BRITISH STANDARD

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13529:2003

Products and systems for the protection and repair of concrete structures — Test methods — Determination of resistance to severe chemical attack

The European Standard EN 13529:2003 has the status of a British Standard

ICS 91.080.40

National foreword

This British Standard is the official English language version of EN 13529:2003.

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;

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EN 13529

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English version

Products and systems for the protection and repair of concrete structures - Test methods - Resistance to severe chemical attack

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essai - Résistance aux fortes attaques chimiques

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Widerstand gegen starken chemischen Angriff

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Contents

Foreword

This document (EN 13529:2003) has been prepared by Technical Committee CEN/TC 104, "Concrete and related products", the Secretariat of which is held by DIN.

It has been prepared 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of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by March 2004.

Annex A 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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a method for determining the resistance to severe chemical attack of surface protection systems.

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).

prEN 1504-2, *Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 2 : Surface protection systems*.

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

EN ISO 868, *Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:1985).*

EN ISO 1513, *Paints and varnishes - Examination and preparation of samples for testing (ISO 1513:1992)*.

EN ISO 2808, *Paints and varnishes – Determination of film thickness (ISO 2808:1997).*

EN ISO 2815, *Paints and varnishes – Buchholz indentation test (ISO 2815:2003)*.

EN ISO 15528, *Paints, varnishes and raw materials for paints and varnishes – Sampling (ISO 15528:2000)*.

ISO 4628-1, *Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 1 : General principles and rating schemes*.

ISO 4628-2, *Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 2 : Designation of degree of blistering*.

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 5 : Designation of degree of flaking*.

3 Principle

Resistance of the coating system to severe chemical attack is assessed by exposing one side of the surface protection system to the testing liquid.

4 Apparatus

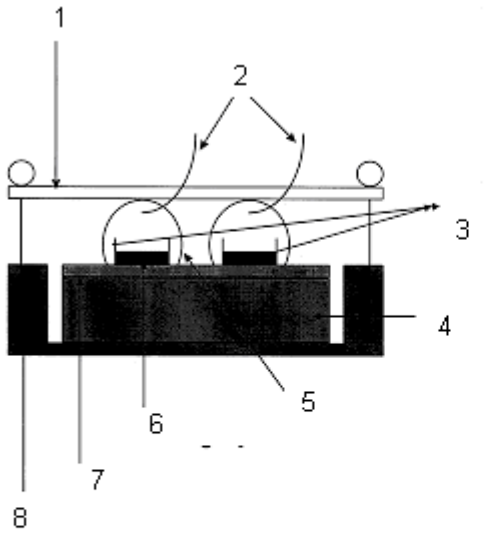
4.1 Laboratory maintained at the temperature of (21 2) °C and the relative humidity of (60 10) %.

4.2 Usual accessories to apply the surface protection system to the basic test pieces.

4.3 Concrete slabs as basic test pieces, according to EN 1766.

4.4 Test apparatus

The test apparatus consists of a metal frame to take up the test piece and to clamp one or two bell-type caisson chambers (see Figure 1) The bell-type caisson chamber consists of a bell-type steel cup with an inner diameter of > 100 mm. (The tested area is a circle with a diameter of 100 mm inside of the glued rings). It is connected to a compressed air vessel equipped with a pressure reducing valve via a compressed air hose. The pressure device is fixed on the surface protection system by a metal clamp. To ensure the tightness of the caisson chamber, a rubber cuff is placed between the surface protection system and the caisson chamber.



Key

1	Fixing plate	5	Caisson chamber
2	Compressed air hose	6	Testing liquid
3	Glued rings	7	Surface Protection System
4	Concrete slab	8	Metal frame

Figure 1 — Test apparatus

5 Sampling

A representative and homogenous sample of the material under test shall be taken as described in EN ISO 15528. The sample shall be examined and prepared as described in EN ISO 1513.

6 Test method

6.1 Test pieces

Test pieces are concrete slabs measuring at least 300 mm x 200 mm x 40 mm and are fabricated in accordance with EN 1766 using a test concrete (C (0.45) with a maximum aggregate size of 8 mm.

Concrete slabs are prepared and stored according to EN 1766. Surface preparation is carried out according to EN 1766 by grit-blasting. After storage, according to EN 1766, the concrete slabs shall be stored for at least 7 days in a climate of (21 2) °C / (60 10) % R. H. before they are coated.

The test pieces are coated, cured and stored in accordance with the manufacturer's instructions. The coating thickness is to be measured in accordance with EN ISO 2808.

NOTE

It is possible to use slabs without any reinforcement.

It is also possible to use slabs with a reinforcement cage according to prEN 1062-7:2002, Informative annex C, C.2.2.3. Then, after a crack-bridging test, the test of resistance against severe chemical attack can follow immediately with the same test pieces.

When the resistance of the coating above the crack in the concrete is to be tested, only one bell-type caisson chamber is used. It is positioned exactly above the notch in the slab.

6.2 Procedure

One or two rings made from non porous material resistant to attack by the testing liquid of approximate dimensions height 20 mm, internal diameter 100 mm, are glued on the coating with a chemically resistant sealant or glue in order to contain the testing liquid. Before the testing liquid is poured in, the initial hardness of the coating is measured (see 6.4). When using two rings, two different testing liquids can be used. The level of the testing liquid shall reach a height of 10 mm. The test can be carried out with or without a pressure of 1 bar. When testing with applied pressure the bell-type caisson chamber is fixed and an air pressure of 1 bar (10^5 Pa) is applied. When testing without pressure, it is necessary to cover the glued ring with a lid to avoid evaporation of the testing liquid.

The test duration depends on the field of application, specified in prEN 1504-2. The duration shall be typically 1, 3, 7, 28 or 90 days.

The standard test temperature shall be (21 2) °C, other test temperatures can be agreed between the interested parties.

6.3 Testing liquids

Testing liquids may be selected from informative annex A or as agreed between the interested parties.

6.4 Evaluation

After being subjected to chemical attack, the testing liquid is removed and the surface is blotted dry using a suitable absorbent or paper cloth and the test pieces are examined in comparison to an unexposed area of the sample for :

- blistering in accordance with ISO 4628-2 ;
- flaking in accordance with ISO 4628-5 ;
- cracking in accordance with ISO 4628-4 ;
- optical changes (e. g. colour, gloss) in accordance with ISO 4628-1 ;
- if it is possible, adhesion or hardness (Buchholz indentation test according to EN ISO 2815 or Shore hardness according to EN ISO 868 appropriate to the type of coating) are measured ;
- penetration of the testing liquid through the coating.

The coating thickness is measured in accordance with EN ISO 2808. The examination is carried out 1 hour and 24 hours after removal of the testing liquid.

7 Test Report

The test report shall contain the following information :

a) reference to this European standard ;

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

f) date of supply of the product ;

g) date of preparation of the test specimens and any deviation from the prescribed method of preparation ;

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

i) dry film thickness in micrometers of the coating and method of measurement in accordance with EN ISO 2808 and whether it is a single or multi-coat system ;

j) full details of the testing liquid to be used for the test ;

k) description of all evaluation results ;

l) details of the test equipment used ;

m) any deviation of the test method specified ;

n) date of the test.

Annex A
(informative)

List of testing liquids

A.1 General

Each group of testing liquids represents a whole class of similar acting substances. For example, group 9 a) is a mixture of 50 vol.-% of acetic acid and 50 vol.-% of propionic acid. When a coating is resistant to this testing liquid, the coating is resistant to all organic acids (except formic acid) and their salts (in an aqueous solution).

Other testing liquids can be agreed between the interested parties (e. g. oxidizing acids, higher concentrations etc.).

Table A.1 — List of testing liquids

	Group	Testing liquid
1.	Petrol	47,5 Vol.-% toluene 30,4 Vol.-% isooctane 17,1 Vol.-% n-heptane 3,0 Vol.-% methanol 2,0 Vol.-% tert.-butanol
2.	Aviation fuel	1. 50,0 Vol.-% isooctane 50,0 Vol.-% toluene 2. Aviation Tasoline 100 LL Nato-code F-18 3. Turbo Fuel A-1 Nato-code F-34/F-35
3.	Heating oil and diesel fuel and unused motor and gear oils	80,0 Vol.-% n-paraffine (C_{12} - C_{18}) 20,0 Vol.-% methylnaphthalene
4.	All hydrocarbons incl. group 2 and 3 except 4 a and 4 b and used motor and gear oils	60,0 Vol.-% toluene 30,0 Vol.-% xylene 10,0 Vol.-% methylnaphthalene
4 a)	Benzene and benzene containing mixtures (incl. 2 – 4 b)	30,0 Vol.-% benzene 30,0 Vol.-% toluene 30,0 Vol.-% xylene 10,0 Vol.-% methylnaphthalene
4 b)	Crude oil	10,0 % by weight iso-octane 10,0 % by weight toluene 20,0 % by weight heating oil 10,0 % by weight 1-methylnaphtaline (min 95 %) 47,7 % by weight heavy fuel oil 0,2 % by weight thiophene (99 %) 0,3 % by weight dibenzyldisulfide 0,5 % by weight dibutyldisulfide (97 %) 1,0 % by weight mixture of naphthenic acids (acid value 230) 0,1 % by weight phenol 0,2 % by weight pyridine mixed with 2 % by weight water
5.	Mono- and polyalcohols (up to 48 Vol.-% methanol), glycol ethers	48,0 Vol.-% methanol 48,0 Vol.-% ispropanol 4,0 Vol.-% water

"*continued*"

Table A.1 (*end)*

	Group	Testing liquid
5 a)	All alcohols and glycol ethers (incl. 5)	methanol
6.	Halogenated hydrocarbons (incl. 6 b)	trichloroethylene
6 a)	All aliphatic halogenated hydrocarbons (incl. 6 and 6 b)	dichloromethane
6 b)	Aromatic halogenated hydrocarbons	monochlorobenzene
7.	All organic esters and ketones (incl. 7 a)	50,0 Vol.-% ethylacetate 50,0 Vol.-% methylisobutylketone
7 a	Aromatic esters and ketones	50,0 Vol.-% salicylic acid methylester 50,0 Vol.-% acetophenone
8.	Aliphatic aldehydes	35 – 40 % solution of formaldehyde
9.	Aqueous solutions of organic acids up to 10 %	10 % aqueous acetic acid
9 a)	Organic acids (except formic acid) and their salts (in aqueous solution)	50,0 Vol.-% acetic acic 50,0 Vol.-% propionic acid
10.	Inorganic acids up to 20 % and acidic hydrolysing salts in aqueous solution (pH < 6) except hydrofluoric acid and oxidizing acids and their salts	sulfuric acid (20 %)
11.	Inorganic bases and their alkaline hydrolysing salts in aqueous solution (pH > 8) except solutions of ammonium and oxidizing solutions of salts (e. g. hypochloride)	sodium hydroxide (20 %)
12.	Solutions of inorganic non-oxidizing salts showing a pH = 6 – 8	aqueous solution of sodium chloride (20 %)
13.	Amines and their salts (in aqueous solution)	35,0 Vol.-% triethanolamine 30,0 Vol.-% n-butylamine 35,0 Vol.-% N, N-dimethylaniline
14.	Aqueous solutions of organic surfactants	1. 3,0 % Protectol KLC 50 2,0 % Marlophen NP 9,5 95,0 % water 2. 3,0 % Texapon N 28 2,0 % Marlipal O 13/80 95,0 % water
15.	Cyclic and acyclic ethers	Tetrahydrofuran (THF)
15 a)	Acyclic ethers	diethyl ether

A.2 Remarks

Group 2 :

The test should be carried out with all testing liquids. Using only one testing liquid, the applicability applies only to this testing liquid.

Groups 9 – 12 :

1. If all tests are passed when testing groups 9 and 9 a), the applicability applies to all concentrations of organic acids in aqueous solution except formiac acid > 10 %.

2. Inorganic acids of group 10 should be tested with the respective testing liquid of the group (Sulfuric acid) and with the highest concentration required (e. g. 40 %). By that, this inorganic acid applies to the tested highest concentration, all other inorganic acids belonging to this group only up to the limit concentration of the testing liquid of this group (20 %).

3. If the tests are passed with the testing liquids of group 10 and 11, the applicability applies to group 12, too.

Group 14 :

The test should be carried out with both testing liquids. For the preparation of the mixture, the following substances should be used :

“Protectol KLC 50” is a product of BASF AG (Ludwigshafen). It is a solution of 50 wt% of Dimethyl-n-($C_{12}/_{14}$-alcyl-benzyl-ammoniumchloride $[(H_3C)_2N((CH_2(n\text{-}CH_3)(CH_2\text{-}C_6H_5)]CL$ (n=11/13) in water.

“MarlophenNP 9,5” is a product of Hüls AG (Marl). It is a liquid, containing 99 wt% of Isononylphenol-Polyglycolether $C_9H_{19}\text{-}C_6H_4\text{-}O(CH_2CH_2O)_nH$ and about 1 wt% of water.

“Texapon N 28” is a product of Henkel KGaA (Düsseldorf). It is a solution of Sodiumlaurylethersulfate $[C_{12}H_{25}\text{-}O\text{-}[(CH_2)_n\text{-}O]_m\text{-}SO_3]Na$ and Sodium chloride in water. The viscosity of “Texapon N 28” is about 2800 mPas.

“Malipal O 13/80” is a product of Hüls AG (Marl). It is a liquid, containing about 99 wt% of fatty alcohol-Polyglycolethers $R\text{-}O(CH_2CH_2O)_nH$ (Mean degree of polymerisation n 8) and a little amount of polymerised ethylenoxide (1 wt%) and traces of water (about 0.2 wt%).

Bibliography

prEN 1062-7:2003, *Paints and varnishes – Coating materials and coating systems for exterior masonry and concrete – Part 7 : Determination of crack bridging properties*.

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