BS EN 12873-1:2014

BSI Standards Publication

Influence of materials on water intended for human consumption — Influence due to migration

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

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National foreword

This British Standard is the UK implementation of EN 12873-1:2014. It supersedes BS EN 12873-1:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EH/6, Effects of materials on water quality.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Influence of materials on water intended for human consumption - Influence due to migration - Part 1: Test method for factory-made products made from or incorporating organic or glassy (porcelain/vitreous enamel) materials

Influence des matériaux en contact sur l'eau destinée à la consommation humaine - Influence de la migration - Partie 1: Méthode d'essai des matériaux de fabrication industrielle constitués de ou contenant des matériaux organiques ou vitreux (émaux vitrifiés)

Einfluss von Materialien auf Trinkwasser - Einfluss infolge der Migration - Teil 1: Prüfverfahren für fabrikmäßig hergestellte Produkte aus oder mit organischen oder glasartigen Materialien (Emails/Emaillierungen)

This European Standard was approved by CEN on 14 May 2014.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

Foreword

This document (EN 12873-1:2014) 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 January 2015, and conflicting national standards shall be withdrawn at the latest by January 2015.

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

This document supersedes EN 12873-1:2003.

The major revisions of EN 12873-1:2003 are:

- the inclusion of procedures for testing glassy (porcelain/vitreous enamel) materials. This inclusion enabled an improvement of the title of the standard;
- the test temperatures, outlined in Clause 4 'Principle', are more specific;
- the use of chromic acid is removed because of safety concerns;
- the examples of extended collection and analysis of migration waters (Annex C) are more systematic.

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

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 European Standard 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.

Annex F, which is informative, provides information on a Cell system for testing glassy materials.

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

This standard, Part 1, is the first 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 membrane water treatment systems.

1 Scope

This European Standard specifies a procedure to determine the migration of substances from factory-made or factory-applied products for use in contact with water intended for human consumption. Materials used to make such products include plastics, rubber and glassy (porcelain/vitreous enamel) materials.

This European Standard is applicable to products 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 the finished products.

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 15826, *Vitreous and porcelain enamels - Terminology*

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

EN ISO 28764, *Vitreous and porcelain enamels - Production of specimens for testing enamels on sheet steel, sheet aluminium and cast iron (ISO 28764)*

3 Terms and definitions

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

3.1
test
technical operation that consists of the determination of one or more characteristics of a given product

3.2
test procedure
specified technical method for performing a test

3.3
test report
document that presents test results and other information relevant to a test

3.4
test laboratory
laboratory that performs tests

3.5
product
manufactured item, in its finished form, that comes into contact with water intended for human consumption, or a component part of a manufactured item

3.6
homogeneous product
a product where the water contact surface is made from the same material as the remainder of the product

3.7
non-homogeneous product
product where the water contact surface is made from a material that differs from those comprising the remainder of the product

3.8
fitting, ancillary
complete functional unit made up of one or more components or materials, parts of which are in contact with water, e.g. taps, valves, water meters, water heaters, water filters, pipe connectors and flexible hose assemblies

3.9
test sample
sample of a product submitted for testing

3.10
test piece
test sample, or a part of it, that is tested

3.11
tap water
water intended for human consumption (see also 5.1.1)

3.12
test water
water used for migration testing (5.1.2 and 5.1.3)

3.13
prewashing water
water used for prewashing (5.1.4)

3.14
blank water
test water (5.1.2 and 5.1.3) which has been kept at the same specified conditions as migration water (3.18) but without contact with test pieces

3.15
migration period
period of time (24 h or 72 h, see Clause 4) in which the migration is carried out under specified conditions

3.16
migration
movement of a substance or substances from test pieces into test water

3.17
migration water
test water after exposure to a test piece under specified conditions

3.18
migration rate
the mass of a measured substance or substances (in mg) migrating from one square decimetre of a test piece into the test water in one day at a specified temperature (°C)

3.19
lining
layer of material applied to a product and intended to come into contact with drinking water, e.g. the inside surfaces of pipes, fittings or storage vessels

Note 1 to entry: Excluded are layers, such as coatings, not intended for contact with drinking water, e.g. as applied to the outside surfaces of pipes and fittings for corrosion protection.

3.20
geomembranes
flexible water impermeable membranes normally used to avoid draining of stored water into surrounding soil and sub-soil strata

3.21
glassy material
porcelain, vitreous enamel coating (as defined in EN 15826) that is in contact with water and applied to a variety of products that produce or store water at elevated temperature

4 Principle

Each test piece is subjected to a specified pre-treatment procedure of stagnation and prewashing. The surface of the test piece that is exposed in practice to water intended for human consumption, is brought into contact with test water during at least three sequential migration periods. A migration period is either:

— 72 h at (23 ± 2) °C for products intended to come into contact with cold water;

— 24 h at a specified temperature at (60 ± 2) °C (warm water test) and/or (85 ± 2) °C (hot water test) for products intended to come into contact with warm or hot water.

Migration rates for the first three migration periods are determined by analysis of the required substances in the corresponding migration waters. Referring product standards and/or national regulatory authorities may specify the number of sequential migration periods to be carried out.

NOTE 1 The test is carried out under conditions to ensure that calculation of a reliable migration rate is facilitated. These conditions are not meant to simulate 'real use conditions'. Relating the results obtained from this standard to 'real use conditions' is carried out using a conversion procedure. This procedure will be specified in product standards or national regulations.

NOTE 2 The choice of the type of test water (chlorinated and/or chlorine-free), the temperature of the test water, the number of additional migration periods will be specified in product standards or national regulations.

NOTE 3 If testing at warm or hot temperature is required national regulations may require additional cold water testing.

5 Reagents

For the purposes of this standard, the listed reagents in Clause 5 will apply.

5.1 Waters to be used for testing

5.1.1 Tap water, Water that is intended for human consumption with a free chlorine content less than 0,2 mg/l as Cl_2.

5.1.2 Test water, Chlorine free water with a conductivity of < 2 mS/m and a total organic content (TOC) of < 0,2 mg/l, e.g. prepared by reverse osmosis, deionization or distillation, followed by activated carbon filtration.

5.1.3 Chlorinated test water, test water according to 5.1.2 will have an active chlorine content of (1 ± 0,2) mg/l as Cl_2 (5.3.1).

5.1.4 Prewashing water, prewashing water is tap water.

5.2 Cleaning liquids for glassware

5.2.1 Hydrochloric acid, concentrated (30 % mass per volume) analytical reagent grade.

5.2.2 Hydrochloric acid solution, prepared by slowly adding (0,5 ± 0,01) l of concentrated hydrochloric acid (5.2.1) to (0,5 ± 0,01) l of test water (5.1.2).

NOTE Care is needed because preparing the solution may generate heat.

5.2.3 Nitric acid, concentrated (65 % mass per volume) analytical reagent grade.

5.2.4 Nitric acid solution, (2 % mass per volume) is prepared by slowly adding (0,15 ± 0,01) l of concentrated nitric acid (5.2.3) to (5,0 ± 0,1) l of test water (5.1.2).

NOTE Care is needed because preparing the solution may generate heat.

5.3 Other reagents

5.3.1 Sodium hypochlorite solution, prepared from a technical or general purpose reagent grade of sodium hypochlorite (NaOCl), using test water (5.1.2) and having a known concentration of about 0,1 % by mass of free chlorine determined in accordance with EN ISO 7393-2.

Unless tests have proved otherwise the sodium hypochlorite solution should be considered unstable and prepared on the day of use.

6 Apparatus

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

The material PTFE should only be used when there is a small contact area with the test water. Thus PTFE is unsuitable for containers. Usually glassy materials are tested only for release of metal ions, consequently, the use of substances, such as PTFE and silicones, can be tolerated.

6.2 Plates stainless steel, mild steel, (sand-blasted) glass or concrete/cement-mortar plates, for testing linings or the material itself. The plates shall be covered completely with the test material.

NOTE In the case of glassy materials it is possible to coat only one surface.

6.3 Equipment, capable of maintaining the appropriate migration temperature, e.g. (23 ± 2) °C, or (60 ± 2) °C or (85 ± 2) °C.

6.4 Laboratory glassware, steel and stainless-steel plates and sand blasted glass plates shall be cleaned by washing with a biodegradable laboratory detergent, followed by exposing to either hydrochloric acid solution (5.2.2) (except for stainless steel) or nitric acid solution (5.2.4) for 2 to 3 days and finally by thoroughly rinsing with test water (5.1.2). Drain the plates and dry them in a hot air cabinet.

7 Test samples and test pieces

7.1 Sampling, transport and storage of test samples

Sample products in accordance with the relevant product standards or national regulations where applicable.

Ensure that the surface of test pieces intended to come into contact with test water shall be free from adhesive tape, labels, ink or pencil marks. Care shall be taken to ensure that the transport and storage conditions shall not influence the test results.

Ensure that transportation simulates the manufacturer's normal practice; e.g. employment of end-caps if used.

If the test samples have to be stored, then this should be done in the absence of light at (23 ± 5) °C, in stainless-steel containers, tissue-paper, glassware or other materials, that do not influence the results of the migration test, except where the supplier of the test samples provides alternative written storage instructions that are those that the products are subject to in practice.

Storage envelopes or pockets should not be sealed, dusting powder should not be used and cleaning should not be carried out unless any of these procedures form part of the usual production procedures. Where appropriate, storage containers should be cleaned using the same procedures as are used for the test containers.

7.2 Test piece preparation

7.2.1 General

Prepare test pieces in such a way that only the surface intended to come into contact with drinking water is exposed to the test water (5.1.2 and/or 5.1.3).

For homogeneous materials it is acceptable to expose the whole test piece to the test water, including surfaces not intended to come into contact with drinking water. Calculate the total surface area of the test piece in contact with the testing water. The calculation of the surface-area-to-volume (S/V) ratio (7.3) shall include the total surface area of the test piece in contact with the testing water.

If a homogeneous product has to be cut to obtain the required test piece size, this should be done in a manner that ensures the area of the cut edges is as small as possible.

7.2.2 Pipes and hoses

Prepare test pieces for pipes and hoses in the following manner:

— Use the internal diameter for the S/V ratio calculation;

— Assess migration from pipes with an internal diameter ≤ DN 80 by using pipes as test vessels with a length that provides sufficient migration water for analysis;

— Migration from pipes with an internal diameter > DN 80, where the internal and external surfaces have the same properties, can be assessed by either immersing pipe segments in test water (5.1.2 and/or 5.1.3) in glass containers or using one of the test arrangements detailed in Annex B;

— Test pieces from composite pipes, i.e. pipes whose internal and external surfaces have different properties, with an internal diameter > DN 80, shall be tested in such a way that only the surface area intended to come into contact with drinking water is exposed to the test water (5.1.2 and/or 5.1.3). Suitable arrangements are given in Annex B.

7.2.3 Fittings and ancillaries

Prepare test pieces for fittings and ancillaries in the following manner:

— The number of fittings or ancillaries to be tested has to be chosen in such a way that the requirements described in 7.2.1 are satisfied;

— Assess migration from fittings and ancillaries by immersion according to the requirements described in 7.2.1.

7.2.4 Factory applied linings (excluding glassy materials)

Prepare test pieces for factory applied linings (excluding glassy materials) in the following manner:

— Pipes with factory applied linings shall be tested according to 7.2.2, taking the internal diameter into account;

— If it is not possible to test the original final product then test pieces shall be prepared by the manufacturer or a contractor in accordance with the manufacturer's written instructions under supervision of the responsible body. Test plates shall be fully coated in accordance with the standard factory procedure. If this is impractical, then a method giving an equivalent product surface to that produced by the standard factory procedure shall be used;

— Assess migration from other linings applied to other products by immersing plates (e.g. steel, stainless steel or (sand-blasted) glass plates), completely coated with the product, in the test water (5.1.2 and/or 5.1.3);

— The number of coated plates has to be chosen in such a way that they meet the requirements of 7.3 when tested in containers (6.1) that are completely filled with test water (5.1.2 and/or 5.1.3) and closed with a lid.

7.2.5 Geomembranes

Geomembranes are tested in the following manner:

— Geomembranes (3.21) may be homogeneous (composed of one material only) or non-homogeneous (comprising a complex laminate system of several materials);

— Assess migration from geomembranes, if homogeneous, by immersing test pieces in the test water (5.1.2 and/or 5.1.3). If non homogeneous go to 7.2.8.

7.2.6 Glassy materials

If it is not possible to test the original final product then test pieces shall be prepared by the manufacturer or a contractor in accordance with the manufacturer's written instructions under supervision of the responsible body. Test plates shall be coated in accordance with the standard factory procedure. If this is impractical, then a method giving an equivalent product surface to that produced by the standard factory procedure shall be used.

Assess migration by immersing in or exposing coated plates to the test water (5.1.2 and/or 5.1.3). Testing can be carried out using a cell system according to Annex F.

The number of coated plates has to be chosen in such a way that they meet the requirements of 7.3 when tested in containers (6.1) that are completely filled with test water (5.1.2 and/or 5.1.3) and closed with a lid.

Test pieces shall be prepared in accordance with EN ISO 28764 if applicable.

7.2.7 Other homogeneous products

Migration from other homogeneous products shall be assessed using test pieces immersed in the test water (5.1.2 and/or 5.1.3).

7.2.8 Other non-homogeneous products

Test pieces derived from non-homogeneous products shall have the same composition and structure as the finished products.

Test 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 (5.1.2 and/or 5.1.3). (See also Annexes B and F).

7.3 Surface area-to-volume ratio (S/V)

The ratio of the surface area (S) of the test piece intended to come into contact with test water to the volume (V) of the test water shall be expressed per decimetre, i.e dm^{-1} (which is dm^2/dm^3 or dm^2/l). Use a surface area-to-volume ratio in the range of 5 dm^{-1} to 40 dm^{-1}.

S/V ratios may be specified by national regulations.

If the test piece has an irregular or textured surface then, for calculations, the surface is considered to be smooth. If the shape of the test piece is such that accurate calculation of the surface is impracticable then use an estimated surface area of the test piece. In this case the length and width shall be recorded together with a sufficiently detailed description of the product(s) to enable further test pieces to be prepared that will be within ± 10 % of the surface area of the original test piece.

The supplier of the test samples shall be instructed to ensure that they represent the product as it is used in contact with water intended for human consumption.

8 Pre-treatment of test pieces

8.1 General

Test pieces are pre-treated prior to migration testing by procedures involving flushing, stagnation and prewashing.

If it is not possible, because of laboratory time constraints, to carry out the pre-treatment and test procedure without a break, the break shall be during the pre-treatment procedure. The migration periods shall be consecutive and without a break.

8.2 Test pieces to be tested at (23 ± 2) °C (Cold water test)

8.2.1 Flushing

If possible, flush test pieces with flowing tap water (5.1.1) for (60 ± 5) min flowing from the test piece with a speed of 1 m/min to 3 m/min.

In order to avoid the use of large quantities of water the arrangement described in Annex A may be used to flush large diameter products.

Test pieces that cannot be flushed shall be placed in an appropriate vessel, e.g. a bucket, having a flow of water from the bottom upwards such that the calculated speed with regard to the upper open surface of the vessel is 1 m/min to 3 m/min for (60 ± 5) min.

8.2.2 Stagnation with test water

The stagnation procedure involves the following steps:

— test pieces shall be immersed in, filled with, or exposed to, test water (5.1.2 and/or 5.1.3) for a period of (24 ± 1) h at (23 ± 2) °C;

— remove the water;

— prewash the test pieces according to 8.4.

8.3 Test pieces to be tested at elevated temperature (60 °C and/or 85 °C)

8.3.1 Flushing

Flush test pieces according to 8.2.1

8.3.2 Stagnation with test water at elevated temperature

The stagnation procedure at elevated temperature involves the following steps:

— test pieces shall be immersed in, filled with, or exposed to, test water (5.1.2 and/or 5.1.3) for a period of (24 ± 1) h at (60 ± 2) °C (warm water test) or (85 ± 2) °C (hot water test);

— remove the water;

— prewash the test pieces according to 8.4.

8.4 Prewashing

The prewashing procedure involves the following steps:

— flush test pieces according to 8.2.1;

— rinse the test pieces with test water (5.1.2 and/or 5.1.3) for 2 min.

9 Test procedure

9.1 Migration of substances

9.1.1 General

The migration procedure (9.1.2) shall be performed at (23 ± 2) °C. Products intended to come in contact with drinking water at elevated temperatures have to be tested at elevated temperatures (9.1.3) and at (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.

9.1.2 Cold water test procedure

9.1.2.1 Carry out the following procedure using test water without chlorine (5.1.2) and/or test water with chlorine (5.1.3).

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 (5.1.2) 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 (5.1.2).

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 or national regulations) 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” ISO/TS 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 need to be 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:

$$C^{T}{}_{n} = a^{T}{}_{n} - b^{T}{}_{n} \quad (1)$$

where

c^T_n is the concentration of the measured substance in mg/l;

a^T_n is the concentration of the substance in mg/l measured in the migration water;

b^T_n 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^T_n for a migrated substance from the concentration c^T_n as followed:

$$M^T_n = c^T_n / (S/V \times t) \quad (2)$$

where

M^T_n is the migration rate for the n^{th} migration period (3.15) 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 $\overline{M}^T_n$ for the duplicate values of M^T_n for each test water (5.1.2 and 5.1.3).

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 may 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 11.4.

11.2 General information

General information on the test report shall include:

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

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

— name and address of client;

— description and identification of the test item;

— the proposed use of the product;

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

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

— a statement that the report shall not be reproduced, except in full with the written approval of the testing laboratory;

— the information on the product shall at least include;

  — trade name or designation of manufactured product;

  — complete identification and date of receipt of test item and date of performance of test;

  — names of the primers and undercoats used, together with the wet film thickness of each lining applied;

  — details of the test piece preparation;

  — name of the manufacturer of the product;

  — production place and date;

  — organisation submitting the sample;

  — organisation responsible for preparing the test pieces;

  — description of sampling procedure.

11.3 Information on the test procedure

The information on the test procedure shall include:

— reference to this standard and (if applicable) to the referring standard or national regulation;

— number of test pieces used together in a migration;

— volume of the test water (V) in litres;

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

— S/V ratio used;

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

— test waters and test temperature;

— any deviation from the test procedure specified in this standard;

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

— dates of start and completion of the test.

11.4 Test results

The test results, including 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, for example:

— 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]
$a^T{}_n$				
$\overline{a}^T{}_n$				
$b^T{}_n$				
$\overline{b}_n^T$				
$c^T{}_n$				
$\overline{M}^T{}_n$				
C_{tap}				
[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 Figures A.1 and A.2.

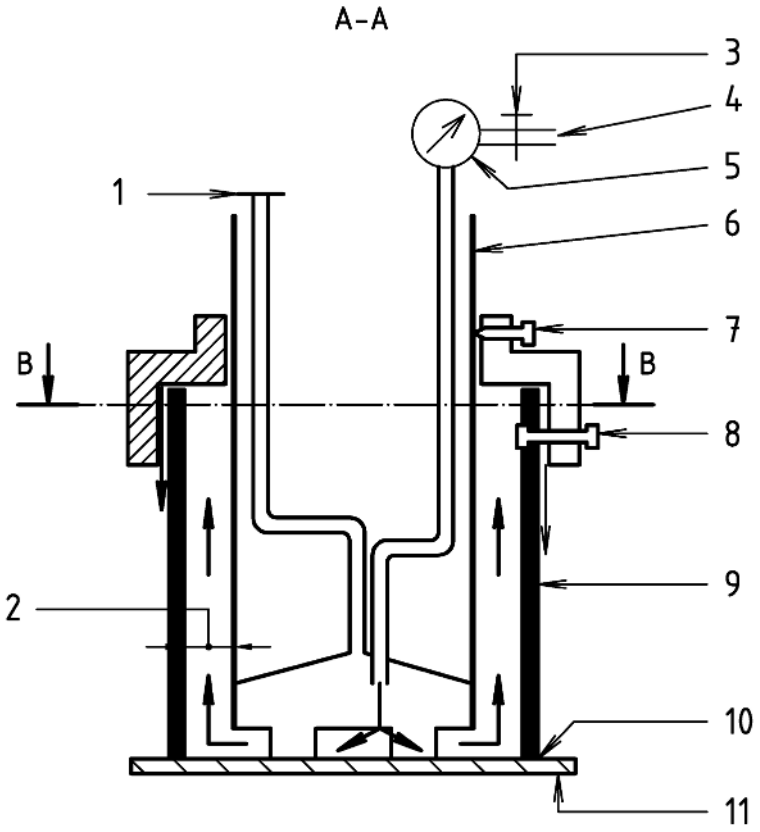
This arrangement is designed to avoid the use of large quantities of water to produce the required flow rate over the test piece surface.

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 metre 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 stabilise the set up.

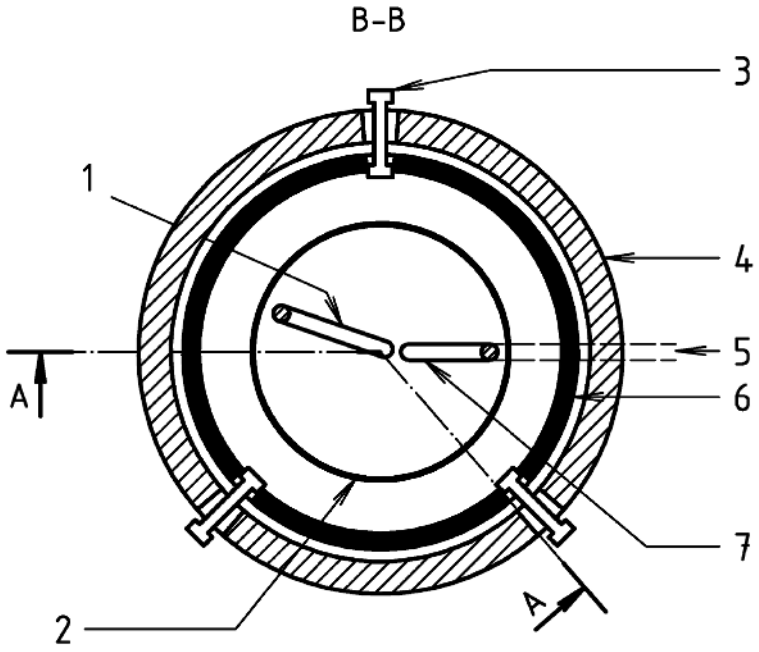
Towards the top of the cylinder there is an adjustable ring with three or four screws to adjust the height of the ring for different lengths of test pieces. There are also three or four screws which can be tightened into the outside of the test piece in order to ensure that the cylinder is centred within 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
2 gap > 5 mm
3 valve
4 wash water
5 flow metre
6 main cylinder
7 height adjusting crew
8 centering screw
9 test piece
10 seal
11 base plate

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



Key

1 air vent
2 main cylinder
3 centering screw
4 adjustable ring
5 wash water
6 test piece
7 water inlet

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

Annex B
(informative)

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

B.1 Arrangements for testing

Use the test arrangements shown in Figures 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.

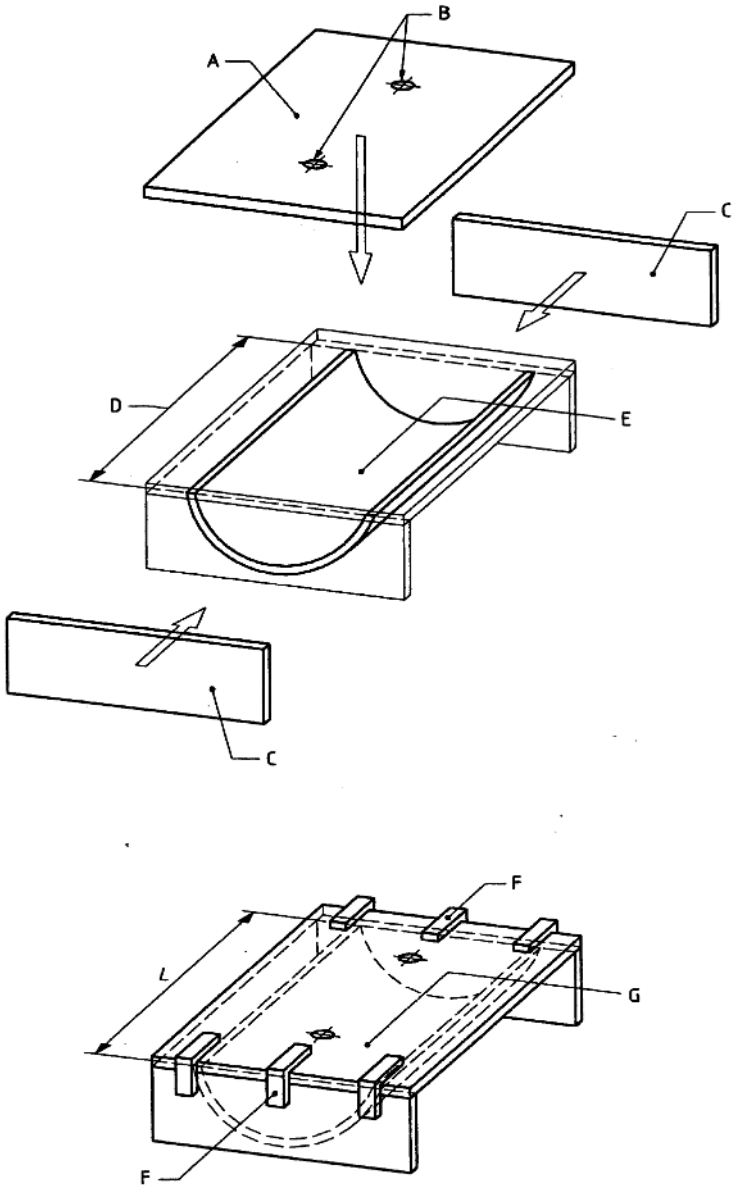
In case of dispute, the procedure given in Clause 8 shall be used.

B.3 Blank test

Carry out the blank test in accordance with 9.2.1, ensuring that all materials that will come into contact with the test water 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

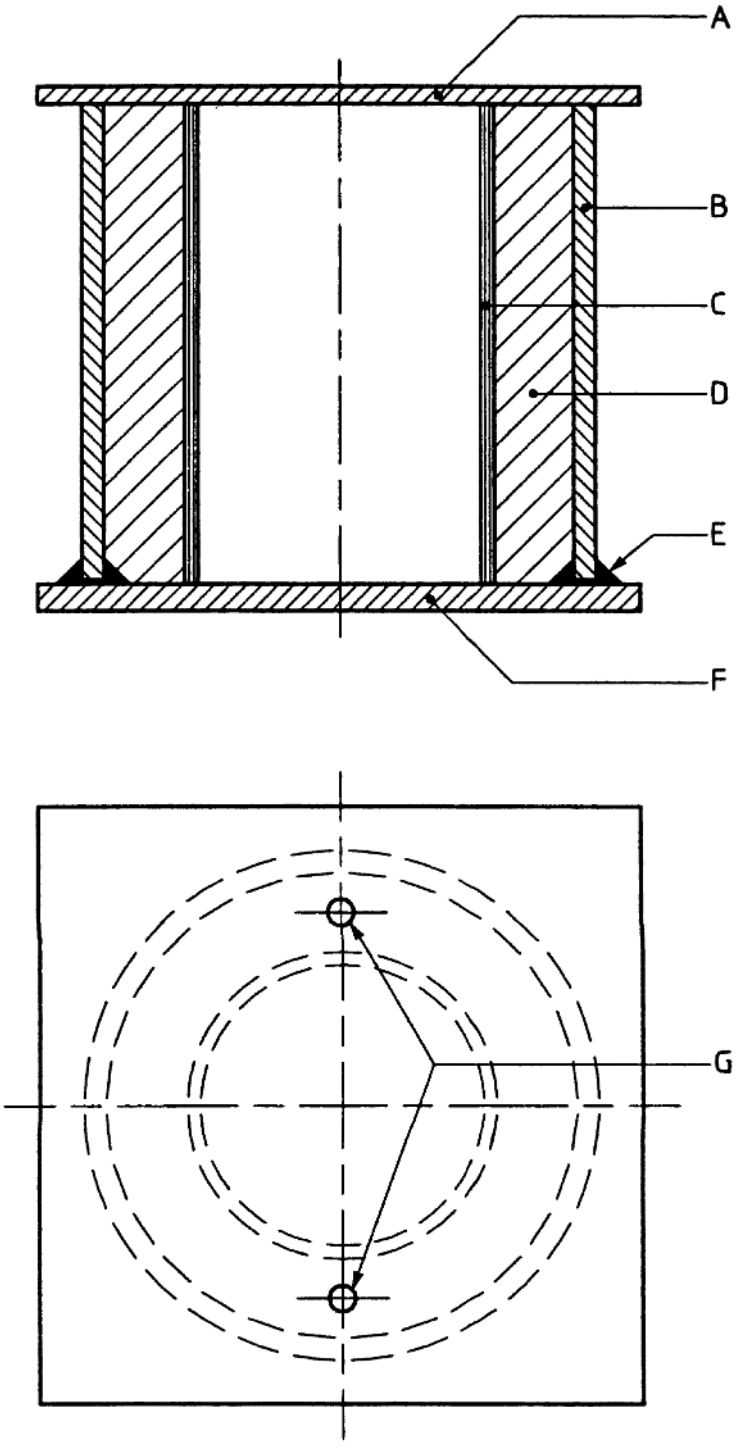
Secure the end pieces against the pipe segments to provide a seal, e.g. by means of clamps or bolts. If a seal cannot be achieved then ensure that any material used will not affect the outcome of the test, e.g. tape or film in the form of a gasket, with minimal surface in contact with test water (6.1).



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 1



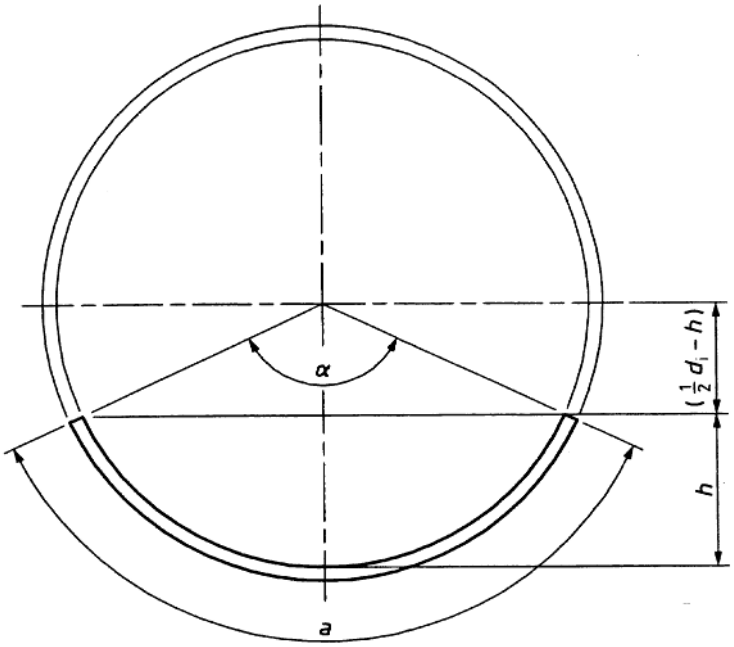
Key

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 stainles 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.1 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:

$$a = \frac{\alpha}{360} \times \pi d_i \tag{B.1}$$

where

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

α is the sector angle, in degrees i.e.

$$\cos\left(\frac{\alpha}{2}\right) = \frac{d_i - 2h}{d_i} \tag{B.2}$$

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

where

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

α 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 decimeters, 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.

1) 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 migration periods or during sampling for analysis (e.g. by evaporation, adsorption on test vessels, etc.).

2) 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).

3) If the recovery of the substances does not meet the requirement specified in either the referring standard or by the national regulatory authorities, then the whole test procedure should be checked, and if necessary repeated, until the required performance is obtained.

Annex E
(informative)

Flow diagrams for migration test procedure for cold water temperature and elevated temperature

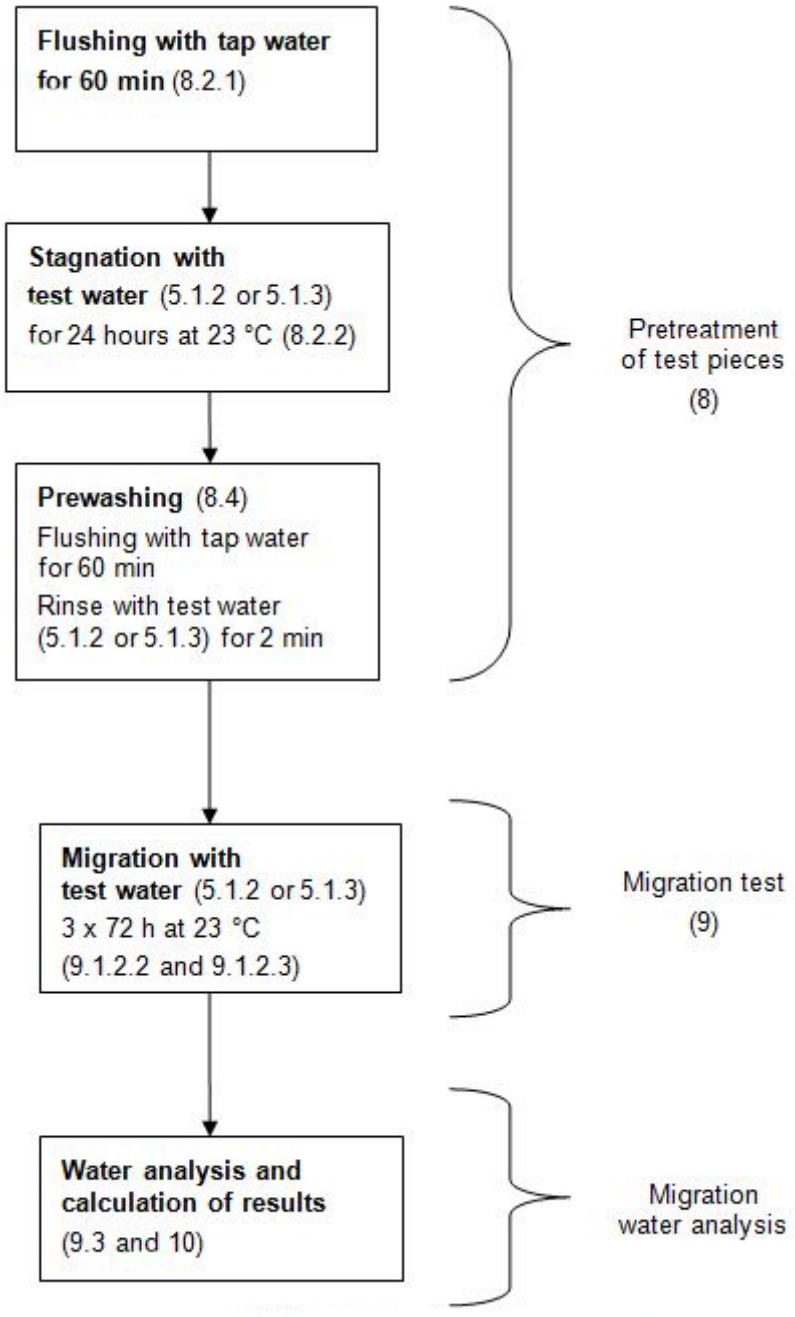


Figure E.1 — Testing at 23 °C

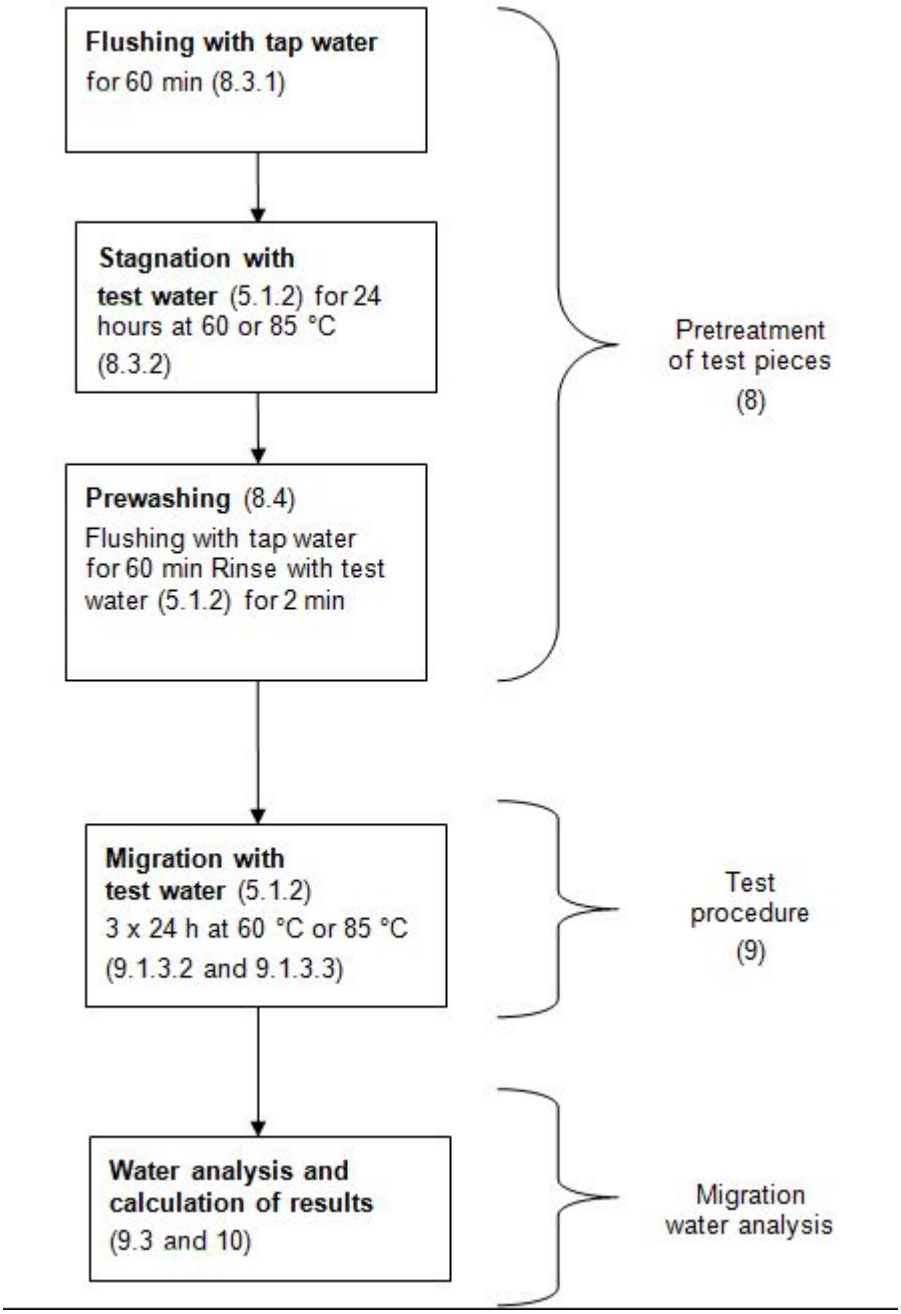
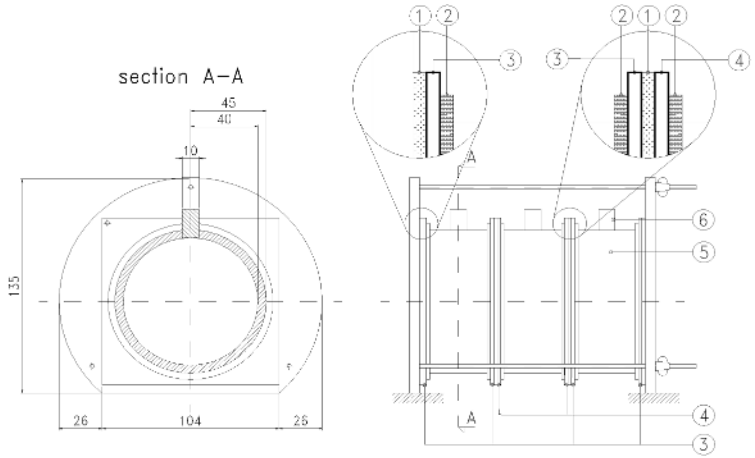


Figure E.2 — Testing at elevated temperature

Annex F
(informative)

Description of a cell system for testing glassy materials

The apparatus contains three cells, one for the blank test in the centre and two testing cells at each side of the blank. Each cell contains two test plates in contact with test water.



Key

1	PTFE thermal insulating plate	dimension min.: 105 mm × 105 mm, thickness 2 mm
2	silicone rubber gaskets	internal Ø 80 mm, external Ø min. 90 mm
3	test plate	dimension min.: 105 mm × 105 mm, thickness 2 mm
4	blank plate – Borosilicate Glass	dimension min.: 105 mm × 105 mm, thickness 2 mm
5	glass ring – Borosilicate Glass	internal Ø 80 mm, external Ø min. 90 mm, high 36 mm, discharge hole Ø 10mm
6	silicone rubber stoppers	Ø 10 mm, height 20 mm

Figure F.1 — Diagram of cell system

The migration test apparatus shall be assembled vertically creating three adjacent cells, one for a blank test in the centre and two test cells on both sides of it (Figure F.1).

A PTFE insulating plate is put between the enamelled sample plate, in contact with the non-enamelled face, and a blank sample plate, made from borosilicate glass, as shown in Figure F.1 with careful placing of the silicone rubber gaskets between the cell glass ring and the sample plates, and ensuring that the silicone rubber gaskets do come out of the glass ring rim. In this way all the cells have 2 coated faces in contact with test water.

After tightening the screws, the cell is placed horizontally and the separate parts of the apparatus filled with test water (5.1.2), taking care to eliminate any air bubbles that may exist near the walls. Then the apparatus is closed and the relevant migration procedure carried out.

Calculation of the surface area to volume (S/V) is shown in Table F.1.

Table F.1 — Calculation of the surface area to volume

Surface				**Volume**			**S/V**
Internal diameter 2 *r*	Surface	N° of sample plates p. cell	Total attacked Surface p. cell	Glass Cell height (*h*)	Silicon gasket height (*h*)	Volume	
dm	dm^2		dm^2	dm	dm	dm^3	dm^{-1}
	$\pi \times r^2$		$2\pi \times r^2$			$\pi \times r^2 \times h$	
0,80	0,50	2	1,00	0,36	0,02	0,20	5

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

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