



# SLOVENSKI STANDARD

## SIST EN 1504-5:2013

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Nadomešča:  
SIST EN 1504-5:2005

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**Proizvodi in sistemi za zaščito in popravilo betonskih konstrukcij - Definicije, zahteve, kontrola kakovosti in vrednotenje skladnosti - 5. del: Injektiranje betona**

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 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

**Ta slovenski standard je istoveten z: EN 1504-5:2013**

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**ICS:**

91.080.40      Betonske konstrukcije      Concrete structures

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 1504-5**

April 2013

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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

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This European Standard was approved by CEN on 20 January 2013.

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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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## Foreword

This document (EN 1504-5:2013) 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 October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1504-5:2004.

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 Directive(s).

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

Compared with the previous version, the following changes have been made:

- a) changes in Table 1, Table 2, Table 4, Table 6, Table 7 and Table 8;
- b) modification of Annexes A, B, C and ZA;
- c) revision of normative references;
- d) renumbering of the tables.

EN 1504 consists of the following parts, under the general title *Products and systems for the protection and repair of concrete structures — Definitions, requirements, quality control and evaluation of conformity*:

- *Part 1: Definitions*;
- *Part 2: Surface protection systems for concrete*;
- *Part 3: Structural and non-structural repair*;
- *Part 4: Structural bonding*;
- *Part 5: Concrete injection*;
- *Part 6: Anchoring of reinforcing steel bar*;
- *Part 7: Reinforcement corrosion protection*;
- *Part 8: Quality control and evaluation of conformity*;
- *Part 9: General principles for the use of products and systems*;
- *Part 10: Site application of products and systems and quality control of the works*.

Part 5 of EN 1504 includes a normative Annex A dealing with classification, an informative Annex B dealing with special applications and an informative Annex C dealing with Factory Production Control on products.

**EN 1504-5:2013 (E)**

It has been developed by Subcommittee 8 “Products and systems for the protection and repair of concrete structures”, the secretariat of which is held by AFNOR.

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

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## Introduction

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

- principle 1 [IP]: Protection against ingress and waterproofing;
- Filling cracks (method 1.5);
- principle 4 [SS]: Structural strengthening;
- Injecting cracks, voids or interstices (method 4.5);
- Filling cracks, voids or interstices (pressureless) (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 agents that might induce corrosion of steel reinforcement;
- to strengthen the structure by strengthening the concrete.

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**EN 1504-5:2013 (E)****1 Scope**

This European Standard 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 European Standard 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 [2], under contact grouting;
- preliminary injection works, if necessary, to temporarily stop water passage during waterproofing injection.

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**2 Normative references**

SIST EN 1504-5:2013

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 times and soundness*

EN 196-2, *Methods of testing cement — Part 2: Chemical analysis 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 1504-1:2005, *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*

EN 1504-9:2008, *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 and splitting 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 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 12618-2:2004, *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 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 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)*

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

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

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

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

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

**EN 1504-5:2013 (E)**

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)*

ISO 13320, *Particle size analysis — Laser diffraction methods*

**3 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 1504-1:2005, EN 1504-8:2004, EN 1504-9:2008 and the following apply.

**3.1 injection products and systems**  
products and systems which, when injected into a concrete structure, restore the structural integrity and/or durability

[SOURCE: EN 1504-1:2005, 3.2.2]

Note 1 to entry: Injection products can be classified in three categories, according to the intended use.

**3.1.1 injection product for force transmitting filling of cracks, voids and interstices in concrete**  
(F)  
product able to bond to the concrete surface and transmit forces across it

Note 1 to entry: Products for injection for force transmitting filling of cracks, voids and interstices can also be used for saturation without receiving a force transmitting bond.

Note 2 to entry: 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 product for ductile filling of cracks, voids and interstices in concrete**  
(D)  
flexible product which is able to accommodate subsequent movement

**3.1.3 injection product for swelling fitted filling of cracks, voids and interstices in concrete**  
(S)  
product which is 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 1 to entry: 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 viscosity of 1 000 mPa·s
- to reach a recorded lowering of the filtration stability for injection products formulated with hydraulic binder

Note 1 to entry: Pot life is an identification test carried out under standard laboratory conditions.

Note 2 to entry: Test sample: 1 000 ml.

### 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

Note 1 to entry: The workable time is given by the manufacturer.

Note 2 to entry: The workable time 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 are best 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 not mechanical treated surface of the concrete

### 3.7

#### **injectability**

ability of an injection product to penetrate in a crack, which is given by the minimum crack width into which the product is injectable

Note 1 to entry: Following crack widths are considered: 0,1 mm | 0,2 mm | 0,3 mm | 0,5 mm | 0,8 mm.

Note 2 to entry: Crack width is expressed in millimetres.

Note 3 to entry: The injectability is declared by the manufacturer, and tested with the injectability test(s) (see Clause 4).

### 3.8

#### **moisture state of the crack, voids or interstices**

water content in the crack or flowing from the crack

Note 1 to entry: The following conditions are considered: dry, damp, wet, flowing water.

#### **3.8.1**

##### **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 1 to entry: A dry crack is indicated if the colour of the crack and dry surface concrete is the same.

#### **3.8.2**

##### **damp**

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

Note 1 to entry: A difference of colour between the crack surface and the dry surface concrete gives evidence of a damp crack.

**EN 1504-5:2013 (E)****3.8.3****wet**

standing water in the crack

Note 1 to entry: The presence of water drops on the crack surface is characteristic of a wet crack.

**3.8.4****flowing water**

water that flows through the crack, voids or interstices

Note 1 to entry: The manufacturer will 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 actions on structures

Note 1 to entry: Actions on structures are induced by:

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

Note 2 to entry: Traffic induced crack movements of 10  $\mu\text{m}$  to 15  $\mu\text{m}$  during cure do not influence the adhesion of injection products formulated with reactive polymer binder.

Note 3 to entry: Gels will not be used for cracks submitted to daily movements unless also injected in excess outside the structure.

Note 4 to entry: Injection products formulated with hydraulic binder will not be used for the injection of cracks submitted to high frequency changes during hardening. These products are normally not 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/mm<sup>2</sup> within 10 h at the minimum use temperature.

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

Tables 1, 2 and 3 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 EN 1504-9. Performance characteristics which are required for “all intended uses” are marked with  $\blacksquare$ . All other performance characteristics which are marked with  $\square$  may be required for “certain intended uses”. See Annex B for special applications.

The performance characteristics of products are classified as follows:

- basic characteristics, compressive strength, strength related to adhesion, volume change (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 time 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 1.5 as described in EN 1504-9:2008) are listed in the following tables:

- Table 1: “Injection products for force transmitting filling of cracks (F) — Performance characteristics” when category F products are used for these purpose;
- Table 2: “Injection products for ductile filling of cracks (D) — Performance characteristics” when category D products are used for these purpose;
- Table 3: “Injection products for swelling fitted filling of cracks (S) — 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 EN 1504-9:2008) and *Filling cracks, voids or interstices* (method 4.6) are listed in Table 1: “Injection products for force transmitting filling of cracks (F) — Performance characteristics”.

Corrosion behaviour of injection products formulated with hydraulic binder is assessed by measuring chloride content. Injection products formulated with reactive polymer binder for category F and category D injection are deemed to have no corrosive effect on reinforcement.

The certain intended uses are subject to specific conditions on the works:

- a) glass transition temperature shall be considered if the temperature of the hardened product in the crack can be:
  - 1) higher than 21 °C (temperature conditions by measuring adhesion strengths) for category F products formulated with reactive polymer binder;
  - 2) lower than 3 °C (temperature conditions by measuring elongation ability) for category D products;
- b) chloride content and corrosion behaviour shall be considered by injection of reinforced concrete;
- c) watertightness shall be considered for waterproofing injection.

The injectability test (into dry or non-dry medium) is performed at the minimum crack width declared by the manufacturer and the least favourable moisture state of the crack declared by the manufacturer for the tested product.

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.