BRITISH STANDARD

BS EN
14944-1:2006

Influence of cementitious products on water intended for human consumption — Test methods —

Part 1: Influence of factory made cementitious products on organoleptic parameters

The European Standard EN 14944-1:2006 has the status of a British Standard

ICS 13.060.20; 67.250

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 14944-1:2006.

The UK participation in its preparation was entrusted to Technical Committee EH/6, Effects of materials on water quality, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 47 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 April 2006

ISBN 0 580 48154 9

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14944-1

April 2006

ICS 13.060.20; 67.250

English Version

Influence of cementitious products on water intended for human consumption - Test methods - Part 1: Influence of factory made cementitious products on organoleptic parameters

Influence des produits à base de ciment sur l'eau destinée à la consommation humaine - Méthodes d'essai - Partie 1: Influence des produits à base de ciment fabriqués en usine sur les paramètres organoleptiques

Einfluss von zementgebundenen Produkten auf Wasser für den menschlichen Gebrauch - Prüfverfahren - Teil 1: Einfluss fabrikmäßig hergestellter zementgebundener Produkte auf organoleptische Parameter

This European Standard was approved by CEN on 13 February 2006.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 14944-1:2006: E

Contents

Foreword

This document (EN 14944-1:2006) 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 October 2006, and conflicting national standards shall be withdrawn at the latest by October 2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

It describes a test method to determine the influence(s) of factory made cementitious products on the organoleptic parameters of water intended for human consumption.

Annex A, which is normative, describes additional procedures for testing factory made pipes (cement mortar lined and concrete).

Annex B, which is normative, describes additional procedures for testing factory made fittings (cement mortar lined and concrete).

Annex C, which is normative, describes additional procedures for testing factory made storage systems (cement mortar, cement mortar lined and concrete).

Annex D, which is informative, provides examples of typical test pieces and test conditions as a function of S/V ratio.

Annex E, which is informative, describes test arrangements for testing factory made cementitious products

Annex F, which is normative, describes additional procedures for testing factory made cementitious products at elevated temperature.

Annex G, which is informative, provides a means of discriminating between porous and non-porous coatings on factory made products.

Annex H, which is informative, provides a schematic description of the test (preconditioning and migration) procedure.

This European Standard provides a bibliography.

This European Standard will result in one of a series of standards that support appropriate standards.

This European Standard is Part 1 of a series dealing with the influence of cementitious and associated non-cementitious products/materials on water intended for human consumption, including:

— Part 1: Influence of factory made cementitious products on organoleptic parameters

— Part 2[1]: Influence of site-applied cementitious materials and associated non-cementitious products/materials on organoleptic parameters

— Part 3: Migration of substances from factory made cementitious products.

— Part 4[2]: Migration of substances from site-applied cementitious materials and associated non-cementitious products/materials.

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

---

[1] The work on Part 2 of EN 14944 has not yet begun.

[2] The work on Part 4 of EN 14944 has not yet begun.

Introduction

With respect to any potential adverse effects of products and materials on the quality of water intended for human consumption, it should be understood that relevant national regulations remain in force until verifiable European acceptance criteria are adopted.

1 Scope

This European Standard specifies a method to determine the influence of factory made cementitious products on the odour, flavour, colour and turbidity of test waters after contact with the products.

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

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. 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 1622:1997, *Water analysis — Method for the determination of threshold odour number (TON) and threshold flavour number (TFN)*

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*

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 27888, *Water quality — Determination of electrical conductivity (ISO 7888:1985)*

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)*

EN ISO 7027:1999, *Water quality — Determination of turbidity (ISO 7027:1999)*

EN ISO 7887:1994, *Water quality — Examination and determination of colour (ISO 7887:1994)*

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 7393-1:1985)*

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 7393-2:1985)*

EN ISO 9963-2, *Water quality — Determination of alkalinity — Part 2: Determination of carbonate alkalinity (ISO 9963-2:1994)*

EN ISO 16264, *Water quality — Determination of soluble silicates by flow analysis (FIA and CFA) and photometric detection (ISO 16264:2002)*

ISO 6058, *Water quality — Determination of calcium content — EDTA titrimetric method*

ISO 10523, *Water quality — Determination of pH*

3 Terms and definitions

For the purpose of this European Standard, the following terms and definitions apply.

3.1
appropriate body
certification body, inspection body or test laboratory, as relevant to a particular requirement

3.2
cementitious product
factory made product containing a cementitious material supplied in the hardened state with a formed surface prior to its incorporation into the construction works

3.3
cementitious 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-cementitious product
product which is applied to the surface of a cementitious 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 (25μm - 200μm thickness) surface layer to a cement mortar lining in order to restrict (but not prevent) interactions between the mortar and conveyed water (ISO 16132 [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 spray-applied to a laboratory test plate (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 to a substrate by the chosen method

3.9
odour
organoleptic attribute perceptible by olfactory organ on sniffing certain volatile substances (ISO 5492 [2])

3.10
flavour
complex combination of the olfactory, gustatory, and trigeminal sensations perceived during tasting. The flavour may be influenced by tactile, thermal, painful and/or kinaesthetic effects (ISO 5492 [2])

3.11
colour
optical property that causes the changing of the spectral composition of transmitted visible light measured at three wavelengths (see section 3 of EN ISO 7887:1994)

3.12
turbidity
reduction of transparency of a water due to the presence of undissolved matter (see 3.1 of EN ISO 7027:1999)

3.13
threshold odour number (TON)
dilution ratio of the migration water with the reference water at the same temperature, beyond which this diluted sample does not have any perceptible odour (see EN 1622)

3.14
threshold flavour number (TFN)
dilution ratio of the migration water with the reference water at the same temperature, beyond which this diluted sample does not have any perceptible flavour (see EN 1622)

3.15
testing panel:
group of people meeting the relevant requirements of EN 1622

3.16
test
technical operation that consists of the determination of one or more characteristics of a given product

3.17
test procedure
specified technical method for performing a test

3.18
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

3.19
test piece
the sample or portion which is to be conditioned, treated or otherwise prepared to be tested to obtain a single test result

3.20
nominal diameter (DN/ID) or (DN/OD)
numerical designation of the size of a component, which is a whole number approximately equal to the actual dimensions in millimetres. This applies to either the internal diameter (DN/ID) or the external diameter (DN/OD).

3.21
preconditioning
succession of contact periods of a test piece with the preconditioning water (3.22) before contact with the test water

3.22
preconditioning water
water used for preconditioning prepared as described in 5.4.1

3.23
reference water
water described as without odour, flavour, colour and turbidity conforming to the requirements in 5.4.2

3.24
test water
water used for testing purposes prepared as described in 5.4.3 and 5.4.4

3.25
migration water:
test water which has been in contact with a test piece under specified conditions

3.26
blank water
test water which has been kept at the same specified conditions as migration water but without contact with the test piece

3.27
disinfection treatment water
preconditioning water containing chlorine as described in 5.3.2

3.28
tap water
drinking water distributed by a public supplier

NOTE 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 normative Annexes A, B and C.

3.29
demineralised water
water conforming to the requirements in EN ISO 3696 for Grade 3.

4 Principle

Each test piece is subjected to a specified preconditioning procedure where the surface which is exposed in practice 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 {with 50 mg/l Cl_2 (5.3.2) if requested to simulate chlorine disinfection treatment}.

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.

After each contact period, each migration water is assessed for odour, flavour, colour and turbidity.

NOTE The selection of:

a) the appropriate test water, chlorinated and/or chlorine-free, from those made available in this European Standard;
b) the temperature of the test water;
c) the need for chlorination during preconditioning;

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

5 Reagents

5.1 General requirements

Use only reagents of analytical quality unless otherwise stated.

5.2 Chlorine neutralisation reagents

5.2.1 Ascorbic acid solution, prepared by dissolving (4,0 ± 0,1) g of ascorbic acid in one litre of reference water (5.4.2).

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

5.2.2 Sodium thiosulfate solution, comprising a solution of 3,5 g/l of sodium thiosulfate pentahydrate ($Na_2S_2O_3$.$5H_2O$) and stored in the absence of light at a temperature below 10°C, for a maximum of 4 months.

5.3 Disinfection reagents

5.3.1 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.

5.3.2 Disinfection treatment water, consisting of a batch of preconditioning water (5.4.1) with a free chlorine content of (50 ± 5) 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 (5.3.1).

5.4 Waters to be used for testing

5.4.1 Preconditioning water prepared by dissolving (222 ± 2) mg anhydrous calcium chloride ($CaCl_2$) and (336 ± 2) mg sodium hydrogen-carbonate ($NaHCO_3$) in one litre of demineralised water (3.29). The pH is determined in accordance with ISO 10523 and adjusted to 7,4 ± 0,1 by bubbling air and/or CO_2 into the solution.

NOTE The target total hardness is 200 mg/l as $CaCO_3$ and the target alkalinity is 244 mg/l as HCO_3.

5.4.2 Reference water, a natural water without gas and with parameters that conform to the requirements given in Table 1.

When a reference water is chlorinated to 1,0 mg/l free chlorine and then dechlorinated after 72 h with either the ascorbic acid solution (5.2.1) or the sodium thiosulfate solution **(**5.2.2), its organoleptic parameters, odour, flavour colour and turbidity shall conform to the requirements given in Table 1.

Table 1 — Reference water

Parameter	Test method [a]	Requirement	Unit
Conductivity	EN 27888	500 ± 50	µS/cm
pH	ISO 10523	7,3 ± 0,2	pH unit
Calcium	ISO 6058	80 ± 10	mg Ca/l
Alkalinity	EN ISO 9963-2	350 ± 50	mg HCO_3^-/l
Silica	EN ISO 16264	15 ± 5	mg SiO_2/l
Odour	EN 1622	< 2	TON
Flavour	EN 1622	< 2	TFN
Colour	EN ISO 7887:1994 [b]	< 0,1	m^{-1}
Turbidity	EN ISO 7027:1999 [c]	< 0,1	FNU

[a] Alternative methods, either calibrated against the reference methods or which have proven comparable analytical performance, may be used.

[b] Section 3

[c] Clause 6

5.4.3 Test water without chlorine content (chlorine-free), shall consist of a batch of reference water (5.4.2) used for contact with test pieces and preparation of the blank water (3.26).

5.4.4 Test water with chlorine content (chlorinated), consisting of reference water (5.4.2) with a free chlorine content of (1,0 ± 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 (5.3.1)

5.5 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 (5.5). Rinse the glassware in demineralised water (3.29);

b) Clean the inner surface of the glassware with hydrochloric acid (5.5) and rinse it with demineralised water. For stainless steel, clean with nitric acid (5.5) and then rinse with demineralised water;

c) Before use, rinse the glassware, and appropriate apparatus, at least three times using preconditioning water before preconditioning (8.3) or reference water before the test procedure (Clause 9).

6.2 Apparatus and materials for test piece preparation (see normative 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 cementitious proxy samples (see normative Annexes A, B and C of this European Standard).

6.2.1.2 Plates

In order to provide a sufficient volume of migration water for assessment, the surface area of one face of a plate should be between 10 000 mm^2 and 90 000 mm^2. 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 normative Annexes A, B or C and informative Annexes 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 normative Annexes A, B or C and informative Annexes 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 by the appropriate normative Annex A, B or C of this European Standard.

Clean moulds and any filling frame used with a mould, by thoroughly washing with non-perfumed detergent (5.5) and tap water (3.28), rinsing with copious amounts of tap water, followed by a final rinse with demineralised water (3.29) and dry before use.

Where a factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent then where 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 by this European Standard.

6.3 Apparatus and materials for preconditioning and migration procedure

6.3.1 vessels, containers, covers, connectors and stoppers, made of materials which do not affect the odour, flavour, colour and turbidity assessment under the specified test conditions such as glass, polytetrafluoroethylene (PTFE) or stainless steel.

NOTE The material PTFE should only be used when there is a small contact area with the test water. Thus PTFE is unsuitable for containers.

6.3.2 equipment, capable of maintaining the test temperature within ± 2°C for the duration of the test.

6.3.3 where required, **sealants** that do not affect the odour, flavour, colour and turbidity assessments under the specified test conditions.

6.4 Apparatus for odour and flavour assessment

6.4.1 erlenmeyer and volumetric flasks, beakers, measuring cylinders, immersion tanks, volumetric pipettes, funnels and stoppers made of glass, PTFE or stainless steel.

NOTE The material PTFE should only be used when there is a small contact area with the test water. Thus PTFE is unsuitable for containers.

6.4.2 testing vessels, comprising the following glassware (which shall be reserved for odour and flavour assessment only and cleaned separately from other items): testing bottles for odour assessment and testing glasses for flavour assessment conforming to the requirements given in EN 1622.

6.4.3 waterbath or incubator, conforming to the requirements of EN 1622.

6.5 Apparatus for colour and turbidity assessment

6.5.1 Apparatus for the determination of colour, conforming to the requirements of section 3 of EN ISO 7887:1994.

6.5.2 Apparatus for the determination of turbidity, conforming to the requirements of 6.3.1 of EN ISO 7027:1999.

7 Samples and test pieces

7.1 Sampling, transport and storage of samples

Carry out sampling of factory made products in accordance with the relevant product standard, system standard or the national or European regulations, or the relevant normative Annex to this European Standard, as appropriate.

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

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

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

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

7.2 Preparation of test pieces

7.2.1 General

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

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

a) ensure that test pieces are representative of the finished product;

b) during the preparation of test pieces, include any procedures which are performed in practice for curing and cleaning;

c) ensure that the minimum age of the test piece, at test, conforms to that recommended by the manufacturer for the product to be ready for use;

d) ensure that the surface area of the test piece is sufficient to fulfil the appropriate surface area to volume (S/V) ratio in accordance with the requirements of 7.3.

7.2.2 Factory made pipes, fittings and storage systems

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

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

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

7.3.1 General

The following general principles apply for S/V ratios:

a) the surface area to volume ratio (S/V) of the test piece exposed to the test water relates to realistic service conditions;

b) where no difference in material composition and production process exists in the range of sizes produced, only the largest S/V ratio is required to be tested;

c) the ratio of the surface area, *S*, of the test piece intended to come into contact with volume, *V*, of the test water is expressed per decimetre, i.e. dm^{-1}.

NOTE The unit, dm^{-1}, can also be expressed as dm^2/dm^3 or dm^2/l.

7.3.2 Pipes

Test pipes of sizes up to DN/ID 800 by this method at the actual S/V ratio of the pipe diameter.

The S/V ratio is calculated, in dm^{-1}, according to the formula:

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

where:

[DN/ID] (3.20) is the value of the nominal size related to the internal diameter, in mm.

Test pipes of sizes greater or equal to DN/ID 800 using an S/V ratio of (0,50 ± 0,02) dm^{-1}.

NOTE 1 But see 7.3.1 (b) for the acceptable minimum requirement for testing pipes that are produced in a range of sizes.

NOTE 2 Migration from pipes full of water in the service condition is controlled by the intrinsic S/V ratio of the pipe. In the case of a pipe of diameter DN/ID 800 the intrinsic S/V ratio is 0,5 dm^{-1}. This S/V ratio is the same as that specified in 7.3.4 to be a worst-case test condition for factory made cementitious storage systems. In consequence, an S/V ratio of 0,5 dm^{-1} has also been specified to be a worst-case test condition for all large diameter cementitious pipes (generally precast concrete) of diameter greater than or equal to DN/ID 800.

7.3.3 Fittings

Test fittings of sizes up to DN/ID 800 by this method at the actual S/V ratio of the fitting modified by a factor of 0,4.

The S/V ratio is calculated, in dm^{-1}, according to the formula:

$$S/V = 0{,}4 \times \frac{400}{[DN/ID]} \qquad \ldots(2)$$

where:

DN/ID (3.20) is the nominal internal diameter in mm.

Test fittings of sizes greater than of equal to DN/ID 800 using an S/V ratio of (0,20 ± 0,01) dm^{-1}.

NOTE 1 But see 7.3.1 (b) for the acceptable minimum requirement for testing fittings that are produced in a range of sizes.

NOTE 2 Migration from fittings full of water in the service condition is controlled by the intrinsic S/V ratio of the fitting. In the case of a fitting of diameter DN/ID 800 the intrinsic S/V ratio is 0,5 dm^{-1}. The factor of 0,4 in equation (2) has been specified to be a worst-case test condition to allow for the difference in the service condition between the small contact lengths of fittings in comparison with those of pipes.

7.3.4 Storage systems (cement mortar, cement mortar lined or concrete)

Test storage systems at an S/V ratio of (0,50 ± 0,02) dm^{-1}.

NOTE The effective limit value of 0,5 dm^{-1} is the S/V ratio of a storage system of one m^3 volume. Smaller storage systems are unlikely to be manufactured using cementitious products. Hence, for test purposes a worst-case S/V ratio has been specified.

8 Pre-treatment of samples (curing, preconditioning and disinfection)

8.1 General

The procedures for curing cementitious products are given in 8.2.

The procedures for preconditioning and disinfection at (23 ± 2)°C are given in 8.3.

8.2 Curing

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

8.3 Preconditioning

8.3.1 General

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

If disinfection treatment is required, carry out preconditioning in accordance with 8.3.3. If it is not required follow the procedure in 8.3.2.

8.3.2 Preconditioning without disinfection treatment

Fill test pieces with, or immerse them in, or otherwise bring them into contact with (see the test arrangements in informative Annex E), preconditioning water (5.4.1) for a succession of five contact periods, without rinsing between contact periods, at a temperature of (23 ± 2)°C as follows:

— three periods of (24 ± 1) h;

— one period of (72 ± 1) h;

— one period of (24 ± 1) h.

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

8.3.3 Preconditioning with disinfection treatment

Carry out preconditioning as described in 8.3.2 but for the final 24 hour contact period replace the preconditioning water by the disinfection treatment water (5.3.2).

After contact with the disinfection treatment water determine the pH in accordance with ISO 10523. If the pH exceeds 9,5 stop the testing.

If the pH is less than or equal to 9,5 rinse the test piece by filling it or immersing it in fresh preconditioning water (5.4.1) at room temperature, at least five times, until no increase in free chlorine is detected in the preconditioning water. The total duration of rinsing shall not exceed one hour.

9 Test procedure

9.1 General

Where testing of products at 23°C is required carry out the following procedures at 9.2 at (23 ± 2) °C.

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

9.2 Preparation of migration water for the assessment of odour, flavour, colour and turbidity

9.2.1 Migration procedure

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

Immerse in, or fill with, or otherwise bring the test piece (7.2) into appropriate contact with test water (5.4.3 and/or 5.4.4) and allow to stand for (72 ± 1) h at (23 ± 2) °C. In all cases (immersion, filling or other contact arrangement), ensure that the test piece or vessel/container is completely immersed or filled and minimize headspace in order to minimize contact between the test piece and air, using a cover for the vessel/container.

At the end of this period, collect the migration water and immediately determine the odour as TON, flavour as TFN, colour as a spectral absorption coefficient and turbidity in FNU, in accordance with Clauses 10 and 11 respectively.

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

9.2.2 Second and third migration periods

Repeat 9.2.1 two more times using fresh test water each time, ensuring that the test pieces are put into contact with the same type of test water (e.g. chlorine-free) for the three successive periods.

9.3 Control samples (blank test)

For each contact period, carry out a blank test procedure using the same test conditions (test water, test temperature, contact periods, sealants used etc.) as described in 9.2 but omitting the test piece or replacing it by a glass container or plate, as appropriate.

10 Determination of odour as TON and flavour as TFN

If the test has been performed with chlorinated test water, dechlorinate the migration and blank waters with either the ascorbic acid solution (5.2.1) or the sodium thiosulfate solution (5.2.2), in accordance with the procedure of Annex A of EN 1622:1997.

Determine the odour as the threshold odour number, TON, and flavour as the threshold flavour number, TFN, of each migration water and blank water in accordance with EN 1622.

At the end of the migration procedure, the blank water may acquire a slight perceptible odour and/or flavour. If the odour or flavour is found to be abnormal, consider the test invalid and repeat the entire procedure using new test pieces.

11 Determination of colour and turbidity

Determine colour and turbidity of each migration water and blank water after each contact period in accordance with section 3 of EN ISO 7887:1994 for colour and Clause 6 of EN ISO 7027:1999 for turbidity.

At the end of the migration procedure, if the blank water does not conform to the specification for colour and turbidity in 5.4.2, consider the test invalid and repeat the entire procedure using new test pieces.

12 Expression of results

Express the results for each contact period:

— as a threshold odour number (TON) and a threshold flavour number (TFN) in accordance with EN 1622;

— as a spectral absorption coefficient, in m^{-1}, at three wavelengths for colour in accordance with section 3 of EN ISO 7887:1994;

— in units of FNU for turbidity in accordance with Clause 6 of EN ISO 7027:1999.

13 Test report

The test report shall include the following information:

13.1 General information

a) date of issue;

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

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

d) name and address of client;

e) description and identification of the sample/test piece;

f) a signature and title or 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 test piece(s) tested;

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

13.2 Information on the product

a) trade name or designation of the factory made/manufactured product;

b) complete identification and date of receipt of sample/test piece;

c) details of the test piece preparation;

d) the name of the manufacturer for the product, the place of manufacture and date and, where relevant, the body submitting the sample and, where relevant, the body responsible for preparing the samples/test pieces;

e) description of sampling procedure, where relevant.

13.3 Information on the test procedure

a) reference to this European Standard and to the referring product or system standard or national or European regulation as appropriate;

b) dates of start and completion of the test;

c) number of test pieces used together in the migration procedure;

d) volume, *V*, of the test water, in litres;

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

f) actual S/V ratio used in the procedure;

g) disinfection procedure (if applicable);

h) source of reference water;

i) test waters and test temperature;

j) any deviation from the test procedure specified in this standard;

k) any factors which may have affected the results, such as any incidents or any operating details not specified in this European Standard.

13.4 Test results

a) threshold odour number, TON;

b) threshold flavour number, TFN;

c) colour, as a spectral absorption coefficient, in m^{-1};

d) turbidity, in FNU;

e) for the three contact periods for chlorinated and/or chlorine-free migration waters and blank water;

f) information relevant to the test results for TON and TFN, obtained from EN 1622, including the particular method chosen and the number of test panellists, shall be included.

Annex A
(normative)

Additional procedures for testing factory made pipes (cement mortar lined and concrete)

A.1 Sampling, test piece preparation and storage

A.1.1 Sampling

See also 7.1 and 7.2.

Sample factory made cement mortar lined pipes and concrete pipes at the point of release of the factory as finished products, for preparation as test pieces.

Where specified, pipes may be sampled indirectly as proxy samples (3.6) of the fresh mortar or concrete used in their manufacture, for preparation as test pieces.

A.1.2 Test piece preparation and storage

A.1.2.1 General

Test pieces prepared from factory made cement mortar lined pipes or concrete pipes shall:

a) be either one of the following:

1) complete pipes;

2) cylindrical sections of pipe sawn from complete pipes using tap-water-cooled/lubricated (3.28) sawing procedures;

3) blocks or cores sawn or cored from complete pipes using tap-water-cooled/lubricated (3.28) sawing or coring procedures;

4) proxy test pieces, where specified, prepared by the manufacturer from samples of fresh mortar or concrete (3.6) used in the manufacture of pipes, in accordance with either A.1.2.3 for mortar or A.1.2.4 for concrete, in order to provide hardened surfaces representative of the contact surface of the finished product;

b) be of sufficient surface area to fulfil the appropriate surface area to volume (S/V) ratio for the migration procedure, in accordance with the requirements of 7.3;

c) be of suitable general dimensions (see informative Annex D) e.g. length, surface area, diameter etc. to provide sufficient migration water for assessment;

d) have their surface area to volume (S/V) ratios (as required in the migration procedure; see 7.3), calculated using their nominal internal diameters (DN/ID) where cylindrical in section;

e) be suitably documented and identified and be free from any surface contamination e.g. adhesive tape, labels, ink or pencil marks;

f) be protected from contamination and mechanical damage in the factory using unused food grade packaging materials when it is necessary to store them prior to despatch to the test laboratory;

g) be subject to comparable conditions for storage in the test laboratory as for storage in the factory;

h) be taken at the point of release, or in the case of proxy samples (3.6), be of a minimum age recommended by the manufacturer for the product to be ready for use, before any testing shall begin.

A.1.2.2 Pipes sampled as finished products

See A.1.2.1 a) for test piece preparation.

Informative Annex E gives examples of suitable test arrangements for use in the migration procedure.

A.1.2.3 Pipes sampled as fresh mortar

A.1.2.3.1 General

Test pieces shall be prepared from samples of the fresh mortar (3.8) used to line factory made pipes and be either spray-applied to stainless steel plates in accordance with A.1.2.3.2.1 or be cast as prisms in accordance with A.1.2.3.2.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh mortar from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in A.1.2.3.2.3.

A.1.2.3.2 Test pieces (fresh mortar)

A.1.2.3.2.1 Coated plates

Where test plates are specified, they shall be made by coating one face of a stainless steel plate (6.2.1.1) with the fresh mortar used in the manufacture of the pipe using the same process of application used in the factory. In addition:

a) coated plate shall not be marked for identification purposes but shall be identified in an alternative traceable manner e.g. by mechanical marking on the rear of the test plate;

b) coated plate shall be placed in the vicinity of the pipe that it represents and shall undergo the same curing regime as that applied to the pipe;

c) after curing, the undamaged coated plate shall be stored under the same environmental conditions that apply to the finished pipe during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the pipe;

d) following the curing/storage period, the coated plate shall be placed in an unused food grade plastics bag and sealed. A damaged plate shall be discarded.

A.1.2.3.2.2 Prisms

a) Where test prisms are specified, they shall be prepared from the fresh mortar used in the manufacture of the pipe, sampled in accordance with EN 1015-2, and formed as prisms of dimensions 1,6 dm x 0,4 dm x 0,4 dm, in accordance with EN 196-1, as specified in EN 1015-11, with the following modifications:

1) the tolerances given in EN 1015-11 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE 1 Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

NOTE 2 Where the S/V ratio specified for use in the test procedure is 0,2 dm^{-1}, a test prism of dimensions 1,6 dm x 0,2 dm x 0,2 dm may be used, prepared in accordance with the procedure given in EN 1015-11 but with the modifications given above.

b) Prisms shall be made and cured in accordance with EN 1015-11 with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the prism shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) a mould shall be covered and be placed in the vicinity of the pipe that it represents and the prism shall undergo the same curing regime as that applied to the pipe. Covers to moulds shall be made of an impermeable material that does not react with cement;

4) on removal from the mould after curing, the undamaged prism shall be stored under the same environmental conditions that apply to the finished pipe during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the pipe;

5) following the curing/storage period, the prism shall be placed in an unused food grade plastics bag and sealed. A damaged prism shall be discarded.

A.1.2.3.2.3 Test arrangements (fresh mortar)

The test arrangements for test pieces prepared from the fresh mortar used to line pipes should be either:

a) as given in Figure E.6 in informative Annex E, for test plates, or;

b) as given in Figure E.7 in informative Annex E, for test prisms.

In Figure E.7, the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

A.1.2.4 Pipes sampled as fresh concrete

A.1.2.4.1 General

Where required, test pieces shall be prepared from samples of the fresh concrete (3.7) used to make pipes and be cast, compacted and cured in accordance with A.1.2.4.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh concrete from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in A.1.2.4.3.

A.1.2.4.2 Test pieces (fresh concrete)

a) Test pieces shall be prepared from the fresh concrete used to manufacture the pipe, sampled in accordance with EN 12350-1, and formed as either cubes or cylinders, in accordance with EN 12390-1 for shape and dimensions, with the following modifications:

1) the tolerances given in EN 12390-1 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

b) Cubes or cylinders shall be made and cured in accordance with EN 12390-2, with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the cube or cylinder shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) the mould shall be covered and be placed in the vicinity of the pipe that it represents and shall undergo the same curing regime as that applied to the pipe. Covers to moulds shall be made of an impermeable material which does not react with cement;

4) on removal from the mould after curing, the undamaged cube or cylinder shall be stored under the same environmental conditions that apply to the finished pipe during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the pipe;

5) following the curing/storage period, the cube or cylinder shall be placed in an unused food grade plastics bag and sealed. A damaged cube or cylinder shall be discarded.

A.1.2.4.3 Test arrangements - Cubes/cylinders

A.1.2.4.3.1 Testing one face only

The test arrangement should be as given in Figure E.5 in informative Annex E where a cylindrical test container of stainless steel (6.2.1.2) or glass (6.2.2) is attached and sealed with sealing compound (6.3.3) to a cast surface of the cube or cylinder.

A.1.2.4.3.2 Testing fully immersed

The test arrangement should be as given in Figure E.7 in informative Annex E where the cube (or cylinder) is tested fully immersed in test water during the migration procedure.

In Figure E.7 the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

A.2 Surface area to volume (S/V) ratio

The S/V ratio for pipes to be used in the migration procedure shall be as given in 7.3.2.

NOTE See 7.3.1 (b) for a testing policy option where pipes of nominally identical composition and production process are produced in a range of sizes.

A.3 Pretreatment of test pieces (preconditioning and disinfection)

Preconditioning and any disinfection pretreatment shall be carried out in accordance with either 8.3.2 or 8.3.3, as appropriate.

A.4 Test procedure

A.4.1 Migration procedure at 23 °C

Where testing of factory made pipes at 23^{o}C is required, the migration procedure shall be carried out in accordance with Clause 9.

NOTE Where specified, hardened test pieces made from fresh mortar or concrete, used in the manufacture of pipes may represent the finished product in the migration procedure, see A.1.2.3 and A.1.2.4.

A.4.2 Migration procedure at elevated temperature

Where testing of factory made pipes at elevated temperature is required, the test pieces and test arrangements to be used in the migration procedure are as given in this Annex and the migration procedure is as given in normative Annex F.

NOTE See Note to A.4.1.

A.5 Expression of results

Express results in accordance with Clause 12.

A.6 Reporting

Report results in accordance with Clause 13.

Annex B
(normative)

Additional procedures for testing factory made fittings (cement mortar lined and concrete)

B.1 Sampling, test piece preparation and storage

B.1.1 Sampling of Factory made fittings

See also 7.1 and 7.2.

Sample factory made cement mortar lined fittings and concrete fittings at the point of release of the factory as finished products, for preparation as test pieces.

Alternatively, fittings may be produced in the factory in the form of equivalent-pipes (see B.1.2.2.1 for cement mortar and B.1.2.2.2 for concrete) under the same manufacturing conditions, composition and nominal diameter as the fitting and be sampled at the point of release of the factory, in place of a finished fitting, for preparation as test pieces.

Where specified, fittings may be sampled indirectly as proxy samples (3.6) of the fresh mortar or concrete used in their manufacture, for preparation as test pieces.

B.1.2 Test piece preparation and storage

B.1.2.1 General

Test pieces prepared from factory made cement mortar lined fittings or concrete fittings shall:

a) be either of the following:

1) blocks or cores sawn or cored from complete fittings (generally of large diameter) using tap-water-cooled/lubricated (3.28) sawing or coring procedures;

2) complete equivalent-pipes prepared by the manufacturer in accordance with B.1.2.2.1 in the case of mortar lined fittings or B.1.2.2.2 for concrete fittings;

3) cylindrical sections of equivalent-pipe sawn using tap-water-cooled/lubricated (3.28) sawing procedures;

4) proxy test pieces, where specified, prepared by the manufacturer from samples of fresh mortar or concrete (3.6) used in the manufacture of fittings, in accordance with either B.1.2.4 in the case of mortar or B.1.2.5 for concrete, in order to provide hardened surfaces representative of the contact surface of the finished product;

b) be of sufficient surface area to fulfil the appropriate surface area to volume (S/V) ratio for the migration procedure, in accordance with the requirements of 7.3;

c) be of suitable general dimensions (see informative Annex D) e.g. length, surface area, diameter etc. to provide sufficient migration water for assessment;

d) have their surface area to volume (S/V) ratios (as required in the migration procedure ; see 7.3), calculated using their nominal internal diameters (DN/ID) where cylindrical in section;

e) be suitably documented and identified and be free from any surface contamination e.g. adhesive tape, labels, ink or pencil marks;

f) be protected from contamination and mechanical damage in the factory using unused food grade packaging materials when it is necessary to store them prior to despatch to the test laboratory;

g) be subject to comparable conditions for storage in the test laboratory as for storage in the factory;

h) be taken at the point of release, or in the case of proxy samples, be of a minimum age recommended by the manufacturer for the product to be ready for use, before any testing shall begin.

B.1.2.2 Production of equivalent-pipes

B.1.2.2.1 Cement mortar lined

Factory produced batches of fresh cement mortar (3.8) for manufacturing cement mortar lined ferrous metal fittings, shall be applied to the internal surface of a straight length of ferrous metal pipe of appropriate internal diameter in order to produce an equivalent-pipe of nominal internal diameter (DN/ID) equal to that intended for the finished cement mortar lined fitting.

B.1.2.2.2 Concrete

Factory produced batches of fresh concrete (3.7) for manufacturing concrete fittings, shall be formed (e.g. spun, sprayed, vibro-cast etc.) into a concrete pipe of suitable length in order to produce an equivalent-pipe of nominal internal diameter (DN/ID) equal to that of the finished concrete fitting.

B.1.2.3 Equivalent pipes sampled as finished products

See B.1.2.1 a) for test piece preparation.

Informative Annex E gives examples of suitable test arrangements for use in the migration procedure.

B.1.2.4 Fittings sampled as fresh mortar

B.1.2.4.1 General

Test pieces shall be prepared from samples of the fresh mortar (3.8) used to line factory made fittings and be either spray-applied to stainless steel plates in accordance with B.1.2.4.2.1 or be cast as prisms in accordance with B.1.2.4.2.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh mortar from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in B.1.2.4.2.3.

B.1.2.4.2 Test pieces (fresh mortar)

B.1.2.4.2.1 Coated plates

Where test plates are specified, they shall be made by coating one face of a stainless steel plate (6.2.1.1) with the fresh mortar used in the manufacture of the fitting using the same process of application used in the factory. In addition:

a) the coated plate shall not be marked for identification purposes but shall be identified in an alternative traceable manner e.g. by mechanical marking on the rear of the test plate;

b) the coated plate shall be placed in the vicinity of the fitting that it represents and shall undergo the same curing regime as that applied to the fitting;

c) after curing, the undamaged coated plate shall be stored under the same environmental conditions that apply to the finished fitting during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the fitting;

d) following the curing/storage period, the coated plate shall be placed in an unused food grade plastics bag and sealed. A damaged plate shall be discarded.

B.1.2.4.2.2 Prisms

a) Where test prisms are specified, they shall be prepared from the fresh mortar used in the manufacture of the fitting, sampled in accordance with EN 1015-2, and formed as prisms of dimensions 1,6 dm x 0,4 dm x 0,4 dm, in accordance with EN 196-1, as specified in EN 1015-11, with the following modifications:

1) the tolerances given in EN 1015-11 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE 1 Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

NOTE 2 Where the S/V ratio specified for use in the test procedure is 0,2 dm^{-1}, a test prism of dimensions 1,6 dm x 0,2 dm x 0,2 dm may be used, prepared in accordance with the procedure given in EN 1015-11 but with the modifications given above.

b) Prisms shall be made and cured in accordance with EN 1015-11 with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the prism shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) a mould shall be covered and be placed in the vicinity of the fitting that it represents and the prism shall undergo the same curing regime as that applied to the fitting. Covers to moulds shall be made of an impermeable material that does not react with cement;

4) on removal from the mould after curing, the undamaged prism shall be stored under the same environmental conditions that apply to the finished fitting during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the fitting;

5) following the curing/storage period, the prism shall be placed in an unused food grade plastics bag and sealed. A damaged prism shall be discarded.

B.1.2.4.2.3 Test arrangements (fresh mortar)

The test arrangements for test pieces prepared from the fresh mortar used to line fittings should be either:

a) as given in Figure E.6 in informative Annex E, for test plates, or;

b) as given in Figure E.7 in informative Annex E, for test prisms.

In Figure E.7, the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

B.1.2.5 Fittings sampled as fresh concrete

B.1.2.5.1 General

Where required, test pieces shall be prepared from samples of the fresh concrete (3.7) used to make fittings and be cast, compacted and cured in accordance with B.1.2.5.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh concrete from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in B.1.2.5.3.

B.1.2.5.2 Test pieces (fresh concrete)

a) Test pieces shall be prepared from the fresh concrete (3.7) used to manufacture the fitting, sampled in accordance with EN 12350-1, and formed as either cubes or cylinders, in accordance with EN 12390-1 for shape and dimensions, with the following modifications:

1) the tolerances given in EN 12390-1 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

b) Cubes or cylinders shall be made and cured in accordance with EN 12390-2, with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the cube or cylinder shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) the moulds shall be covered and be placed in the vicinity of the fitting that it represents and shall undergo the same curing regime as that applied to the concrete fitting. Covers to moulds shall be made of an impermeable material that does not react with cement;

4) on removal from the mould after curing, the undamaged cube or cylinder shall be stored under the same environmental conditions that apply to the finished concrete fitting during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the fitting;

5) following the curing/storage period, cube or cylinder shall be placed in an unused food grade plastics bag and sealed.

B.1.2.5.3 Test arrangements (cubes/cylinders)

B.1.2.5.3.1 Testing one face only

The test arrangement should be as given in Figure E.5 in informative Annex E where a cylindrical test container of stainless steel (6.2.1.2) or glass (6.2.2) is attached and sealed with sealing compound (6.3.3) to a cast surface of the cube or cylinder.

B.1.2.5.3.2 Testing fully immersed

The test arrangement should be as given in Figure E.7 in informative Annex E where the cube (or cylinder) is tested fully immersed in test water during the migration procedure.

In Figure E.7, the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

B.2 Surface area to volume (S/V) ratio

The S/V ratio for fittings to be used in the migration procedure shall be as given in 7.3.3.

NOTE See 7.3.1 (b) for a testing policy option where fittings of nominally identical composition and production process are produced in a range of sizes.

B.3 Pretreatment of test pieces (preconditioning and disinfection)

Preconditioning and any disinfection pretreatment shall be carried out in accordance with either 8.3.2 or 8.3.3, as appropriate.

B.4 Test procedure

B.4.1 Migration procedure at 23 °C

Where testing of factory made fittings in the form of equivalent-pipes, or in any other test piece geometry, at 23 °C is required, the migration procedure shall be carried out in accordance with Clause 9 with the following modification. The factor 0,4 in the calculation of S/V ratio (see 7.3.3) shall be taken into account using a dilution factor of 2,5 by adding 1,5 volumes of test water to 1 volume of migration water obtained after each migration period before carrying out the determinations for odour, flavour, colour and turbidity.

NOTE Where specified, test pieces made from fresh mortar or concrete, used in the manufacture of fittings may represent the finished product in the migration procedure, see B.1.2.4 and B.1.2.5.

B.4.2 Migration procedure at elevated temperature

Where testing of factory made fittings at elevated temperature is required, the test pieces and test arrangements to be used in the migration procedure are as given in this Annex B and the migration procedure is as given in normative Annex F, with the following modification. The factor 0,4 in the calculation of S/V ratio (see 7.3.3) shall be taken into account using a dilution factor of 2,5 by adding 1,5 volumes of test water to 1 volume of migration water obtained after each migration period before carrying out the determinations for odour, flavour, colour and turbidity.

NOTE See Note to B.4.1.

B.5 Expression of results

Express results in accordance with Clause 12.

B.6 Reporting

Report results in accordance with Clause 13.

Annex C
(normative)

Additional procedures for testing factory made storage systems (cement mortar, cement mortar lined and concrete)

C.1 Sampling, test piece preparation and storage

C.1.1 Sampling

See also 7.1 and 7.2.

Sample factory made storage systems at the point of release of the factory as finished products, for preparation as test pieces.

Alternatively where specified, storage systems may be sampled indirectly as proxy samples (3.6) of the fresh mortar or concrete used in their manufacture, for preparation as test pieces.

C.1.2 Test piece preparation and storage

C.1.2.1 General

Test pieces prepared from factory made storage systems manufactured from mortar or concrete or lined with mortar shall:

a) be either:

1) blocks or cores sawn or cored from storage systems using tap-water-cooled/lubricated (3.28) sawing or coring procedures;

or

2) or proxy test pieces, where specified, prepared by the manufacturer from samples of fresh mortar or concrete (3.6) used in the manufacture of storage systems, in accordance with either C.1.2.3 in the case of mortar or C.1.2.4 for concrete, in order to provide hardened surfaces representative of the contact surface of the finished product.

b) be of sufficient surface area to fulfil the appropriate surface area to volume (S/V) ratio for the migration procedure, in accordance with the requirements of 7.3;

c) be of suitable general dimensions (see informative Annex D) e.g. length, surface area, diameter etc. to provide sufficient migration water for assessment;

d) be suitably documented and identified and be free from any surface contamination e.g. adhesive tape, labels, ink or pencil marks;

e) be protected from contamination and mechanical damage in the factory using unused food grade packaging materials when it is necessary to store them prior to despatch to the test laboratory;

f) be subject to comparable conditions for storage in the test laboratory as for storage in the factory;

g) be taken at the point of release, or in the case of proxy samples, be of a minimum age recommended by the manufacturer for the storage system to be ready for use, before any testing shall begin.

C.1.2.2 Storage systems sampled as finished products

See C.1.2.1 a) for test piece preparation.

Informative Annex E gives examples of suitable test arrangements for use in the migration procedure.

C.1.2.3 Storage systems sampled as fresh mortar

C.1.2.3.1 General

Test pieces shall be prepared from samples of the fresh mortar (3.8) used to make or line factory made storage systems and be either spray-applied to stainless steel plates in accordance with C.1.2.3.2.1 or be cast as prisms in accordance with C.1.2.3.2.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh mortar from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in C.1.2.3.2.3.

C.1.2.3.2 Test pieces (fresh mortar)

C.1.2.3.2.1 Coated plates

Where test plates are specified, they shall be made by coating one face of a stainless steel plate (6.2.1.1) with the fresh mortar used in the manufacture of the storage system using the same process of application used in the factory. In addition:

a) the coated plate shall not be marked for identification purposes but shall be identified in an alternative traceable manner by mechanical marking on the rear of the test plate;

b) the coated plate shall be placed in the vicinity of the storage system that it represents and shall undergo the same curing regime as that applied to the storage system;

c) after curing, the undamaged coated plate shall be stored under the same environmental conditions that apply to the finished storage system during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the storage system;

d) following the curing/storage period, the coated plate shall be placed in an unused food grade plastics bag and sealed. A damaged plate shall be discarded.

C.1.2.3.2.2 Prisms

a) Where test prisms are specified, they shall be prepared from the fresh mortar used in the manufacture of the storage system, sampled in accordance with EN 1015-2, and formed as prisms of dimensions 1,6 dm $\times$ 0,4 dm $\times$ 0,4 dm, in accordance with EN 196-1, as specified in EN 1015-11, with the following modifications:

1) the tolerances given in EN 1015-11 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

b) Prisms shall be made and cured in accordance with EN 1015-11 with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the prism shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) a mould shall be covered and be placed in the vicinity of the storage system that it represents and the prism shall undergo the same curing regime as that applied to the storage system. Covers to moulds shall be made of an impermeable material that does not react with cement;

4) on removal from the mould after curing, the undamaged prism shall be stored under the same environmental conditions that apply to the finished storage system during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the storage system;

5) following the curing/storage period, the prism shall be placed in an unused food grade plastics bag and sealed. A damaged prism shall be discarded.

C.1.2.3.2.3 Test arrangements (fresh mortar)

The test arrangements for test pieces prepared from the fresh mortar used to make or line storage systems should be either:

a) as given in Figure E.6 in informative Annex E, for test plates;

or;

b) as given in Figure E.7 in informative Annex E, for test prisms.

In Figure E.7, the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

C.1.2.4 Storage systems sampled as fresh concrete

C.1.2.4.1 General

Test pieces shall be prepared from samples of the fresh concrete (3.7) used to make factory made storage systems and be cast, compacted and cured in accordance with or C.1.2.4.2.

Hardened test pieces shall be monolithic, undamaged and representative in structure, composition and homogeneity of the fresh concrete from which they were prepared.

Test arrangements, for using the test pieces in the migration procedure, shall be as given in C.1.2.4.3.

C.1.2.4.2 Test pieces (fresh concrete)

a) Test pieces shall be prepared from the fresh concrete (3.7) used to manufacture the storage system, sampled in accordance with EN 12350-1, and formed as either cubes or cylinders, in accordance with EN 12390-1 for shape and dimensions, with the following modifications:

1) the tolerances given in EN 12390-1 for shape and dimensions are for guidance only;

2) the joints of moulds shall not be coated with any wax, oil or grease to achieve water tightness;

3) where the factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent, the same release agent shall be applied to the internal surfaces of the mould, otherwise the use of release agents is not permitted by this European Standard.

NOTE Where release agents are not permitted, moulds of steel or cast iron may not be suitable for forming test pieces for use in the migration procedure.

b) Cubes and cylinders shall be made and cured in accordance with EN 12390-2 with the following modifications:

1) irrespective of the type of material from which a mould is made, the mould, together with any filling frame, shall be thoroughly washed with non-perfumed detergent (5.5) and water, rinsed with copious amounts of tap water, given a final rinse with demineralised water (3.29) and then dried before use;

2) the cube or cylinder shall not be marked for identification purposes but shall be identified in an alternative traceable manner;

3) the mould shall be covered and be placed in the vicinity of the storage system that it represents and the cube or cylinder shall undergo the same curing regime as that applied to the storage system. Covers to moulds shall be made of an impermeable material that does not react with cement;

4) on removal from the mould after curing, the undamaged cube or cylinder shall be stored under the same environmental conditions that apply to the finished storage system during storage at the factory until it reaches the minimum age recommended by the manufacturer for use of the storage system;

5) following the curing/storage period, the cube or cylinder shall be placed in an unused food grade plastics bag and sealed. A damaged test piece shall be discarded.

C.1.2.4.3 Test arrangements (fresh concrete)

The test arrangements for cubes or cylinders prepared from the fresh concrete used to make the storage system should be either:

a) as given in Figure E.5 in informative Annex E where a cylindrical test container of stainless steel (6.2.1.2) or glass (6.2.2) is attached and sealed with sealing compound (6.3.3) to a cast surface of the cube or cylinder;

or;

b) as given in Figure E.7 in informative Annex E where the cube (or cylinder) is tested fully immersed in test water.

NOTE Where the arrangement in Figure E.7 is used it is unlikely that a cube larger than 100 mm × 100 mm × 100 mm will be suitable given the fixed S/V ratio of 0,5 dm^{-1} for storage systems (C.2) and the dimensions of containers normally used in the laboratory. Where this arrangement is used it is permitted to test at an S/V ratio of 2,0 dm^{-1} and to dilute each migration water obtained at C.4.1.1 or C.4.1.2 by adding three volumes of test water to one volume of each migration water before carrying out the determinations for flavour, odour, colour and turbidity.

In Figure E.7 the test vessel and mesh support shall be made of inert material that does not affect the analytical results. The test vessel shall be provided with a cover in order to minimise contact with the air. The mesh support shall allow direct contact with test water on all sides of a test piece but shall not significantly affect the surface area of a test piece exposed to the test water.

C.2 Surface area to volume (S/V) ratio

The S/V ratio for factory made storage systems to be used in the migration procedure shall be as given in 7.3.4.

C.3 Pretreatment of test pieces (preconditioning and disinfection)

Preconditioning and any disinfection pretreatment shall be carried out in accordance with either 8.3.2 or 8.3.3, as appropriate.

C.4 Test procedure

C.4.1 Migration procedures at 23 °C

Where testing of factory made storage systems at 23°C is required, the migration procedure shall be carried out in accordance with Clause 9.

NOTE 1 Where specified, test pieces made from fresh mortar or concrete used in the manufacture of storage systems may represent the finished product in the migration procedure, see C.1.2.3 and C.1.2.4.

NOTE 2 Where the arrangement in Figure E.7 is used for test pieces made of fresh concrete, it is unlikely that a cube larger than 100 mm × 100 mm × 100 mm will be suitable given the fixed S/V ratio of 0,5 dm^{-1} for storage systems and the dimensions of containers normally used in the laboratory. Where this arrangement is used it is permitted to test at an S/V ratio of 2,0 dm^{-1} and to dilute each migration water by adding three volumes of test water to one volume of each migration water before carrying out the determinations for flavour, odour, colour and turbidity.

C.4.2 Migration procedure at elevated temperature

Where testing of factory made storage systems at elevated temperature is required, the test pieces and test arrangements to be used in the migration procedure are as given in this Annex and the migration procedure is as given in normative Annex F.

NOTE See Notes 1 and 2 to C.4.1.

C.5 Expression of results

Express results in accordance with Clause 12.

C.6 Reporting

Report results in accordance with Clause 13.

Annex D
(informative)

Examples of typical test pieces and test conditions as a function of S/V ratio

D.1 General

The selection of the appropriate type of, or geometry for, a test piece will either be specified by the product standard or system standard or in national or European regulations.

Tabulated dimensions, in mm, are given in Tables D.1 to D.4 for:

— pipes and fittings (as equivalent-pipes representing those fittings) of cylindrical section ;

— test pieces to which a cylinder of stainless steel or glass is to be attached as the test container;

— square test plates coated on one face with mortar and to be tested completely immersed;

— standard specimens moulded from proxy samples i.e. prisms (mortar), cubes (concrete) and cylinders (concrete) where all faces are to be exposed to test water.

The implications of the values given in the tables for the selection of, and dimensions of, appropriate test pieces vary as a function of S/V ratio. In the particular case where the S/V ratio in the test procedure is 0,2 dm^{-1}, only one test piece type is of suitable dimensions i.e. mortar prism B in Table D.4. The mould used to form prism B is, however, only suitable for proxy samples of factory made mortar.

NOTE 1 Shaded areas in tables give the range of test piece dimensions or volumes of test water that are likely to be impracticable for use in laboratory conditions. In particular, 15 litres is likely to be the limiting volume for test water.

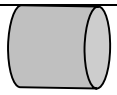
NOTE 2 In general, the tabulated values for dimensions (l) and (d) have been rounded to the nearest 5 millimetres and volumes of test water have been rounded to the nearest 5 mm.

NOTE 3 In the case of organoleptic testing, it should be noted that a minimum volume of approximately two litres of migration water is required to carry out determinations.

D.2 Pipes and fittings

Where cylindrical sections of pipes or fittings represented by equivalent-pipes are appropriate as test pieces, the tabulated values (l) in Table D.1 give the length of section, as a function of S/V ratio, required to provide a number of fixed volumes of migration water.

Table D.1 — Pipe or fitting of cylindrical section (internal surface exposed to test water)

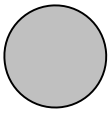
	**Internal surface $S = \pi.d.l$**				**Criteria:** **l > 100 mm** **l < 300 mm preferred**		
Pipe or fitting DN	(d in mm)	2000	1000	800	600	300	150	100
S/V (dm^{-1})		**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
l (mm) for:	V = 2 L	*1*	*3*	*4*	*7*	30	115	255
	V = 5 L	*2*	*6*	*10*	*20*	70	285	637
	V = 10 L	*3*	*15*	*20*	*35*	140	*565*	*1275*
	V = 15 L	5	19	30	53	212	849	1910

D.3 Test pieces to which a cylinder of stainless steel or glass is to be attached

In the case of test pieces, such as a face of a concrete cube or cylinder, sawn block or core, to which a cylinder of stainless steel (6.2.1.2) or glass (6.2.2) is to be attached in a watertight manner, the values (d) in Table D.2 are the diameters of the cylinder. Therefore in order to make use of the values in the table, given the practical problems of attaching a cylinder of stainless steel or glass to a concrete surface, cylinders to the diameters in the table should be attached to surfaces of larger diameter.

NOTE To minimise any errors due to the curvature of the surface of a test piece e.g. a concrete core sampled from a pipe, the ratio of pipe diameter DN/ID to cylinder diameter should be greater than 3.

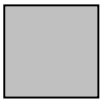
Table D.2 — Circular surface exposed to test water (e.g. cylinder attached to surface of a concrete cube, cylinder, sawn block or core)

	**Circular surface $S = \pi d^2/4$**				**Criteria :** **d > 100 mm** **d < 300 mm preferred**			
S/V (dm^{-1})		**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
d (mm) for:	V = 2 L	70	100	115	130	185	260	320
	V = 3 L	85	125	140	160	225	320	390
	V = 4 L	100	145	160	185	260	370	450
	V = 5 L	115	160	180	205	290	410	505
	V = 10 L	160	225	250	290	410	585	715
	V = 15 L	195	275	310	355	505	715	875
h (water in attached cylinder) in mm		500	250	200	150	75	37,5	25
	(h too large)							(h too small)

D.4 Square test plates coated with mortar

Where test pieces are square test plates coated with mortar, the values in Table D.3 are the limiting dimensions of a coated plate that is to be tested completely immersed.

Table D.3 — Square surface exposed to test water (e.g. test plate)

	**Square surface $S = a^2$**				**criteria:** **a > 100 mm** **a < 300 mm preferred**			
S/V (dm^{-1})		**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
a (mm) for:	*V* = 2 *L*	65	90	100	115	165	230	285
	V = 5 *L*	100	140	160	185	260	365	445
	V = 10 *L*	140	200	225	260	365	515	630
	V = 15 *L*	175	245	275	315	445	630	775

D.5 Moulded test pieces where all faces are exposed to test water

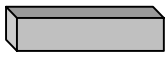
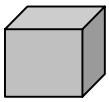
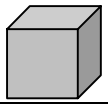
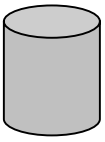
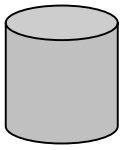
Where test pieces are to be formed in moulds from fresh mortar or concrete and then exposed with all faces in contact with test water, the values in Table D.4 identify the types of test piece and the limiting dimensions to be considered, i.e.:

— mortar prisms;

— concrete cubes;

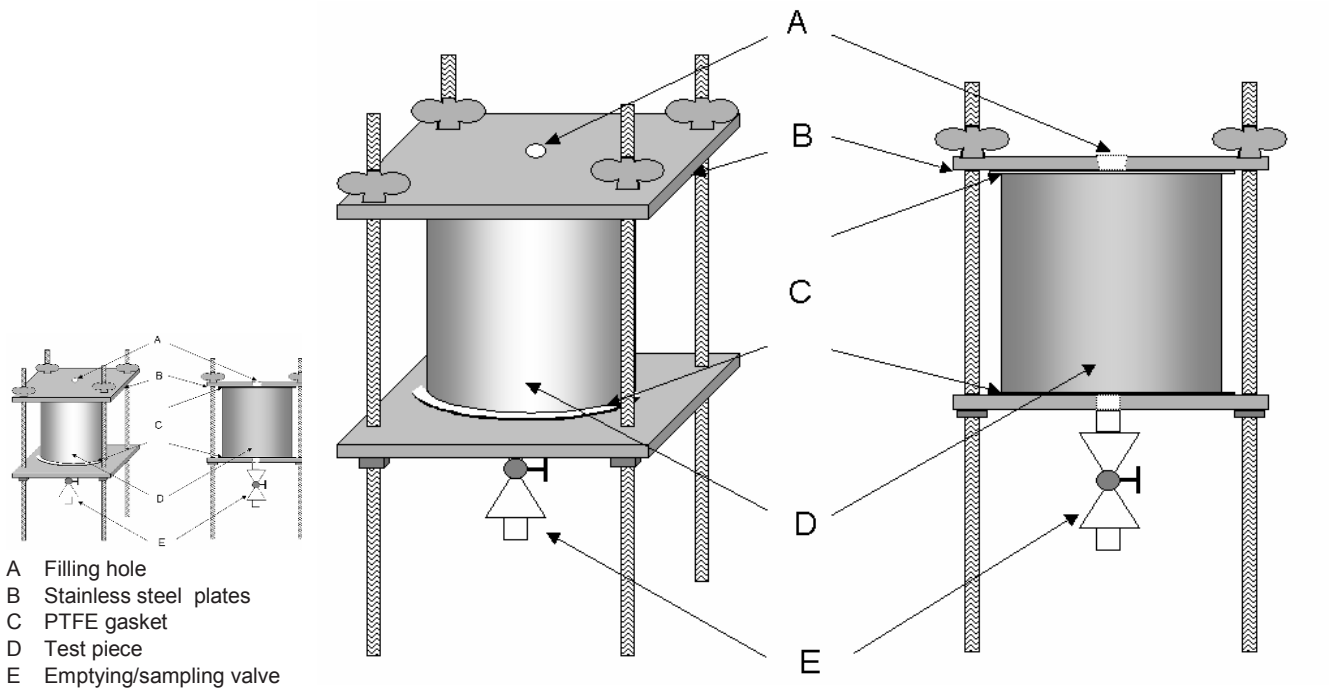
— concrete cylinders.

Table D.4 — Typical standard moulded test pieces and volumes of test water as a function of S/V ratio where all faces are exposed to test water

Mortar prism A 	Dimensions : 160 mm × 40 mm × 40 mm (S = 2,88 dm^2)						
***S*/*V* (dm^{-1})**	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	14,40	7,20	5,75	4,30	2,15	1,10	0,70
	(V too large)					(V too small)	
Mortar prism B 	Dimensions : 160 mm × 20 mm × 20 mm (S= 1,36 dm^2)						
S/V (dm^{-1})	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	6,80	3,40	2,70	2,05	1,00	0,50	0,35
	(V too small)						
Concrete cube A 	Dimensions : 100 mm × 100 mm × 100 mm (S = 6,0 dm^2)						
S/V (dm^{-1})	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	30,00	15,00	12,00	9,00	4,50	2,25	1,50
	(V too large)						
Concrete cube B 	Dimensions : 150 mm × 150 mm × 150 mm (S = 13,5 dm^2)						
S/V (dm^{-1})	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	67,50	33,75	27,00	20,25	10,15	5,05	3,40
	(V too large)						
Concrete cylinder A 	Dimensions : L = 200 mm, D = 100 mm (S = 7,85 dm^2)						
S/V (dm^{-1})	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	39,25	19,65	15,70	11,80	5,90	2,95	1,95
	(V too large)						
Concrete cylinder B 	Dimensions : L = 226 mm, D = 113 mm (S = 10,03 dm^2)						
S/V (dm^{-1})	**0,20**	**0,40**	**0,50**	**0,67**	**1,33**	**2,67**	**4,00**
V (L)	50,15	25,05	20,05	15,05	7,50	3,75	2,50
	(V too large)						

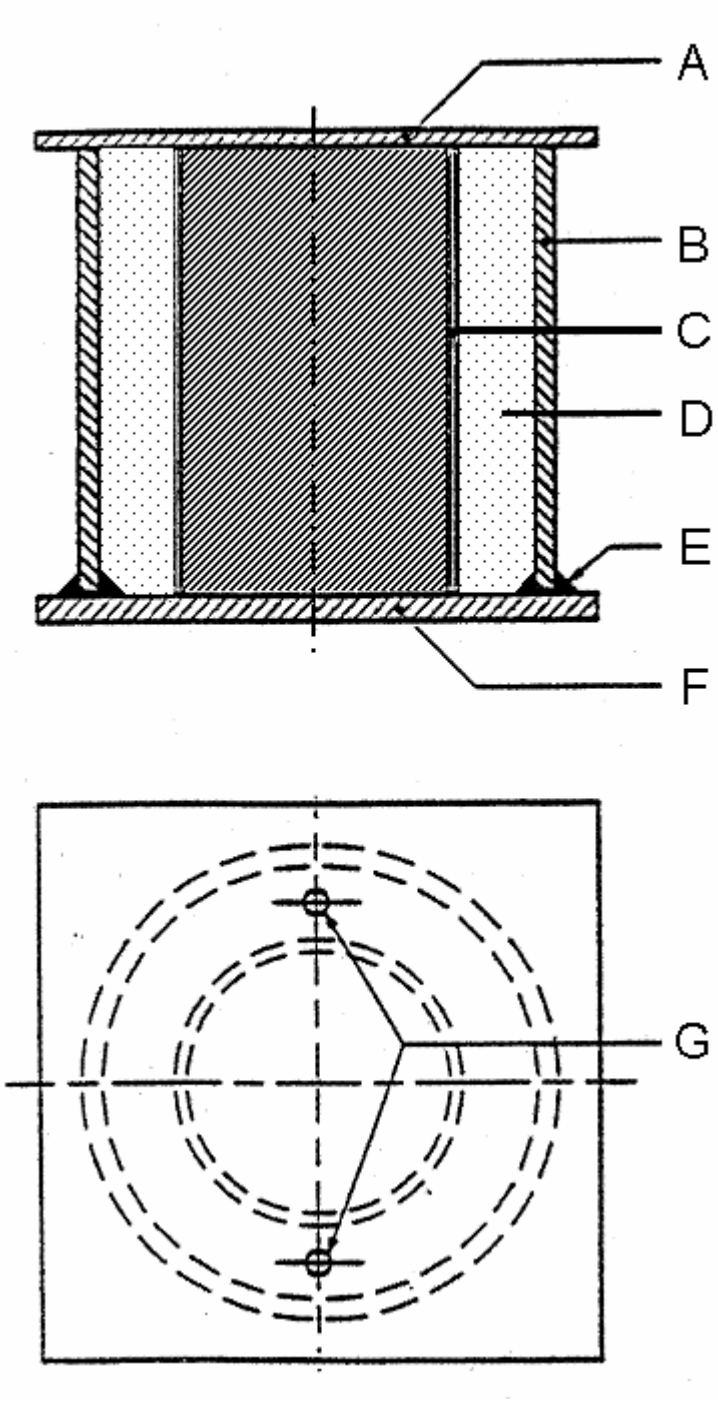
Annex E
(informative)

Test arrangements for testing factory made cementitious products



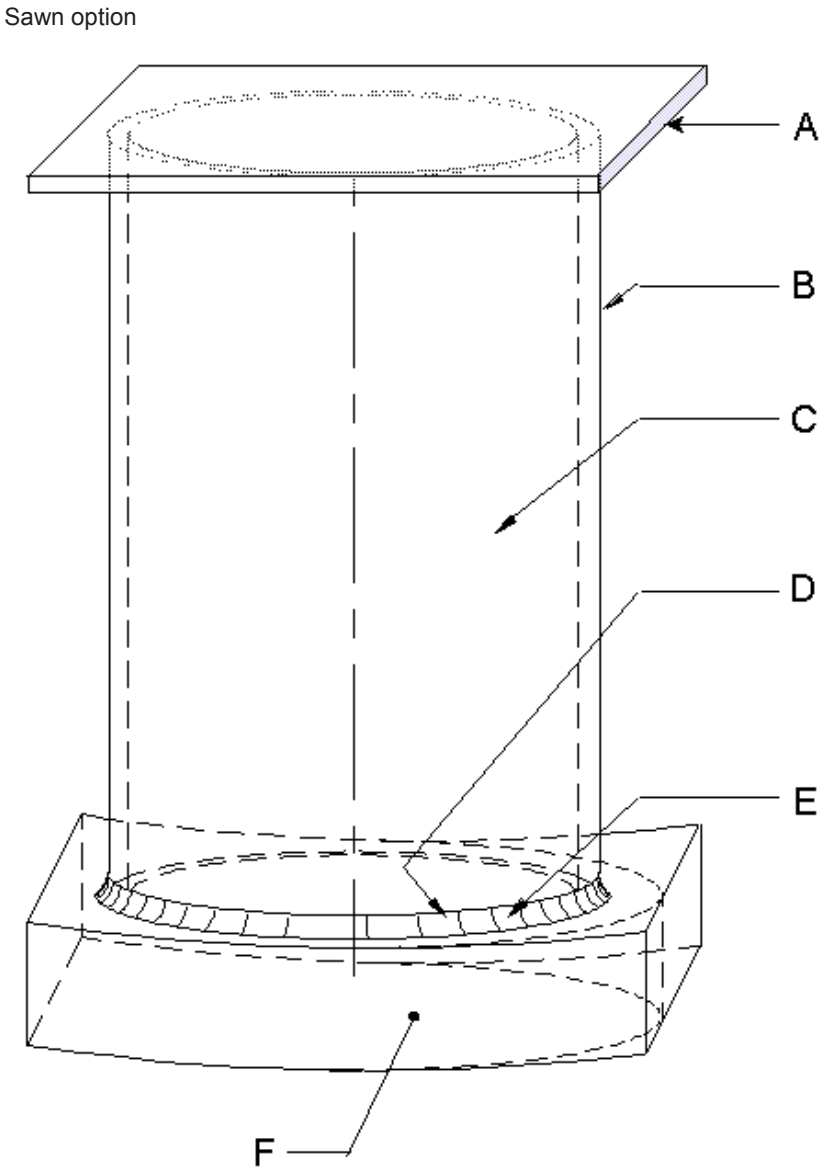
A Filling hole
B Stainless steel plates
C PTFE gasket
D Test piece
E Emptying/sampling valve

Figure E.1 — Typical test arrangement for pipes and equivalent-pipes (representing fittings) of small diameter



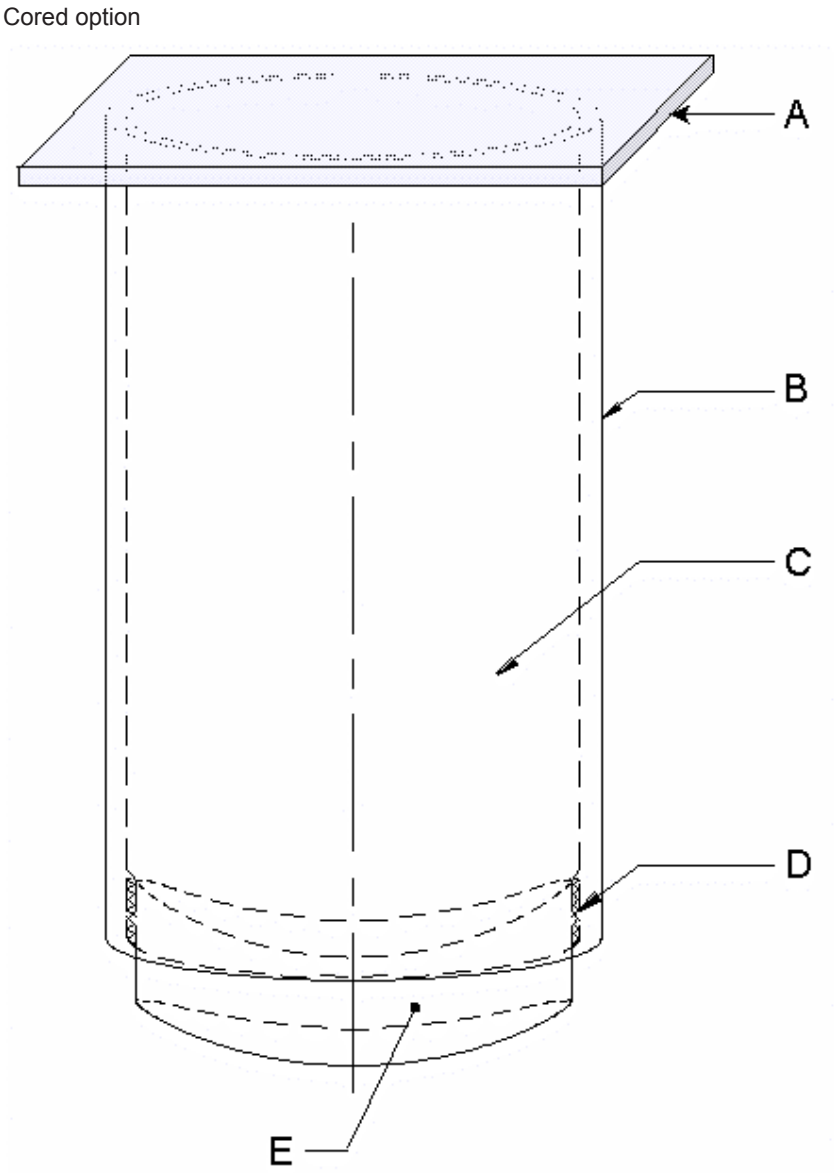
Key
A Top plate of glass or stainless steel
B Pipe wall
C Cylinder of glass or stainless steel
D Test water (test piece completely filled)
E Seal between pipe section and plate, if necessary
F Bottom plate of glass or stainless steel
G Hole in top plate for filling with test water and release of air (sealed with stoppers)

Figure E.2 — Typical test arrangement for pipes and equivalent-pipes (representing fittings) of DN/ID greater than 800



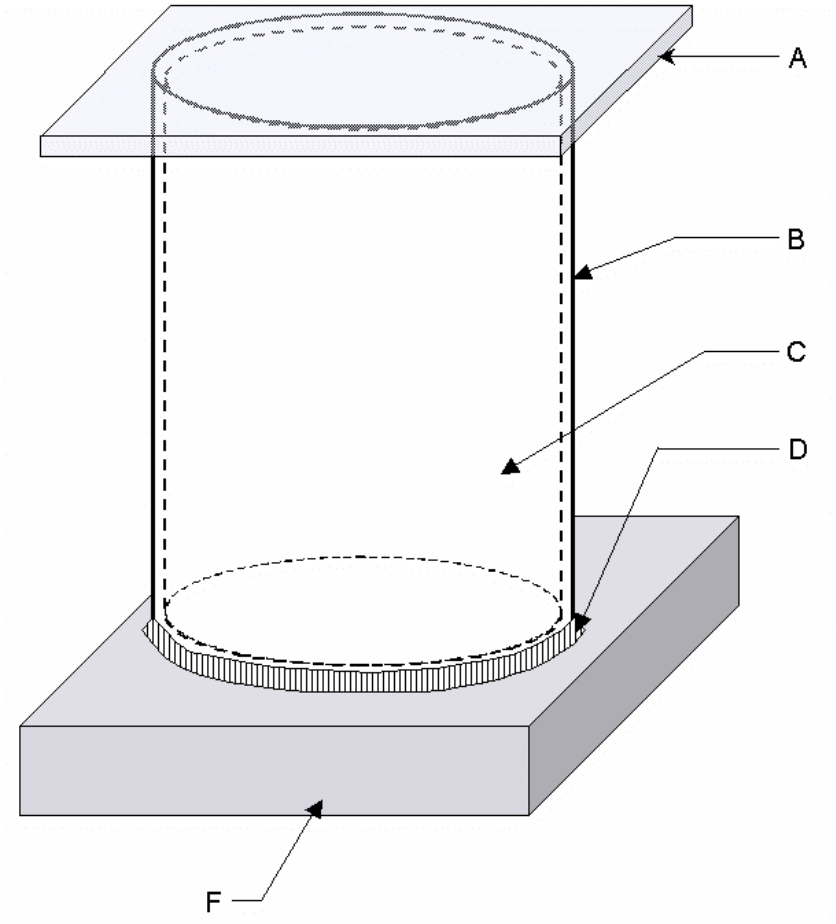
Key
A Cover
B Glass or stainless steel cylinder
C Test water
D Shaped extremity (to fit the sample curvature)
E Sealant
F Sawed concrete sample (taken from pipe wall)

Figure E.3 — Typical test arrangement for blocks sawn from: pipes, fittings or storage systems



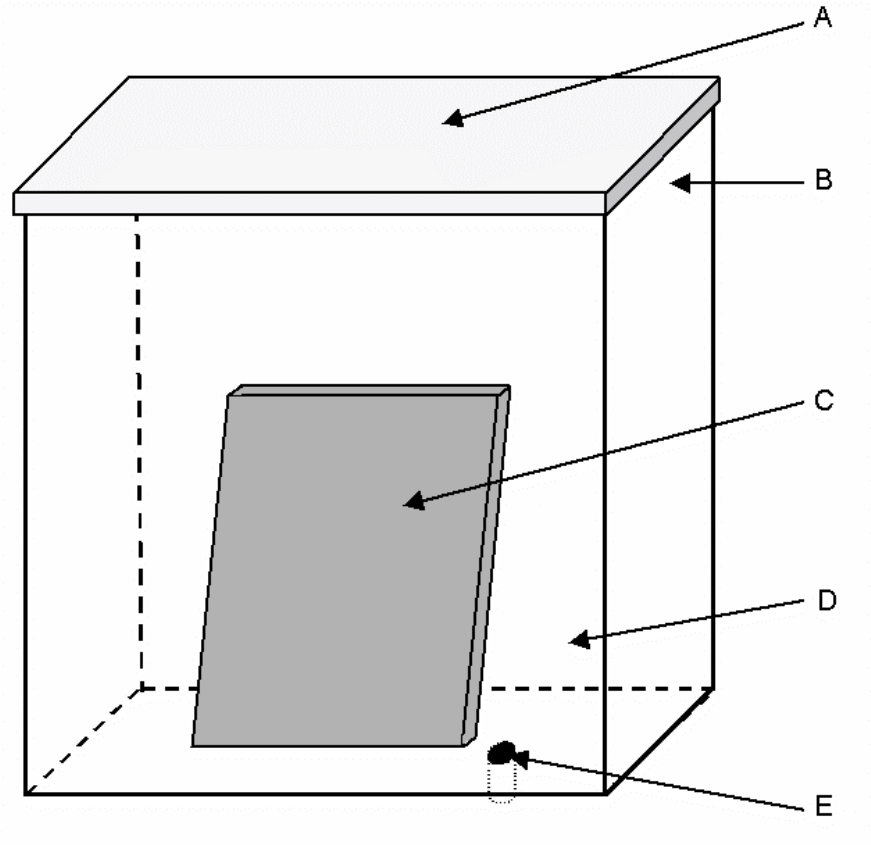
Key
A Cover
B Glass or stainless steel cylinder
C Test water
D Sealant
E Cored concrete sample (taken from pipe wall)

Figure E.4 — Typical test arrangement for blocks cored from: pipes, fittings or storage systems



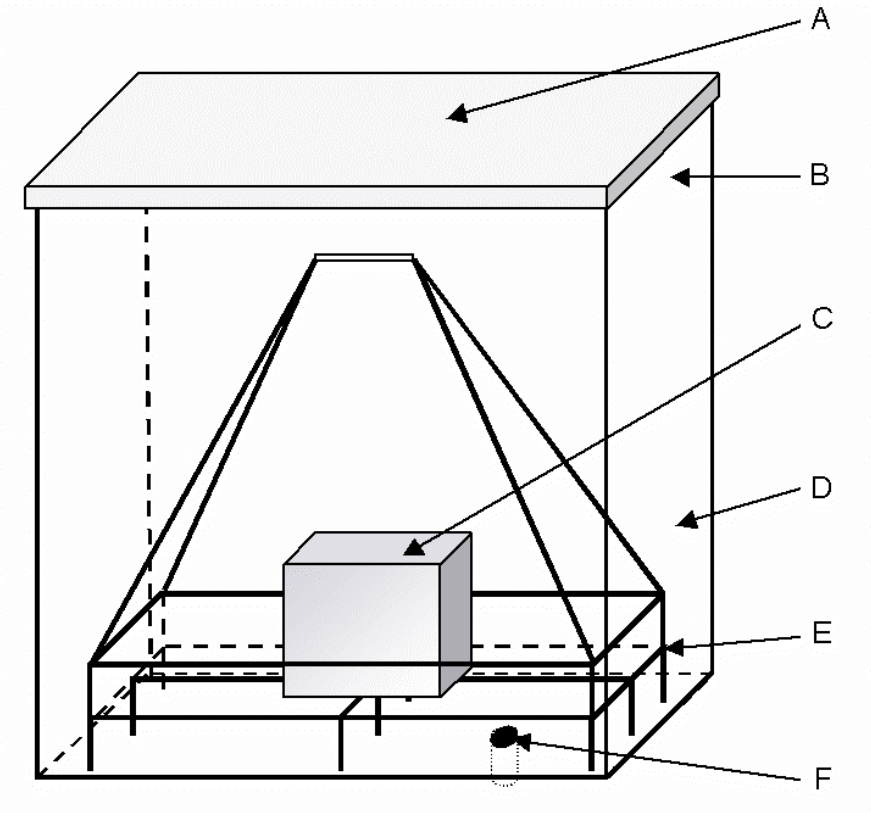
Key
A Cover
B Glass or stainless steel cylinder
C Test water
D Sealant
E Test piece (cube or cylinder)

Figure E.5 — Typical test arrangement for testing, on one face only, cubes or cylinders made from fresh concrete



Key
A Cover
B Container
C Test piece (mortar-coated stainless steel plate)
D Test water
E Drain/stopcock

Figure E.6 — Typical test arrangement for stainless steel test plates coated with fresh mortar



Key
A Cover
B Container
C Test piece
D Test water
E Mesh support
F Drain/stopcock

Figure E.7 — Typical test arrangement for testing, fully immersed, cubes or cylinders prepared from fresh concrete or prisms prepared from fresh mortar

Annex F
(normative)

Additional procedures for testing factory made cementitious products at elevated temperature

F.1 General

Sampling, test piece preparation, storage, test arrangements, surface to volume (S/V) ratio and pre-treatment of test pieces (preconditioning and disinfection) shall be carried out in accordance with either normative Annex, A, B or C, of this European Standard, as appropriate to product type.

F.2 Test procedure at elevated temperature

F.2.1 General

The elevated temperature to be used for testing will either be specified by the product standard or system standard or in national or European regulations.

Carry out the following procedures at the specified test temperature controlled to ± 2°°C.

F.2.2 Preparation of migration water for the assessment of odour, flavour, colour and turbidity

Begin the first contact period immediately after preconditioning the test piece in accordance with either 8.3.2 or 8.3.3, as appropriate.

Immerse in, or fill with, or otherwise bring the test piece (see normative Annex A, B or C) into appropriate contact with test water (5.4.3) and allow to stand for (24 ± 1) h at the test temperature controlled to ± 2 °C. In all cases (immersion, filling or other contact arrangement), ensure that the test piece or vessel/container is completely immersed or filled. Use a cover for the vessel/container in order to minimize:

— evaporation of test water;

— loss of any volatile components;

— headspace and contact between the test piece and air.

At the end of this period, collect the migration water and allow to cool in a covered vessel to (23 ± 2) °C. Following cooling, and without delay, determine the odour, flavour, colour and turbidity, in accordance with Clauses 10 and 11 respectively.

Repeat F.2.2 two more times using fresh test water (5.4.3) each time.

F.3 Control samples (blank test)

For each contact period, carry out a blank test procedure using the same test conditions (test water, test temperature, contact periods, sealants used etc.) as described in F.2 but omitting the test piece or replacing it by a glass container or plate, as appropriate.

F.4 Expression of results

Express results in accordance with Clause 12.

F.5 Reporting

Report results in accordance with Clause 13.

Annex G
(informative)

Discrimination between porous and non-porous coatings on factory made products

G.1 Principle

The coating used to coat the factory made cementitious product is applied in the laboratory to a stainless steel plate to produce a laboratory blank. The coated surface of the factory made product and the coated surface of the blank are brought, independently, into contact with demineralised water for 24 h each. At the end of the migration period the pH is determined on the water in contact with the blank and the water in contact with the coated product, and the results compared. On the basis of the difference in pH between the waters, the coating on the product is classified as either porous or non-porous.

G.2 Apparatus

G.2.1 **square stainless steel plates,** of dimensions between 10 000 mm^2 and 25 000 mm^2.

G.2.2 **cylinders**, of stainless steel or glass of approximate length of 125 mm and approximate diameter 90 mm.

G.2.3 **pH meter**, capable of measuring to an accuracy of 0,1 pH units.

G.3 Materials and reagents

G.3.1 **Sealing compound/sealant**, conforming to 6.3.3.

G.3.2 **Demineralised water**, conforming to the requirements given in EN ISO 3696, grade 3.

G.4 Test procedure

G.4.1 General

The laboratory blank (see G.4.2) and the coated product (see G.4.3) are tested at the same S/V ratio but with varying volumes of demineralised test water.

G.4.2 Laboratory blank

Carry out the following procedures in the laboratory in accordance with the manufacturer's instructions for application and curing.

Apply the coating to one face of a stainless steel test plate (G.2.1) to the same thickness as the coating applied in the factory to the product in order to produce a laboratory blank. Allow to cure.

Immediately after the coating has cured, attach a cylinder (G.2.2) to the coated face of the laboratory blank using a sealing compound (6.3.3) to give a water-tight seal between the base circumference of the cylinder and the coated face (see Figure E.3 in informative Annex E for a similar test arrangement). Allow the sealing compound to cure.

Determine the volume of demineralised water (3.29) to be used for testing the laboratory blank, as follows:

a) in the case where the coated product is a complete pipe, equivalent pipe or a cylindrical section of pipe, use the volume of demineralised water for the blank test given in Table G.1 appropriate to the diameter DN/ID of the product. Interpolation between values is permitted.

b) in the case where the coated product is a sawn block or core taken from a pipe, equivalent pipe, section of pipe or from a storage system, use a fixed volume of demineralised water of approximately one half litre for testing the laboratory blank.

Table G.1 — Typical volumes of demineralised water required in the blank test (pipe/equivalent pipe or cylindrical pipe-section of DN/ID ≤ 300)

Pipe diameter DN/ID	60	80	100	150	250	300
S/V (dm^{-1})	6,67	5,0	4,0	2,67	1,6	1,33
Volume of water (dm^3)	0,1	0,13	0,16	0,24	0,40	0,48
Depth of water in cylinder (mm)	15	20	25	37	63	75
NOTE Tabulated values assume that the test pieces are vertical when tested.						

Pour the appropriate volume of demineralised water into the cylinder (**G.2.2**) and cover the open end using a plate of stainless steel or glass. Allow to stand in the laboratory for approximately 24 h.

G.4.3 Coated product

Bring only the coated surface of the factory coated product into contact with demineralised water (3.29) as follows:

a) In the case where the coated product is a complete pipe, equivalent pipe or cylindrical section of pipe, seal (see 6.3.3) one end of the product against a stainless steel or glass plate and test the product held vertically by partially filling with one litre of demineralised water. Cover the test arrangement with a plate of stainless steel or glass and allow to stand in contact with the water for 24 h.

b) In the case where the coated product is a sawn block or core, attach a cylinder (G.2.2) to the coated face in the same way as given in G.4.2 for attaching a cylinder to a laboratory blank. Pour approximately one half litre of demineralised water into the cylinder and cover the open end using a plate of stainless steel or glass. Allow to stand for approximately 24 h.

G.5 Determination of pH

Immediately following the 24 h migration period determine the pH of each water using the pH meter (G.2.3).

G.6 Expression of results

Express the results, to the nearest 0,1 pH unit, as pH_{coat} for the factory coated product and as pH_{blank} for the laboratory blank.

G.7 Classification criteria

Where the pH difference:

— $pH_{coat} - pH_{blank} \geq + 1,0$ pH unit, classify the coating as porous.

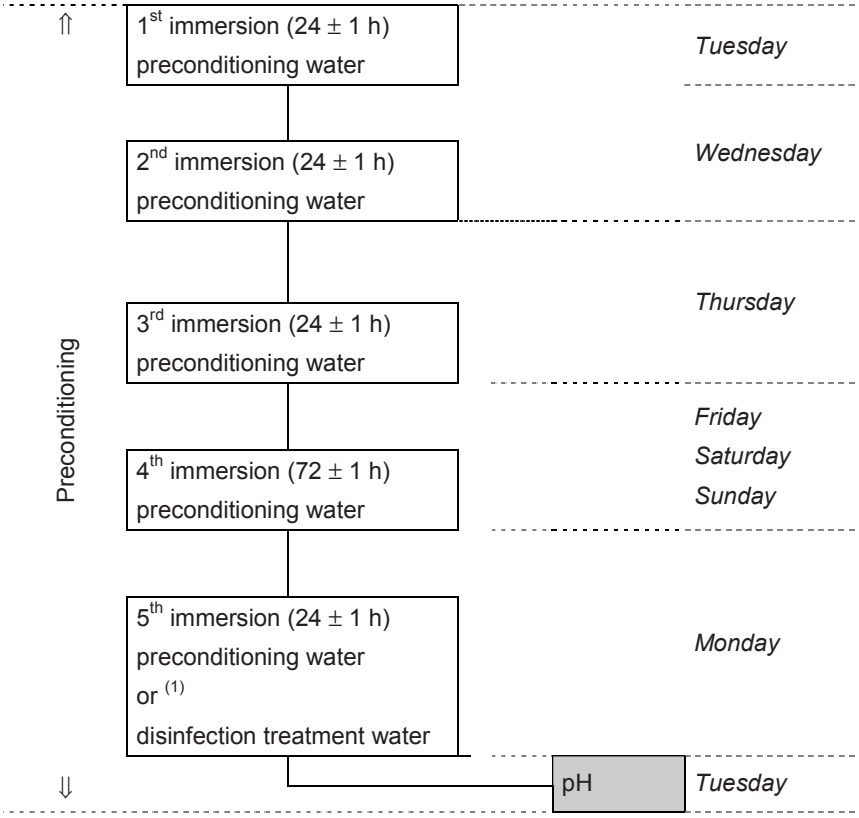
— $|pH_{coat} - pH_{blank}| < 1,0$ pH unit, classify the coating as non-porous.

Annex H
(informative)

Schematic description of the test procedure

H.1 Preconditioning

A schematic description of the preconditioning is given in Figure H.1.



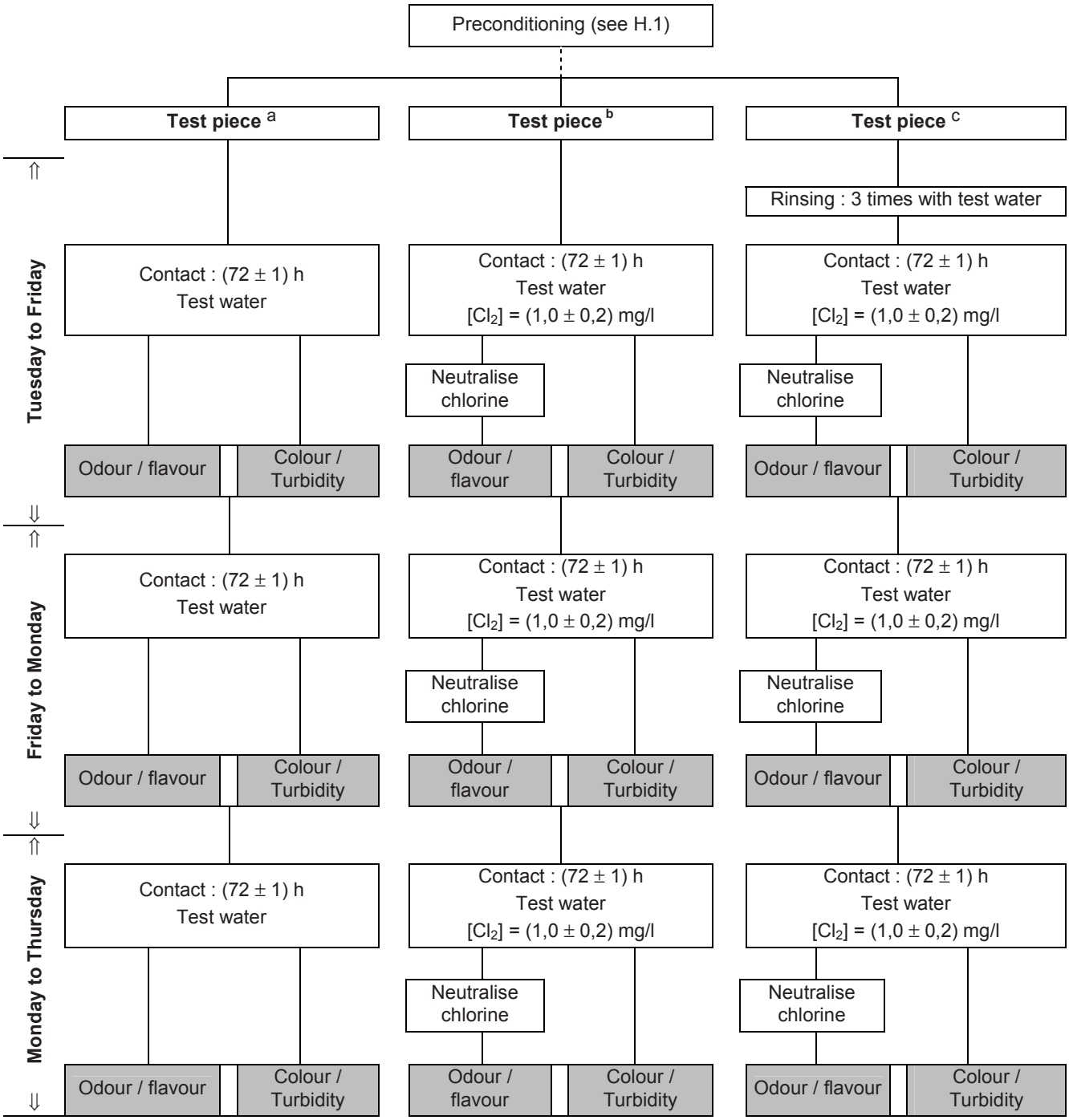
a If disinfection treatment is required, replace the preconditioning water (5.4.1) for the fifth contact period, by disinfection treatment water (5.3.2).

NOTE The days of the week are for guidance only.

Figure H.1 — Schematic description of the preconditioning

H.2 Production of migration water for organoleptic assessment at 23 °C

A schematic description of the procedure is given in Figure H.2.



[a] This scheme should be used where neither the preconditioning stage (see H.1) nor the migration procedure (see 9.2) involves the use of chlorinated waters.

[b] This scheme should be used where only the test water (see 5.4.3) used in the migration procedure is chlorinated.

[c] This scheme should be used where chlorinated disinfection water (5.3.2**)** has been used in the preconditioning stage (see H.1) and chlorinated test water (5.4.3) is to be used in the migration procedure.

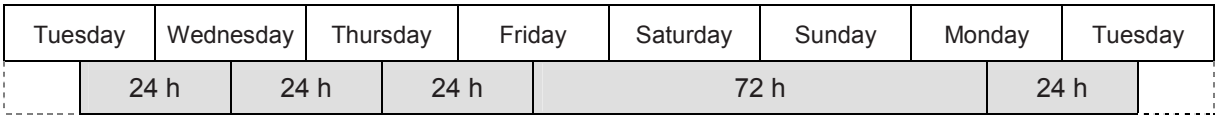
NOTE The days of the week are for guidance only.

Figure H.2 — Schematic description of the test

H.3 Typical Schedule

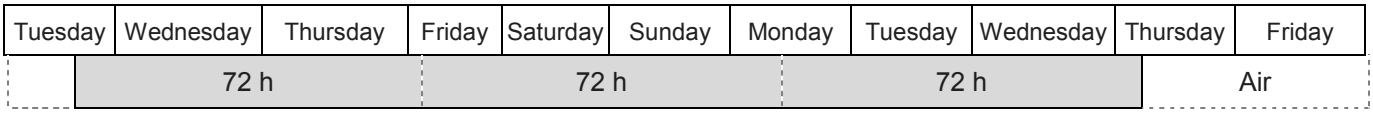
H.3.1 Preconditioning

The following diagram shows a typical schedule of the preconditioning.



H.3.2 Production of migration waters

The following diagram shows a typical schedule of the production of migration waters.



Bibliography

[1] ISO 16132, *Ductile iron pipes and fittings - Seal coats for cement mortar linings*

[2] ISO 5492, *Sensory analysis - Vocabulary*

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL