SLOVENSKI STANDARD
SIST EN 1504-3:2006

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Proizvodi in sistemi za zaġļ ito in popravilo betonskih konstrukcij - Definicije, zahteve, kontrola kakovosti in ovrednotenje skladnosti - 3. del: Konstrukcijska in nekonstrukcijska popravila

Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 3: Structural and non-structural repair

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Definitionen, Anforderungen, Qualitätsüberwachung und Beurteilung der Konformität - Teil 3: Statisch und nicht statisch relevante Instandsetzung

Produits et systemes pour la protection et la réparation des structures en béton - Définitions, exigences, maîtrise de la qualité et évaluation de la conformité - Partie 3 : Réparation structurale et réparation non structurale

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Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 3: Structural and non-structural repair

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

Foreword

This European Standard (EN 1504-3:2005) 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of an identical text or by endorsement, at the latest by June 2006, and conflicting national standards shall be withdrawn at the latest by December 2008.

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

This European Standard does not supersede any other European Standard.

European Standard 1504 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Construction Products Directive (89/106/EC). For the relationship between Part 3 and the EU Directive, see compulsory informative Annex ZA, which is an integral part of this document.

This European Standard includes an informative Annex A, dealing with factory production control, informative Annex B, dealing with special applications and an informative Annex C dealing with the release of dangerous substances.

This document is one part of the European Standard on "*Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity*". The other parts are listed below:

— *Part 1: Definitions*

— *Part 2: Surface protection systems for concretes*

— *Part 4: Structural bonding*

— *Part 5: Concrete injection*

— *Part 6: Anchoring of reinforcing steel bar*[1]

— *Part 7: Reinforcement corrosion protection*[1]

— *Part 8: Quality control and evaluation of conformity*

— *Part 9: General principles for use of products and systems*[2]

— *Part 10: Site application of products and systems and quality control of the works*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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[1] To be published.

[2] ENV 1504-9 will be modified when adopted as EN according to finalisation of this European Standard.

1 Scope

This European Standard specifies requirements for the identification, performance (including durability) and safety of products and systems to be used for the structural and non-structural repair of concrete structures.

This European Standard covers repair mortars and concretes, possibly used in conjunction with other products and systems, to restore and/or to replace defective concrete and to protect reinforcement, necessary to extend the service life of a concrete structure exhibiting deterioration. The fields of application covered are in accordance with ENV 1504-9 as follows:

Principle 3	Concrete restoration	Method 3.1	Applying mortar by hand
		Method 3.2	Recasting with concrete
		Method 3.3	Spraying mortar or concrete
Principle 4	Structural strengthening	Method 4.4	Adding mortar or concrete
Principle 7	Preserving or restoring passivity	Method 7.1	Increasing cover to reinforcement with mortar or concrete
		Method 7.2	Replacing contaminated concrete

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 1015-17, *Methods of test for mortars for masonry – Part 17: Determination of water-soluble chloride content of fresh mortars*

EN 1504-1:2005, *Products and systems for the protection and repair of concrete structures – Definitions requirements, quality control and evaluation of conformity – Part 1: Definitions*

EN 1504-8:2004, *Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 8: Quality control and evaluation of conformity*

ENV 1504-9:1997, *Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 9: General principles for use of products and systems*

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*

EN 1767, *Products and systems for the protection and repair of concrete structures – Test methods – Infrared analysis*

EN 1770, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of the coefficient of thermal expansion*

EN 1877-1, *Products and systems for the protection and repair of concrete structures – Test methods – Reactive functions related to epoxy resins – Part 1: Determination of epoxy equivalent*

EN 1877-2, *Products and systems for the protection and repair of concrete structures – Test methods – Reactive functions related to epoxy resins – Part 2: Determination of amine functions using the total basicity number*

EN 12190, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of compressive strength of repair mortar*

EN 12192-1, *Products and systems for the protection and repair of concrete structures – Granulometry analysis - Part 1: Test method for dry components of premixed mortar*

EN 12617-4, *Products and systems for the protection and repair of concrete structures – Test methods – Part 4: Determination of shrinkage and expansion*

EN 13036-4, *Road and airfield surface characteristics – Test methods – Part 4: Method for measurement of slip/skid resistance of a surface – The pendulum test*

EN 13057, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of resistance of capillary absorption*

EN 13294, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of stiffening time*

EN 13295, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of resistance to carbonation*

EN 13395-1, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of workability – Part 1: Test for flow of thixotropic mortars*

EN 13395-2, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of workability – Part 2: Test for flow of grout or mortar*

EN 13395-3, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of workability – Part 3: Test for flow of repair concrete*

EN 13412, *Products and systems for the protection and repair of concrete structures – Test methods – Determination of modulus of elasticity in compression*

EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests*

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

EN ISO 3251, *Paints, varnishes and plastics – Determination of non-volatile matter content (ISO 3251:2003)*

EN ISO 9514, *Paints and varnishes – Determination of the pot life of multicomponent coating systems – Preparation and conditioning of samples and guidelines for testing (ISO 9514:2005)*

EN ISO 11358, *Plastics – Thermogravimetry (TG) of polymers – General principles (ISO 11358:1997)*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1504-1:2005, EN 1504-8:2004 and ENV 1504-9:1997 and the following apply.

3.1
bonding agent
component of a repair system used to promote adhesion of a repair mortar or concrete to a concrete substrate, for the purposes of achieving a permanent bond, which is not affected by moisture and strong alkali in service

3.2
stiffening time
time beyond which the workability of a hydraulic or polymer modified hydraulic cement repair concrete or mortar is lost

3.3
restrained shrinkage/expansion
ability of a repair product or system, when bonded onto a prepared concrete substrate, to accommodate stresses due to volume change

3.4
capillary absorption
ability of the repair product or system to absorb water without application of hydrostatic pressure

3.5
thermal compatibility
property of a repair product or system, when bonded onto a prepared concrete substrate, to accommodate cyclic changes in temperature

3.6
high flow mortar or concrete
repair product formulated to exhibit extremely high flow characteristics, outside the limits of normal methods of test, and which flows through narrow gaps and around areas of congested reinforcement, without bleeding or segregation

4 Performance characteristics for intended uses

Table 1 lists the performance characteristics of structural and non-structural repair products and systems which are required for “all intended uses” or “for certain intended uses” according to the “principles” and "methods” defined in ENV 1504-9.

Performance characteristics which are required for “all intended uses” are marked with ■ .

All other performance characteristics which are marked with □ may be required for “certain intended uses”.

The repair system shall be selected based on an assessment of the actual or potential causes of deterioration and consideration of the appropriate principles and methods for protection and repair specified in ENV 1504-9.

Table 1 — Performance characteristics of structural and non-structural repair products for all intended uses and certain intended uses

Performance characteristics	Repair principle			
	3		4	7
	Repair method			
	3.1, 3.2	3.3 [a]	4.4	7.1, 7.2
Compressive strength	■	■	■	■
Chloride ion content [b]	■	■	■	■
Adhesive bond	■	■	■	■
Restrained shrinkage/expansion [c]	■	■	■	■
Durability a) Carbonation resistance [b d]	■	■	■	■
Durability b) Thermal compatibility Part 1 or Part 2 or Part 4 of EN 13687 [e]	□	□	□	□
Elastic modulus	□	□	■	□
Skid Resistance [f]	□		□	□
Coefficient of thermal expansion [c g]	□	□	□	□
Capillary absorption (water permeability) [e h]	□	□	□	□

Repair methods as defined in ENV 1504-9:1997

3.1 Concrete restoration by applying mortar by hand.

3.2 Concrete restoration by recasting with concrete.

3.3 Concrete restoration by spraying mortar or concrete.

4.4 Structural strengthening by adding mortar or concrete.

7.1 Increasing cover to reinforcement with additional cementitious mortar or concrete.

7.2 Replacing contaminated or carbonated concrete.

■ For all intended uses.

□ For certain intended uses.

[a] Because of the nature of the method of application, some of the test methods may be modified. Refer to EN 14487-1.

[b] This requirement is not relevant for repair of unreinforced concrete.

[c] If thermal cycling is undertaken this test is not required in addition.

[d] Where the repair system includes a surface protection system with proven protection against carbonation (see EN 1504-2) or is a PC mortar this test is not relevant.

[e] Depending on environmental exposure conditions.

[f] Relevant to trafficked areas only.

[g] Relevant to PC only.

[h] Corrosion resistance is addressed by the requirements for the chloride content and water permeability of the product.

5 Requirements

5.1 Identification requirements

The manufacturer shall undertake selected representative initial identification tests for the product or system as specified in Table 2. These tests may be used to confirm the composition of the product at any time. Acceptable tolerances are given in Table 2. The manufacturer shall hold the test records.

Table 2 — Identification requirements

Property	Test method	Tolerances on values declared by manufacturer
Granulometry of dry components	EN 12192-1	Manufacturers declared values and tolerances
Infrared analysis [a]	EN 1767	Confirmed by comparison [b]
Compressive strength	EN 12190	Greater than 80 % of manufacturers declared value
Density	EN 12190	± 5 %
Stiffening time [c]	EN 13294	Manufacturers declared value and tolerances
Workability – thixotropic mortar [d]	EN 13395-1	Manufacturers declared value and tolerances
Workability – flow of mortar [d]	EN 13395-2	Manufacturers declared value and tolerances
Workability – flow of concrete [d]	EN 13395-3	Manufacturers declared value and tolerances
Thermogravimetric analysis [e]	EN ISO 11358	Confirmed by comparison [b]
Epoxide equivalent [e]	EN 1877-1	± 5 %
Amine function [e]	EN 1877-2	± 6 %
Pot life [e]	EN ISO 9514	± 20 %
Volatile/non-volatile matter in liquid components [e]	EN ISO 3251	± 10 %

[a] For all products containing organic materials.

[b] Check for signs of change in composition.

[c] As an alternative method, the change in workability with time by methods EN 13395 Parts 1, 2 and 3 may be used.

[d] Depending on the nature of the material.

[e] For PCs only.

5.2 Performance requirements

The manufacturer shall undertake initial performance tests on repair products in accordance with Table 3 and the product shall comply with the requirements.

Table 3 — Performance requirements for structural and non-structural repair products

Item No.	Performance characteristic	Reference substrate (EN 1766)	Test method	Requirement			
				Structural		Non-Structural	
				Class R4	Class R3	Class R2	Class R1
1	Compressive strength	None	EN 12190	≥ 45 MPa	≥ 25 MPa	≥15 MPa	≥10 MPa
2	Chloride ion Content	None	EN 1015-17	≤ 0,05 %		≤ 0,05 %	
3	Adhesive bond	MC(0,40)	EN 1542	≥ 2,0 MPa	≥ 1,5 MPa	≥ 0,8 MPa [a]	
4	Restrained shrinkage / expansion [b c]	MC(0,40)	EN 12617-4	Bond strength after test [d e]			No requirement
				≥ 2,0 MPa	≥ 1,5 MPa	≥ 0,8 MPa [a]	
5	Carbonation [f] Resistance	None	EN 13295	d_k ≤ control concrete (MC(0,45))		No requirement [g]	
6	Elastic modulus	None	EN 13412	≥20 GPa	≥15 GPa	No requirement	
7	Thermal compatibility [f h] Part 1, Freeze-thaw	MC(0,40)	EN 13687-1	Bond strength after 50 cycles [d e]			Visual inspection after 50 cycles [e]
				≥ 2,0 MPa	≥ 1,5 MPa	≥ 0,8 MPa	
8	Thermal compatibility [f h] Part 2, Thunder shower	MC(0,40)	EN 13687-2	Bond strength after 30 cycles [d e]			Visual inspection after 30 cycles [e]
				≥ 2,0 MPa	≥ 1,5 MPa	≥ 0,8 MPa [a]	
9	Thermal compatibility [f h] Part 4, Dry cycling	MC(0,40)	EN 13687-4	Bond strength after 30 cycles [d e]			Visual inspection after 30 cycles [e]
				≥ 2,0 MPa	≥ 1,5 MPa	≥ 0,8 MPa [a]	
10	Skid resistance	None	EN 13036-4	Class I : > 40 units wet tested Class II : > 40 units dry tested Class III : > 55 units wet tested		Class I : > 40 units wet tested Class II : > 40 units dry tested Class III : > 55 units wet tested	
11	Coefficient of thermal expansion [c]	None	EN 1770	Not required if tests 7, 8 or 9 are carried out, otherwise declared value		Not required if tests 7,8 or 9 are carried out, otherwise declared value	
12	Capillary Absorption	None	EN 13057	≤ 0,5 $kg \cdot m^{-2} \cdot h^{-0,5}$		≤ 0,5 $kg \cdot m^{-2} \cdot h^{-0,5}$	No requirement

Requirements for Repair Principles 3, 4 and 7:
Method 3.1 - Concrete restoration by applying mortar by hand.
Method 3.2 - Concrete restoration by recasting with concrete.
Method 3.3 - Concrete restoration by spraying mortar or concrete.
Method 4.4 - Structural strengthening by adding mortar or concrete.
Method 7.1 - Increasing cover to reinforcement with additional cementitious mortar or concrete.
Method 7.2 - Replacing contaminated or carbonated concrete.

[a] The value of 0,8 MPa is not required where cohesive failure occurs in the repair material. If cohesive failure occurs a minimum tensile strength of 0,5 MPa is required.

[b] Not required for Repair Method 3.3.

[c] Not required if thermal cycling is undertaken.

[d] Mean value with no single value less than 75 % of the minimum requirement.

[e] Maximum permissible average crack width ≤ 0,05 mm with no crack ≥ 0,1 mm and no delamination.

[f] For durability.

[g] Not suitable for protection against carbonation unless the repair system includes a surface protection system with proven protection against carbonation (see EN 1504-2).

[h] Choice of method depends on the exposure conditions. When a product satisfies Part 1 it is deemed to satisfy Part 2 and Part 4.