

BS 6920-2.1:2014



BSI Standards Publication

Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water

**Part 2: Methods of test – Section 2.1:
Samples for testing**

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Summary of pages

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Foreword

Publishing information

This part of BS 6920 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 June 2014. It was prepared by Technical Committee EH/6, *Effects of materials on water quality*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 6920 supersedes BS 6920-2.1:2000+A3:2008, which is withdrawn.

Relationship with other publications

The following parts and sections of BS 6920 have been published.

- Part 1: *Specification*;
- Part 2: *Methods of test*;
 - Section 2.1: *Samples for testing*;
 - Section 2.2: *Odour and flavour of water*;
 - Subsection 2.2.1: *General method of test*;
 - Subsection 2.2.2: *Method of testing odours and flavours imparted to water by multi-layered hoses and composite pipes and tubes*;
 - Subsection 2.2.3: *Method of testing odours and flavours imparted to water by hoses for conveying water for food and drink preparation*;
 - Section 2.3: *Appearance of water*;
 - Section 2.4: *Growth of aquatic microorganisms test*;
 - Section 2.5: *The extraction of substances that may be of concern to public health*;
 - Section 2.6: *The extraction of metals*;
- Part 3: *High temperature tests*;
- Part 4: *Method for the GCMS identification of water leachable organic substances*.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- New definitions for the terms multi-layered product (see 3.2), inradius (3.5), thermoplastic material (3.6), thermosetting material (3.7), cure (3.8), solvent cement (3.10) and porous seal coat (3.11) have been provided.
- The specification of metal couplings has been changed (see 4.2.2).
- A new requirement for porous seal coats has been added (see 6.13.2).
- New requirements for *in-situ* applied pipe linings and coatings (see 7.2), resin anchors (7.7) and solvent cements (7.8) have been added.
- Reporting requirements have been amended (see Clause 9).

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this part of BS 6920 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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 cannot confer immunity from legal obligations.

1 Scope

This section of BS 6920 describes the preparation of test samples of all types of non-metallic (including cementitious) materials and products, including water fittings and components, pipes and materials used in coating, protection, lining, jointing, sealing and lubrication, for their suitability for use in contact with water intended for human consumption, with regard to their effect on the quality of the water.

This standard does not cover metallic materials and products, unless they will be used in conjunction with a non-metallic material, e.g. coating.

NOTE Under the relevant National Regulations [1] to [7], the National Regulator may specify additional provisions in some cases and will assess the significance of the results obtained.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 864-2, *Capillary and compression tube fittings of copper and copper alloy – Part 2: Specification for capillary and compression fittings for copper tubes*

BS 887:1982, *Specification for precision vernier callipers*

BS 4372:1968, *Specification for engineers' steel measuring rules*

BS 6920-1:2014, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 1: Specification*

BS 6920-2.2.2, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.2: Odour and flavour of water – Subsection 2.2.2: Method of testing odours and flavours imparted to water by multi-layered hoses and composite pipes and tubes*

BS 6920-2.2.3, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.2: Odour and flavour of water – Subsection 2.2.3: Method of testing odours and flavours imparted to water by hoses for conveying water for food and drink preparation*

BS 6920-2.3, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.3: Appearance of water*

BS 6920-2.4, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.4: Growth of aquatic microorganisms test*

BS 6920-2.5, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.5: The extraction of substances that may be of concern to public health*

BS 6920-2.6, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.6: The extraction of metals*

BS 6920-3, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 3: High temperature tests*

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

BS EN 1057, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 1992-3, *Eurocode 2 – Design of concrete structures – Part 3: Liquid retaining and containing structures*

BS EN 12620, *Aggregates for concrete*

BS EN 30012-1, *Quality assurance requirements for measuring equipment – Part 1: Metrological confirmation system for measuring equipment*

BS EN ISO 2808 (BS 3900-C5), *Paints and varnishes – Determination of film thickness*

BS EN ISO 3696, *Water for analytical laboratory use – Specification and test methods*

BS EN ISO 10523:2012, *Water quality – Determination of pH*

BS ISO 2230, *Rubber products – Guidelines for storage*

3 Terms and definitions

For the purposes of this part of BS 6920, the following terms and definitions apply.

3.1 material

prepared form of a substance, or of a combination of substances, suitable for use in a manufacturing process; it can be organic or mineral

3.2 multi-layered product

product whose water-contact surface is made from a material that differs from those comprising the remainder of the product

3.3 product

all or a component part of a manufactured item, in its finished form, that comes into contact with water

3.4 test sample

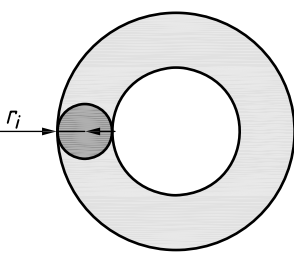
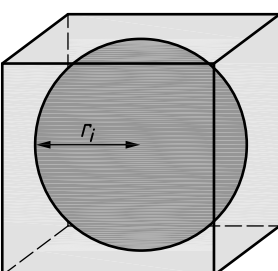
sample of the material, product, or part of a product, submitted to the test procedure

NOTE In some cases the sample might consist of more than one example (test piece or article) of the product.

3.5 inradius

the radius of the largest sphere that will fit in the thickest section of a rubber based test material or product (see Figure 1)

Figure 1 The radius of the largest sphere that will fit in the thickest section of a rubber based test material or product

	
a) Inradius of an o-ring	b) Inradius of a cube
NOTE The cross sectional thickness of the thickest section of a test sample = 2 x inradius.	
Solid shape	Solid shape
	Where s is the side length
Tetrahedron	$\frac{\sqrt{6}}{12}s$
Cube	$\frac{1}{2}s$
Octahedron	$\frac{\sqrt{6}}{6}s$

3.6 thermoplastic material

polymeric organic material that becomes pliable and mouldable above a specific temperature, but returns to a solid state upon cooling

NOTE Examples include ABS, PVC, nylon, polyethylene and acetal (POM).

3.7 thermosetting material

polymeric organic material that once formed into its final manufactured (irreversibly cured – see 3.8) state is infusible and insoluble

NOTE Examples include most rubber materials used in contact with water, together with phenolic resins, some polyurethanes and epoxy resins.

3.8 cure

curing in relation to materials refers to the change (usually irreversible) in both the chemistry and physical properties of the material. For most materials this can be as a result of cross-linking of polymer chains (brought about by a chemical reaction), radiation (e.g. UV light and/or heat). For cementitious materials the process of cure is different. With the exception of radiation mediated cures, for most materials curing is temperature and duration dependent

NOTE Many products that change into their final form suitable for use in contact with water do so by means of solvent loss (organic or water), i.e. drying, not curing, e.g. solvent cements and many one-part coatings. Drying is usually temperature and duration dependent.

3.9 anaerobic adhesive

adhesive that cures spontaneously in the absence of oxygen, curing being inhibited by the presence of oxygen and catalyzed by metal ions

3.10 solvent cement

solution containing appropriate solvents, that might also contain dissolved plastics, used to join plastic materials such as ABS, PVC, etc; the cement cures by the loss of the solvent(s)

3.11 porous seal coat

polymeric materials applied in a thin (25 µm to 200 µm thickness) surface layer to a cement mortar lining in order to restrict (but not prevent) interactions between the mortar and water

4 Apparatus

4.1 Test plates

4.1.1 Glass plates, constructed of sand-blasted glass, that has been sand-blasted on all surfaces, and having a total surface area of (15 000 ±500) mm². The width of the plates shall not exceed 60 mm. Soak the plates for 24 hours in 10% nitric acid and thoroughly rinse in tap water. Clean them in an aqueous solution of a biodegradable laboratory detergent. Rinse thoroughly in tap water and then once in distilled water conforming to grade 3 of BS EN ISO 3696. Drain and dry in a hot air cabinet and store in polyethylene bags (**4.2.1**).

4.1.2 Special glass plates, conforming to **4.1.1** except that only one side has been sand-blasted.

4.1.3 Stainless steel plates, of the same surface area and dimensions as the glass plates described in **4.1.1**. The plates shall be cleaned before use in accordance with **4.1.1** omitting the soaking in 10% nitric acid.

4.2 Other apparatus

4.2.1 Polyethylene bags, of a type suitable for food contact.

Prior to use, the bags shall be stored in a closed container. The bags shall not be used for thermosetting rubber compounds (see **6.3**).

4.2.2 Stainless steel couplings, female/female, 15 mm diameter compression couplings.

Take the coupling apart and discard the compression “olives”; retain the body of the coupling and the two screw collars. Immerse the couplings in an aqueous solution of a biodegradable laboratory detergent for 5 min. Rinse the couplings with distilled water conforming to grade 3 of BS EN ISO 3696, and then immerse in a 1% by volume solution of nitric acid for 1 min. Rinse in tap water and then in distilled water again. Drain and dry in a hot air cabinet and store in polyethylene bags (**4.2.1**).

NOTE Some anaerobic adhesives do not cure adequately on stainless steel. In this case advice should be sought from the manufacturer of the adhesive on a suitable metal to use for the coupling that gives a satisfactory cure and does not lead to a failure in the Extraction of Metals test (see BS 6920-2.6).

4.2.3 Test container, made of glass, as specified in the appropriate section of BS 6920, and of size as given in **5.1.2**.

5 Procedure

5.1 General

5.1.1 Nature of samples

The samples used for testing shall be manufactured products or components of water fittings drawn from representative production batches that have received no other treatment, except for the exclusions given below.

In a very few special applications, e.g. within water undertakings' distribution systems involving products used for joints in service reservoirs, or large tanks constructed in accordance with BS EN 1992-3, the surface area to volume ratio used for the tests described in BS 6920-2.2 (appropriate sub-section), BS 6920-2.3, BS 6920-2.5 and BS 6920-2.6 shall be 1 000 mm²/L.

5.1.2 Sample and test container size

Use, wherever possible, a sample with a total surface area of (15 000 ±500) mm² and a test container (4.2.3) bearing a calibration mark for a capacity of 1 000 ml. If in exceptional circumstances this size of sample cannot be obtained, use a test container calibrated for a capacity in accordance with Table 1. The sample shall be made up from one or more articles drawn from the same production batch or cut from a single larger product. The maximum length and width of any single sample shall be 150 mm and 70 mm respectively.

Table 1 Test container calibration mark

Sample surface area mm ²	Volume indicated by calibration mark ml
≥ 5 500 to < 9 500	500
≥ 9 500 to < 13 000	750
≥ 13 000 to < 19 000	1 000
≥ 19 000 to ≤ 26 000	1 500

During testing, the samples shall always be completely submerged in the test water. If the density of the sample is less than that of water, the sample shall be kept totally submerged for the duration of the test by using glass-encapsulated weights.

Determine the dimensions of all samples using measuring equipment calibrated in accordance with BS EN 30012-1. The instruments used shall include rules and callipers conforming to the accuracy requirements of BS 4372:1968, 2.5.4 and BS 887:1982, Clause 6 respectively.

For all rubber (elastomeric) materials record the maximum inradius (3.5) of the test piece for inclusion in the final report.

If the sample has a textured finish to the surface, or the shape of the sample is such that accurate calculation of the surface area is impracticable, then a sample of estimated surface area shall be used. In this case the length and width shall be recorded together with a sufficiently detailed description of the product(s) to enable further samples to be prepared that will be within ±10% of the surface area of the original sample.

NOTE The supplier of the samples should be instructed to ensure that the products or test samples represent the product as it is used in contact with water intended for human consumption. If the product has to be cut to obtain the required sample area, this should be done before the samples receive any post-cure or special surface treatment and in a manner that ensures the area of the cut edges is as small as possible.

5.2 Sample storage

The samples shall be protected from contamination by dirt, oil, grease, excessive heat, sunlight and volatile chemicals. Store samples in the laboratory in polyethylene bags (4.2.1) and in the absence of light at $(21 \pm 4) ^\circ\text{C}$ except where the individual supplying the samples provides alternative written storage instructions, which are those that the products are subject to in practice. Use a fresh bag for each product or set of products made from an identical material.

Do not test samples bearing adhesive tape or labels, ink or pencil marks. Polyethylene bags (4.2.1) are not suitable for the storage of thermosetting rubber compounds (6.3).

6 Factory made products

6.1 General

Products made from certain material types shall be subject to the additional requirements given in 6.2 to 6.14.

6.2 Thermoplastic products

Thermoplastic products shall be tested in any typical/suitable manufactured form using the production method for which they are designed, e.g. moulding grades for moulded test samples, extrusion grades for extruded samples.

Granules shall not be tested. Test samples shall be manufactured products, e.g. test sheets, extruded or moulded products etc.

NOTE By their very nature the materials used to manufacture these products are designed to melt when heated and solidify when cooled; when reheated they will again melt (unlike thermosetting products).

6.3 Thermosetting products

Thermosetting materials, including thermosetting elastomers, shall be tested in their final manufactured form.

NOTE 1 Unlike thermoplastics materials, the performance of thermosetting materials, e.g. most rubber compounds, glass reinforced plastics (GRP) and epoxy resin based products can vary in the BS 6920 tests according to the conditions of final cure (together with any post cure treatments) and method of manufacture, e.g. compression moulding and extrusion.

Elastomeric products shall be stored in accordance with BS ISO 2230 except that storage envelopes or pockets shall not be sealed, dusting powder shall not be used and cleaning shall not be carried out unless any of these procedures form part of the usual production procedures.

Suppliers of elastomeric products shall be instructed to arrange for storage of the products for at least four weeks before dispatch to the laboratory.

NOTE 2 If samples of elastomeric products are tested within four weeks of manufacture, the results obtained with these methods might not be representative of the material as it is used in practice.

6.4 Multi-layered (composite) products

6.4.1 General

Samples of multi-layered products shall be made of all the component parts or coatings, but with only the water contact material in contact with the test water (see also 6.4.2).

NOTE 1 Cistern or spiral-wound glass-reinforced plastics pipes, reinforced hoses or laminate pipes and tubes are typical examples of multi-layered products.

NOTE 2 Provided that the products are not site-applied products (see Clause 7), multi-layered products may be tested in the form of specially prepared samples containing all the component materials present in the finished article, and manufactured in a similar way.

Reinforced hoses, and multi-layered pipes and tubes shall be tested in accordance with BS 6920-2.2.2 for potential effects on the odour and flavour of water.

NOTE 3 The method described in BS 6920-2.2.2-2014, Clause 8 can also be used to prepare leachates from multi-layered hoses and pipes (including in-situ relined pipes) for the Appearance of Water test (BS 6920-2.3), the Extraction of substances that may be of concern to public health (BS 6920-2.5) and the Extraction of Metals test (BS 6920-2.6).

6.4.2 Hoses

To ensure that test samples are as representative as possible of potential use, obtain a minimum length of 20 m of hose as one continuous piece and cut off lengths from the centre of the hose to give the appropriate surface area for testing. Do not test the remainder of the hose.

In the case of hoses prepared for testing in accordance with BS 6920-2.2.2 and BS 6920-2.2.3, the test samples shall consist of 1 m lengths of the complete hose, including all reinforcements and outer coverings.

6.5 Ion-exchange resins

(2 ± 0.2) g of the resin beads shall be placed in a test container (4.2.3) calibrated for a capacity of 1 000 ml.

NOTE The BS 6920 methods are unsuitable for testing of other water treatment materials, e.g. polyphosphate, coagulants etc.

6.6 Greases, oils and lubricants

6.6.1 Greases

(5 ± 0.5) g of the sample shall be evenly spread over the sand-blasted surface of a special glass plate (4.1.2). The plate shall be placed in a test container (4.2.3) calibrated for a capacity of 1 000 ml. Testing shall start immediately, or in strict accordance with the instructions for use.

6.6.2 Oils

A special glass plate (4.1.2) shall be dipped into the material or product and the plate shall be allowed to drain for 30 min. Testing shall start immediately, or in strict accordance with the instructions for use.

6.6.3 Water miscible lubricants

NOTE These products are designed to facilitate assembly of joints etc. and are designed to be readily flushed away once the joint is complete.

6.6.3.1 Low viscosity lubricants (oils)

A special glass plate (4.1.2) shall be dipped into the product and the plate shall be allowed to drain for 30 min. The plate shall then be placed into a 1 L beaker, through which tap water is allowed to gently flow at a low rate (0.5 L to 0.75 L per min) for 60 min.

NOTE Ensure that the water entering the beaker does not directly disturb the test plate surfaces.

The plate shall then be removed from the beaker and allowed to drain for 2 min to 4 min and then placed on test immediately.

6.6.3.2 High viscosity lubricants (greases)

(5 ±0.5) g of the sample shall be spread over the sand blasted surface of a special glass plate (4.1.2). The plate shall then be placed into a 1 L beaker, through which tap water is allowed to gently flow at a low rate (0.5 L to 0.75 L per min) for 60 min.

NOTE 1 Ensure that the water entering the beaker does not directly disturb the test plate surfaces.

The plate shall then be removed from the beaker and allowed to drain for 2 min to 4 min and then placed on test immediately.

NOTE 2 Since the grease/lubricant may be easily washed off the plate, it is essential to ensure that the test water is added so as to cause the least possible disturbance of the grease film on the test plate in the test containers, both at the commencement of each test, and also at each change of test water. Similarly, it is important to ensure that pre-test rinsing with the test waters does not disturb the grease film.

NOTE 3 In all cases it is likely that some or all of the product will wash off the plate during the test period – this is normal but it should be noted in the final report.

6.7 Braided gland packings

NOTE A sample of a gland packing with a nominal surface area of 15 000 mm² has an actual surface area of up to ten times this value once it is in contact with water intended for human consumption and the water has entered the structure of the packing. In addition, when this type of product is used in practice the actual area of the product in contact with water intended for human consumption is very small; on the basis of static volumes and contact areas in valves and pumps a realistic "worst-case" surface area to volume contact ratio appears to be about 1 000 mm² in contact with 1 L of water.

6.7.1 Testing

These products shall be tested using the reduced nominal surface area to volume ratio of 1 000 mm² to 1 L of water. The size of the test sample piece shall be determined by assuming that the surface of the product is, in fact, a smooth surface; this will give the correct sample size with the nominal surface area required. Testing shall be undertaken in accordance with the appropriate section of BS 6920.

6.7.2 Test report

The test report shall include the following statement.

"This product has been tested at the reduced surface area (nominal) of 1 000 mm² in 1 L of test water, and under the conditions of test it was found to conform with the requirements of BS 6920-1, for use as a gland packing only.

It has not been assessed for conformity to the requirements of BS 6920-1 at the standard surface area of 15 000 mm² in 1 L of test water."

6.8 Heat shrink products

These products shall be tested after they have been fully shrunk using the manufacturer's recommended heat treatment method, including the temperature and time of heating.

NOTE 1 Heat shrink products are designed to shrink to a tight fit (over components) when heated.

When a heat shrink product is to be fitted over probes etc. before the heat treatment is given, test samples shall be prepared by shrinking the material onto a metal rod made from a non-corroding material (e.g. aluminium or stainless steel) of a similar diameter to the proposed use.

Full details of the method used shall be recorded. After heat treatment, calculate the surface area of the sample and then test in the normal way using a surface area/volume ratio of 15 000 mm²/L. Full details of the heat shrink treatment used to prepare the test specimens shall be included in the final report.

NOTE 2 The normal heat treatment used for these products is hot air, although exceptionally other heating methods e.g. steam, hot water, may be recommended by the manufacturer.

6.9 UV cured products

NOTE These products rely upon sufficient exposure (penetration into the product) of both an adequate strength and wavelength of UV light to bring about a complete cure. The presence of pigments in the product, of course, affects penetration of the product. Most of these products, in their uncured form, contain styrene; the presence of free-styrene in the cured product is a sensitive indicator of the efficacy of the curing conditions.

Test samples shall be prepared under supervision of the test laboratory staff. The test report shall contain the following information relating to sample preparation:

- a) main wavelength(s) of the UV light emissions (if known);
- b) distance of the light from the test samples;
- c) duration of exposure to the UV light source.

6.10 Ceramic and graphite based products

6.10.1 Ceramic products

These products shall be tested in accordance with BS 6920-1:2014, Clause 8 (no other tests are required).

NOTE These products might leach metals into water.

6.10.2 Graphite based products

6.10.2.1 Carbon products

Graphite products based entirely upon carbon without any other ingredients shall be tested in accordance with BS 6920-1:2014, Clause 8 (no other tests are required).

6.10.2.2 Carbon products with metallic binders and lubricants

Graphite products containing metal additives, including binders and lubricants shall be tested in accordance with BS 6920-1:2014, Clause 8 (no other tests are required).

NOTE Additional parameters might be required to cover the specific metal(s) included as additives, e.g. molybdenum.

6.10.2.3 Carbon products with organic binders

Graphite products containing organic based binders/resins shall be tested to the full requirements of BS 6920-2, excepting subsections 2.2.2 and 2.2.3.

6.10.2.4 Activated carbon products

Activated carbon products based upon a plastics matrix (porous moulded blocks) shall be tested to the full requirements of BS 6920-2, excepting subsections 2.2.2 and 2.2.3.

NOTE The National Regulator may specify other test requirements for the effect any activated carbon product (including granular and powdered) might have on water quality.

6.11 Metallic magnets with no organic component

These products shall be tested in accordance with BS 6920-2.6.

6.12 Jointing and gasket products (not plastics and rubbers)

NOTE 1 These products (e.g. compressed fibre gaskets) are used to seal flat face joints (for braided gland packings see 6.7).

These products shall be tested in accordance with BS 6920-2.2 (appropriate sub-section), BS 6920-2.3, BS 6920-2.5 and BS 6920-2.6, using a surface area of 1 000 mm² consisting only of the cut edge of the material.

NOTE 2 This can be achieved by clamping one or more layers of the material between stainless steel plates (4.1.3).

These products shall be tested for the growth of aquatic organisms in accordance with BS 6920-2.4 using the standard sample size (15 000 mm²) consisting of a cut sheet of the material.

NOTE 3 These materials usually consist of sheets with a suitable surface finish on both of the main faces. In use, however, it is the cut edge of the material and not the main faces that will usually be exposed to water intended for human consumption, and water may well enter the matrix structure of these products through this cut edge. On the basis of these applications a realistic "worst-case" surface area to volume contact ratio appears to be about 1 000 mm² in contact with 1 L of water. Whilst this sample size is adequate for the leaching tests, due to some very bad in-service failures caused by some of these materials (including biodegradation of the material and significant biofilm development downstream) no relaxation in the sample size for the Growth of aquatic microorganisms test (BS 6920-2.4) is acceptable.

6.13 Factory-applied coatings

6.13.1 General

The manufacturer or supplier shall be instructed to apply samples of these products to suitably sized test pieces or panels of a material with similar adherent properties to the material(s) for which the coating is designed, in accordance with the manufacturer's written instructions. The test pieces or panels shall be resistant to rusting or corrosion under the conditions of the tests (e.g. stainless steel).

The panels shall be given the same number of coats (including primers and undercoats) and identical maturing and curing conditions (where appropriate) as would be applied to articles being coated in the factory.

All surfaces and edges of the panels shall be covered completely with the water contact coating.

The final overall dimensions of the test panels shall conform to 5.1.2. A test container (4.2.3) calibrated for a capacity of 1 000 ml shall be used.

NOTE These products should be prepared and cured by the manufacturer/supplier and tested as received without any further curing/treatment. To ensure that the samples provided are typical of normal production they should be drawn from the production line wherever possible and the following additional information provided: the date of preparation, the mode of preparation application (including temperatures) together with the curing conditions where appropriate.

6.13.2 Porous seal coats

NOTE 1 These products (3.11) are typically factory applied over cement mortar linings on the inside of ductile iron pipes used for conveying drinking water.

Test samples for all tests apart from the Growth of aquatic microorganisms test (BS 6920-2.4) shall consist of suitable lengths of cement mortar lined pipes coated with the porous seal coat as part of the normal manufacturing process. After preconditioning, in accordance with 6.14.1.3, prepare test extracts by filling suitable lengths of pipe with the test water; dilute these in accordance with BS 6920-2.2.2:2014, 8.3.1 before appropriate testing.

NOTE 2 It might be necessary to place inert rods or sealed tubes within the pipe sections in order to achieve the surface area to volume ratio specified in Table 1.

For the Growth of aquatic microorganisms test (BS 6920-2.4) test samples shall consist of suitably sized cement mortar blocks made from the same formulation as used to line the pipes and cured under the same conditions. After the porous seal coat has been applied (and cured) on the cement mortar block in an identical manner to the lined pipe lengths, precondition the test samples in accordance with 6.14.1.3 before testing in accordance with BS 6920-2.4.

6.14 Factory made cementitious products

6.14.1 General

6.14.1.1 Testing of products with and without organic additives or coatings

NOTE 1 Cementitious products for use in contact with water intended for human consumption are either made in a factory or made for application on site (see 7.9).

NOTE 2 The test methods in BS 6920 were originally established for use with materials and products made of non-metallic, typically, organic substances.

Where cementitious, factory made products contain organic substances as additives (e.g. polymers, admixtures etc.) or have had organic coatings (e.g. porous seal coats etc.) applied to them, they shall be tested in accordance with BS 6920-2, excepting subsections 2.2.2 and 2.2.3 (see 6.14.2.1).

Where cementitious products are free from organic additives or coatings, they shall be tested in accordance with BS 6920-2.6 (see 6.14.2.1).

NOTE 3 Factory made cementitious products for use in contact with water intended for human consumption are generally cement-mortar linings to metallic pipes or boilers. On occasion, however, factory made concrete products e.g. concrete pipes, elements for water-retaining structures etc. may be used in the water intended for human consumption.

6.14.1.2 Sampling from factory made cementitious products

A test sample shall consist of a representative section, segment, block etc., of suitable size, for the particular dimensional requirements of a test method (see 5.1.1 and 5.1.2).

A sufficient number of test samples shall be taken and preconditioned (see 6.14.1.3) to meet the requirements of all the test methods specified for the particular product.

6.14.1.3 Curing of factory made cementitious products

Factory made cementitious products shall have been cured in the factory, under the normal manufacturing conditions, before test samples are taken and preconditioned.

6.14.1.4 Preconditioning of samples taken from factory made cementitious products

Test samples of all factory made cementitious products, including those with non-cementitious coatings, e.g. porous seal coats, shall be preconditioned in accordance with the following procedure.

- a) Before testing, place the sample in a clean and dust-free container of 1 L capacity. Fill the container with water obtained from a tap connected directly to a service pipe at mains pressure, and having an aggressivity index (*I*) of greater than 12.0. Calculate the aggressivity index using the following equation:

$$I = \text{pH} + \log_{10} (AH) \quad (1)$$

where:

- A* is the total alkalinity (in mg/L of CaCO₃);
- H* is the calcium hardness (in mg/L of CaCO₃).

NOTE 1 Information concerning the alkalinity and hardness of water may be obtained from the local water supplier.

- b) Measure the pH of the water after 24 h in accordance with BS EN ISO 10523. Discard the water and refill the container with fresh tap water. Continue this process of sequential soaking until the pH of the water is less than (9.0 ± 0.1) on two successive occasions. Dry and then store the sample in a polyethylene bag (4.2.1), at the same temperature used during the curing of the test sample, for a maximum of six days before testing is started.

NOTE 2 It is possible that a water which has an I value of about 12 but with a low alkalinity and hardness might be aggressive to the sample and a pH value of <9.0 might not be achieved. In this case it is necessary to precondition with an alternative water of a comparable aggressivity index.

NOTE 3 In general, samples taken from cementitious products (factory made or site applied) are preconditioned before testing. Preconditioning reflects the pre-service commissioning procedures e.g. flushing etc., experienced by the product but also minimizes the potential for a pH increase during testing, which could adversely affect results.

6.14.2 Test method requirements

6.14.2.1 Factory made cementitious products free from organic additives or organic coatings

6.14.2.1.1 General

Cementitious products free from organic additives/coatings shall be tested in accordance with BS 6920-2.6.

6.14.2.1.2 Linings to calorifiers or boilers

These products shall be tested in accordance with BS 6920-2.6 at an elevated temperature of (85 ± 2) °C.

6.14.2.1.3 Factory made cementitious products containing organic additives and/or having organic coatings applied to them

These products, including those used in calorifiers or boilers, shall be tested in accordance with all sections of BS 6920-2, excepting subsections 2.2.2 and 2.2.3.

Products that are used in contact with hot water, e.g. cementitious linings for calorifiers and boilers, shall be tested in accordance with BS 6920-3.

7 Site-applied materials and products

7.1 General

WARNING. Many site-applied materials and coatings contain hazardous substances, including solvents. It is essential that all the manufacturer's safety warnings are observed during the preparation of these samples.

NOTE Site applied materials and products include all coatings, sealing compounds, soldering fluxes, anaerobic adhesives and most cementitious products intended for application on site.

7.1.1 Test sample preparation

Product application instructions shall be checked for consistency with the method of test sample preparation used and retained on file together with the relevant Material Safety Data Sheets (MSDS).

Test samples shall be prepared by, or the preparation witnessed by, the test laboratory staff, who shall then take responsibility for the subsequent pre-test curing of the test samples.

The samples shall consist of all specified component parts and shall be supplied to the test laboratory together with all relevant instructions for site application, including information on the time for complete cure relative to temperature.

Test samples shall be prepared as follows, using all the specified component parts of the product in accordance with the manufacturer's recommendations, including method(s) of mixing of component parts (where appropriate) and method of application.

Test samples of site applied coatings and linings for application by the use of specialist spray equipment, shall be prepared using this equipment, and shall not be hand mixed and applied.

Apply all relevant primers or undercoats to all surfaces of suitable test plates, e.g. glass (4.1.1) or stainless steel (4.1.3 and 7.9.2.1) before application of the finish coat.

NOTE 1 Alternatively, the product may be applied to the sand-blasted surface of a special glass plate (4.1.2), with two coated plates being prepared for each test sample. During application and curing, the individual plates may be placed horizontally (sand-blasted/coated side uppermost) on a material that is known to be free from adverse effects on water quality.

Where the product consists of two or more parts, these shall be prepared in strict accordance with the manufacturer's instructions and the precise mixing ratio used as either mass or volume shall be recorded, together with the method of mixing (where appropriate) and application. If specified by the manufacturer or supplier, the wet film thickness of each coating shall be determined and recorded in accordance with BS EN ISO 2808. Where a minimum thickness for the material is given, test samples shall be prepared in accordance with this thickness.

NOTE 2 It is necessary to prepare a sufficient number of panels for the tests to be carried out.

During the application of the sample and throughout the curing period, the test pieces shall be kept suspended (e.g. by using stainless steel or copper wire or nylon monofilament) so as to avoid contact of the sample with apparatus. If specialized equipment is normally required for site application of a material, then the test pieces shall be prepared by a contractor under the personal supervision of, and to the satisfaction of, an officer from the testing laboratory.

7.1.2 Curing

Where the coating consists of two or more individual layers, e.g. primer, undercoat and top coat, each of the intermediate coats shall be cured in accordance with the manufacturer's instructions; where these instructions specify the maximum time before the next coat is applied, these instructions shall be followed. The full details of how the complete coating system was prepared and cured shall be recorded.

Immediately following completion of the preparation of the test samples, they shall be cured in accordance with the manufacturer's instructions and published curing curves, at the lowest specified curing temperature.

If the material is intended for use in water undertakings' installations then the cure period shall not exceed 21 days and the atmospheric temperature shall not exceed $(7 \pm 2) ^\circ\text{C}$.

Unless the manufacturer's instructions specify variations in curing temperature during the cure period, the test samples shall be maintained at the lowest recommended cure temperature ($\pm 2 ^\circ\text{C}$) throughout the cure period. Throughout the cure period, the test samples shall be placed (test panels shall be suspended) in a thermostatically controlled, cooled incubator with fan-assisted air circulation, and with ventilation to prevent accumulation of volatile substances.

NOTE Some products have very specific curing regimes where temperatures are controlled, e.g. where the air in the structure to be coated is heated to and thermostatically controlled at $30 ^\circ\text{C}$ for 24 h using industrial heaters. Manufacturers may therefore request non-standard curing conditions using higher cure temperatures, e.g. $25 ^\circ\text{C}$ or $30 ^\circ\text{C}$.

If non-standard curing conditions are requested by the manufacturer, the manufacturer's or supplier's user instruction sheets, detailing the cure temperature requirements together with a statement describing how the elevated cure temperature is to be achieved and maintained throughout the duration of the cure, shall be obtained from the manufacturer. The procedure used shall be credible and achievable on site. If non-standard curing conditions are used in the preparation of test samples it shall be ensured that this is included in the test report for the product.

7.1.3 Testing

The cured samples shall be tested in suitably sized test containers (4.2.3) immediately after completion of the curing period, and any additional treatment specified by the manufacturer, before the material is placed in permanent contact with drinking water.

7.2 *In-situ* applied pipe linings and coatings

NOTE 1 These products are applied as linings within water pipes by the use of specialist equipment, e.g. rotating head spray, etc.

Test samples for all tests apart from the Growth of aquatic microorganisms test (BS 6920-2.4) shall consist of suitable lengths of pipe that have been lined with the coating prepared and applied (with the appropriate specialized equipment) in strict accordance with the manufacturer's instructions and the requirements of the relevant water industry code of practice. After any curing and/or additional rinses or treatment specified in the manufacturer's or supplier's Instruction for use of the coating, test extracts shall be prepared by filling suitable lengths of pipe with the test water; these shall be diluted in accordance with BS 6920-2.2.2:2014, **8.3.1** before appropriate testing.

NOTE 2 It might be necessary to place inert rods or sealed tubes within the pipe sections in order to achieve the surface area to volume ratio specified in Table 1. Alternatively, in the case of large diameter pipes, it is acceptable to prepare test plates as specified below for all tests.

For the Growth of aquatic microorganisms test (BS 6920-2.4) the coating shall be prepared and applied to suitably sized test plates (**4.1.2** or **4.1.3**) in strict accordance with the manufacturer's instructions, using the same specialist equipment and conditions used to line the pipe. After any curing or any additional rinses or treatments specified in the Instructions for use for the coating, they shall be tested in accordance with BS 6920-2.4.

7.3 Sealing compounds

Sealing compounds shall be applied to glass plates (**4.1.1**) or cast samples for testing as sheets (2 mm to 5 mm thick) between food-grade polyethylene film. If polyethylene film is used, it shall be removed from the semi-cured sheets within 48 h and the sheets shall be suspended, as in **7.1.1**, for the remainder of the cure period.

7.4 Jointing compounds

0.25 g of the sample shall be applied to both screw threads of a stainless steel coupling (**4.2.2**), the olives shall be discarded and the coupling shall be reassembled so that the compression nuts are finger tight. The reassembled coupling shall be rinsed in tap water for 10 min before placing it in a test container (**4.2.3**) calibrated for a capacity of 1 000 ml.

NOTE Do not cure but test immediately.

7.5 Solder fluxes

A test piece shall be made up in accordance with the following instructions.

Clean two 60 mm lengths of 22 mm diameter copper pipe conforming to BS EN 1057 in accordance with **4.2.2**. Clean one 22 mm diameter straight copper capillary coupling provided with internal (lead-free) solder rings conforming to BS 864-2 in accordance with **4.2.2**, but omit the acid wash. Apply the solder flux to the pipes in accordance with the manufacturer's instructions, assemble the joint and heat until the solder melts. Cool the joint and, after rinsing in accordance with the appropriate test method given in BS 6920-2.2 (appropriate sub-section), BS 6920-2.3, BS 6920-2.4, BS 6920-2.5 or BS 6920-2.6, place the test piece in a test container (**4.2.3**) calibrated for a capacity of 1 000 ml and test immediately.

If the manufacturer of the flux recommends a specific solder mix, then use a 22 mm straight copper capillary end-feed coupling conforming to BS 864-2, and cleaned in accordance with **4.2.2**. Use the recommended solder in sufficient quantity to fill the annulus around the joint, determined by visual inspection of an additional sample after assembly.

7.6 Anaerobic adhesives

Anaerobic adhesive shall be applied to both threads of a stainless steel coupling (4.2.2) in accordance with the manufacturer's instructions, and the coupling reassembled. The assembly shall be cured in accordance with the adhesive manufacturer's instructions.

The assembly shall be placed in a test container (4.2.3) calibrated for a capacity of 1 000 ml.

NOTE Some anaerobic adhesives do not cure adequately on stainless steel. In this case advice should be sought from the manufacturer of the adhesive on a suitable metal to use for the coupling that gives a satisfactory cure and does not lead to a failure in the Extraction of Metals test (BS 6920-2.6).

7.7 Resin anchors

The product shall be prepared in accordance with the manufacturer's instruction and applied to the sand blasted surface of a special glass plate (4.1.2), at the recommended maximum thickness, to give a total exposed surface area of 1 000 mm². It shall be cured at the minimum recommended temperature, for the shortest duration recommended.

7.8 Solvent cements

Assemble test pieces made up of the cement applied during the assembly of a pipe joint (two short lengths of pipe plus a female/female coupling having a total surface area of 15 000 mm²). If this is not possible apply the cement to a pipe or recommended fitting for which they are designed – paint the solvent cement onto an area of 1000 mm² on a recommended pipe or fitting. Cure the test pieces at the manufacturer's or supplier's minimum recommended temperature for the minimum recommended duration.

Do not test solvent cements as dry films of cement on glass plates after evaporation of the solvent(s).

7.9 Site applied cementitious products (see 7.1 and Note 2 to 6.14.1.1)

7.9.1 General

For the purposes of testing, site applied cementitious products for use in contact with water intended for human consumption, shall be classified into two main categories:

- a) products which do not contain an additive;
- b) products which contain an additive (generally non-metallic but not exclusively), in addition to the cementitious (inorganic) component.

In the case of site applied products in category b), a further sub-classification shall be made:

- 1) products which include the additive (typically an organic polymer) as formulated;
- 2) products to which the additive (usually an admixture) is added to the cementitious component on site.

NOTE The special requirements in this Clause vary depending on the chemical nature of the site applied product (i.e. organic-free versus organic-containing) and on the point at which any additive (organic or inorganic) is included in the site applied product (i.e. either as formulated or added on site).

The general requirements for sampling, curing of test samples and preconditioning of test samples are given in 7.9.2. The particular requirements for testing, appropriate to the different types of site applied products, are given in 7.9.3, 7.9.4 and 7.9.5.

7.9.2 Sampling, curing and preconditioning of test samples

7.9.2.1 Sampling from site applied cementitious products

A test sample shall consist of a representative quantity of the product, either applied to a stainless steel test plate (see 4.1.3), or cast into a rigid mould of sufficient size appropriate to the dimensional requirements of a test method (see 5.1.1 and 5.1.2).

NOTE Stainless steel test plates are used, in preference to glass plates, in order to obviate any potential enhancements to migration which could result from chemical reactions between alkalis derived from cement and glass.

A sufficient number of test samples shall be taken and preconditioned (see 6.14.1.4) to meet the requirements of all of the test methods specified for a particular product.

7.9.2.2 Curing of test samples taken from site applied cementitious products

Immediately following completion of the preparation of the test samples, they shall be cured in accordance with the manufacturer's instructions and published curing curves, taking into account any requirements to maintain the water content of the surrounding air at a specified minimum relative humidity. Unless the manufacturer's instructions specify variations in curing temperature during the cure period, the test samples shall be maintained at the lowest recommended cure temperature (± 2 °C) and the minimum required relative humidity throughout the cure period, in thermostatically controlled and cooled conditions.

Where the instructions do not provide specific curing conditions, these shall be 14 days at (7 ± 2)°C at a minimum relative humidity of 80%.

NOTE It is important to ensure that cementitious specimens are maintained in an atmosphere with a suitable relative humidity to prevent test samples from drying out prematurely, as this could affect adversely the hardening of the material.

7.9.2.3 Preconditioning of test samples taken from site applied cementitious products

Precondition test samples of all site applied cementitious products in accordance with 6.14.1.4, except where the special requirements given in 7.9.5.3.2 apply. Dry, and then store the sample in a polyethylene bag (4.2.1) at the same temperature used during the cure of the test sample, for a maximum of six days before testing is started.

7.9.3 Test method requirements for site applied cementitious products free from additives

7.9.3.1 General

Site applied cementitious products which are free from additives shall be tested in accordance with 6.14.2.1.1.

NOTE Products which contain inorganic additives are treated in the same generic way as those which are additive-free.

However, special requirements apply, for testing and assessing the results obtained from the extraction of metals test in BS 6920-2.6, where the inorganic additive has been added as an admixture on site (see 7.9.5.3).

7.9.3.2 Linings to calorifiers or boilers

Site applied cementitious linings to calorifiers/boilers which are free from additives shall be tested in accordance with 6.14.2.1.2.

7.9.4 Test method requirements for site applied cementitious products which contain organic additives as formulated

Site applied cementitious products which contain organic additives (typically a polymer) that are components of the product as formulated shall be tested in accordance with BS 6920-2, excepting subsections 2.2.2 and 2.2.3.

7.9.5 Test method requirements for site applied cementitious products which contain organic additives added on site**7.9.5.1 General**

Where site applied cementitious products contain an organic additive/admixture added on site, the cementitious (inorganic) component and the admixture (organic) component shall be tested separately.

The cementitious component shall be tested in accordance with 7.9.5.2.

The admixture (organic) component shall be subject to, both, indirect testing within a standard cementitious matrix (see Note 2 to 7.9.5.3.1) and a limited amount of comparative testing, for the extraction of metals, versus a control sample of the standard cementitious matrix, in accordance with 7.9.5.3.

7.9.5.2 Test method requirements for the cementitious component of products to which organic additives are added on site

The cementitious component of a product, to which organic additives are added on site, shall be tested in accordance with BS 6920-2.6.

7.9.5.3 Test method requirements for admixtures added on site**7.9.5.3.1 General**

Admixtures shall be tested, at the manufacturer's maximum recommended dosage, for drinking water applications, in an indirect way, within a cement-mortar comprising a CEM 1 cement, conforming to BS EN 197-1 with a strength class of 42.5 or higher, and sand conforming to BS EN 12620, in the proportions 1:3 by mass.

NOTE 1 Pre-packaged mortar mixes might not meet these requirements. They should not be used unless full details of cement class and sand quality, together with their mix ratios, are available and conform with these requirements.

In addition, comparative testing for the extraction of metals (see 7.9.5.3.2) shall be carried out against the same cement-mortar without the admixture.

Test samples and control samples shall be cast into suitable rigid moulds, in order to present a surface area of 15 000 mm² in contact with a 1 L total volume in distilled water, at the test temperature, during testing.

NOTE 2 For curing and preconditioning see 7.9.2.2 and 7.9.2.3 respectively.

Organic admixtures shall be tested within a cement-mortar matrix in accordance with all of the test methods in BS 6920-2, excepting subsections 2.2.2 and 2.2.3.

7.9.5.3.2 Extraction of metals

Organic admixtures, within a cement-mortar matrix (see Note 2 to 7.9.5.3.1), together with samples of the cement-mortar without the admixture, shall be cured in a nominally identical manner; preconditioned using the same number of sequential soakings (determined as the minimum number required, whether for a test or control sample, for conformity to the pH criterion in 6.14.1.4); before being subjected to the test method for the extraction of metals in BS 6920-2.6.

The results of the testing shall be assessed on the final extracts by comparing the differences obtained between the test and control samples, with the specification criteria in BS 6920-1:2014, Table 1.

8 Sample description

An accurate record of the test product samples shall be kept in accordance with Clause 9.

9 Reporting

9.1 General

In addition to the requirements set out in the relevant sections of BS 6920-2, each report shall contain the information specified in 9.2 and that specified in 9.3 to 9.5, as applicable.

9.2 Test product (all samples)

The report for each test product shall contain information on the following:

- a) nature of the product, e.g. valve component, pipe, sheet;
- b) general composition of the product, e.g. rubber, plastic;
- c) nature of the material, e.g. nitrile rubber, polyethylene;
- d) trade name and designation of both the material and the test product;
- e) method of manufacture;
- f) date(s) of manufacture and/or batch details;
- g) name and address of the manufacturer of the product;
- h) organization submitting the product for testing;
- i) organization responsible for preparing the samples (if different);
- j) description of the sampling procedure (if known);
- k) condition on receipt by the test laboratory, including packaging in contact with the test product;
- l) conditions of storage between sample receipt and the start of testing;
- m) comprehensive description of the test sample including material type, colour, shape/form, dimensions (mm) (including maximum thickness expressed as inradius (3.5) for rubber materials), appearance, opacity and, if appropriate, component type;
- n) surface area of one example of the product exposed to the test water calculated from the actual dimensions;
- o) number of examples of the product required to give the total surface area required for one test (15 000 mm²);

- p) volume of test water (in litres) used for a single test together with the temperature at which the test container(s) plus sample(s) and test water were maintained throughout the extraction/test period(s).

9.3 Cementitious products

The report for each cementitious product shall include details of any preconditioning given, including the Aggressivity Index of the preconditioning water, together with the pH values of each of the sequential preconditioning leachates.

Additionally, for admixtures, the final report shall include the volume of admixture added to a specified mass of cement.

9.4 Factory applied products

9.4.1 Coatings and test samples prepared by the manufacturer or supplier

The report for these products shall include the method of preparation of the test sample, including, where appropriate:

- a) number and thickness of coats applied (including primers);
- b) details of the method of application of the product;
- c) ambient temperature at the time of preparation;
- d) date of preparation of the sample;
- e) processing conditions, including cure conditions (temperature and duration, etc), if applicable;
- f) substrate onto which the product has been applied;
- g) whether the product was prepared in accordance with the application instructions.

9.4.2 Products used in assembly, e.g. water miscible greases and lubricants, solvent cements etc. and test samples prepared by the test laboratory in accordance with BS 6920-2.1

The report for these products shall include the method of preparation of the test sample, e.g. whether the sample was prepared in accordance with the application instructions, and the cure conditions, if any, used before testing started.

9.5 Site applied products

The report for site applied products shall include the following:

- a) typical uses of the product;
- b) batch number(s) of site applied products (and other products, when known); if this information is not available this shall be stated in the final report;
- c) description of the appearance (and colour) of the components used to make up the final product;
- d) the minimum temperature for application (if applicable), together with the minimum temperature and elapsed time after application before it is suitable for use in contact with water – as recommended by the manufacturer;
- e) a statement on how the application and curing/drying conditions will be achieved and maintained on site in the case of temperatures above 7 °C;

- f) method of preparation of test sample including whether the sample was prepared in accordance with the user instructions (including component mix ratios if appropriate), and the number and nature of coats applied, curing/drying conditions (including temperature and duration, plus relative humidity where this is a requirement for the material, film thickness (for each coat/layer) etc.;

NOTE If non-standard cure conditions (other than those set out in 7.1.2) have been used for the product then a statement highlighting these conditions should be included.

- g) sample description;
- h) for samples prepared at a different location to the test laboratory the following additional information:
- 1) location;
 - 2) description of equipment used and the area where the samples were prepared;
 - 3) full description of sample preparation, mixing ratios and batches numbers;
 - 4) chain of custody of the test samples, method of transfer to the test laboratory and temperature profiles of the test samples during transport to the laboratory for final curing;
 - 5) time and temperature of final curing.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 6920-2.2.1, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2: Methods of test – Section 2.2: Odour and flavour of water – Subsection 2.2.1: General method of test*

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