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| STN | **Vplyv materiálov na pitnú vodu<br>Vplyv migrácie (vylúhovania)<br>Časť 2: Skúšobná metóda pre nekovové a necementové výrobky používané na mieste** | **STN<br>EN 12873-2<br><br>75 8702** |
|---|---|---|

Influence of materials on water intended for human consumption - Influence due to migration - Part 2: Test method for non-metallic and noncementitious site-applied materials

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

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# EUROPEAN STANDARD
# NORME EUROPÉENNE
# EUROPÄISCHE NORM

# EN 12873-2

December 2021

ICS 13.060.20; 67.250

Supersedes EN 12873-2:2005

English Version

# Influence of materials on water intended for human consumption - Influence due to migration - Part 2: Test method for non-metallic and noncementitious site-applied materials

Influence des matériaux en contact sur l'eau destinée à la consommation humaine - Influence due à la migration - Partie 2 : Méthode d'essai des matériaux appliqués sur site, excepté les matériaux métalliques et ceux à base de ciment

Einfluss von Materialien auf Trinkwasser - Einfluss infolge der Migration - Teil 2: Prüfverfahren für vor Ort aufgebrachte nicht metallische und nicht zementgebundene Materialien

This European Standard was approved by CEN on 15 November 2021.

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.

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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 (EN 12873-2:2021) 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of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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 will supersede EN 12873-2:2005.

Significant technical difference between this edition and EN 12873-2:2005 is as follows:

- the test temperatures, outlined in Clause 4 ‘Principle’, are more specific;
- the use of chromic acid is removed because of safety concerns;
- the use of sulphuric acid has been removed;
- the examples of extended collection and analysis of migration waters (Annex C) are more systematic.

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, Turkey and the United Kingdom.

# Introduction

In respect of potential adverse effects on the quality of water intended for human consumption caused by the materials, it is called to mind that, while awaiting the adoption of verifiable European acceptance criteria, the relevant national regulations remain in force.

This document has been drawn up with the objective to describe a test method to determine the migration of substances from products made from, or incorporating, organic and glassy (porcelain/vitreous enamel) material for use in contact with water intended for human consumption.

Annex A, which is normative, describes an alternative arrangement for flushing pipes having a nominal size greater than DN 80.

Annex B, which is informative, describes additional procedures for testing non-homogeneous products and pipes having a nominal size greater than DN 80.

Annex C, which is informative, describes a schedule for the preparation of migration waters.

Annex D, which is informative, describes procedural tests using standard additions (positive controls).

Annex E, which is informative, describes the migration test procedure in a schematic manner.

This document will result in one of a series of standards on test methods which support the appropriate standards.

With regards to potential adverse effect on the quality of water intended for human consumption, caused by the material testing covered by this document:

1) This document provides no information as to whether the final product tested using this methodology may be used without restriction in any of the Member States of the EU or EFTA.

2) It should be noted that, whilst awaiting the adoption of verifiable European criteria, existing national regulations concerning the use of this material test method remain in force.

NOTE Conformity with this document does not confer or imply acceptance or approval of the material in any of the Member States of the EU or EFTA. The use of the methodology covered by this document is subject to regulation or control by National Authorities.

This document, Part 2, is the second in a series of standards for dealing with the influence of migration from materials on water intended for human consumption, including:

— Part 1: Test method for factory-made products made from or incorporating organic and glassy (porcelain/vitreous enamel) materials;

— Part 2: Test method for non-metallic and non-cementitious site-applied products;

— Part 3: Test method for ion exchange and absorbent resins;

— Part 4: Test method for water treatment membranes.

# 1 Scope

This document specifies a procedure to determine the migration of substances from non-metallic and non-cementitious site-applied materials for use in contact with water intended for human consumption.

It is applicable to site-applied materials intended to be used under various conditions for the transport and storage of water intended for human consumption, including raw water used for the production of water intended for human consumption. It covers the extraction by water of substances from these materials after their application on site.

The document is applicable to materials whose physical or chemical properties alter during or after on-site application, such as coatings, paints, and adhesives. In addition, some site-applied materials that do not change in such a manner, e.g. greases or lubricants, are also included.

# 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 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)*

(23 ± 2) °C (cold water test). Depending on the intended use of the product and specified in the product standard the test at elevated temperatures shall either be carried out at (60 ± 2) °C (warm water test) or at (85 ± 2) °C (hot water test).

NOTE 1 The number of tests to be carried out, e.g. single tests or duplicate tests for each water type, will be specified in product standards or national regulations.

NOTE 2 The choice of the type of test water (chlorinated and/or chlorine-free) will be specified by product standards or national regulations.

NOTE 3 Thin layer chromatography tanks (volume 3,5 to 4 l) with lids made from glass can be used as containers to carry out the tests.

### 9.1.2 Cold water test procedure

**9.1.2.1** Carry out the following procedure using test water without chlorine (5.2.2) and/or test water with chlorine (5.2.3).

**9.1.2.2** Fill or immerse the test pieces using the appropriate test water and allow to stand for (72 ± 1) h at (23 ± 2) °C. In both cases, ensure that the test pieces or vessels/containers are completely immersed or filled and free of headspace in order to retain volatile substances. At the end of this period, collect the migration waters for analysis. For each analyte the concentration $a^{T}_{n}$ (Clause 10) shall be determined.

**9.1.2.3** Repeat 9.1.2.2 two more times using fresh test waters, ensuring that the test pieces are put in contact with the same type of test water (e.g. without chlorine) for all the three periods.

**9.1.2.4** It may be necessary to increase the number of migration periods. The sequence for an extended number of migration periods shall be in accordance to Table C.1.

### 9.1.3 Elevated temperature test procedure

**9.1.3.1** Carry out the following procedure using test water without chlorine at the test temperature detailed in 9.1.1.

**9.1.3.2** Fill or immerse the test pieces using the test water (5.2.2) and allow to stand for (24 ± 1) h at the test temperature. The test water shall reach the test temperature within 1 h after the products are filled or immersed. At the end of this period, collect the migration water for analysis. For each analyte the concentration $a^{T}_{n}$ (Clause 10) shall be determined.

**9.1.3.3** Repeat 9.1.3.2 two more times using fresh test water without chlorine (5.2.2).

**9.1.3.4** It may be necessary to increase the number of migration periods. The sequence for an extended number of migration periods shall be in accordance to Table C.2.

## 9.2 Procedural blank tests

**9.2.1** For each migration period carry out a blank test procedure, using the same test conditions (test water, test temperature, migration periods, stoppers, etc.) as described in 9.1, but omitting the test piece.

**9.2.2** Where only glass or stainless steel plates and/or stoppers are used (e.g. pipes that are filled with test water) to seal test pieces, use a glass container for the procedural blank. Where other stoppers, connectors or sealants are used (e.g. PTFE), include these in the procedural blank with the same contact condition.

**9.2.3** Determine at the end of each migration period the concentration $b^T_n$ (Clause 10) of each analyte of interest.

**9.2.4** If any of the blank results are greater than the relevant lowest concentration of interest for the substance determined (e.g. a value lying between the limit of detection and the concentration not to be exceeded in drinking water as specified in the referring standard) then steps shall be taken to eliminate the source of contamination, after which the entire test procedure shall be repeated.

### 9.3 Analysis

Carry out the required analysis on the migration waters using the respective analytical methods. Determine at the end of each migration period the concentration of the analyte. General guidance on analytical performance requirements such as detection limit and accuracy is contained in "Guide to analytical quality control for water analysis", EN ISO 13530.

If migration waters are not analysed immediately then ensure that the storage time and conditions do not adversely affect the analytical result.

NOTE For some analytical methods and/or specific test procedures, recovery rates for the substances being determined are established using positive controls. Annex D gives further guidance.

## 10 Calculation of test results

### 10.1 Calculation of the concentration of the substances in the migration water

Calculate for each migration water the concentration of the measured substance as follows;

$$c_n^T = a_n^T - b_n^T \quad (1)$$

where

$c_n^T$ is the concentration of the measured substance in mg/l;

$a_n^T$ is the concentration of the substance in mg/l measured in the migration water;

$b_n^T$ is the concentration of the substance in mg/l measured in the blank water.

For the conditions:

$T$ is the test temperature [(23 ± 2) °C or (60 ± 2) °C or (85 ± 2) °C];

$n$ is the sequence number of the migration period (1, 2, 3, …).

NOTE The migration of substances from materials into water depends on the type of material and the migration conditions: temperature, contact time, the S/V ratio and whether the water is static or flowing. For static test conditions and constant temperature, the increase in the concentration of the substance in the test water is asymptotic. However, for practical purposes the increase with time is assumed to be linear.

### 10.2 Calculation of the migration rate of the measured substances

Calculate for each migration water the migration rate $M_n^T$ for a migrated substance from the concentration $c_n^T$ as follows:

$$M_n^T = \frac{c_n^T}{t \times S / V} \quad (2)$$

where

$M_n^T$ is the migration rate for the n$^{th}$ migration period (3.14) in mg dm$^{-2}$d$^{-1}$;

$t$ is the duration of the migration period in days, either one day (24 ± 1) h for elevated temperatures or three days (72 ± 1) h for (23 ± 2) °C (9.1.2 and 9.1.3);

$S/V$ is the surface area-to-volume ratio in dm$^{-1}$ (7.3).

Where duplicates have been carried out, calculate the arithmetic mean migration rate $\bar{M}_n^T$ for the duplicate values of $M^T{}_n$ for each test water (5.2.2 and 5.2.3).

NOTE The measured concentration or the calculated migration rate is normally used to calculate the possible concentration that could occur at a consumer's tap. The procedure for this and comparison with pass/fail values is described in national regulations. The procedure normally takes into account, in some manner, the contact time and the surface-to-volume ratio of the product or material with drinking water. Examples of such procedures are: a case-by-case procedure where other factors can be taken into account, the testing is carried out using a surface-to-volume ratio that reflects the type of product, and a product-related 'conversion factor' (based the contact time and the surface-to-volume ratio of the product with drinking water) is employed.

## 11 Test report

### 11.1 Content of the test report

The test report shall include the information of 11.2 to 11.6.

### 11.2 General information

The dated test report shall include the following general information:

a) name and address of test laboratory and location where the test was carried out when different from the address of the testing laboratory;

b) unique identification of report (such as serial number) and of each page, and total number of pages of the report;

c) name and address of client;

d) description and identification of the test item;

e) the proposed use of the product;

f) a signature and title or an equivalent marking of person(s) accepting technical responsibility for the test report and date of issue;

g) a statement to the effect that the test results relate only to the items tested;

h) a statement that the report shall not be reproduced except in full without the written approval of the testing laboratory;

### 11.3 Information on the material

The information on the material shall at least include the following:

a) trade name or designation of manufactured material;

b) complete identification and date of receipt of test item and date of performance of test;

c) the names of the primers and undercoats used, together with the wet film thickness of each layer applied;

d) details of the test piece preparation;

e) the name of the manufacturer of the material;

f) the production place and date;

g) the organization submitting the material;

h) description of sampling procedure.

### 11.4 Information on the test pieces

The information on the test piece shall include at least the following:

a) typical uses of the material;

b) source of application instructions;

c) site of test piece preparation, including ambient temperature and humidity (if appropriate);

d) person(s) responsible for test piece preparation;

e) date and time of test piece preparation;

f) full details of test piece preparation, including component part mix ratios (if appropriate), method of application (brush, airless spray, etc.), number and type of component layers (coats), thickness of each layer, time and temperature of curing of both top and any intermediate coats, any special curing conditions (e.g. controlled humidity, minimum application temperature);

g) chain of custody of the test pieces; method of transfer to the test laboratory and temperature profiles of the test pieces during transport to the laboratory for final curing (if required);

h) date and time of receipt of the test pieces by the test laboratory (if required);

i) test piece description;

j) date and time of the start of pre-treatment;

k) description of additional pre-treatment procedure (if applicable);

l) any deviations from the manufacturer/supplier application instructions.

## 11.5 Information on the test procedure

The information on the test procedure shall include the following:

a) reference to this document and (if applicable) to relevant product/system standards including year of publication;

b) number of test pieces used together in a migration;

c) volume of the test liquid (V) in litres;

d) surface area of test piece exposed to the test liquid (S) in square decimetres calculated from the actual dimensions of the test pieces;

e) actual S/V ratio;

f) disinfection procedure (if applicable);

g) source of reference water and test water and (if applicable) details of preparation;

h) test waters and test temperature;

i) any deviation from the test procedure specified in this document;

j) any factors which may have affected the results, such as any incidents or any operating details not specified in this document;

k) dates of start and completion of the test.

## 11.6 Test results

The test results shall, at least, include the duplicate and mean results (if carried out) and calculations shall be presented for each test temperature, type of test water and analysed substance in tabular form, e.g.:

— tested product;

— date of test performance;

— test temperature;

— S/V-ratio;

— applied Conversion factor ($F_C$);

— total migration periods;

— analysed Substance.

**Table 1 — Test results**

| | **Sequence number of migration period** | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | n [a] |
| $a^{T}{}_{n}$ | | | | |
| $a^{T}{}_{n}$ | | | | |
| $b^{T}{}_{n}$ | | | | |
| $c^{T}{}_{n}$ | | | | |
| $c^{T}{}_{n}$ | | | | |
| $M^{T}{}_{n}$ | | | | |
| [a] n specifies additional migration periods. | | | | |

# Annex A
(normative)

# Arrangement for flushing pipes with nominal size greater than DN 80

An alternative arrangement for flushing large diameter products is shown in Figure A.1 and A.2.

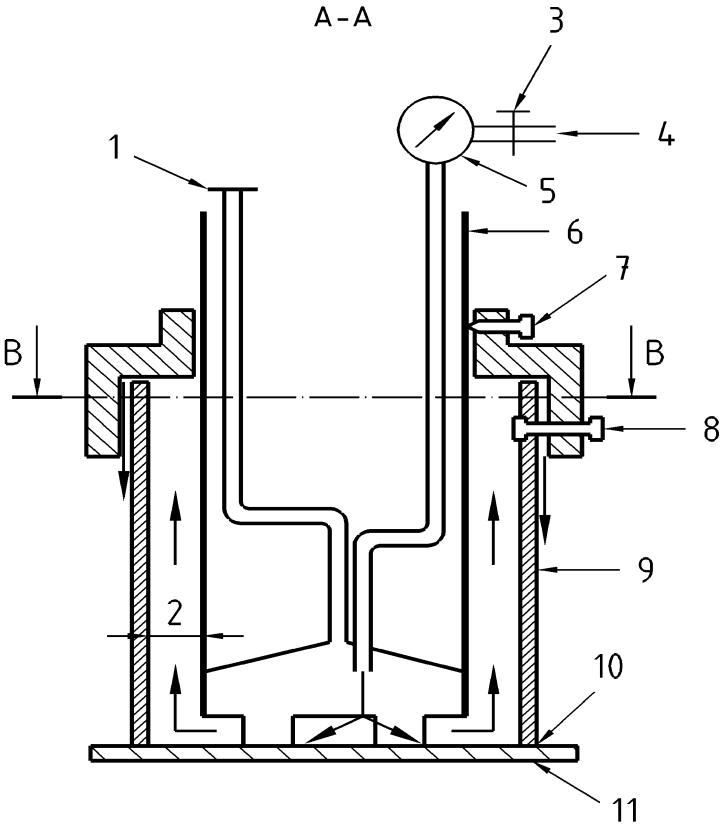
This arrangement is designed to avoid the use of large quantities of water to produce the required flow rate over the test piece surface.

The device is a cylinder made of inert material (6.1) with a diameter less than that of the internal diameter of the test piece.

The diameter of the cylinder should be at least 10 mm less than that of the internal diameter of the test piece. This will leave a gap of at least 5 mm between the wall of the cylinder and the test piece. If the gap is any smaller than this, there will be too much resistance to the water flow.

The tap water is delivered via a valve and flow meter through a pipe to a space at the bottom of the cylinder. The cylinder is supported on the base plate by three or four short legs. The space into which the pipe delivers the water is to allow for equal flow of water over the whole inside of the test piece. The space has an air vent, which is opened, at the start of the prewashing period in order to let out the air, which would otherwise be trapped in the distribution space. Most of the volume of the cylinder is empty space which can be filled with e.g. water or sand in order to stabilize the set up.

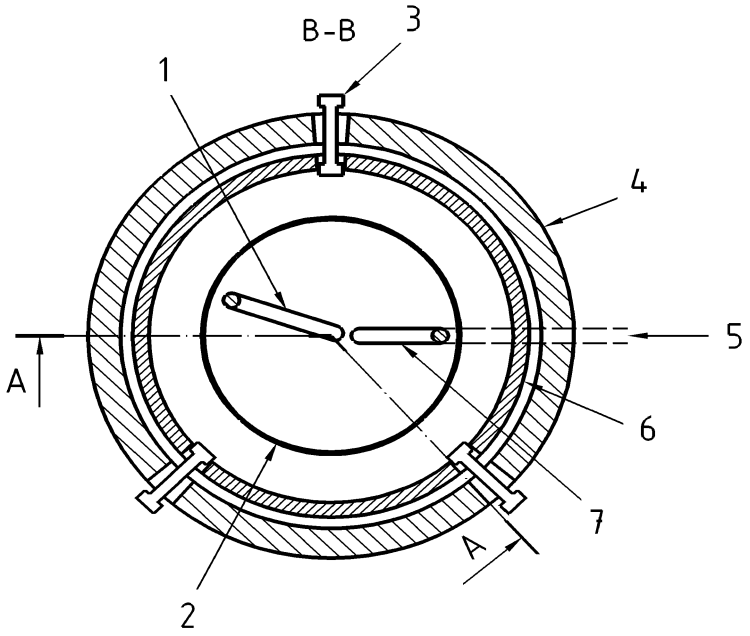
Towards the top of the cylinder there is an adjustable ring with three or four screws to adjust the height of the ring for different lengths of test pieces. There are also three or four screws which can be tightened into the outside of the test piece in order to ensure that the cylinder is centred within the test piece, thus ensuring equal flows of water over the whole inside surface of the test piece. The position of the ring is adjusted to allow a free flow of water over the top edge of the test piece. A vertical gap of about 10 mm should be sufficient.




**Key**

| | | | |
|---|---|---|---|
| 1 | Air vent | 7 | Height adjusting screw |
| 2 | Gap > 5 mm | 8 | Centering screw |
| 3 | Valve | 9 | Test piece |
| 4 | Wash water | 10 | Seal |
| 5 | Flow meter | 11 | Base plate |
| 6 | Main cylinder | | |

**Figure A.1 — Example of an arrangement for flushing large diameter pipes**




**Key**

| | | | |
|---|---|---|---|
| 1 | Air vent | 5 | Wash water |
| 2 | Main cylinder | 6 | Test piece |
| 3 | Centering screw | 7 | Water inlet |
| 4 | Adjustable ring | | |

**Figure A.2 — Example of an arrangement for flushing large diameter pipes**

# Annex B
(normative)

# Additional procedure for testing non-homogeneous products and pipes with nominal size greater than DN 80

## B.1 Arrangement for testing

Use the test arrangements shown in Figure B.1 and B.2.

Take precautions to ensure that there is no loss of test water during the migration periods.

## B.2 Flushing of the test piece

Flush the test piece in accordance with either Clause 8 or, to avoid the use of large quantities of water, the procedure given in Annex A.

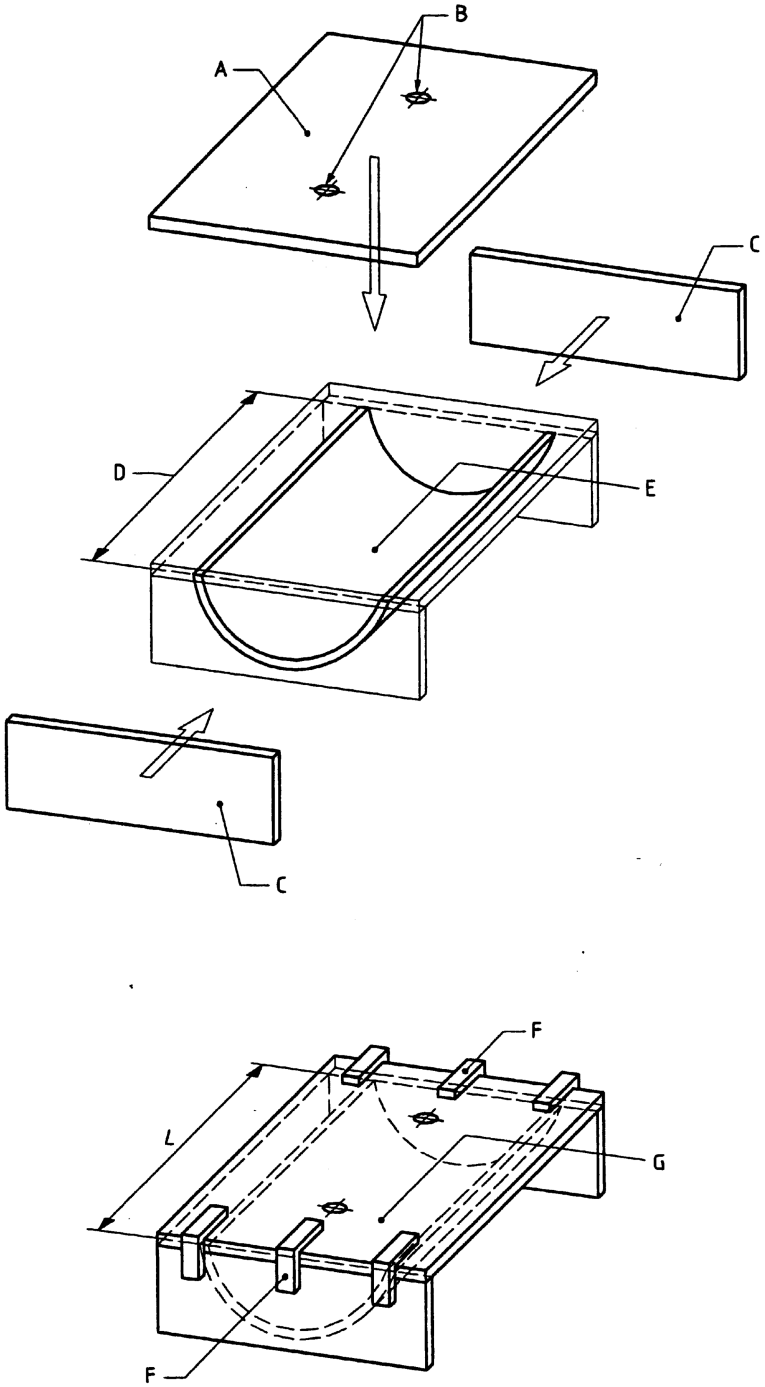
In case of dispute, the procedure given in Clause 8 shall be used.

## B.3 Blank test

Carry out the blank test in accordance with 9.2, ensuring that all materials that will come into contact with the test liquid will be included in the blank test and that they are present at the same surface-area-to-volume ratio as in the actual test arrangement.

## B.4 Sealing

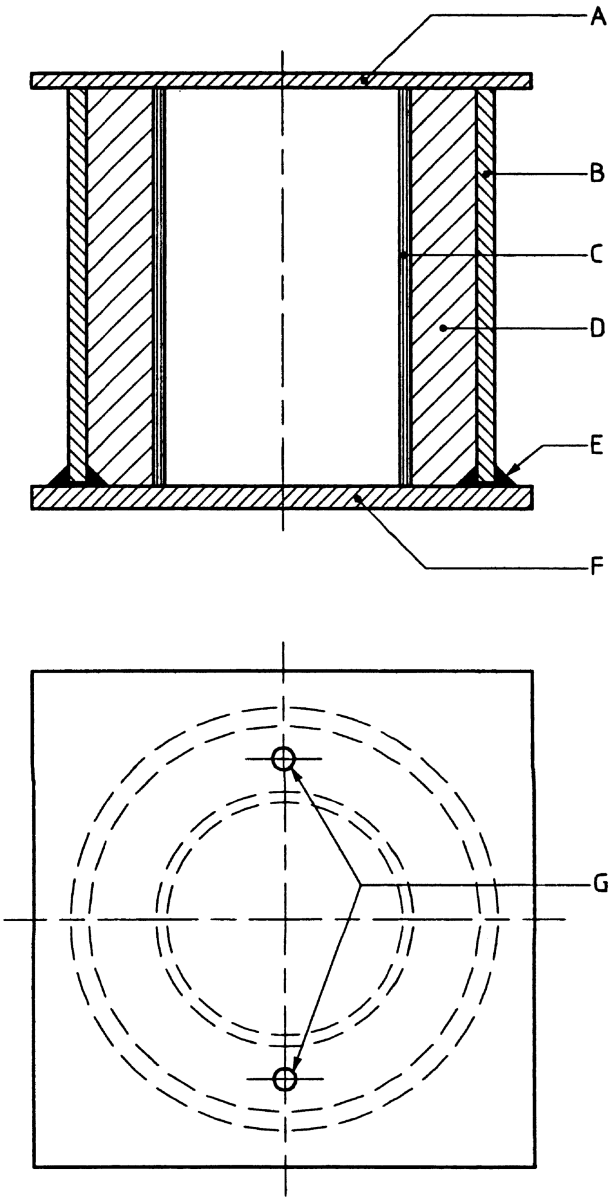
Secure the end pieces against the pipe segments to provide a seal, e.g. by means of clamps or bolts. If a seal cannot be achieved then ensure that any material used will not affect the outcome of the test, e.g. tape or film in the form of a gasket, with minimal surface in contact with test water (6.1).




**Key**

A cover of glass or stainless steel
B hole in top plate for filling with test water and release of air (sealed with stoppers)
C end piece of stainless steel
D length of test piece
E test piece
F clamps or bolts
G test piece completely filled with test water

**Figure B.1 — Test arrangement**



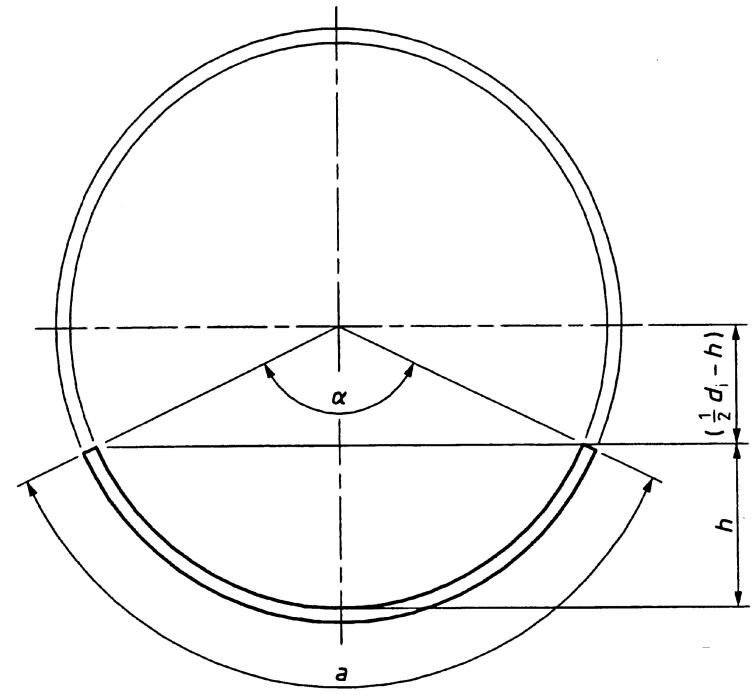

**Key**

A top plate of glass or stainless steel
B pipe wall
C cylinder of glass or stainless steel
D test water (test piece completely filled)
E seal between pipe section and plate, if necessary
F bottom plate of glass or stainless steel
G hole in top plate for filling with test water and release of air (sealed with stoppers)

**Figure B.2 — Test arrangement 2**

## B.5 Calculation of the surface area-to-volume ratio (S/V) value for test arrangement 1

Calculate the S/V value for test arrangement 1 in Figure B.3 when S and V are calculated as follows.




**Key**

a arc length of the pipe segment in millimetres

h height of the pipe segment in millimetres

**Figure B.3 — Cross section pipe segment**

From the cross section of the pipe segment calculate the arc length $a$ and the surface area $A$ of the hatched circle segment using the following formulae:

$$a = \frac{\alpha}{360} \times \pi d_i \quad \text{(B.1)}$$

where

$d_i$ is the internal diameter of the pipe from which the segment is taken, in millimetres;

$\alpha$ is the sector angle, in degrees, i.e.

$$\cos(1/2\alpha) = \frac{d_i - 2h}{d_i} \quad \text{(B.2)}$$

$$A = [(\frac{\alpha}{360}) \times (1/4\pi(d_i)^2)] - [(1/2d_i - h)^2 \times \tan(1/2\alpha)] \quad \text{(B.3)}$$

where

$A$ is the surface area of the hatched circle segment, in square millimetres;

$\alpha$ is the sector angle, in degrees;

$d_i$ is the internal diameter of the pipe from which the segment is taken, in millimetres.

$$S = 10^{-4} \times a \times L \quad \text{(B.4)}$$

where

$S$ is the inner surface area of the test piece (pipe segment), in square decimetres, exposed to the test water;

$L$ is the length of the pipe segment, in millimetres.

$$V = 10^{-6} \times A \times L \quad \text{(B.5)}$$

where

$V$ is the volume of the test water, in litres.

# Annex C
(informative)

# Examples of extended collection and analysis of migration waters

If more than three migration periods are specified, for example by national regulations, the migration sequence could be in accordance with Table C.1 (cold water test) or Table C.2 (warm/hot water test).

**Table C.1 — Sequence for obtaining migration water for 72 h extraction periods (cold water test)**

| Week | Number migration period | End of migration period | Duration of test water contact | Analysis of migration water |
|---|---|---|---|---|
| 1 | 1 | Friday | 3 d | analysed |
| 2 | 2 | Monday | 3 d | analysed |
| 2 | 3 | Thursday | 3 d | analysed |
| | | | | |
| 3 | 4 | Monday | 4d | Not analysed |
| 3 | 5 | Thursday | 3d | May be analysed |
| | | | | |
| 4 | 6 | Monday | 4d | Not analysed |
| 4 | 7 | Thursday | 3d | May be analysed |
| | | | | |
| 5 | 8 | Monday | 4d | Not analysed |
| 5 | 9 | Thursday | 3d | analysed |

**Table C.2 — Sequence for obtaining migration water for 24 h extraction periods (Warm and hot water test)**

| Week | Number migration period | End of migration period | Duration of test water contact | Analysis of migration water |
|---|---|---|---|---|
| 1 | 1 | Wednesday | 1 d | analysed |
| 1 | 2 | Thursday | 1 d | analysed |
| 1 | 3 | Friday | 1 d | analysed |
| | | | | |
| 2 | 4 | Monday | 3 d | Not analysed |
| 2 | 5 | Tuesday | 1 d | Not analysed |
| 2 | 6 | Wednesday | 1 d | May be analysed |
| 2 | 7 | Thursday | 1 d | May be analysed |
| 2 | 8 | Friday | 1 d | May be analysed |
| | | | | |
| 3 | 9 | Monday | 3 d | Not analysed |
| 3 | 10 | Tuesday | 1 d | Not analysed |
| 3 | 11 | Wednesday | 1 d | May be analysed |
| 3 | 12 | Thursday | 1 d | May be analysed |
| 3 | 13 | Friday | 1 d | May be analysed |
| | | | | |
| 4 | 14 | Monday | 3 d | Not analysed |
| 4 | 15 | Tuesday | 1 d | Not analysed |
| 4 | 16 | Wednesday | 1 d | May be analysed |
| 4 | 17 | Thursday | 1 d | May be analysed |
| 4 | 18 | Friday | 1 d | May be analysed |
| | | | | |
| 5 | 19 | Monday | 3 d | Not analysed |
| 5 | 20 | Tuesday | 1 d | Not analysed |
| 5 | 21 | Wednesday | 1 d | May be analysed |
| 5 | 22 | Thursday | 1 d | analysed |

# Annex D
(informative)

# Procedural tests using standard additions (positive controls)

Periodically establishing recovery levels of substances determined from analytical methods and specific test procedures is good laboratory practice. Any requirements for particular products will be specified in the referring standards or by the appropriate national regulatory authorities.

a) A positive control should be included, where appropriate, in order to ensure that there are no significant losses of the measured substance, migrating from the test piece, during the extraction periods or during sampling for analysis (e.g. by evaporation, adsorption on test vessels, etc.).

b) A solution of known concentration of the substance to be determined should be prepared using the test water and further treated as described in 9.2 (procedural blank tests).

c) If the recovery of the substances does not meet the requirement specified in either the product/system standard (or by regulations), then the whole test procedure should be checked, and if necessary repeated, until the required performance is obtained.

# Annex E
(informative)

# Flow diagrams (Figures E.1 and E.2) for migration test procedure for cold water temperature and elevated temperature

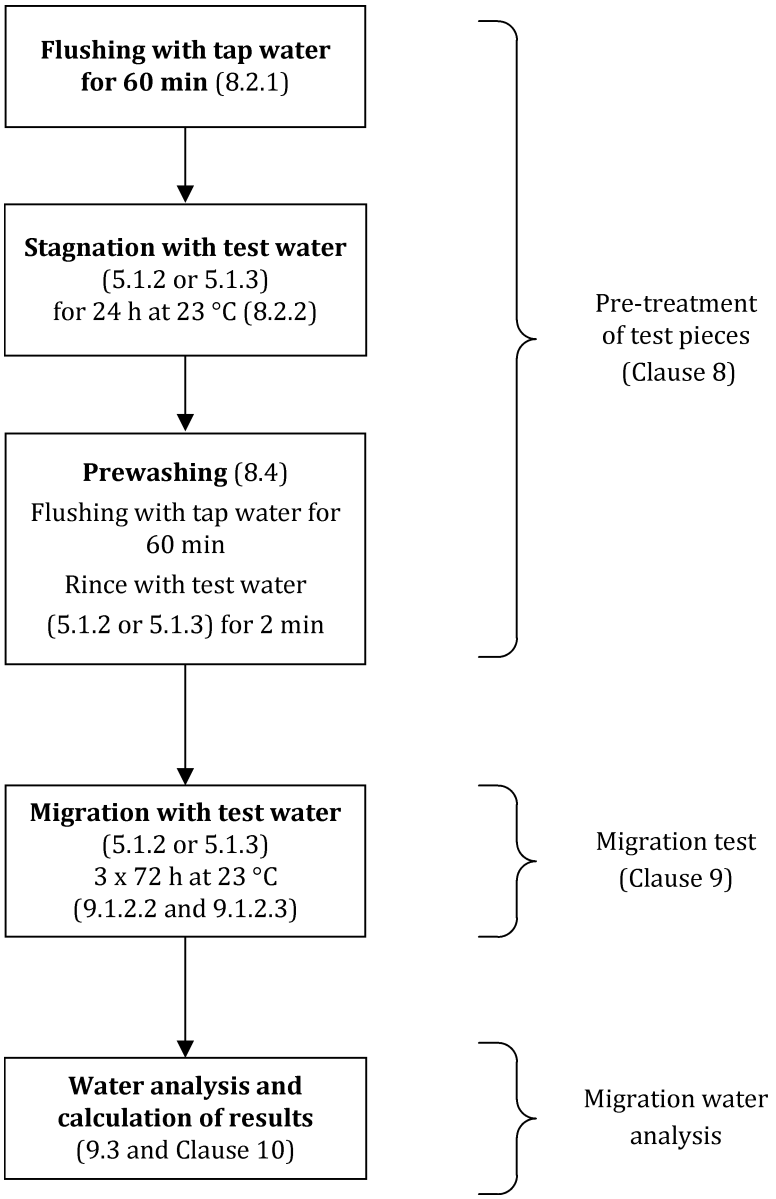



**Figure E.1 — Testing at 23 °C**

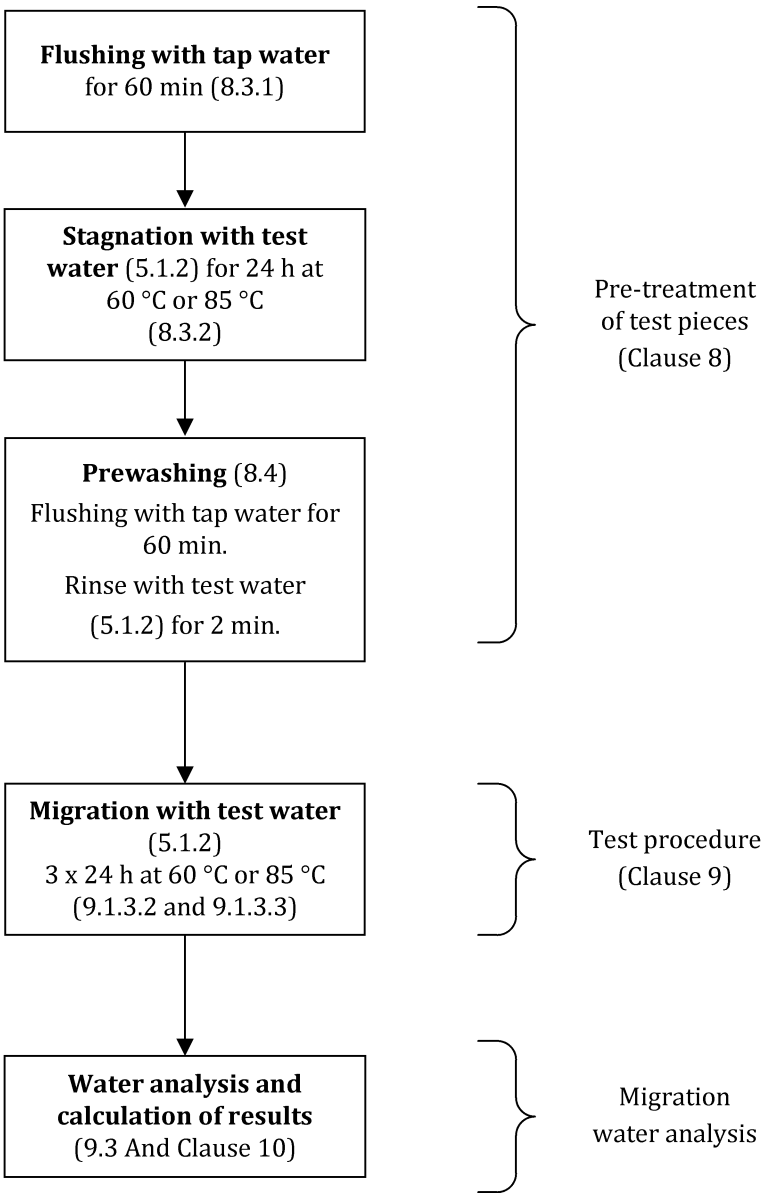



**Figure E.2 — Testing at elevated temperature**

# Bibliography

EN ISO/TS 13530, *Water Quality – Guidance on analytical quality control for chemical and physiochemical water analysis. (ISO/TS 13530)*