

Products and systems for the protection and repair of concrete structures — Definitions, requirements, quality control and evaluation of conformity —

Part 4: Structural bonding

The European Standard EN 1504-4:2004 has the status of a British Standard

ICS 91.080.40

National foreword

This British Standard is the official English language version of EN 1504-4:2004. EN 1504-4 is a candidate “harmonized” European Standard and fully takes into account the requirements of the European Commission mandate M/128, *Products related to concrete, mortar and grout*, given under the EU Construction Products Directive (89/106/EEC), and is intended to lead to CE marking. The date of applicability of EN 1504-4:2004 as a “harmonized” European Standard, i.e. the date after which this standard may be used for CE marking purposes, is subject to an announcement in the *Official Journal of the European Communities*.

The Commission in consultation with Member States has agreed a transition period for the co-existence of “harmonized” European Standards and their corresponding national standard(s). It is intended that this period will comprise a period, usually nine months, after the date of availability of the European Standard, during which any required changes to national regulations are to be made, followed by a further period, usually of 12 months, for the implementation of CE marking. At the end of this co-existence period, the national standard(s) will be withdrawn.

EN 1504-4:2004 is the subject of transitional arrangements agreed under the Commission mandate. In the UK, there are no corresponding national standards of national origin. 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;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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

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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*

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.

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 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 EN 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.

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	☐	☐
b) to top horizontal surfaces	☐	☐
c) by injection	☐	☐
2. Suitability for application and curing under the following special environmental conditions:		
a) low or high temperature (Note 3)	☐	☐
b) wet substrate		■
3. Adhesion:		
a) plate to plate	■	
b) plate to concrete	■	
c) corrosion protected steel to corrosion protected steel (Note 4)	☐	
d) corrosion protected steel to concrete (Note 4)	☐	
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	☐	☐
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.