

Australian/New Zealand Standard™

**Testing of products for use in contact
with drinking water**



AS/NZS 4020:2018

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CH-034, Materials in Contact with Drinking Water. It was approved on behalf of the Council of Standards Australia on 12 June 2018 and by the New Zealand Standards Approval Board on 2 May 2018. This Standard was published on 29 June 2018.

The following are represented on Committee CH-034:

Association of Accredited Certification Bodies
Australian Building Codes Board
Australian Chamber of Commerce and Industry
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Australian Paint Manufacturers' Federation
International Copper Association Australia
Ministry of Health, New Zealand
Plastics Industry Pipe Association of Australia
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Australian/New Zealand Standard™

Testing of products for use in contact with drinking water

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CH-034, Materials in Contact with Drinking Water, to supersede AS/NZS 4020:2005, *Testing of products for use in contact with drinking water*.

The objective of this Standard is to specify requirements for the suitability of products for use in contact with drinking water, with regard to their effect on the quality of water.

In preparing this Standard, consideration has been given to comparable overseas Standards, to minimize duplication of effort and to maintain commonality, wherever reasonable, with those Standards. Particular consideration has been given to the various parts of BS 6920, *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*. Several of the test procedures and criteria given in BS 6920 have been adopted or modified for Australian and New Zealand requirements.

This Standard departs from BS 6920 as follows:

- (a) This Standard provides a method of testing for the leaching of compounds for elastomeric materials that may produce a mutagenic effect.
- (b) The requirement for products to be tested at surface area-to-volume ratios that are not less than those in the intended end-use exposure (with the exception of the test for growth of aquatic micro-organisms). Where there is a difference between test and end-use exposures, provision is made for a scaling factor to be applied to the test result.
- (c) The inclusion of testing for metals extracted from metal products that are often components of products in contact with drinking water.

Significant changes from the previous edition include the following:

- (i) The inclusion of guidance on retesting requirements when there is a change in formulation of products not listed on the Watermark Scheme of Products.
- (ii) The inclusion of informative guidelines for applying and interpreting AS/NZS 4020.
- (iii) A revision of Table 1 to more clearly define the different types of products to be tested.
- (iv) The allowance of reduced testing for very small area to volume metal and inorganic products.
- (v) A reduction in the range of products required to be tested for a mutagenic effect.
- (vi) The inclusion of a test for leachable organic compounds.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendices to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is for information and guidance only.

Statements expressed in mandatory terms in Notes to Figures and Tables are deemed to be requirements of this Standard.

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FOREWORD

Guidelines for drinking water quality in Australia have been prepared by the National Health and Medical Research Council (NHMRC). In New Zealand, drinking water quality is subject to the Drinking Water Standards for New Zealand prepared by the Ministry of Health. The Australian Drinking Water Guidelines (ADWG) and Drinking Water Standards for New Zealand (DWSNZ) cover a range of physical, chemical, microbiological and radiological characteristics relevant to the health and aesthetic concerns of consumers, and recommended values for those characteristics.

One of the important factors influencing the quality of water supplied to consumers is the effect of the various materials that come into contact with the water as it passes through the system. The potential effect becomes more critical as the size of the system decreases from water supply to reticulation to plumbing systems, and the residence time in contact with these systems increases. This Standard provides a means to test such materials in order that the achievement of the appropriate national recommended water quality values is not jeopardized. The Standard prescribes methods of testing and conformance limits for the effects of a product on the taste and appearance of water, the ability of a product to support the growth of aquatic micro-organisms and the quantity of toxic metals and non-metallic substances leached from the product when exposed to the test water. In addition, the Standard prescribes extraction procedures for products in contact with hot water and in end-of-line situations. The hot water tests apply where water has the potential for human consumption, food preparation, utensil washing and oral hygiene.

Not all of the physical and chemical characteristics listed in the NHMRC/ARMCANZ guidelines and the DWSNZ are specifically referred to in this Standard. For those characteristics not listed, it is envisaged that the methods of testing given in this Standard and the recommended values given by NHMRC/ARMCANZ or the DWSNZ will be sufficient and readily adapted by the responsible authority.

The dominant principle of this Standard is to allow water quality requirements, as adopted by the particular authority responsible for water supply quality, to be met at consumers' taps by specifying a range of tests. Besides the effects of materials, this quality will depend on other factors, including commissioning and operational procedures such as flushing of mains, which are the responsibility of the local water agency.

This Standard is published for use by manufacturers, water agencies and regulators in Australia and New Zealand to allow for the selection of materials exposed to drinking water, and as a basis for identifying the performance that can be expected by purchasers of products used in water supply systems.

It is intended that appropriate Australian and New Zealand Standards and other specifications will refer to this Standard if they specify requirements for the effects of a particular product on the quality of drinking water.

The Standard applies only to water quality at customer taps with respect to general health requirements for the consumer. It is not intended as either a long-term indication of the corrosion resistance of the material itself or any short-term effects due to highly localized and unpredictable conditions of water chemistry.

It is the understanding of the Committee that prepared this Standard that, in line with the intention of the ADWG and the DWSNZ, the only products that are required to satisfy the provisions of this Standard are products that are in contact with drinking water during service.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard

Testing of products for use in contact with drinking water

1 SCOPE

This Standard specifies requirements for the suitability of products for use in contact with drinking water, with regard to their effect on the quality of water. These products include pipes, fittings, components, and materials used in coating, protection, lining, jointing, sealing and lubrication applications in the water supply and plumbing industry. The Standard requires that products intended for use in contact with drinking water be tested by exposure to test water. Where appropriate, a scaling factor is applied to such tests to compensate for differences between laboratory and field conditions.

NOTE: This Standard may be used to test the suitability of products intended for use in contact with types of water other than drinking water.

This Standard does not take into account possible changes in installation practices or environmental factors not directly associated with the product. As a guide, re-verification testing of products to this Standard is desirable after a period of five years.

NOTES:

- 1 Products captured by the Plumbing Code of Australia (PCA) or by other regulatory requirements may have specific re-verification testing requirements, but they are beyond the scope of this Standard.
- 2 For products that are not captured by the PCA, guidance on when re-verification testing is required due to a formulation change is provided in Appendix O.
- 3 Chemicals used directly for treating raw water to provide a suitable drinking water supply are not covered by this Standard.
- 4 Guidelines for applying and interpreting this Standard are provided in Appendix R.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1012	Methods of testing concrete
1012.8.1	Part 8.1: Method for making and curing concrete—Compression and indirect tensile test specimens
1012.8.2	Part 8.2: Method for making and curing concrete—Flexure test specimens
2031	Water quality—Sampling for microbiological analysis
2567	Laminar flow cytotoxic drug safety cabinets
4276	Water microbiology
4276.2	Part 2: Culture media, diluents and reagents
5082	Polybutylene (PB) plumbing pipe systems—Metric series
5082.1	Part 1: Metric polybutylene (PB) pipes for hot and cold water applications
5082.2	Part 2: Mechanical and fusion jointing systems

AS/NZS

1477	PVC pipes and fittings for pressure applications
2243	Safety in laboratories
2243.3	Part 3: Microbiological safety and containment
2492	Cross-linked polyethylene (PE-X) pipes for pressure applications

AS/NZS	
2537	Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications (series)
2642	Polybutylene (PB) plumbing pipe systems
2642.1	Part 1: Polybutylene (PB) pipe extrusion compounds
2642.2	Part 2: Polybutylene (PB) pipe for hot and cold water applications
2642.3	Part 3: Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications
3000	Electrical installations
3500	Plumbing and drainage
3500.4	Part 4: Heated water services
3518	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
4129	Fittings for polyethylene (PE) pipes for pressure applications
4130	Polyethylene (PE) pipes for pressure applications
4131	Polyethylene (PE) compounds for pressure pipes and fittings
4441	Oriented PVC (PVC-O) pipes for pressure applications (ISO 16422:2014, MOD)
4765	Modified PVC (PVC-M) pipes for pressure applications
5601	Gas installations
5601.1	Part 1: General installations
5601.2	Part 2: LP Gas installations in caravans and boats for non-propulsive purposes
ISO	
2230	Rubber products—Guidelines for storage
3696	Water for analytical laboratory use—Specification and test methods
5725	Accuracy (trueness and precision) of measurement methods and results
5725-2	Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method
5814	Water quality—Determination of dissolved oxygen—Electrochemical probe method
7027	Water quality—Determination of turbidity
7027-1	Part 1: Quantitative methods
7393	Water quality—Determination of free chlorine and total chlorine
7393-2	Part 2: Colorimetric method using <i>N,N</i> -diethyl-1, 4-phenylenediamine, for routine control purposes
7887	Water quality—Examination and determination of colour
SAA HB	
131-1999	Guidelines for applying and interpreting AS/NZS 4020, Products for use in contact with drinking water (Note: This Handbook is now withdrawn.)
BS	
748	Specification for haemocytometer and particle counting chambers
5586	Sensory analysis apparatus
5586-1	Part 1: Specification for wine-tasting glass

- BS
6068 Water quality
6068-2 Part 2: Physical, chemical and biochemical methods
- BS EN ISO
5814 Water quality. Determination of dissolved oxygen. Electrochemical probe method
- US EPA
625 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater
Method 625: Base/neutrals and Acids
- 3510 Method 3510: Separatory funnel liquid-liquid extraction
- 3520 Method 3520: Continuous liquid-liquid extraction
- 8260B Method 8260B: Volatile organic compounds by gas chromatography/mass spectrometry (GC/MS)
- 8270D Method 8270D: Semivolatile organic compounds by chromatography/mass spectrometry (GC/MS)
- NHMRC/ARMCANZ
Australian Drinking Water Guidelines 2011, Version 3.3, updated November 2016, NHMRC
Manual on analytical quality control for the water industry, Water Research Centre, Technical Report NS30, 1989
- New Zealand Ministry of Health
Drinking-water Standards for New Zealand, 2005 (Revised 2008)
- APHA, AWWA and WEF
Standard methods for the examination of water and waste water, American Public Health Association, American Water Works Association, Water Environment Federation
- HMSO
Methods for the examination of waters and associated materials. The microbiology of drinking water, Part 1—Water quality and Public Health, UK, 2002
Methods for the examination of waters and associated materials, The microbiology of drinking water—Part 2—Practices and procedures for sampling, Environment Agency, UK, 2010
- OECD
Guideline for testing of chemicals: Bacterial Reverse Mutation Test. Test No 471. OECD, July 1997
- MALLEVIALLE, J. and SUFFET, I.H. (eds), *Identification and treatment of tastes and odors in drinking water*, American Waterworks Association Research Foundation/Lyonnaise des Eaux, published by American Waterworks Association, Denver, USA, 1987, Appendices A and B, pp 227–250.
- MARON, D.M. and AMES B.N., 'Revised methods for the *Salmonella* mutagenicity test', Elsevier Biomedical Press and Berkeley, CA, USA *Mutation Research*, Mutat. Res. 1983, Vol 113, pp 173–215.

3 DEFINITIONS

For the purposes of this Standard, the definitions below apply.

3.1 Anaerobic adhesive

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

3.2 Cementitious

Cementitious products are those products that are made from cement-based materials.

3.3 Colour (true colour)

The colour produced by a solution containing 1 mg of platinum per litre (in the form of hydrogen hexachloroplatinate (IV) in the presence of 2 mg of cobalt (II) chloride hexahydrate per litre) is 1 true colour, or Hazen, unit.

NOTE: The unit of colour is the Hazen Unit (HU).

3.4 Cytotoxic

Poisonous (toxic) to cells under the conditions of test.

3.5 Drinking water

Water that has the potential for human consumption, food preparation, utensil washing and oral hygiene. For the purpose of this Standard—

- (a) tap water and drinking water are synonymous;
- (b) cold water has a temperature less than 40°C; and
- (c) hot water has a temperature in the range 40°C to 80°C inclusive. Also see Clause 3.9.

3.6 End-of-line fitting

Any product, or part of a product, installed within 250 mL draw-off of a drinking water delivery point.

NOTE: Products typically include taps, tap components, fittings, flexible tubes, drink dispensers, boiling water dispensers, drinking fountains, water treatment appliances, hose-connection vacuum breakers, ball valves and flow-control valves.

3.7 Extract (leachate)

The solution formed when the product has been in contact with the test water.

3.8 Inorganic

Inorganic products are those products that contain 0% polymeric and 0% metallic material in contact with the conveyed water.

3.9 Maximum holding water temperature

The temperature, nominated by the manufacturer, at which the product is held in contact with water for an extended period, for example, several hours. During this time, there is a no-flow condition through the product.

3.10 Mean dissolved oxygen difference (MDOD)

MDOD is the difference between the mean dissolved oxygen content for each test sample subtracted from the mean of the control result.

3.11 Metallic

Metallic products are those products that contain 100% metallic material in contact with the conveyed water.

3.12 Mutagenic

Causes genetic changes to bacteria under the conditions of test.

3.13 Organoleptic

Pertaining to a method of systematically assessing the effects of a substance on the human senses, particularly taste or smell.

3.14 Polymeric

Polymeric products are those products that contain more than 0% polymeric material in contact with the conveyed water.

3.15 Product

A manufactured item that comes into contact with drinking water, including a component part of a manufactured item.

3.16 Sample

A product, or part of a product, submitted for testing for suitability for use in contact with drinking water.

3.17 Scaling factor

The ratio of the end-use surface area-to-volume ratio to the test surface area-to-volume ratio.

3.18 Taste panellist

An individual who has volunteered and who has been trained to participate in the assessment of water samples for taste.

3.19 Test water

Water in contact with normally in-service wetted surface areas and used as the medium to obtain extracts from samples of the product under test.

3.20 Threshold dilution

The highest dilution level of the sample at which a taste is detectable.

3.21 Turbidity

Reduction of transparency of a liquid caused by the presence of undissolved matter.

NOTE: The unit of turbidity is the Nephelometric Turbidity Unit (NTU).

3.22 Water fitting

Anything fitted or fixed in connection with the supply, measurement, control, distribution and utilization of water.

3.23 WaterMark Certification Scheme

The Australian Building Codes Board (ABCB) scheme for certifying and authorizing plumbing and drainage materials and products.

3.24 WaterMark Schedule of Products

The list of products included in the WaterMark Certification Scheme.

4 TEST SAMPLES

4.1 Selection and preparation of samples

The sampling of product and preparation of samples for testing shall be carried out in accordance with Appendix A. Sufficient samples of the product shall be provided to conduct all of the tests required.

Products shall be tested as a complete assembly or alternatively the separate components or sub-assemblies shall be tested individually. For test results from components or sub-assemblies to be acceptable, the sum of the tested exposures shall be equal to or greater

than the actual exposures of the complete assembly, except for the growth of aquatic micro-organisms test, where the tested exposure shall be in the range of 1000 mm²/L to 15 000 mm²/L.

NOTE: Care should be taken in considering the approval of materials that are not in final product form. The performance of materials is affected by the processing conditions, which may influence results of the tests described in this Standard. Any changes in the material formulation, the process of manufacture, the method of application, or the surface area-to-volume ratio in end use could affect the suitability of the product for use in contact with drinking water and re-testing may be required.

4.2 Range of product sizes

Where a manufacturer produces a complete range of product sizes of the same material composition, tests on the greatest surface area-to-volume ratio product shall qualify the remainder of the range, provided that the same manufacturing conditions and processes are used for the complete range of products.

4.3 Product exposure

Wherever possible, samples of the product shall be tested by in-the-product exposure (see Paragraph A4.1), so that only the surface that is normally wetted in end use is exposed to the test water.

Where in-the-product exposure is not possible, or where unfabricated material is being tested, the product surface or a representative sample of the material surface shall be tested by immersion exposure (see Paragraph A4.2). The ratio of exposed surface area to test water volume for immersion exposure testing shall be equal to (within 5%) or greater than the surface area-to-volume ratio in the intended end use, and shall not be less than 1000 mm²/L.

Where testing for the growth of aquatic micro-organisms, the ratio shall be in the range 1000 mm²/L to 15 000 mm²/L. Where the end-use exposure is greater than 15 000 mm²/L, the test result shall be based on a testing exposure of 15 000 mm²/L and no scaling factor shall be applied to this result. Where a product has multiple non-metallic components, the non-metallic wetted components shall be tested at the end-use exposure, with the exception that end-of-line fittings shall be tested at an exposure for each component in contact with 250 mL of water. The MDOD result shall be the average of the results for individual components.

5 SCALING FACTORS

5.1 General

Scaling factors are normally specified in the relevant product Standard. The discussion below applies to situations in which this is not the case.

Flexible hoses shall be tested as end-of-line fittings unless otherwise specified in the relevant product Standard.

Scaling factors shall not be applied to qualify products for end-use surface area-to-volume ratios higher than the test ratio, that is, the scaling factor shall not be greater than 1. Scaling factors shall only qualify products for use at surface area-to-volume ratios lower than the test ratio.

A scaling factor is generally not applicable to in-the-product testing (e.g. the testing of pipe). In this method of exposure, the ratio of the exposed surface area to the test water volume will in most cases be equal to the surface area-to-volume ratio in end use (i.e. a scaling factor of 1).

An exception applies in certain cases of in-the-product testing, where in end use the internal surface of the product is effectively in contact with a substantially larger volume of water than in the test. Examples of such products are valves and fittings connected into water supply pipelines. A further exception applies in the testing of end-of-line-fittings such as taps and their components, where in the end-use situation the extract contained in the fitting is effectively diluted before consumption. Similarly, the use of a composite extract in the metals extraction test for end-of-line fittings has the effect of providing an inbuilt scaling factor.

In immersion exposure testing, the selected surface-area-to-volume ratio in the test can be greater than in the intended end use. Where this is the case, a scaling factor having a value of less than 1 may be applied in the evaluation of the test result. For end-of-line fittings requiring the total immersion procedure, the fitting is tested in 250 mL of test water. In addition, the testing exposure shall not be less than 1000 mm²/L.

5.2 Determination of scaling factors

The scaling factor specified shall be in the range 0.01 to 1.0 and shall apply to all tests. The test report shall include the value and method of derivation of the scaling factor.

NOTE: Examples of the method of scaling factor calculation in some typical product applications are given in Appendix B. In the case of domestic plumbing fittings, a scaling factor based on the layout in Figure B1 will apply, unless the manufacturer presents another valid approach.

5.3 Application of scaling factors

The scaling factor shall be applied by sample size selection (to produce the surface area-to-volume ratio applicable to the end-use situation) and/or by the application of the scaling factor to each test (see Paragraph B3, Example 1). Where used for a test, the scaling factor shall be applied as follows:

(a) *Taste*

The extract is diluted with fresh test water in proportion to the scaling factor.

(b) *Appearance*

The extract is diluted with fresh test water in proportion to the scaling factor or, alternatively, the concentration of each colour and/or turbidity value in the extract is multiplied by the scaling factor.

(c) *Growth of aquatic micro-organisms*

The mean dissolved oxygen difference is multiplied by the scaling factor.

(d) *Cytotoxic and mutagenic activity*

The extract is diluted with fresh test water in proportion to the scaling factor.

(e) *Metals*

The extract is diluted with fresh test water in proportion to the scaling factor or, alternatively, the concentration of each metal in the extract is multiplied by the scaling factor.

(f) *Organic compounds*

The extract is diluted with fresh test water in proportion to the scaling factor or, alternatively, the concentration of each compound in the extract is multiplied by the scaling factor.

5.4 Restrictions on the use of scaling factors

The maximum allowable dilution of the extract prior to assessment for taste (Appendix C), appearance (Appendix D), cytotoxic activity (Appendix F), mutagenic activity (Appendix G) and extraction of metals (Appendix H) shall not exceed one part extract to 99 parts of test water.

Additionally the scaling factor applied to the test result in the appearance test [see Clause 5.3(b)] or the extraction of metals test [see Clause 5.3(e)] shall be ≥ 0.01 .

In the growth of aquatic micro-organisms test [see Clause 5.3(c)], the scaling factor applied to the test result shall be ≥ 0.33 .

NOTE: Where a scaling factor of less than 0.33 is required for the growth of aquatic micro-organisms test, adjustment of the surface area-to-volume ratio is necessary prior to testing.

6 TEST REQUIREMENTS

6.1 General

Products shall be subjected to tests for taste, appearance, growth of aquatic micro-organisms, cytotoxicity, mutagenicity, metals, and organic compounds dependent on the type of product and whether it is used in-line, at end-of-line or in hot water systems, in accordance with Table 1, Clauses 6.4 to 6.8 and Clause 7 as appropriate. The results of these tests shall comply with the requirements set out below.

Non-polymeric products (other than end of line products), that have an area to volume ratio of less than 100 mm²/L, shall only be tested for cytotoxicity and metals to demonstrate conformance with this Standard (AS/NZS 4020).

Inorganic products (other than end of line products), that have an area to volume ratio of less than 500 mm²/L shall only be tested for cytotoxicity and metals to demonstrate conformance with this Standard (AS/NZS 4020).

NOTE: A flow diagram for all the tests is shown in Appendix P.

6.2 Taste

When the product is tested in accordance with Appendix C, if a reportable taste is detected by any member of the taste panel in the first dilution of the first and/or seventh chlorinated or unchlorinated extract, the product shall be deemed unsuitable for contact with drinking water unless two further samples are examined and each panellist reports no taste in the first dilution of the final (i.e. seventh) chlorinated or unchlorinated extract from these samples.

NOTE: A flow diagram for taste testing is shown in Appendix Q.

6.3 Appearance

When the product is tested in accordance with Appendix D, the increase in true colour and turbidity of the water in the first extract shall be less than five Hazen Units (HU) and 0.5 Nephelometric Turbidity Units (NTU) respectively. If a single sample does not comply with this requirement after a seventh extract, the product shall be deemed unsuitable for contact with drinking water unless three further samples are examined and the mean colour and turbidity of their final (i.e. seventh) extracts are not increased by more than 5 HU or 0.5 NTU respectively.

6.4 Growth of aquatic micro-organisms

When the product is tested in accordance with Appendix E, the MDOD shall be less than or equal to 2.4 mg/L.

6.5 Cytotoxic activity

When the product is tested in accordance with Appendix F, the extract shall not cause a cytotoxic response.

If a single sample gives a cytotoxic response, two further samples of the product shall be examined using fresh reagents.

TABLE 1
SELECTION OF TESTS

Test	In-line products			Water-heating systems	End-of-line products	
	Metallic	Inorganic	Polymeric		Metallic	Polymeric
Taste (Appendix C)	Cold or hot Appendix J	Cold or hot Appendix J	Cold or hot Appendix J	NR	Cold or hot Appendix I	Cold or hot Appendix I
Appearance (Appendix D)	Cold or hot Appendix J	Cold or hot Appendix J	Cold or hot Appendix J	Hot	Cold or hot Appendix I	Cold or hot Appendix I
Microbial (Appendix E) (see Note 1)	NR	NR	Cold	Cold If applicable	NR	Cold
Cytotoxicity (Appendix F)	Cold or hot Appendix J	Cold or hot Appendix J	Cold or hot Appendix J	Hot	Cold or hot Appendix I	Cold or hot Appendix I
Mutagenicity (Appendix G) (see Note 3)	NR	NR	Cold or hot Appendix J	Hot	NR	Cold or hot Appendix J
Metals (Appendix H)	Cold or hot Appendices H and J	Cold or hot Appendices H and J	Cold or hot Appendices H and J	Hot	Cold or hot Appendices H and I	Cold or hot Appendices H and I
Organic compounds (Clause 6.8) (see Note 4)	NR	NR	Cold or hot	Hot	NR	Cold or hot

NOTES:

- 1 The microbial test shall be undertaken for all polymeric products and water heating systems that operate at temperatures up to 55°C.
- 2 NR: The test is not required.
- 3 Only those products that contain an elastomeric material in contact with drinking water shall be tested for mutagenicity.
- 4 Products conforming with AS/NZS 1477, AS/NZS 2492, AS/NZS 2537 series (where the fitting material is solely comprised of PEX material that fully complies with AS/NZS 2492 material requirements, including the water contact requirement), AS/NZS 2642.2, AS/NZS 2642.3 (where the fitting material is solely comprised of PB material that fully complies with AS/NZS 2642.1), AS/NZS 3518, AS/NZS 4129 (where the fitting material is solely comprised of PE material that fully complies with AS/NZS 4131), AS/NZS 4130, AS/NZS 4441, AS/NZS 4765, AS 5082.1 or AS 5082.2 (where the fitting material is solely comprised of PB material that fully conforms with AS/NZS 2642.1) are not required to be tested for organic compounds.

6.6 Mutagenic activity

Products that have an elastomeric material in contact with drinking water shall not produce a positive mutagenic response when tested in accordance with Appendix G.

If a single sample gives a statistically significant result, two further samples shall be extracted using fresh reagents and the reversion test repeated with the same strain of bacterium. A positive result shall be confirmed by testing for mutagenicity of the extract using the alternative micro-organism test system.

6.7 Metals

6.7.1 *Products in general*

When the product is tested in accordance with Appendices H to J, the amounts of the specified metals in the first and/or final extracts shall not exceed the limits given in Table 2.

If the limit for any metal is exceeded in the final (seventh) extract from any of the duplicate samples, the product shall be deemed unsuitable for contact with drinking water unless a further three samples are examined and the mean of the specified metals in their final seventh extracts does not exceed the limits specified in Table 2.

Where the product tested is applied to a metal fitting, the assessment shall be made on the differences in concentrations of the specified metals between the final extracts and the metal-fitting blank test.

Where a cementitious product has been tested, the assessment shall be made on the differences in concentrations of the specified metals between the final extracts and the reagent blank test.

6.7.2 *End-of-line fittings*

The procedure for testing end-of-line fittings for extraction of metals shall be in accordance with Appendix I.

If either of the duplicate samples exceeds the concentration limits specified in Table 2, a further three fresh samples of the product shall be examined. The product shall be deemed to pass the test if the mean of the specified metals for all samples does not exceed the limits given in Table 2.

6.8 Organic compounds

Leachate preparations shall be obtained in accordance with D6.1, as applicable. The product leachate shall be extracted in accordance with US EPA 625, 3510 or 3520 and then analysed in accordance with US EPA 8260B or US EPA 8270D, with the exception of pesticides. The amounts of organic compounds detected shall not exceed the health guideline values listed in Australian Drinking Water Guidelines and/or the Drinking Water Standards for New Zealand as applicable.

7 HOT WATER TESTS

Where products are designed for use in hot water installations and the water in contact with the product surfaces meets the definition given in Clause 3.5(c), products shall be tested in accordance with Appendix J or K. For end-of-line fittings used in cold and hot water applications, a maximum temperature shall be used for test extractions in accordance with Appendix I.

Products that pass the tests required in Appendix I, J or K meet the requirements for hot water exposure up to the temperature used in testing. Products that pass these tests shall also be deemed to comply with the cold water requirements for all tests undertaken as part of the hot water testing program.

TABLE 2
MAXIMUM ALLOWABLE
CONCENTRATIONS OF METALS

Metal	Maximum allowable concentration, mg/L
Aluminium**	0.2
Antimony (Sb)*	0.003
Arsenic (As)*	0.01
Barium (Ba)*	0.7
Boron (B)*	1.4
Cadmium (Cd)*	0.002
Chromium (Cr)*	0.05
Copper (Cu)*	2
Iron (Fe)**	0.3
Lead (Pb)*	0.01
Manganese (Mn)**	0.1
Mercury (Hg)*	0.001
Molybdenum (Mo)*	0.05
Nickel (Ni)*	0.02
Selenium (Se)*	0.01
Silver (Ag)*	0.1

* These values are the lower values taken from the Australian Drinking Water Guidelines and the Drinking Water Standards for New Zealand.

** These values were taken from the Australian Drinking Water Guidelines, aesthetic related guidelines.

APPENDIX A
SAMPLE PREPARATION
(Normative)

A1 SCOPE

This Appendix specifies the preparation of samples of products, for testing their suitability for use in contact with drinking water. It is applicable for all products.

A2 APPARATUS

The following apparatus shall be used:

- (a) *Sample storage bags* Storage bags shall be food-grade material (such as polyethylene), for storing samples in the laboratory.

A fresh bag shall be used for each product type or sets of products made from an identical material. Unsealed bags shall be used for elastomeric compounds. If manufacturers supplying samples provide alternative written instructions to which the products are subject in practice, the samples shall be stored as advised.

- (b) *Glass plates* Glass plates shall have a frosted/blasted surface and shall have dimensions suitable for the tests specified in Paragraphs A7.3, A7.4, A7.5, A7.6 and A7.8. Plates shall be prepared as follows:

- (i) Clean the plates in an aqueous solution of biodegradable laboratory detergent.
- (ii) Rinse thoroughly in tap water and then once in distilled water complying with ISO 3696 Grade 3.
- (iii) Drain and dry.

- (c) *Test containers for immersion testing* The containers shall be made of clear borosilicate glass for all tests with the exception of the growth of aquatic micro-organisms test (see Paragraph E7). The containers shall be of the required size to accommodate the sample while maintaining the required surface area-to-volume ratio. The containers shall be provided with a method of sealing during test extractions, using materials such as polyethylene film, aluminium foil or borosilicate glass, that are known to have no significant effect on the test results. Aluminium foil shall not be used for sealing test containers in the metals extraction test.

- (d) *Temperature-measuring device.*

- (e) *Relative humidity-measuring device.*

- (f) *Glass-encapsulated weights* For weighing down the products, where necessary.

A3 SAMPLES

The samples used for testing shall, wherever possible, be manufactured products or components of water fittings drawn from production batches. The products shall be tested in the condition in which they are intended to be used in service. Wherever possible, samples of the actual product (e.g. pipe, fitting, appliance) shall be tested by filling with test water so that only the surface normally wetted in use is exposed to the water.

If it is not possible to test a finished product, or where unfabricated material is being tested, a representative sample of the material shall be tested by immersion exposure.

A scaling factor may be applied (see Clause 5) provided the surface area-to-volume ratio adopted for testing is greater than the end-use ratio.

Successful evaluation of the product having the highest surface area-to-volume ratio shall qualify all lower surface area-to-volume ratios in the product range. For example, for polyvinyl chloride pipe manufactured to AS/NZS 1477, the smallest PN 12 pipe is DN 20 having an internal surface area of 169 000 mm² per litre of contents. Successful evaluation of DN 20 pipe shall qualify all of the PN 12 or lower-pressure class pipes manufactured to AS/NZS 1477.

Where the material being tested is not in final product form, a statement to that effect shall be included in the test report.

NOTES:

- 1 A format for presenting data to the testing laboratory is given in Appendix L.
- 2 Care should be taken in considering the approval of materials that are not in final product form. The performance of materials is affected by the processing conditions, which may influence results of the tests described in this Standard.
- 3 An option that may be considered in some circumstances is the use of simulated samples, but that direction/approach shall be made in the relevant product Standard.
- 4 A description of the use of simulated samples, if allowed, is given in Appendix M.

A4 PRODUCT EXPOSURE

A4.1 In-the-product exposure

In-the-product exposure shall be used, wherever possible, for the extraction tests. Samples shall be completely filled with test water so that the surface area-to-volume ratio is equal to the actual ratio in end use.

In certain cases, the product in end use will be in contact with a larger volume of water than in the test. In such cases, a scaling factor (see Clause 5) shall be applied in the evaluation of the test result.

The test water volume will vary according to the size of the product; therefore it is necessary to ensure that a sufficient volume of extractant can be obtained for each test. For products having a small volume, it may be necessary to use more than one sample for each test to obtain the required volume of test water.

The growth of aquatic micro-organisms test shall be carried out by immersion exposure (see Paragraph A4.2).

NOTE: Products may need to be sectioned to obtain the required sample size for immersion exposure.

A4.2 Immersion exposure

Immersion exposure shall be used for samples that cannot be evaluated by in-the-product exposure. In immersion exposure, areas that do not come in contact with drinking water shall be prevented from being in contact with the test water.

The sample shall be placed in the test container which shall be filled with test water to cover the sample.

During the extraction, 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 submerged by using glass-encapsulated weights.

The surface area-to-volume ratio selected for immersion exposure testing shall be equal to the nominal end-use ratio, or alternatively, the sample shall be tested at a surface-area-to-volume ratio that is greater than the end-use ratio, and a scaling factor (see Clause 5) used in the evaluation of the test result. An exception applies to the growth of aquatic micro-organisms test, where the surface area-to-volume ratio shall be in the range 1000 mm²/L to 15 000 mm²/L.

The actual surface area-to-volume ratio used in each immersion exposure test shall be within 5% of the exposure ratio intended for the test. When calculating the surface area-to-volume ratio, no adjustments shall be made to take account of variations due to surface texture.

The minimum surface area-to-volume ratio used for all immersion exposure testing shall be 1000 mm²/L.

A5 SAMPLE TRANSPORT AND STORAGE

During the period between packaging and receipt by the laboratory, and during storage in the laboratory, the samples shall be protected from contamination by dirt, oil, grease, excessive heat, sunlight and volatile chemicals. Samples shall be stored in accordance with Paragraph A2(a).

WARNING: DO NOT APPLY ADHESIVE TAPE OR LABELS, INK OR PENCIL TO TEST SAMPLES.

A6 SAMPLE WASHING

On the day that testing is to start, samples of the products to be tested shall be rinsed dynamically in flowing distilled water, or as required by the test method, to remove dirt, dust or other foreign material.

A7 SPECIAL PRODUCTS

A7.1 General

The products in Paragraphs A7.2 to A7.8 require special treatment. All of these products shall be tested by immersion exposure (see Paragraph A4.2) in a clear borosilicate glass test container [see Paragraph A2(c)].

A7.2 Elastomeric products

Elastomeric products shall be stored in accordance with 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.

NOTE: Elastomeric samples should not be tested within four weeks of manufacture because they may not be representative of the product when it is used in service.

A7.3 Greases

The product shall be evenly applied to the surface of a glass plate [see Paragraph A2(b)] to produce a test panel having the required surface area-to-volume ratio.

A7.4 Coatings

The product shall be evenly applied to the surface of a glass plate [see Paragraph A2(b)] to produce a test panel having the required surface-area-to-volume ratio. Alternatively, the product shall be applied to a panel of a corrosion-resistant material (e.g. stainless steel). The coating shall be applied at the specified film thickness and cured in accordance with the manufacturer's instructions.

NOTE: When preparing the test panels, account should be taken of the curing conditions (time, temperature, and relative humidity) that are applicable to the practical use of the product. Field-applied coating and lining systems should be applied in accordance with the manufacturer's instruction under the supervision of the testing laboratory. They should be applied at the most challenging application conditions allowable by the manufacturer. These include having the highest allowable thinner addition, the maximum film thickness per coat, the shortest curing period between coats and the shortest final curing period prior to immersion, with all coats being applied at the lowest allowable curing temperature.

For multiple-layer coating systems, a separate test shall be undertaken for each coating layer. When testing the final coat, the surface area-to-volume ratio in the test shall not be less than the final coat exposure ratio in end use. When testing a layer under the final coat, the minimum required exposure ratio is less than that required for the final coat. The minimum surface area-to-volume ratio for testing each layer shall be determined by use of the multipliers given in Table A1.

TABLE A1
MULTIPLE-LAYER COATING SYSTEM
TEST PANEL PREPARATION

Number of layers in system	Layer	Surface area-to-volume ratio multiplier
Two coat	Final coat	1
	First coat	1/3
Three coat	Final coat	1
	Second coat	1/3
	First coat	1/6
Four coat	Final coat	1
	Third coat	1/3
	Second coat	1/6
	First coat	1/12

Each layer in a multiple-layer coating system shall be tested either separately or in one combined test.

CA7.4 For example, testing of a three-layer system that has a surface area-to-volume ratio of 15 000 mm²/L in the end use would be carried out using three separate tests, with a minimum exposure ratio of 15 000 mm²/L for the final coat, 5000 mm²/L for the second coat, and 2500 mm²/L for the first coat. Alternatively, a single test including all three layers would be carried out, with a total minimum exposure ratio of 22 500 mm²/L (final coat at 15 000 mm²/L, second coat at 5000 mm²/L, and first coat at 2500 mm²/L).

Layers that are 1 mm or more from the water contact surface of the coating are not normally expected to contribute to leaching, and are not required to be tested.

NOTE: Testing of all the layers together has the potential advantage of reducing the total amount of testing required. However, if a failure occurs during testing, it would be necessary to retest the layers individually to identify the cause of the failure.

A7.5 Sealing compounds

The product shall be evenly applied to the surface of a glass plate [see Paragraph A2(b)] to produce a test panel having the required surface area-to-volume ratio. Alternatively, the test panel shall be produced as a cast sheet (2 mm to 5 mm thick) between food-grade polyethylene film. Immediately following preparation, the panel shall be cured in accordance with the manufacturer's instructions.

During the cure period the test panel shall be suspended, for example by a wire or a nylon monofilament, to prevent contact with other surfaces. Where cast sheet is used as the test panel, the polyethylene film shall be removed when the sheet is sufficiently cured to be self supporting. The sheet shall then suspended for the remainder of the cure period.

A7.6 Jointing compounds

The product shall be evenly applied to the surface of a glass plate [see Paragraph A2(b)] to produce a test panel having the required surface area-to-volume ratio. The panel shall be tested immediately (without curing).

A7.7 Solder fluxes

The product shall be evenly applied to the surface of a copper sheet to produce a test panel having the required surface area-to-volume ratio. The copper sheet is then placed in a muffle furnace at a temperature of 300°C, and allowed to heat until the flux flows (approximately 30 s to 1 min). The panel shall be tested after cooling.

A7.8 Anaerobic adhesives

The product shall be evenly applied to the surface of a glass plate [see Paragraph A2(b)] to produce a test panel having the required surface area-to-volume ratio, then cured in accordance with the manufacturer's instructions in an anaerobic chamber.

A8 CEMENTITIOUS PRODUCTS

Cementitious products are those that have been manufactured from or are coated with cementitious materials. The samples used for testing shall be manufactured products (see Paragraph A3), or test blocks that are representative of the manufactured products. Samples of cementitious products shall be given a standard moist-curing treatment of 28 d at $(23 \pm 2)^\circ\text{C}$ as specified in AS 1012.8.1 or AS 1012.8.2, or in accordance with the manufacturer's instructions.

NOTE: When preparing the test samples, account should be taken of the curing conditions (time, temperature, and relative humidity) that are applicable to the practical use of the product.

The cured samples shall be pre-conditioned by sequential soaking in water that has an aggressivity index (*AI*) of 12.0 or greater, to remove readily soluble alkali constituents.

The aggressivity index is given by the following equation:

$$AI = pH + \log_{10} (AH) \quad \dots A1$$

where

A = the total alkalinity expressed as mg/L of CaCO_3

H = the calcium hardness expressed as mg/L of CaCO_3

Pre-conditioning water shall be obtained from a tap connected directly to a service pipe at mains pressure. If the tap water has an *AI* of less than 12.0, it shall be treated as follows:

- (a) Add calcium carbonate.
- (b) Dissolve the calcium carbonate by stirring and passing carbon dioxide through the water until it is clear.
- (c) Pass filtered air through the water until the pH rises to an equilibrium level.
- (d) Measure the *AI*. If not 12.0 or greater, repeat the process.

After curing, the sample shall be treated as follows:

- (i) Rinsed with pre-conditioning water for 10 min.
- (ii) Samples that are to be tested by in-the-product exposure shall be filled with pre-conditioning water. Samples to be tested by immersion exposure shall be pre-conditioned in a clean and dust-free container of 1 L capacity.
- (iii) Soak the samples for 24 h and measure the pH of the water in accordance with Standard methods for the examination of water and waste water.
- (iv) Discard the water and replace with fresh pre-conditioning water.
- (v) Continue this process of sequential soaking until the pH of the water is less than 9.0 on two successive occasions.

- (vi) If a pH level of less than 9.0 is not achieved after 10 sequential soakings, discontinue the test. Test the samples after pre-conditioning.
- (vii) Test the samples after pre-conditioning.

The test water used for all of the tests shall have the same aggressivity index as the pre-conditioning water. The level of copper in the test water shall be determined, to ensure that it is in accordance with Table E2.

Samples of cementitious products shall be maintained in a moist condition between the stages of curing, pre-conditioning, and testing.

A9 METAL ALLOYS

Where metal alloys are used, laboratories shall test any part that comprises 30% or greater of the wetted area, for all relevant elements listed in Table 2. These metals shall be recorded on the test report.

APPENDIX B

SCALING FACTORS—DERIVATION AND APPLICATION

(Informative)

B1 INTRODUCTION

A scaling factor has been defined in Clause 3.17 of this Standard (AS/NZS 4020) and the circumstances in which scaling factors may be used in the evaluation of test results have been described in Clause 5.

B2 CALCULATION OF SCALING FACTORS

The scaling factor is calculated using the following equation:

$$SF = \frac{A_f}{V_f} \div \frac{A_t}{V_t}$$

$$= \frac{A_f V_t}{A_t V_f} \quad \dots B1$$

where

SF = scaling factor

A_f = surface area of product exposed to water in the field, in square millimetres

V_f = volume of water to which the product is exposed in the field, in litres

A_t = surface area of the product exposed to water in the test, in square millimetres

V_t = volume of water to which the product is exposed in the test, in litres

NOTE: Scaling factors cannot be greater than 1.0. That is, the test surface area-to-volume ratio for the test product cannot be less than the end-use ratio. If the scaling factor were greater than 1.0, it could not be applied to the taste, appearance, cytotoxicity or mutagenicity tests.

B3 EXAMPLES OF SCALING FACTOR CALCULATIONS

Example 1 Sealing gasket (immersion exposure)

The smallest ductile iron pipe in a manufacturer's product range is DN 100. The pipes have an effective length of 5.5 m and an internal diameter after cement mortar lining of 102 mm. The pipe joints are sealed with a rubber ring gasket and the estimated water contact area for each gasket is 6960 mm². The surface area-to-volume ratio used for the immersion exposure testing is the specified minimum of 1000 mm²/L.

$$\begin{aligned} A_t &= 1000 \text{ mm}^2 & A_f &= 6960 \text{ mm}^2 \\ V_t &= 1.0 \text{ L} & V_f &= 44.9 \text{ L} \\ \frac{A_t}{V_t} &= 1000 \text{ mm}^2 / \text{L} & \frac{A_f}{V_f} &= 155 \text{ mm}^2 / \text{L} \end{aligned}$$

$$\begin{aligned} SF &= \frac{A_f}{V_f} \div \frac{A_t}{V_t} \\ &= \frac{155}{1000} \\ &= 0.155 \end{aligned}$$

Example 2 Sluice valve (in-the-product exposure)

The smallest sluice valve in a manufacturer's range is size DN80. This valve represents the highest surface area-to-volume ratio in the product range. In service, the valves are installed in an AS/NZS 1477 DN80 PN 15 PVC pipeline having an internal diameter of 77.0 mm. There are 10 × 6 m lengths of pipe between valves. The valve has a volume of 1.6 L. In the pipeline, the valve is exposed to a further 280 L of water.

$$\begin{aligned} V_t &= 1.6 \text{ L} & V_f &= 1.6 + 280 \\ & & &= 281.6 \text{ L} \end{aligned}$$

$$SF = \frac{A_f V_t}{A_t V_f}$$

$$\text{Because } A_f = A_t$$

$$\begin{aligned} SF &= \frac{V_t}{V_f} \\ &= \frac{1.6}{281.6} \\ &= 0.0057 \end{aligned}$$

The maximum scaling factor of 0.01 would be used rather than the calculated scaling factor.

NOTE: For the growth of aquatic micro-organisms test (see Appendix E), appropriately sized samples of the individual water contact components of the product are tested by immersion exposure. A scaling factor based on the water contact surface area under end-use conditions is then calculated for each component.

Example 3 Domestic plumbing systems

Domestic plumbing typically has a high proportion of fittings such as tees and elbows in the piping system. Because the pipes are small in diameter compared to reticulation pipe, the surface area-to-volume ratios of the fittings are correspondingly higher.

An example of a cold water domestic plumbing layout is shown in Figure B1. In this example, the plumbing uses copper piping and brass fittings in the form of tees and elbows. The water in the fittings is assumed to be mixed with the water in the piping by turbulent flow when water is withdrawn from the system.

A scaling factor, which relates the surface area-to-volume ratio of the fitting being tested to the average surface area-to-volume ratio for all the fittings in the cold water system, can be determined.

The total wetted surface area for all of the fittings in the cold water system, calculated as shown in Table B1, is 16 130 mm². The total length of piping in the cold water system is approximately 40 m of DN20 pipe and 19.3 m of DN15 pipe. The volume of water contained in this piping and the associated fittings is calculated to be 10.87 L.

The average surface area-to-volume ratio for the fittings in service is therefore as follows:

$$\begin{aligned}\frac{A_f}{V_f} &= \frac{16\,130}{10.87} \\ &= 1484 \text{ mm}^2 / \text{L}\end{aligned}$$

Provided that the fittings all have a similar composition and a similar method of manufacture, any fitting can be tested to qualify the range of fittings for use in domestic plumbing systems of the type shown in Figure B1.

In-the-product tests on DN20 elbows, for example, would be evaluated using the scaling factor derived below. The DN20 elbow has a surface area of 1100 mm² and a volume of 0.0042 L.

$$\begin{aligned}A_t &= 1100 \text{ mm}^2 & A_f &= 16\,130 \text{ mm}^2 \\ V_t &= 0.0042 \text{ L} & V_f &= 10.87 \text{ L} \\ \frac{A_t}{V_t} &= 261\,905 \text{ mm}^2 / \text{L} & \frac{A_f}{V_f} &= 1484 \text{ mm}^2 / \text{L} \\ SF &= \frac{A_f}{V_f} \div \frac{A_t}{V_t} \\ &= \frac{1484}{261\,905} \\ &= 0.0057\end{aligned}$$

The maximum scaling factor of 0.01 would be used rather than the calculated scaling factor.

NOTE: The calculated scaling factor in both the sluice valve example and the plumbing fitting example is 0.0057. This would correspond to a laboratory dilution of one part extract to 175 parts test water, greater than the allowed level of extract dilution (see Clause 5.4). A pass result at the maximum allowable laboratory dilution would, however, qualify either product for use at the calculated scaling factor.

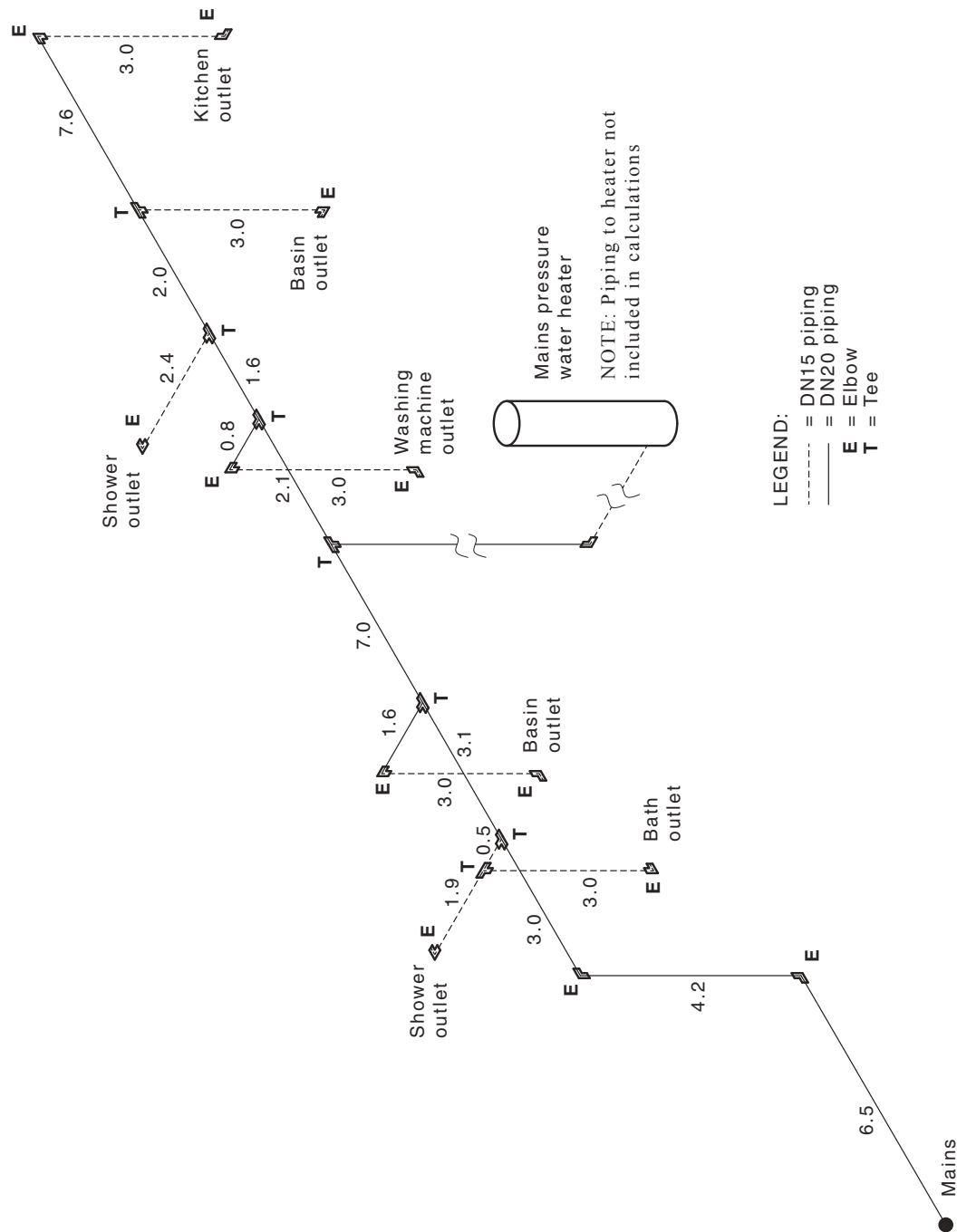
TABLE B1
SURFACE AREAS OF FITTINGS

Fitting	Surface area mm ²	Number of fittings	Total surface area mm ²
DN20 × DN20 × DN15 tee	965	2	1930
DN20 tee	1190	4	4760
DN20 elbow	1100	2	2200
DN20 × DN15 × DN15 tee	1190	1	1190
DN20 × DN15 elbow	850	3	2550
DN15 elbow	500	7	3500
Total		19	16130

Example 4 Growth of aquatic micro-organisms test

Scaling factors of 0.01 to 1.0 can apply to the growth of aquatic micro-organisms test. However, where the scaling factor is in the range 0.01 to 0.33, scaling can be applied only by adjusting the area-to-volume ratio of the sample prior to testing. This is because the test method (see Appendix E) does not allow for scaling of the test result by values lower than 0.33 (as this invalidates the result).

By way of example, consider a fitting that has a surface area-to-volume ratio of 100 000 mm²/L, and the product standard specifies a scaling factor of 0.05. For some tests, the test result can be multiplied by 0.05. However, for the growth of aquatic micro-organisms test, this cannot be done. Instead, the sample size is selected to give a surface area-to-volume ratio of 5000 mm²/L. The requirement (in Appendix E) that a value lower than 0.33 cannot be used to scale the test result does not mean that the product cannot have a scaling factor less than 0.33. It does mean that the scaling factor needs to be achieved by adjustment of the surface area-to-volume ratio prior to commencement of the test.



DIMENSIONS IN METRES

FIGURE B1 EXAMPLE OF A DOMESTIC MAINS PRESSURE COLD WATER PIPING LAYOUT

APPENDIX C

TEST METHOD—TASTE

(Normative)

C1 SCOPE

This Appendix sets out a method for assessing the ability of a product to impart a discernible taste to drinking water.

C2 INTRODUCTION

WARNING: CONDUCT THIS TEST WITH DUE REGARD TO THE POSSIBLE PRESENCE IN THE EXTRACTS OF SUBSTANCES THAT MAY BE HAZARDOUS TO THE HEALTH OF THE TASTE PANELLISTS. ONLY PRODUCTS FOUND TO BE SATISFACTORY IN THE MICROBIOLOGICAL GROWTH TEST (SEE APPENDIX E), THE ORGANIC SUBSTANCES TESTS (SEE CLAUSE 6.8, AND APPENDICES F AND G) AND THE METALS EXTRACTION TESTS (SEE APPENDICES H AND I) MAY BE ASSESSED IN THIS TEST, UNLESS DETAILS OF THE CHEMICAL COMPOSITION AND PROCESS OF MANUFACTURE OF THE SAMPLES ARE KNOWN AND ANY POSSIBLE HAZARD CAN BE ASSESSED.

Some materials are capable of leaching into water compounds, giving rise to unacceptable tastes at very low concentrations.

All taste assessment procedures are subjective and fall into the following two basic types:

- (a) Those that involve the tasting of a water sample and its qualitative classification on the basis of the intensity and nature of the taste.
- (b) Those in which a semi-quantitative determination of taste intensity is made by a group of people who assess a series of dilutions of the sample.

The method described in this Appendix (C) involves a combination of these procedures.

NOTE: Experience gained from the assessment of a wide variety of different materials indicates that odours are not encountered in the absence of a discernible taste. It is for this reason that this method is concerned with taste alone.

C3 PRINCIPLE

A sample of the product is exposed to chlorine-free test water for 24 h and the extract is then diluted and assessed by a taste panel. If more than one panellist reports a taste in the first dilution, the same samples shall be exposed to the test water for a further six sequential periods, including one 72 h period and concluding with a 24 h period, fresh chlorine-free test water being used for each period. The water from the seventh exposure period is diluted and then assessed by a taste panel. The test procedure is also carried out using chlorinated test water.

C4 TEST PREMISES

The assessment of taste shall be performed in a room that is free from obtrusive draughts and noise and has a general environment that allows the panellists to perform their task unobserved. No air fresheners or room deodorizers shall be used in the room, which shall be sited away from any activity that could generate interfering odours. The temperature of the room shall be $(21 \pm 4)^{\circ}\text{C}$.

C5 REAGENTS

C5.1 Test waters

C5.1.1 General

Test water shall be of drinking quality and shall have a hardness of 50 mg/L (as calcium carbonate), except for the testing of cementitious products (see Paragraph A8). The test water shall be prepared using distilled or deionized water (complying with Grade 3 of ISO 3696), as follows:

- (a) To 20 mL of sodium bicarbonate (NaHCO_3) solution (0.04 M) add 12.5 mL of calcium chloride (CaCl_2) solution (0.04 M).
- (b) Dilute the mixture to 1 L with distilled or deionized water.

C5.1.2 Chlorine-free test water

Accurately determine the free residual chlorine concentration in the test water (see Paragraph C5.1.1) in accordance with ISO 7393-2. As prepared, the test water will not contain any free residual chlorine. Add a sufficient quantity of a fresh solution of sodium thiosulfate to neutralize any measured free residual chlorine.

C5.1.3 Chlorinated test water

Accurately determine the free residual chlorine concentration in the test water (see Paragraph C5.1.1) and add a sufficient quantity of sodium hypochlorite solution (see Paragraph C5.2) to give a final free residual chlorine concentration of (1 ± 0.1) mg/L.

NOTE: Chloraminated water has been tested and found to have no effect on results.

C5.1.4 Sodium hypochlorite solution

Dilute a quantity of commercial sodium hypochlorite solution with distilled water to give a final concentration of 1% by mass available chlorine.

C5.2 Distilled water

The distilled water shall comply with Grade 3 of ISO 3696.

C6 APPARATUS

The following apparatus shall be used:

- (a) *Test containers* Containers shall be treated as follows:
 - (i) Clean with an aqueous solution of a biodegradable laboratory detergent.
 - (ii) Rinse in distilled water (see Paragraph C5.3).
 - (iii) Drain and dry in a hot air cabinet.
 - (iv) Before use, rinse with chlorine-free test water (see Paragraph C5.1.2).
- (b) *Dilution beakers* Consisting of graduated borosilicate glass beakers cleaned as for the test containers [see Paragraph C6(a)] and having a capacity of at least 250 mL.
They shall be reserved exclusively for taste assessment.
- (c) *Water bath and incubator* Capable of maintaining a temperature of $20 \pm 2^\circ\text{C}$.
- (d) *Tasting glass* Consisting of a cup supported by a stem resting on a base, the opening of the cup being narrower than the convex part of the cup. The opening shall be (45 ± 2) mm, the maximum internal diameter of the cup shall be (62 ± 3) mm and the internal length of the cup shall be (100 ± 2) mm. The physical characteristics of the cup shall comply with BS 5586-1. Before use, the glass shall be cleaned and dried in accordance with Paragraph A2 of BS 5586-1.
- (e) *Glass-encapsulated weights* For weighing down the products, if necessary.