



SLOVENSKI STANDARD
SIST EN 14944-3:2024

01-marec-2024

Nadomešča:
SIST EN 14944-3:2009

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

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Ta slovenski standard je istoveten z: EN 14944-3:2023

ICS:

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

SIST EN 14944-3:2024

en,fr,de

EUROPEAN STANDARD

EN 14944-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2023

ICS 13.060.20; 67.250

Supersedes 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 European Standard was approved by CEN on 7 August 2023.

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

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

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

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2024, and conflicting national standards shall be withdrawn at the latest by June 2024.

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

This document supersedes 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 EN 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*

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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*

EN 14944-3:2023 (E)**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 16132:2016, 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

EN 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 ± 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.

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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 ± 1) mg anhydrous calcium chloride (CaCl_2), (140 ± 1) mg sodium hydrogen carbonate (NaHCO_3) and (48 ± 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 CO_2 into the solution.

NOTE The target total hardness is 100 mg/l as CaCO_3 , the target alkalinity is 122 mg/l as HCO_3^- and the silica concentration is 10 mg/l as 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 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).

EN 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 mm² and 90 000 mm². 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 (3.6) 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 ± 2 °C for the duration of the test.