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**Vpliv cementnih proizvodov na pitno vodo - Preskusne metode - 4. del: Prehajanje snovi iz cementnih materialov, uporabljenih na terenu, in pripadajočih necementnih proizvodov/materialov**

Influence of cementitious products on water intended for human consumption — Test methods — Part 4: Migration of substances from site applied cementitious materials and associated noncementitious products/materials

Einfluss zementgebundener Produkte auf Wasser für den menschlichen Gebrauch - Prüfverfahren - Teil 4: Migration von Substanzen aus bauseits angewendeten zementgebundenen Materialien und zugehörigen nicht zementgebundenen Produkten/Materialien

Influence des produits à base de ciment sur l'eau destinée à la consommation humaine — Méthodes d'essai — Partie 4 : Migration de substances à partir de matériaux à base de ciment appliqués sur site et de produits/matériaux associés exempts de ciment

**Ta slovenski standard je istoveten z: prEN 14944-4**

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**ICS:**

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**prEN 14944-4**

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ICS

English Version

## Influence of cementitious products on water intended for human consumption - Test methods - Part 4: Migration of substances from site applied cementitious materials and associated noncementitious products/materials

Einfluss zementgebundener Produkte auf Wasser für den menschlichen Gebrauch - Prüfverfahren - Teil 4: Migration von Substanzen aus bauseits angewendeten zementgebundenen Materialien und zugehörigen nicht zementgebundenen Produkten/Materialien

This draft European Standard is submitted to CEN members for enquiry. 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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

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## European foreword

This document (prEN 14944-4:2023) 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 CEN Enquiry.

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

This document 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 document 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.

[oSIST prEN 14944-4:2023](https://standards.iteh.ai/catalog/standards/sist/f13fe4ef-639b-4acd-90e4-f716f9a94c24/osist-pren-14944-4-2023)

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**prEN 14944-4:2023 (E)****1 Scope**

This document specifies a method to determine the migration of substances from hardened cement based site-applied or site-formed materials (including pre-packaged mortars) into test waters after contact with the products. It also covers determination of migration from individual constituents of cement based products and materials (see Annex A and B) and from associated non-cement based products for approval purposes (see Annex C).

Site-applied or site-formed cement based materials which cannot be cast as cubes or prisms e.g. some spray applied systems, fall in the scope of EN 14944 –3 and not under this standard.

This document is applicable to site-applied or site-formed cement based materials 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. It is also applicable to individual constituents of cement based products/materials and to associated non-cement based products/materials.

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 are referred to in the text in such a way that some or all of their content constitutes requirements 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 196-1, *Methods of testing cement - Part 1: Determination of strength*

EN 197-1, *Cement - Part 1: Composition, specifications and conformity criteria for common cements*

EN 206-1, *Concrete - Part 1:- Specification, performance, production and conformity*

EN 480-1, *Admixtures for concrete, mortar and grout - Test methods - Part 1: Reference concrete and reference mortar for testing*

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

EN 12350-2, *Testing fresh concrete - Part 2: Slump test*

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

EN 12620, *Aggregates for concrete*

EN 13639, *Determination of total organic carbon in limestone*

prEN 14944-3:2018, *Influence of cement based products on water intended for human consumption - Test methods - Part 3: Migration of substances from factory-made cement based products*

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 16132, *Ductile iron pipes and fittings — Seal coats for cement mortar linings*

### 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 to 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 prEN 14944-1:2018 and ISO 16132

#### 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) 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 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

#### 3.8

##### **fresh mortar**

cement mortar that is fully mixed and still in a condition of being applied

**prEN 14944-4:2023 (E)****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****preconditioning**

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

**3.14****test water**

water used for testing purposes

**3.15****migration water**

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

**3.16****blank water**

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

**3.17****tap water**

drinking water distributed by a public supplier

**3.18****demineralised water**

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

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### 3.19

#### Type I addition

nearly inert additions

### 3.20

#### Type II addition

pozzolanic or latent hydraulic additions

## 4 Principle

The procedure specifies the method for producing test pieces (normally in the form of cubes or prisms) from the site applied or site formed material under test. It also specifies the method of producing concrete or mortar test pieces for assessing individual unapproved constituents of these materials or associated non-cement based products/materials.

NOTE 1 The procedure for assessing unapproved constituents is based on the assumption that constituent-specific limit values will be available for substances released from constituents where tested by a subtractive procedure within a reference concrete mix that is broadly representative of the intended use.

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:

- 72 h at  $(23 \pm 2)$  °C for products/materials intended to come into contact with chlorinated or chlorine-free cold water;
- 24 h at a specified elevated temperature for products/materials 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 2 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 3 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.

NOTE 4 Referring standards and/or national or European regulations can specify further sequential migration periods. Reference is made to Annex H for further guidance on the sequence and number of migration periods that can be specified.

## 5 Reagents

### 5.1 Sodium hypochlorite solution

**5.1.1 Sodium hypochlorite solution**, prepared from a commercial solution of sodium hypochlorite (NaOCl), using test water (5.2.2) and having 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.

### 5.2 Waters to be used for testing

#### 5.2.1 Preconditioning water

Preconditioning water is prepared by dissolving  $(222 \pm 2)$  mg anhydrous calcium chloride ( $\text{CaCl}_2$ ) and  $(336 \pm 2)$  mg sodium hydrogen-carbonate ( $\text{NaHCO}_3$ ) in one litre of demineralized water (3.19). The pH is determined in accordance with EN ISO 10523 and adjusted to  $7,4 \pm 0,1$  by bubbling air and/or  $\text{CO}_2$  into the solution.

NOTE The target total hardness is 200 mg/l as  $\text{CaCO}_3$  and the target alkalinity is 244 mg/l as  $\text{HCO}_3^-$ .

#### 5.2.2 Test water,

Test water is 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 ( $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$ ) in one litre of demineralized water (3.19). 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  $\text{SiO}_2$ .

#### 5.2.3 Test water without chlorine content (chlorine-free)

Test water without chlorine content (chlorine-free) shall consist of a batch of test water (5.2.2) used for contact with test pieces and preparation of the blank water (3.17).

#### 5.2.4 Test water with chlorine content (chlorinated)

Test water with chlorine content (chlorinated) shall consist of test water (5.2.2) 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 (5.1).

### 5.3 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 demineralized water (3.19).
- 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 (8.2) or test water before the test procedure (9).

## 6.2 Apparatus and materials for test piece preparation (see Annexes A, B and C)

### 6.2.1 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 samples (see Annexes A, B and C).

### 6.2.2 Moulds for concrete or mortar

Moulds for preparing test pieces of concrete or mortar shall be made from alkali-resistant material that does not interfere with analyses of migration waters.

A mould used to cast concrete test pieces shall normally give a test specimen with total surface area of approximately 60,000 mm<sup>2</sup> as appropriate to the tolerance permitted on S/V ratio, see Annex D.

NOTE High density polyethylene (HDPE) containers have been found to be satisfactory for this use.

Where steel moulds conforming to the requirements of EN 12390-1 are used, the joints shall not be coated with any wax, oil or grease to achieve water tightness.

A mould used to cast mortar test pieces shall give a test specimen with total surface area of approximately 28,800 mm<sup>2</sup> as appropriate to the tolerance permitted on S/V ratio, see Annex D

Other mould sizes for casting concrete or mortar may be used, provided the permitted tolerance on S/V ratio can be achieved during testing, see Annex D.

Where a site-applied or site-formed cement based product is not suitable for casting in a mould, e.g. some spray applied products, it should be applied and tested according to prEN 14944-3.

### 6.2.3 Cleaning and use of moulds

Clean moulds and any filling frame used with a mould, by thoroughly washing with non-perfumed detergent (5.3) and tap water (3.18), rinsing with copious amounts of tap water, followed by a final rinse with demineralized water (3.19) and dry before use.

The use of release agents to coat the internal surfaces of moulds is not permitted by This document.

NOTE Release agents for use with site-applied or site-formed cement based materials are examples of associated non-cement based materials and are tested in accordance with Annex C.

## 6.3 Apparatus and materials for preconditioning and migration procedure

### 6.3.1 Vessels, containers, covers, connectors and stoppers

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 (9).

### 6.3.2 Equipment

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Equipment capable of maintaining the test temperature (9) within  $\pm 2$  °C for the duration of the test.

**6.3.3 sealants**

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

**7 Samples and test pieces****7.1 Sampling, transport and storage of samples**

Carry out sampling of site-applied products/materials in accordance with the relevant product standard, system standard or Annex to this document, as appropriate.

NOTE See the national or European regulations for additional information.

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 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**

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

- a) Ensure that test pieces are representative of the finished product;
- b) ensure that the manufacturer's recommendations are followed with respect to mixing and compacting into the moulds;
- c) during the preparation of test pieces, include any procedures which are performed in practice for curing (but excluding the application of an applied curing compound) and cleaning;
- d) 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;
- e) 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.

### 7.3 Surface area to volume ratio (S/V) for use in the test procedure

The following principles apply for S/V ratios:

- The surface area to volume ratio (S/V) of the test piece exposed to the test water shall not be smaller than the S/V ratio of the product/material in the 'worst case' service condition;
- 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.  $\text{dm}^{-1}$ ;
- the applicant for the product/material under test shall state the maximum ('worst case') S/V ratio for the use of the product or material in the service condition and this shall appear on his literature and on report for this testing.

S/V ratio for use in the test procedure shall be as follows:

**Table 1**

'Worst case' S/V Ratio for the use of the product or material in the service condition	S/V ratio in the test procedure
$> 5 \text{ dm}^{-1}$	Actual 'worst case' S/V ratio
$> 1,3 \text{ dm}^{-1}$ and $\leq 5 \text{ dm}^{-1}$	$5 \text{ dm}^{-1}$
$\leq 1,3 \text{ dm}^{-1}$	$1,3 \text{ dm}^{-1}$

NOTE The unit,  $\text{dm}^{-1}$ , can also be expressed as  $\text{dm}^2/\text{dm}^3$  or  $\text{dm}^2/\text{L}$

## 8 Pre-treatment of samples (curing and preconditioning)

### 8.1 General

The procedures for curing products and materials are given in the relevant Annexes A, B, or C. The procedure for preconditioning at  $(23 \pm 2) \text{ }^\circ\text{C}$  is given in 8.2.

### 8.2 Preconditioning

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

Immerse test pieces, see the test arrangements in Annex E, in the preconditioning water (5.2.1) for a succession of five contact periods, without rinsing between contact periods, at a temperature of  $(23 \pm 2) \text{ }^\circ\text{C}$  as follows:

- Three periods of  $(24 \pm 1) \text{ h}$ ;
- one period of  $(72 \pm 1) \text{ h}$ ;
- one period of  $(24 \pm 1) \text{ h}$ .

After the fifth contact period determine the pH of the preconditioning water in accordance with 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 [1] 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 (9).