

SLOVENSKI STANDARD

SIST EN 1504-5:2005

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Določeni so pogoji za zaščito in popravilo betonskih konstrukcij - Definicije, zahtevane lastnosti, nadzor kakovosti in ocenjevanje skladnosti - Del 5: Betoniranje

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

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Definitionen, Anforderungen, Qualitätsüberwachung und Beurteilung der Konformität - Teil 5: Injektion von Betonbauteilen

Produits et systemes pour la protection et la réparation des structures en béton - Définitions, prescriptions, maîtrise de la qualité et évaluation de la conformité - Partie 5 : Produits et systemes d'injection du béton

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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 5: Concrete injection

Produits et systèmes pour la protection et la réparation des
structures en béton - Définitions, exigences, maîtrise de la
qualité et évaluation de la conformité - Partie 5 : Produits et
systèmes d'injection du béton

Produkte und Systeme für den Schutz und die
Instandsetzung von Betontragwerken - Definitionen,
Anforderungen, Qualitätsüberwachung und Beurteilung der
Konformität - Teil 5: Injektion von Betonbauteilen

This European Standard was approved by CEN on 9 July 2004.

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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 1504-5:2004) 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of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by December 2008.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", the secretariat of which is held by AFNOR.

This part 5 of 1504 does not supersede any other European Standard.

This part 5 of EN 1504 includes a normative Annex A dealing with classification, an informative Annex B dealing with special applications, an informative Annex C dealing with release of dangerous substances, and an informative Annex D dealing with Factory Production Control on products.

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 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.*

EN 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.*

EN 1504-3¹⁾, *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.*

EN 1504-4, *Products and systems for the protection and repair of concrete structures — Definitions, requirements, quality control and evaluation of conformity — Part 4: Structural bonding.*

EN 1504-6¹⁾, *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.*

EN 1504-7¹⁾, *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 1504-9²⁾, *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.*

¹⁾ To be published.

²⁾ ENV 1504-9 will have to be modified when adopted as EN to reflect the published texts of parts 2 to 8 and part 10.

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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Introduction

Concrete injection is used as a method for the following principles defined in ENV 1504-9:

- principle 1 [IP]: Protection against ingress and waterproofing;

Filling cracks (method 1.4).

- principle 4 [SS]: Structural strengthening;

Injecting cracks, voids or interstices (method 4.5).

Filling cracks, voids or interstices (method 4.6).

Injection is used to avoid the harmful consequences of voids and cracks in concrete:

- to achieve impermeability and hence watertightness;
- to avoid penetration of aggressive agents that might induce corrosion of steel reinforcement;
- to strengthen the structure by strengthening the concrete

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1 Scope

This part of this document specifies requirements and conformity criteria for the identification, performance (including durability aspects) and safety of injection products for the repair and protection of concrete structures, used for:

- force transmitting filling of cracks, voids and interstices in concrete (category F, see 3.1);
- ductile filling of cracks, voids and interstices in concrete (category D, see 3.1);
- swelling fitted filling of cracks, voids and interstices in concrete (category S, see 3.1).

The performance requirements in this part of this document 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.

This part of this document does not cover:

- the treatment of cracks by widening them and sealing them with an elastomeric sealing compound;
- external filling of cavities, that is the placement of product outside the structure (generally within the surrounding foundation soils, or at the interface between the structure and the soil). This is covered by EN 12715, under contact grouting [1];
- preliminary injection works, if necessary, to temporarily stop water passage during waterproofing injection.

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 196-3, *Methods of testing cement — Part 3: Determination of setting time and soundness.*

EN 196-21, *Methods of testing cement — Part 21: Determination of the chloride, carbon dioxide and alkali content of cement.*

EN 445, *Grout for prestressing tendons — Test methods.*

EN 1240, *Adhesives — Determination of hydroxyl value and/or hydroxyl content.*

EN 1242, *Adhesives — Determination of isocyanate content.*

EN 1504-1:1998, *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 the use of products and systems.*

EN 1543, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of tensile strength development for polymers.*

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

EN 1771, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of injectability using the sand column test.*

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

EN 12617-2, *Products and systems for the protection and repair of concrete structures — Test methods — Part 2: Shrinkage of crack injection products based on polymer binder: volumetric shrinkage.*

EN 12618-1, *Products and systems for the protection and repair of concrete structures — Test methods — Part 1: Adhesion and elongation capacity of injection products with limited ductility.*

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 12618-3, *Products and systems for the protection and repair of concrete structures — Test methods — Part 3: Determination of the adhesion of injection products, with or without thermal cycling — Slant shear method.*

EN 12637-1, *Products and systems for the protection and repair of concrete structures — Test methods — Compatibility of injection products — Part 1: Compatibility with concrete.*

EN 12637-3, *Products and systems for the protection and repair of concrete structures — Test methods — Compatibility of injection products — Part 3: Effect of injection products on elastomers.*

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 14068, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of watertightness of injected cracks without movement in concrete.*

EN 14117, *Products systems for the protection and repair of concrete structures - Test methods - Determination of time of efflux of cementitious injection products.*

EN 14406, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of the expansion ratio and expansion evolution.*

EN 14497, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of the filtration stability.*

EN 14498, *Products and systems for the protection and repair of concrete structures — Test methods — Volume and weight changes of injection products after air drying and water storage cycles.*

EN ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1:1993, including Corrigendum 1:1994).*

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993, including Corrigendum 1:1994).*

EN ISO 2811-1, *Paints and varnishes — Determination of density — Part 1: Pyknometer method (ISO 2811-1:1997)*.

EN ISO 2811-2, *Paints and varnishes — Determination of density — Part 2: Immersed body (plummet) method (ISO 2811-2:1997)*.

EN ISO 3219, *Plastics — Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscosimeter with defined shear rate (ISO 3219:1993)*.

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 liquid systems — Preparation and conditioning of samples and guidelines for testing (ISO 9514:1992)*.

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization*.

ISO 13320-1, *Particle size analysis — Laser diffraction methods — Part 1: General principles*.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1504-1:1998, EN 1504-8:2004, ENV 1504-9:1997 and the following apply.

3.1 injection products

injection products as defined in 3.2.5 of EN 1504-1:1998 can be classified in three categories, according to the intended use

3.1.1 injection products for force transmitting filling of cracks, voids and interstices in concrete (F)

products able to bond to the concrete surface and transmit forces across them

NOTE Products for injection for force transmitting filling of cracks, voids and interstices can also be used for saturation without receiving a force transmitting bond.

Unless otherwise stated, injection products are intended for filling of cracks, voids and interstices, so that in the following, only the wording injection products for filling of cracks is used

3.1.2 injection products for ductile filling of cracks, voids and interstices in concrete (D)

flexible products which are able to accommodate subsequent movement

3.1.3 injection products for swelling fitted filling of cracks, voids and interstices in concrete (S)

products which are able, in the reacted state, to swell repeatedly by water adsorption, where the water molecules are bonded to the molecules of the injection product

NOTE This category of products, referred to as gels, are only used for waterproofing purposes for cracks and voids in damp, wet and water - flow conditions.

3.2 injection product formulated with reactive polymer binder (P)

product where the hardening is related to the curing of a reactive polymer binder. The reactive part of a polymer binder involved in the hardening of the binder is the functional group

3.3 injection product formulated with hydraulic binder (H)

product where the hardening is related to the hydration reaction of an hydraulic binder

3.4**pot life for injection products**

period of time taken by the freshly mixed product to:

- increase in temperature by 15 °C, for injection products formulated with reactive polymer binder (or the maximum temperature increase if less than 15 °C); or
- to reach a recorded lowering of the filtration stability for injection products formulated with hydraulic binder

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

3.5**workable time for injection products**

period of time the mixed injection product remains workable in the batch quantities used and at the limit of conditions that the product is fit for the purpose of use. The workable life is assessed by the determination of the pot life, and is equivalent to 70 % of the pot life, if no other recommendations are given by the manufacturer

NOTE The workable life depends on temperature, humidity, volume of mixed product (A+B), reactivity of the product, technology of injection. Reactivity of the product and volume of mixed product should be chosen according to those various parameters and to the anticipated time necessary to inject the concrete structure.

3.6**crack width**

width of the crack measured on the surface of the concrete

3.7**injectability**

ability of an injection product to penetrate in a crack. The injectability is given by the minimum crack width in millimetres into which the product is injectable.

Following crack widths are considered: 0,1 mm | 0,2 mm | 0,3 mm | 0,5 mm | 0,8 mm

NOTE The injectability is declared by the manufacturer, and tested with the injectability test(s) (see Clause 4).

3.8**moisture state of the crack**

water content in the crack or flowing from the crack

The following conditions are considered: dry | damp | wet | water flowing.

Dry: no water in the crack or on the crack flanks; migration of water in the crack is excluded during injection and hardening of injection product.

NOTE A dry crack is indicated if the colour of the crack and dry surface concrete is the same.

Damp: no water in the crack, water on the crack flanks, however without a water layer on the surface of the flanks.

NOTE A difference of colour between the crack surface and the dry surface concrete gives evidence of a damp crack.

Wet: standing water in the crack.

NOTE The presence of water drops on the crack surface is characteristic of a wet crack.

Water flowing: flowing water through the crack.

NOTE The manufacturer should indicate the moisture state or states with which the product is compatible, based on the results of the injectability and other relevant performance tests specified in Clause 4.

3.9

crack movement

change of crack width as a function of time and induced by:

- mechanical influences (e.g. by traffic);
- by physical influences, which can be daily (for example due to exposure to the sun) or seasonally.

NOTE 1 Traffic induced crack movements of 10 µm to 15 µm during cure do not influence the adhesion of injection products formulated with reactive polymer binder.

NOTE 2 Gels should not be used for cracks submitted to daily movements unless also injected in excess outside the structure.

NOTE 3 Injection products formulated with hydraulic binder should not be used for the injection of cracks submitted to high frequency changes during hardening. The products should normally not be used for injection of cracks submitted to daily changes during hardening, unless it can be proved that the adhesion on concrete will be higher than 2 N/mm² within 10 h at the minimum use temperature.

4 Performance characteristics in relation to the general principles of protection and repair

Tables 1.a, 1.b and 1.c list the performance characteristics of concrete injection products 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 performance characteristics of products are classified as follows:

- basic characteristics, related to adhesion, shrinkage, compatibility with steel and concrete, glass transition temperature, watertightness essential for the intended use;
- workability characteristics, related to the work conditions which the product can be used for (width, moisture state of the crack); these characteristics are declared by the manufacturer, and tested accordingly;
- reactivity characteristics, related to the workable life and the development of strength;
- durability, related to the long term behaviour of the hardened product under climatic conditions.

NOTE Workability and reactivity characteristics are product characteristics for the designer and contractor.

The performance characteristics of injection products used in relation to Principle 1 [IP]: Protection against ingress and waterproofing - Filling cracks (method 1.4 as described in ENV 1504-9:1997) are listed in the following tables:

- Table 1.a: "Injection products for force transmitting filling of cracks – performance characteristics" when category F products are used for these purpose;
- Table 1.b: "Injection products for ductile filling of cracks - performance characteristics" when category D products are used for these purpose;
- Table 1.c: "Injection products for swelling fitted filling of cracks - performance characteristics" when category S products are used for these purpose.

Only products formulated with reactive polymer binder can be considered for category D and category S injection.

The performance characteristics of injection products used in relation to Principle 4 [SS]: Structural Strengthening – Injecting cracks, voids and interstices (method 4.5 as described in ENV 1504-9:1997) and Filling cracks, voids or interstices (method 4.6) are listed in Table 1.a: "Injection products for force transmitting filling of cracks - performance characteristics".