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Products and systems for the protection and repair of concrete structures - Test methods  
- Determination of thermal compatibility - Part 5: Resistance to temperature shock

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken -  
Prüfverfahren - Bestimmung der Temperaturwechselverträglichkeit - Teil 5: Widerstand  
gegen Temperaturschock (standards.iteh.ai)

Produits et systemes pour la protection et la réparation des structures en béton -  
Méthodes d'essai - Détermination de la compatibilité thermique - Partie 5: Résistance au  
choc de température

**Ta slovenski standard je istoveten z: EN 13687-5:2002**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 13687-5**

February 2002

ICS 91.080.40

English version

**Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 5: Resistance to temperature shock**

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essai - Détermination de la compatibilité thermique - Partie 5: Résistance au choc de température

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung der Temperaturwechselverträglichkeit - Teil 5: Widerstand gegen Temperaturwechselverträglichkeit

This European Standard was approved by CEN on 21 December 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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

**Management Centre: rue de Stassart, 36 B-1050 Brussels**

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## Foreword

This document EN 13687-5:2002 has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", 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 August 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

It has been elaborated by Subcommittee 8 "Products and systems for the protection and repair of concrete structures", the secretariat of which is held by AFNOR.

This Part of this European Standard is one of a series of inter-related parts dealing with the thermal compatibility of products and systems for the repair and protection of concrete. This part is relevant only to surface protection systems. The other parts of this standard are :

EN 13687-1, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 1: Freeze-thaw cycling with de-icing salt immersion.*

EN 13687-2, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 2: Thunder-shower cycling (thermal shock).*

EN 13687-3, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 3: Thermal cycling without de-icing salt impact.*

EN 13687-4, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 4: Dry thermal cycling.*

Annex A is normative. Annex B is informative.

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

**EN 13687-5:2002 (E)****1 Scope**

This European Standard is the fifth of a series of five parts to assess the thermal compatibility of products and systems for the repair and protection of concrete. This part is relevant only to surface protection systems, and specifies a method for determining the resistance of surface protection systems to high temperature shock.

This test method is also suitable for testing the resistance of surface protection systems against hot chemicals.

**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 (including amendments).

EN 196-1, *Methods of testing cement - Determination of strength*.

EN 1542, *Products and systems for the protection and repair of concrete structures - Test methods - Measurement of bond strength by pull-off*.

EN 1766, *Products and systems for the protection and repair of concrete structures - Test methods - Reference concretes for testing*.

ISO 4628-4, *Paints and varnishes - Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 4: Designation of degree of cracking*.

ISO 4628-5, *Paints and varnishes - Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 4: Designation of degree of flaking*.

**3 Principle**

The principle of the test method consists of applying a layer of the surface protection system to a reference concrete slab (prepared according to EN 1766). After curing, the test specimen is subjected to a temperature shock, which is achieved by applying hot asphalt or bitumen or chemicals. After the thermal load, visible defects are recorded and the adhesion of the surface protection system is determined by pull-off test (according to EN 1542).

**4 Apparatus****4.1 Laboratory**

Maintained at the temperature of  $(21 \pm 2)$  °C and a relative humidity of  $(60 \pm 10)$  %.

**4.2 Usual accessories**

to apply the coating material to the concrete substrate.

**4.3 Two concrete slabs 400 mm x 400 mm x 50 mm**

Using a concrete MC (0,40) according to EN 1766 as substrate for the coating.

#### 4.4 Testing apparatus (see annex B (informative))

The testing apparatus consists of a thermally-insulated steel cylinder, of 1 mm wall thickness, with internal dimensions of 300 mm diameter and 200 mm high. At its base the cylinder has a steel flange, 24 mm wide x 10 mm thick, with a 24 mm wide x 22 mm thick compressible, heat resistant sealing ring to suit. Just above the flange the cylinder is fitted with a suitable draining device to facilitate removal of the test liquid. The base of the apparatus consists of a 350 mm x 350 mm x 12 mm thick steel plate, with four clamps which are used to clamp the test panel between this plate and the sealing ring and flange of the cylinder. The top of the cylinder is fitted with an insulated lid, part of which can be removed to allow fast but safe.

#### 4.5 Silicone oil

as testing liquid at least 11 litres.

NOTE Other hot chemicals can be used in accordance with the manufacturer's instructions.

#### 4.6 Hot plate

#### 4.7 Stirrer with a speed of approx. 200 rpm

#### 4.8 Thermometer or thermocouples

to measure the temperature on the surface of the coating continually.

#### 4.9 Diamond core drill equipment according to EN 1542

with a diamond tool, internal nominal diameter 50 mm.

#### 4.10 Pull-off equipment

for measuring the pull-off strength according to EN 1542.

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### 5 Preparation of test specimens

The application of the surface protection system to the two concrete substrate (4.3) shall be carried out at standard climate conditions (4.1) or such alternative environments as may be specified for the intended use. Two test pieces (4.3) are required for each test, with one serving as a reference test piece.

The side of the concrete slab specimens placed underneath during the casting shall be prepared by grit-blasting in accordance with EN 1766, cured according to A.2.1 (dry conditioning) followed by preparation and application of the surface protection system, in accordance with manufacturer's instructions. Cure the coating under test in a climate ( $21 \pm 2$ ) °C and ( $60 \pm 10$ ) % R. H. in accordance with the manufacturer's instructions.

### 6 Procedure

All components are to be conditioned in the laboratory (4.1) for at least 24 h prior to assembly. The test piece is positioned onto the square base plate with the thermocouple or thermometer firmly fixed to the centre of the surface of the test piece. The sealing ring and flanged cylinder are positioned over the test piece and clamped to the base plate. The test temperature shall be agreed between the interested parties.

It should be selected in multiples of 10 °C. To test the performance of a coating below a mastic asphalt coat, a temperature of ( $250 \pm 5$ ) °C is recommended.

**EN 13687-5:2002 (E)**

Silicone oil or other test liquid is heated to the agreed test temperature ( $\pm 5$  °C) and immediately transferred to the testing apparatus, filling to a depth of  $(155 \pm 5)$  mm. After 3 minutes a stirrer rotating at 200 rpm 50 mm above the test surface is switched on. (In the case of mastic asphalt the temperature on the surface of the test piece must rise to  $(150 \pm 5)$  °C within 7 minutes, and at the end of the test shall exceed 85 °C). The test shall last for 60 minutes and the temperature shall be monitored throughout that time. At completion of the test the oil is drained and the test panel is removed and blotted dry ready for examination.

**7 Evaluation of results**

Examine the test piece for surface cracking (according to ISO 4628-4), flaking (according to ISO 4628-5) or bubbling of a coating or de-bonding or any other obvious change. The bond strength of the coating is measured by pull-off test according to EN 1542 after at least 24 h of cooling down to room temperature. Before measuring pull-off strength the surface of the coating is to be cleaned with a suitable solvent which will remove all traces of the test liquid but which will have no detrimental effect on the adhesion of the dolly to the surface of the test piece.

For comparison purposes the pull-off strength of the reference test piece shall also be measured according to EN 1542.

**8 Test report**

The test report shall at least include the following information:

- a) a reference to this test method standard, including the number and date of issue;
- b) name and address of the test laboratory;
- c) identification number and date of the test report;
- d) name and address of the manufacturer or supplier of the product(s);
- e) a description of the product or system under test and whether it is a single or multi-layer system and the thickness(es) of the layer(s);
- f) name and identification marks or batchnumber of the product(s);
- g) date of supply of the product;
- h) date of preparation of the test specimen and any deviation from the prescribed method of preparation;
- i) conditions of storage of prepared specimens prior to test;
- j) date of test and details of the test equipment used;
- k) test temperature and the test liquid used;
- l) a description of any cracking, flaking, bubbling, spalling, de-bonding or any other change of the material under test;
- m) the test results (single and mean values) of the pull-off tests including individual forms of fracture;
- n) precision data;
- o) any deviation of this standard;
- p) date of test report and signature.



## Annex A (normative)

### Summary of temperatures and humidities for the curing, conditioning and testing of products and systems for protection and repair of concrete structures

#### A.1 Curing

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

- prepare as EN 196-1, cover in film for 24 h;
- demould after 24 h;
- cure under water at  $(21 \pm 2)$  °C for 27 days.

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

- prepare as EN 196-1, cover in film for 24 h;
- demould after 24 h and wrap in film for 48 h;
- uncure and cure for 25 days in a standard laboratory climate of  $(21 \pm 2)$  °C and  $(60 \pm 10)$  % R. H.

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

- cure for 7 days at  $(21 \pm 2)$  °C and  $(60 \pm 10)$  % R. H.

#### 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  $(21 \pm 2)$  °C and  $(60 \pm 10)$  % R. H.

##### A.2.2 Wet Conditioning:

- immerse for 7 days at  $(21 \pm 2)$  °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.