



**SLOVENSKI STANDARD**  
**kSIST FprEN 14944-3:2023**  
**01-julij-2023**

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**Vpliv cementnih proizvodov na pitno vodo - Preskusne metode - 3. del: Prehod snovi iz cementnih, tovarniško izdelanih proizvodov**

Influence of cementitious products on water intended for human consumption - Test methods - Part 3: Migration of substances from factory-made cementitious products

Einfluss von zementgebundenen Produkten auf Wasser für den menschlichen Gebrauch– Prüfverfahren– Teil3: Migration von Substanzen aus fabrikmäßig hergestellten zementgebundenen Produkten

Influence des produits à base de ciment sur l'eau destinée à la consommation humaine - Méthodes d'essais - Partie 3 : Migration de substances à partir des produits à base de ciment fabriqués en usine

**Ta slovenski standard je istoveten z: FprEN 14944-3**

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**ICS:**

13.060.20	Pitna voda	Drinking water
67.250	Materiali in predmeti v stiku z živili	Materials and articles in contact with foodstuffs
91.100.10	Cement. Mavec. Apno. Malta	Cement. Gypsum. Lime. Mortar

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**FINAL DRAFT**  
**FprEN 14944-3**

May 2023

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Will supersede EN 14944-3:2007

English Version

## Influence of cementitious products on water intended for human consumption - Test methods - Part 3: Migration of substances from factory-made cementitious products

Influence des produits à base de ciment sur l'eau destinée à la consommation humaine - Méthodes d'essais - Partie 3 : Migration de substances à partir des produits à base de ciment fabriqués en usine

Einfluss von zementgebundenen Produkten auf Wasser für den menschlichen Gebrauch- Prüfverfahren- Teil3: Migration von Substanzen aus fabrikmäßig hergestellten zementgebundenen Produkten

This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 164.

If this draft becomes a European Standard, 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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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## iTeh STANDARD PREVIEW (standards.iteh.ai)

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**FprEN 14944-3:2023(E)****European foreword**

This document (FprEN 14944-3:2023) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

This document is currently submitted to the Formal Vote.

This document will supersede EN 14944-3:2007.

In comparison with EN 14944-3:2007, the following changes have been made:

- provisions for testing the influence of materials on the migration of organic substances (TOC) have been shifted to prEN 14944-1;
- requirements for disinfection (preconditioning with 50 mg/l chlorine) have been removed;
- a procedure for extending the number of migration periods has been included.

This document describes a test method to determine the migration of inorganic substances in water intended for human consumption.

This European Standard will result in one of a series of standards that support standards for the approval of products and materials in contact with water intended for human consumption.

This European Standard is part of a series dealing with the influence of cement based and associated non-cement-based products/materials on water intended for human consumption, including:

- *Part 1: Influence of factory-made cement-based products on organoleptic parameters and migration of organic substances (TOC)*
- *Part 2: Influence of site-applied cement-based materials and associated non-cement-based products/materials on organoleptic parameters and migration of organic substances (TOC)*
- *Part 3: Migration of substances from factory-made cement-based products*
- *Part 4: Migration of substances from site-applied cement-based materials and associated non-cement-based products/materials*

## 1 Scope

This document specifies a method to determine the migration of substances from factory-made cement-based products into test waters after contact with the products.

This document is applicable to factory-made cement based, e.g. cement mortar linings to metallic pipes, tanks, concrete pipes, etc., intended to be used for the transport and storage of water intended for human consumption, including raw water used for the production of drinking water.

NOTE Tests with the specified test water will not necessarily be representative of materials used in different kinds of waters and especially very soft waters.

## 2 Normative references

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 196-1, *Methods of testing cement - Part 1: Determination of strength*

EN 1015-2, *Methods of test for mortar for masonry - Part 2: Bulk sampling of mortars and preparation of test mortars*

EN 1015-11, *Methods of test for mortar for masonry - Part 11: Determination of flexural and compressive strength of hardened mortar*

EN 10088-1, *Stainless steels - Part 1: List of stainless steels*

EN 12350-1, *Testing fresh concrete - Part 1: Sampling and common apparatus*

EN 12390-1, *Testing hardened concrete - Part 1: Shape, dimensions and other requirements for specimens and moulds*

EN 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests*

EN ISO 7393-1, *Water quality - Determination of free chlorine and total chlorine - Part 1: Titrimetric method using N, N-diethyl-1,4-phenylenediamine (ISO 7393-1)*

EN ISO 7393-2, *Water quality - Determination of free chlorine and total chlorine - Part 2: Colorimetric method using N,N-dialkyl-1,4-phenylenediamine, for routine control purposes (ISO 7393-2)*

EN ISO 10523, *Water quality - Determination of pH (ISO 10523)*

ISO/TS 13530, *Water quality — Guidance on analytical quality control for chemical and physicochemical water analysis*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### 3.1

##### **appropriate body**

certification body, inspection body or testing laboratory, as relevant to a particular requirement

#### 3.2

##### **cement based product**

factory-made product containing a cement-based material supplied in the hardened state with a formed surface prior to its incorporation into the construction works

#### 3.3

##### **cement based material**

material that contains a hydraulic cement in sufficient proportion to act as the main binder by forming a hydrate structure which governs the performance of the material

#### 3.4

##### **associated non-cement-based product**

product which is applied to the surface of a cement-based product, directly or indirectly, during manufacture (or construction) and which either provides a porous seal to the product or which remains as a residue in contact with water, e.g. porous seal coats, formwork release agents and curing compounds

#### 3.5

##### **porous seal coat**

polymeric (usually organic) materials applied in a thin (25 µm – 200 µm thickness) surface layer to a cement mortar lining in order to restrict (but not prevent) interactions between the mortar and conveyed water

Note 1 to entry: See ISO 16132:2004, 3.6 [1].

#### 3.6

##### **proxy sample**

sample of fresh mortar or fresh concrete taken from material to be used for the production of a factory-made product, either applied to one face of a stainless steel plate (6.2.1.1) using the same process of application used in the factory (mortar only) or cast into a mould (mortar or concrete) of appropriate dimensions (e.g. standard cube, cylinder or prism etc.) and compacted (where appropriate), cured and hardened under conditions representative of those intended for the product

#### 3.7

##### **fresh concrete**

concrete that is fully mixed and still in a condition capable of being compacted by the chosen method

#### 3.8

##### **fresh mortar**

cement mortar that is fully mixed and still in a condition of being applied by the chosen method



**3.9****test**

technical operation that consists of the determination of one or more characteristics of a given product

**3.10****test procedure**

specified technical method for performing a test

**3.11****sample**

one or more units, or a specified quantity, drawn from a batch or lot, selected at random for inspection, e.g. at the factory or in a laboratory

**3.12****test piece**

sample or portion which is to be conditioned, treated or otherwise prepared to be tested to obtain a single test result

**3.13****nominal diameter****DN/ID****DN/OD**

numerical designation of the size of a component, which is a whole number approximately equal to the actual dimensions in millimetres

Note 1 to entry: This applies to either the internal diameter (DN/ID) or the external diameter (DN/OD).

**3.14****preconditioning**

succession of contact periods of a test piece with the preconditioning water (3.15) before contact with the test water

**3.15****preconditioning water**

water used for preconditioning

Note 1 to entry: Prepared as described in 5.3.1

**3.16****test water**

water used for testing purposes

Note 1 to entry: Prepared as described in 5.3.2 and used in accordance with 5.3.3 and 5.3.4

**3.17****migration water**

test water which has been in contact with a test piece under specified conditions

**3.18****blank water**

test water which has been kept at the same specified conditions as migration water but without contact with the test piece

**FprEN 14944-3:2023(E)****3.19****tap water**

drinking water distributed by a public supplier

Note 1 to entry: Tap water is used as a lubricant/coolant for the sawing and coring operations used to obtain test pieces generally from products of large dimensions. See Annexes A, B and C.

**3.20****demineralized water**

water of which the mineral matter or salts have been removed by deionization

[SOURCE: ISO 23321:2019, 3.1]

**4 Principle**

Each test piece is subjected to a specified preconditioning procedure where the surface which, in practice will be exposed to water intended for human consumption, is brought into contact with preconditioning water during five sequential periods: three periods of 24 h, 1 period of 72 h and a final period of 24 h.

The preconditioned test piece is then brought into contact with test water, chlorinated and/or chlorine-free during three sequential migration periods. A migration period is either:

- a) 72 h at  $(23 \pm 2)$  °C for products intended to come into contact with chlorinated or chlorine-free cold water;
- b) 24 h at a specified elevated temperature for products intended to come into contact with warm or hot chlorine-free water.

Migration rates are calculated after each contact period by determination of the content of specified substances in the corresponding migration water.

NOTE 1 The test is carried out under conditions that ensure that reliable migration rates are calculated. These conditions are not meant to simulate any service condition. Relating the results obtained from this document to the service condition is carried out using a conversion procedure. This procedure will be specified in regulations.

NOTE 2 The selection of:

- a) the appropriate test water, chlorinated and/or chlorine-free, from those made available in this document,
- b) the temperature of the test water

is specified in product or system standards or in national or European regulations, as appropriate.

**5 Reagents****5.1 Chlorine neutralization reagents**

**5.1.1 Ascorbic acid solution**, prepared by dissolving  $(4,0 \pm 0,1)$  g of ascorbic acid in one litre of test water (5.3.2).

This ascorbic acid solution shall be replaced on a monthly basis.

**5.1.2 Sodium thiosulfate solution**, comprising a solution of 3,5 g/l of sodium thiosulfate pentahydrate ( $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5 \cdot \text{H}_2\text{O}$ ) and stored in the absence of light at a temperature below 10 °C, for a maximum of 4 months.

## 5.2 Sodium hypochlorite solution

**5.2.1 Sodium hypochlorite solution**, prepared from a commercial solution of sodium hypochlorite (NaOCl) and have a known concentration of about 0,1 % by mass of free chlorine determined in accordance with either EN ISO 7393-1 or EN ISO 7393-2.

This sodium hypochlorite solution is unstable and shall be prepared on the day of use.

## 5.3 Waters to be used for testing

**5.3.1 Preconditioning water** shall be unchlorinated test water (see 5.3.2).

**5.3.2 Test water**, prepared by dissolving  $(110 \pm 1)$  mg anhydrous calcium chloride ( $\text{CaCl}_2$ ),  $(140 \pm 1)$  mg sodium hydrogen carbonate ( $\text{NaHCO}_3$ ) and  $(48 \pm 1)$  mg sodium silicate nonahydrate ( $\text{Na}_2\text{SiO}_3 \cdot 9 \cdot \text{H}_2\text{O}$ ) in one litre of demineralized water (3.20).

The pH is determined in accordance with EN ISO 10523 and adjusted to  $7,0 \pm 0,1$  by bubbling air and/or  $\text{CO}_2$  into the solution.

NOTE The target total hardness is 100 mg/l as  $\text{CaCO}_3$ , the target alkalinity is 122 mg/l as  $\text{HCO}_3^-$  and the silica concentration is 10 mg/l as  $\text{SiO}_2$ .

**5.3.3 Test water without chlorine content (chlorine-free)**, shall consist of a batch of test water (5.3.2) used for contact with test pieces and preparation of the blank water (3.18).

**5.3.4 Test water with chlorine content (chlorinated)**, shall consist of test water (5.3.2) with a free chlorine content of  $(1,0 \pm 0,2)$  mg/l as  $\text{Cl}_2$ , determined in accordance with either EN ISO 7393-1 or EN ISO 7393-2, after addition of sodium hypochlorite solution (5.2).

## 5.4 Cleaning liquids for apparatus

Use one of the following cleaning liquids:

- non-perfumed biodegradable detergent;
- hydrochloric acid, 2 mol/l;
- nitric acid, 10 % or 1,5 mol/l.

## 6 Apparatus

### 6.1 General

For cleaning the glassware, and appropriate apparatus, before use, the following general requirements apply:

- a) Clean the glassware to be used, using detergent (5.3). Rinse the glassware in with demineralized water (3.20).
- b) Clean the inner surface of the glassware with hydrochloric acid (5.3) and rinse it with demineralized water. For stainless steel, clean with nitric acid (5.3) and then rinse with demineralized water.
- c) Before use, rinse the glassware, and appropriate apparatus, at least three times using preconditioning water before preconditioning (8.3) or test water before the test procedure (Clause 9).

**FprEN 14944-3:2023(E)****6.2 Apparatus and materials for test piece preparation (see Annexes A, B and C)****6.2.1 Stainless steel plates and cylinders****6.2.1.1 Stainless steel**

Stainless steel shall be austenitic, super austenitic or duplex grades in accordance with the corresponding numerical designations, 1.4301, 1.4436, 1.4429, 1.4259 or 1.4462 in EN 10088-1 for stainless steels.

NOTE The grades above are specified for the use of stainless steel as reinforcement in concrete. Therefore, they are considered to be inert when used in contact with cement-based proxy samples (see Annexes A, B and C).

**6.2.1.2 Plates**

In order to provide a sufficient volume of migration water for assessment, the surface area of one face of a plate should be between 10 000 mm<sup>2</sup> and 90 000 mm<sup>2</sup>. The length/width of the plates should be selected to be consistent with the dimensions of the test container and the volume of test water in which they will be immersed.

**6.2.1.3 Cylinders**

The diameter and length of a cylinder should be consistent with the dimensions of the test piece (see Annexes A, B, C, D and E) and the volume of test water appropriate to the specified S/V ratio given in 7.3.

**6.2.2 Glass cylinders**

The diameter and length of a glass cylinder should be consistent with the dimensions of the test piece (see Annexes A, B, C, D and E) and the volume of test water appropriate to the specified S/V ratio given in 7.3. Glass cylinders should be provided with suitable external (opaque) shielding for use during migration procedures (test pieces and blanks), in order to minimize exposure of migration waters to ambient light.

**6.2.3 Moulds for forming test pieces**

Moulds for forming prisms of mortar shall conform to the requirements of EN 196-1, as specified for use in EN 1015-11, or to EN 12390-1 for forming cubes/cylinders of concrete, with modifications to materials and dimensional tolerances as specified in Annex A, B or C, as appropriate.

Clean moulds and any filling frame used with a mould, by thoroughly washing with non-perfumed detergent (5.3) and tap water (3.19), rinsing with copious amounts of tap water, followed by a final rinse with demineralized water (3.20) and dry before use.

If a factory-made cement-based product has been formed in a process where its entire contact surface has been in contact with a release agent and if proxy samples (3.5) are used, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted.

**6.3 Apparatus and materials for preconditioning and migration procedure**

**6.3.1 Vessels, containers, covers, connectors and stoppers** shall consist of a material, such as glass, PTFE, steel and stainless steel that is inert under the specified test conditions (Clause 9).

**6.3.2 Equipment**, capable of maintaining the test temperature within  $\pm 2$  °C for the duration of the test.

**6.3.3** If required, use only **sealants** that do not affect the determinations under the specified test conditions (see Clause 9).

## 7 Samples and test pieces

### 7.1 Sampling, transport and storage of samples

Carry out sampling of factory-made products in accordance with the relevant product standard, system standard, or the relevant Annex to this document, as appropriate.

NOTE National or European regulations can also apply.

Take care that the transport conditions do not influence the test results.

If it is necessary to store samples or test pieces before testing, ensure that they are protected from contamination taking into account any written instructions that are provided.

Where appropriate, clean storage containers using the same procedures as are used for the test containers.

Ensure that the surfaces of the test pieces intended to come into contact with the test water are free from any contamination, e.g. adhesive tape, labels, ink or pencil marks.

### 7.2 Preparation of test pieces

#### 7.2.1 General

Prepare the test pieces in such a way that only the surface intended to come into contact with drinking water is exposed to the test water except as given in Annex C (see C.1.2.3.2.1) where stainless steel plates are coated with cement mortar on one face only prior to complete immersion during testing.

In the preparation of a test piece the following general principles apply:

- a) ensure that test pieces are representative of the finished product;
- b) during the preparation of test pieces, include any procedures which are performed in practice for curing and cleaning;
- c) ensure that the minimum age of the test piece, at test, conforms to that recommended by the manufacturer for the product to be ready for use;
- d) ensure that the surface area of the test piece is sufficient to fulfil the appropriate surface area to volume (S/V) ratio in accordance with the requirements of 7.3.

#### 7.2.2 Factory made pipes, fittings and storage systems

Where possible, use the product or test piece as the test vessel, with dimensions that provide sufficient migration water for assessment. In cases where this is not practicable (e.g. large pipes, storage systems etc.), and where alternatives are specified, use as appropriate, an alternative test piece described in the relevant Annex A, B or C and an appropriate test arrangement given in Annex E.

Where it is required to discriminate between porous and non-porous coatings already applied to factory-made products, use the test procedure given in Annex G.

**FprEN 14944-3:2023(E)****7.3 Surface area to volume ratio (S/V) for use in the test procedure****7.3.1 General**

The following general principles apply for S/V ratios:

- a) the surface area to volume ratio (S/V) of the test piece exposed to the test water relates to realistic service conditions;
- b) where no difference in material composition and production process exists in the range of sizes produced, only the largest S/V ratio is required to be tested;
- c) the ratio of the surface area, S, of the test piece intended to come into contact with volume, V, of the test water is expressed per decimetre, i.e. dm<sup>-1</sup>.

NOTE The unit, dm<sup>-1</sup>, can also be expressed as dm<sup>2</sup>/dm<sup>3</sup> or dm<sup>2</sup>/l.

**7.3.2 Pipes and fittings**

The S/V ratio is calculated, in dm<sup>-1</sup>, according to the formula:

$$S/V = \frac{400}{[DN/ID]} \quad (1)$$

where

[DN/ID] (3.12) is the nominal internal diameter, in mm.

Test pipes and fittings of DN/ID less than 80, at the actual S/V ratio of the pipe diameter.

Test pipes and fittings of DN/ID equal to 80 and less than 300, at an S/V ratio of (5,0 ± 0,2) dm<sup>-1</sup>.

Test pipes and fittings of DN/ID 300 or greater, at an S/V ratio of (1,3 ± 0,1) dm<sup>-1</sup>.

NOTE See 7.3.1 (b) for the acceptable minimum requirement for testing pipes that are produced in a range of sizes.

**7.3.3 Storage systems (cement mortar, cement mortar lined or concrete)**

Test storage systems at an S/V ratio of (1,3 ± 0,1) dm<sup>-1</sup>.

**8 Pre-treatment of samples (curing and preconditioning)****8.1 General**

The procedures for curing cement-based products are given in 8.2.

The procedure for preconditioning at (23 ± 2) °C is given in 8.3.

**8.2 Curing**

Ensure that test pieces have been subject either to the curing conditions used in manufacture of the factory-made product or, in the case of test pieces formed from proxy samples (3.6), to curing conditions that are representative of those used in the manufacture of the factory-made product (see the relevant Annex A, B or C).

### 8.3 Preconditioning

Precondition test pieces at the appropriate S/V ratio given in 7.3.

Fill test pieces with, or immerse them in, or otherwise bring them into contact with (see the test arrangements in Annex E), preconditioning water (5.3.1) for a succession of five contact periods, without rinsing between contact periods, at a temperature of  $(23 \pm 2)$  °C as follows:

- three periods of  $(24 \pm 1)$  h;
- one period of  $(72 \pm 1)$  h;
- one period of  $(24 \pm 1)$  h.

After the fifth contact period determine the pH of the preconditioning water in accordance with EN ISO 10523. If the pH exceeds 9,5 stop the testing.

Where the pH exceeds 9,5 preconditioning may be repeated using new test pieces.

The results of co-normative research [2] obtained using this preconditioning water indicate that where the pH exceeds 9,5 after the fifth contact period, then steps should be taken to first investigate and then eliminate the cause(s) before proceeding to the test procedure (see Clause 9).

After preconditioning, test pieces shall be rinsed with drinking water; the required tests shall be carried out immediately afterwards in accordance with 9.

## 9 Test procedure

### 9.1 General

Where testing of products is required, at 23 °C, carry out the procedures according to 9.2.

Where testing at elevated temperature is required carry out the procedure in accordance with normative Annex F.

### 9.2 Preparation of migration water for analysis of substances

#### 9.2.1 Introduction

The number of tests to be carried out e.g. single tests or duplicates for each water type is specified in product or system standards, as appropriate.

NOTE See also, for example, national or European regulations

#### 9.2.2 Migration procedure

Begin the first contact period immediately after preconditioning the test piece.

Immerse in, or fill with, or otherwise bring the test piece (7.2) into appropriate contact with test water (5.3.3 and/or 5.3.4) and allow to stand for  $(72 \pm 1)$  h at  $(23 \pm 2)$  °C. In all cases (immersion, filling or other contact arrangement), ensure that the test piece or vessel/container is completely immersed or filled and minimize headspace in order to minimize contact between the test water and air, using a cover for the vessel/container.

At the end of this period, collect the migration water using appropriate sampling bottles for analysis.

NOTE The choice of the type of test water (chlorinated and/or chlorine-free) is specified by the product standard or system standards or in national or European regulations, as appropriate.