from one production batch. The specimen may be cut from a prism 40 mm x 40 x mm 160 mm, as used for other tests.

3.3.2 Test specimens

Cylindrical or square shaped specimens shall be between 25 mm and 50 mm in length and have ends flat and parallel to within ± 25 µm. Lateral dimensions shall not exceed 10 mm. Other lengths may be used provided that they are noted in the report.

The specimens shall be measured in the received condition. If some heat or mechanical treatment is applied to the specimen prior to test, this treatment should be noted in the report.

A minimum of three specimens shall be tested.

3.3.3 Storage of samples

Before starting the test procedure the materials shall be stored for 7 days at (21 ± 2) °C and (60 ± 10) % relative humidity.

3.3.4 Procedure

a) Calibration

Temperature calibration can be achieved by observing the penetration by a (5 ± 0,5) g loaded probe when a crystalline material is heated through its melting point at the same rate as the expansion specimen. The following high purity (> 99 %) materials may be used.

Table 1

Reference material	Melting point, in °C
Indium	156,6
Tin	232,0
Lead	327,5
Zinc	419,6
Aluminium	660,4

The length change measuring and recording system can be calibrated by measuring the linear expansion of a material having known expansion when heated at the same rate as the test specimens. The observed expansion shall be corrected for the difference in expansion between, the specimen holder and probe obtained from a preliminary trial in which either no sample or a specimen of the material of construction of the probe is used. As a working standard high purity alumina (Al_2O_3), platinium, quartz or vacrominium may be used.

b) Procedure

Measure the initial specimen length in the direction of the expansion test to an accuracy of ± 25 µm at room temperature.

Position the specimen in the holder under the probe, with the temperature sensor in contact with the specimen.

Place the specimen holder in the furnace. If measurements at sub-ambient temperature are to be made, cool the specimen to at least 20 °C below the lowest temperature of interest. The refrigerant used for cooling shall not come into direct contact with the specimen.

Select an appropriate sensitivity setting on the recorder.

Heat the specimen at a constant heating rate of (2 ± 1) °C/min over the desired temperature range. Other heating rates may be used provided that they are noted in the report.

3.4 Calculation

3.4.1 Calculate the mean coefficient of linear thermal expansion over the temperature range as specified in the instructions supplied with the equipment, as follows, for example :

$$\alpha_m = \frac{\Delta L_{sp} \cdot k}{L \cdot \Delta T}$$

$$k = \frac{\alpha_{ref} \cdot L_{ref} \cdot \Delta T_{ref}}{\Delta L_{ref}}$$

where :

α_m is the mean coefficient of linear thermal expansion, in µm/(m ·°C) ;

α_{ref} is the mean coefficient of linear thermal expansion, for reference material, in µm/(m ·°C) ;

k is the calibration coefficient ;

L is the specimen length at room temperature, in metres ;

ΔL_{ref} is the change of reference material length due to heating, in micrometres ;

L_{ref} is the reference material length at room temperature, in mètres ;

ΔL_{sp} is the change of specimen length, in micrometres ;

ΔT_{ref} is the temperature difference over which the change in reference material length is measured, in °C ;

ΔT is the temperature difference over which the change in specimen length is measured, in °C.

3.4.2 Select ΔT from a smooth portion of the thermal curves in the desired temperature range ; then obtain ΔL as depicted in figure 1. The α_m shall not be calculated from a temperature range in which a transition point is noted.

3.4.3 Calculate the average value of α_m from the tests on three specimens.

3.5 Test report

The following information shall be included in the test report :

a) identification of the material, including the name of the manufacturer and information on batch number and chemical composition when known ;

b) method of test specimen preparation ;

c) dimensions of test specimen ,

d) description of the thermomechanical analysis apparatus ;

e) purge gas and cooling medium, if used ;

f) temperature range in which the coefficient of linear thermal expansion has been determined ;

g) average value of the coefficient of linear thermal expansion in µm/(m · °C) as determined from the three specimens ;

h) expansion curves obtained ;

j) reference to this European Standard.