



SLOVENSKI STANDARD
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Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 4: Structural bonding

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Definitionen, Anforderungen, Qualitätsüberwachung und Beurteilung der Konformität - Teil 4: Kleber für Bauzwecke (standards.iteh.ai)

Produits et systemes pour la protection et la réparation de structures en béton - Définitions, prescriptions, maîtrise de la qualité et évaluation de la conformité - Partie 4: Collage structural

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English version

Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 4: Structural bonding

Produits et systèmes pour la protection et la réparation de structures en béton - Définitions, prescriptions, maîtrise de la qualité et évaluation de la conformité - Partie 4: Collage structural

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This European Standard was approved by CEN on 23 April 2004.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 1504-4:2004) has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

It has been developed 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of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by August 2006.

This Part 4 of EN 1504 does not supersede any other document.

This document 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 relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This Part 4 of EN 1504 includes an Informative Annex A dealing with special applications and an Informative Annex B dealing with release of dangerous substances.

This Part of this European Standard is one of the Parts of this Standard on products and systems for the repair and protection of concrete structures, the other Parts are listed below:

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

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 for concrete*

prEN 1504-3, *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*

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

prEN 1504-6, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 6: Anchoring of reinforcing steel bar*

prEN 1504-7, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 7: Reinforcement corrosion protection*

EN 1504-8 *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:, *Products and systems for the protection and repair of concrete structures - Definitions, Requirements, Quality control and evaluation of conformity - Part 9: General principles for the use of products and systems*

EN 1504-10, *Products and systems for the protection and repair of concrete structures - Definitions, Requirements, Quality control and evaluation of conformity - Part 10: Site application of products and systems and quality control of the works*

EN 1504-4:2004 (E)

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 Scope

This Part 4 of EN 1504 specifies requirements for the identification, performance (including durability) and safety of structural bonding products and systems to be used for the structural bonding of strengthening materials to an existing concrete structure, including:

- 1) The bonding of external plates of steel or other suitable materials (e.g. fibre reinforced composites) to the surface of a concrete structure for strengthening purposes, including the laminating of plates in such applications.
- 2) The bonding of hardened concrete to hardened concrete, typically associated with the use of precast units in repair and strengthening.
- 3) The casting of fresh concrete to hardened concrete using an adhesive bonded joint where it forms a part of the structure and is required to act compositely.

The performance requirements in this Part of this Standard may not be applicable to highly specialised applications in extreme environmental conditions, e.g. cryogenic use, nor do they cover specialised circumstances such as accidental impact, e.g. due to traffic or ice, or earthquake loading where specific performance requirements will apply.

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, *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, *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, *Products and systems for the protection and repair of concrete structures - Definitions, Requirements, Quality control and evaluation of conformity - Part 9: General principles for the use of products and systems*

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 1799, *Products and systems for the protection and repair of concrete structures - Test methods - Tests to measure the suitability of structural bonding agents for application to concrete surface*

EN 12188, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of adhesion steel-to-steel for characterisation of structural bonding agents*

EN 12189, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of open time*

EN 1504-4:2004 (E)

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

EN 12192-2, *Products and systems for the protection and repair of concrete structures - Granulometry analysis - Part 2: Test method for fillers for polymer bonding agents*

EN 12614, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of glass transition temperatures of polymers*

EN 12615, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of slant shear strength*

EN 12617-1, *Products and systems for the protection and repair of concrete structures - Test methods - Part 1: Determination of linear shrinkage for polymers and surface protection systems (SPS)*

EN 12617-3, *Products and systems for the protection and repair of concrete structures - Test methods - Part 3: Determination of early age linear shrinkage for structural bonding agents*

EN 12618-2, *Products and systems for the protection and repair of concrete structures - Test methods - Part 2: Determination of the adhesion of injection products, with or without thermal cycling - Adhesion by tensile bond strength*

EN 12636, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of adhesion concrete to 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 13733, *Products and systems for the protection and repair of concrete structures - Tests methods - Determination of the durability of structural bonding agents*

EN ISO 178, *Plastics - Determination of flexural properties (ISO 178:2001)*

EN ISO 3451-1, *Plastics - Determination of ash - Part 1: General methods (ISO 3451-1:1997)*

EN ISO 9514, *Paints and varnishes - Determination of the pot-life of liquid systems - Preparation and conditioning of samples and guidelines for testing (ISO 9514:1992)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1504-1, EN 1504-8 and ENV 1504-9 and the following apply.

3.1 structural bonding products and systems

products and systems applied to concrete to provide a durable structural bond to additional applied material

3.2 polymer mortars and polymer concretes (PC)

blended mixtures of polymer binder and graded aggregates which set by polymer reaction

3.3

open time

the maximum time interval between the completion of mixing of the bonding agent to closing of the joint at which the bond strength requirement defined in this document can be met

3.4

pot life for structural bonding products

the period of time taken by the mixed bonding agent to reach a specified temperature in the mixing container

NOTE Pot life is an identification test carried out under standard laboratory conditions.

3.5

workable life for structural bonding products

the period of time the mixed bonding agent remains workable in the batch quantities used and at the limit of conditions that the material is fit for the purpose of use

4 Performance characteristics for intended uses

Table 1 lists the performance characteristics of structural bonding 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”.

Performance requirements are given in 5.2.

The properties of the bonding may be adversely affected by fire and therefore appropriate protection measures will need to be taken where fire is anticipated.

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Table 1 — Performance characteristics for all and certain intended uses

Performance characteristic	Principle of repair 4 Structural strengthening (Note 7)	
	Repair method 4.3 Bonded plate reinforcement (Note 1)	Repair method 4.4 Bonded mortar or concrete (Note 2)
1. Suitability for application:		
a) to vertical surfaces & soffits	<input type="checkbox"/>	<input type="checkbox"/>
b) to top horizontal surfaces.....	<input type="checkbox"/>	<input type="checkbox"/>
c) by injection.....	<input type="checkbox"/>	<input type="checkbox"/>
2. Suitability for application and curing under the following special environmental conditions:		
a) low or high temperature (Note 3).....	<input type="checkbox"/>	<input type="checkbox"/>
b) wet substrate		■
3. Adhesion:		
a) plate to plate	■	
b) plate to concrete	■	
c) corrosion protected steel to corrosion protected steel (Note 4)	<input type="checkbox"/>	
d) corrosion protected steel to concrete (Note 4).....	<input type="checkbox"/>	
e) hardened concrete to hardened concrete.....		■
f) fresh concrete to hardened concrete (Note 5).....		■
4. Durability of composite system:		
a) thermal cycling.....	■	■
b) moisture cycling.....	■	■
5. Material characteristics for the designer:		
a) open time (note 5) (note 6)	■	■
b) workable life (note 6)	■	■
c) modulus of elasticity in compression	■	■
d) modulus of elasticity in flexure.....	<input type="checkbox"/>	<input type="checkbox"/>
e) compressive strength.....	■	■
f) shear strength.....	■	■
g) glass transition temperature	■	■
h) coefficient of thermal expansion	■	■
i) shrinkage	■	■

Notes

- Repair method 4.3 is in accordance with ENV 1504-9. The bonding of external plates to the surface of a concrete structure for strengthening purposes, and the laminating of plates in such applications. An acceptable bond is unlikely to be achieved with stainless steel.
- Repair method 4.4 is in accordance with ENV 1504-9. The bonding of hardened concrete to hardened concrete, typically associated with the use of precast units or the bonding of fresh concrete to hardened concrete where it forms a significant part of the structure and is required to act compositely.
- Temperatures may be specified by the producer for the intended use.
- In this context corrosion protection implies the application of a corrosion inhibiting priming coat to mild steel.
- Not applicable to injection techniques.
- At minimum, standard and maximum application temperatures.

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

Item No	Property	Test Method	Requirement/Tolerance
1	Colour	Visual	Uniform and similar to the description provided by the manufacturer.
2	Granulometry size grading of fillers for polymer bonding agents.	EN 12192-2	Declared value $\pm 5\%$
3	Ash content by direct calcination	EN ISO 3451-1	Declared value $\pm 5\%$ or ± 1 percentage point of the total product, whichever is the greater.
4	Thermogravimetry of polymers: temperature scanning method.	EN ISO 11358	Declared value $\pm 5\%$ or ± 1 percentage point of the total product, whichever is the greater.
5	Infrared analysis of the resin and hardener	EN 1767	The positions and relative intensities of the main absorption bands shall match those of the reference spectrum.
6	Pot life	EN ISO 9514	Declared value $\pm 20\%$
7	Compressive strength	EN 12190	Declared value $\pm 20\%$

5.2 Performance requirements

The manufacturer shall undertake initial performance tests on the product in accordance with Table 3.1 (bonding agents for bonded plate reinforcement) or Table 3.2 (bonding agents for bonded mortar or concrete) and the product shall comply with the requirements.

Table 3.1 — Performance requirements of bonding agent for bonded plate reinforcement

Item No	Performance Characteristic	Reference concrete or mortar	Test Method	Requirements (See Note)								
1	Modulus of elasticity in flexure	—	EN ISO 178	$\geq 2\,000\text{ N/mm}^2$								
2	Shear strength	—	EN 12188	$\geq 12\text{ N/mm}^2$								
3	Open time	EN1766 MC(0.40)	EN 12189	Declared value $\pm 20\%$								
4	Workable life	—	EN ISO 9514	Declared value. Informative Note The workable life is dependent upon the batch quantity and ambient conditions. Users should note that the workable life will usually be less than the pot life.								
5	Modulus of elasticity in compression	—	EN 13412	$\geq 2\,000\text{ N/mm}^2$								
6	Glass transition temperature	—	EN 12614	$\geq 40\text{ C}$								
7	Coefficient of thermal expansion	—	EN 1770	$\leq 100 \times 10^{-6}$ per K								
8a	Total shrinkage for structural bonding agents	—	EN 12617-1	$\leq 0,1\%$								
8b	Total shrinkage for structural bonding agents (alternative test method)	—	EN 12617-3	$\leq 0,1\%$								
9	Suitability for application to vertical surfaces and soffits	—	EN 1799	The material shall not sag flow by more than 1 mm when spread in thicknesses less than 3 mm.								
10	Suitability for application to horizontal surfaces	—	EN 1799	The surface area of the bonding agent at the end of the squeezability test shall not be less than $3\,000\text{ mm}^2$ (60 mm diameter).								
11	Suitability for injection	EN 1766 MC(0.40)	EN 12618-2	For the test performed in the dry, failure shall occur in the concrete.								
12	Suitability for application and curing under special environmental conditions	—	EN 12188 NOTE The test method may need to be performed under environmental conditions other than those specified in EN 12188.	The slant shear strength of scarf-jointed prisms tested in compression at various angles θ shall not be less than the values $\sigma_0\text{ N/mm}^2$ tabulated below. <table border="1"> <thead> <tr> <th>θ</th> <th>$\sigma_0\text{ (N/mm}^2\text{)}$</th> </tr> </thead> <tbody> <tr> <td>50°</td> <td>50</td> </tr> <tr> <td>60°</td> <td>60</td> </tr> <tr> <td>70°</td> <td>70</td> </tr> </tbody> </table>	θ	$\sigma_0\text{ (N/mm}^2\text{)}$	50°	50	60°	60	70°	70
θ	$\sigma_0\text{ (N/mm}^2\text{)}$											
50°	50											
60°	60											
70°	70											