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NSF/ANSI/CAN 61 - 2020

Drinking Water System Components - Health Effects



Standards Council of Canada
Conseil canadien des normes



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NSF International Standard /
American National Standard /
National Standard of Canada
for Drinking Water Additives –

**Drinking Water System Components –
Health Effects**

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Foreword²

In response to a competitive request for proposals from the US Environmental Protection Agency (US EPA), a Consortium led by NSF International (NSF) agreed to develop voluntary third-party consensus standards and a certification program for all direct and indirect drinking water additives. Other members of the Consortium include the American Water Works Association Research Foundation (WRF), the Association of State Drinking Water Administrators (ASDWA), the Conference of State Health and Environmental Managers (COSHEM), and the American Water Works Association (AWWA). (COSHEM has since become inactive as an organization.) Each organization was represented on a steering committee with oversight responsibility for the administration of the cooperative agreement. The Steering Committee provides guidance on overall administration and management of the cooperative agreement. Currently, the member organizations remain active in an oversight role.

Two Standards for additives products have been adopted. NSF/ANSI/CAN 60: *Drinking Water Treatment Chemicals — Health Effects* covers many of the water treatment chemicals, also known as direct additives. This Standard, NSF/ANSI/CAN 61, covers all indirect additives products and materials. Testing to determine the potential of a product to impart taste and/or odor to drinking water is not included in this Standard.

NSF/ANSI/CAN 61, and subsequent product certification against it, has replaced the US EPA Additives Advisory Program for drinking water system components. US EPA terminated its advisory role in April 1990. For more information with regard to US EPA's actions, refer to the July 7, 1988 *Federal Register* (53FR25586).

NSF/ANSI/CAN 61 was developed to establish minimum requirements for the control of potential adverse human health effects from products that contact drinking water. It does not attempt to include product performance requirements that are currently addressed in other voluntary consensus standards established by such organizations as the AWWA, ASTM International, and the American National Standards Institute (ANSI). Because this Standard complements the performance standards of these organizations, it is recommended that products also meet the appropriate performance requirements specified in the standards of such organizations.

Water age can be a major factor in the deterioration of water quality within plumbing systems affecting issues of both public health and aesthetic concerns. With increased water age is an increased potential for the formation of disinfection by-products, increased corrosion, and an increased potential for microbial regrowth. It can also lead to a loss in the effectiveness of corrosion control measures and an increased potential for nitrification of the water.

Within NSF/ANSI/CAN 61, most extraction protocols result in exposure periods between 12 to 24 hours. While these are appropriate for typical drinking water system use, they can be significantly less than in others. Examples of where high water age can occur include:

- water storage tanks in rain water catchment systems where the duration may be weeks or months;
- plumbing system designs in green buildings which result of overall reduction in water usage without a change in piping design to minimize stagnation;
- buildings where stagnant periods occur due to nonuse such as schools between semesters, vacation homes, or seasonal buildings; and
- products on isolated lines with either long or oversized piping resulting low water turnover.

² The information contained in this Disclaimer is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Disclaimer may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

NSF/ANSI/CAN 61 compliant products are often specified in these applications yet the potential accumulation of leachates over extended periods of exposure may or may not be addressed though this Standard. It is important that the design of drinking water plumbing systems take into account potentials for extended aging of water. This may include the flushing of the water piping system after extended periods of nonuse. It is also important for managers of the drinking systems in buildings be aware of the potential for high water age and proactively manage the system to minimize it.

This Standard and the accompanying text are intended for voluntary use by certifying organizations, utilities, regulatory agencies, and/or manufacturers as a basis of providing assurances that adequate health protection exists for covered products. Product certification issues, including frequency of testing and requirements for follow-up testing, evaluation, enforcement, and other policy issues, are not addressed by this Standard.

It is the intent of the Joint Committee to eliminate the extraction water specified in Table N-1.3a from the Standard after August 2020, or a period of five years from the adoption of Table N-1.3b. Use of either Table N-1.3a or N-1.3b provides for transition during this period. Certification bodies and other users of this Standard are strongly encouraged to perform periodic assessments of the effects of this change and provide feedback to the Joint Committee.

In 2020, the Joint Committee developed proposed changes designed to increase the public health protection of this Standard relative to the evaluation of lead leaching from endpoint devices. Due to the significant impact of these changes, the Joint Committee has established an extended effective date for the requirement to become mandatory on January 1, 2024. This effective date was selected to provide manufacturers a reasonable time to reengineer products to meet the new requirements, to have them tested, and to make them available in the marketplace. This date is based on the date of product manufacture. Manufacturers and certifiers are encouraged to actively pursue conformance to the new requirement prior to January 1, 2024. For clarity, the Joint Committee has placed the pending requirements in an informative annex.

All references to gallons (gal) are in US gallons.

This Standard was developed by the NSF Joint Committee on Drinking Water Additives – System Components using the consensus process described by the American National Standards Institute and the Standards Council of Canada's *Requirements and Guidance*. At the time of approval, the Joint Committee consisted of 9 public health / regulatory, 9 industry, 6 product certifier / testing lab, and 8 user representatives.

This Standard is designated as a National Standard of Canada (NSC) in compliance with requirements and guidance set out by the Standards Council of Canada (SCC).

This edition of the Standard contains the following revisions:

Issue 153

This revision modifies the minimum analysis requirements for several materials under Table 3.1 and adds a footnote to the table.

Issue 154

This revision corrects an error found under the product / material evaluation procedures in Section N-1.8.9.2.

Issue 155

The flux sample preparation method was revised under Section N-1.3.2.5.

Issue 156

This revision adds an optional, more stringent requirement for lead release for Section 9 devices (Section 9.5.1.1). It also adds a definition for the term *consumer-facing*.

Suggestions for improvement of this Standard are welcome. This Standard is maintained on a Continuous Maintenance schedule and can be opened for comment at any time. Comments should be sent to: Chair, Joint Committee on Drinking Water Additives – System Components at standards@nsf.org, or c/o NSF International, Standards Department, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA.

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SCC Foreword

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited standards development organization, in compliance with requirements and guidance set out by the SCC. More information on National Standards of Canada can be found at <www.scc.ca>.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada's economic competitiveness and social well-being, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at <www.scc.ca>.

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Consortium Organizations

NSF International

Popularly referred to as NSF, NSF International is a noncommercial agency. It is incorporated under the laws of Michigan as a not-for-profit organization devoted to research, education, and service. It seeks to solve problems involving man and his environment. It wishes to promote health and enrich the quality of life through conserving and improving that environment. Its fundamental principle of operation is to serve as a neutral medium in which business and industry, official regulatory agencies, and the public come together to deal with problems involving products, equipment, procedures, and services related to health and the environment. It is conceived and administered as a public service organization.

NSF is perhaps best known for its role in developing Standards and Criteria for equipment, products, and services that bear upon health. NSF was the lead organization in the Consortium responsible for developing this Standard. NSF conducts research; tests and evaluates equipment, products, and services for compliance with standards and criteria; and grants and controls the use of NSF registered Marks.

NSF offers product certification (listing services) for all products covered by its Standards. Each program has established policies governing the associated product evaluation, Listing Services, follow-up, and enforcement activities. The NSF Listing Mark is widely recognized as a sign that the product or service to which it relates complies with the applicable NSF Standard(s).

Water Research Foundation

The mission of the American Water Works Association Research Foundation (now the Water Research Foundation), is to sponsor practical, applied research on behalf of the drinking water industry of North America. The scope of the research program embraces all aspects of water supply operation, from development and maintenance of water resources to treatment technologies and water quality issues, from storage and distribution system operations to health effects studies and utility planning and management activities. Water Research Foundation (WRF) serves as the centralized industry institution for planning, managing, and funding cooperative research and development in drinking water, including the subsequent transfer of technology and results for practical application by the water utility community.

WRF's purpose in this cooperative program is to provide a communication link with the water utilities throughout North America and serve as the focal point for identification of research needs of the water supply industry with respect to the additives program.

The Association of State Drinking Water Administrators

The Association of State Drinking Water Administrators (ASDWA) is a nonprofit organization whose eligible membership is comprised of drinking water program administrators in each of the 50 states and seven US territories. Through the organization, representatives speak with a collective voice to Congressional committees, the United States Environmental Protection Agency (EPA), professional and trade associations, water utilities, and the general public on issues related to state drinking water programs. With its mission of protecting the public health through assurance of high-quality drinking water, and promoting responsible, reasonable, and feasible drinking water programs at the state and federal levels, the Association is a valued contributor to the consortium, and to the program. It provides the link between the additives program and the state drinking water programs.

The Conference of State Health and Environmental Managers

The Conference of State Health and Environmental Managers (COSHEM), known formerly as the Conference of State Sanitary Engineers (CSSE), is currently inactive as an organization. It brought to the consortium expertise and involvement of state health and environmental program managers. The Conference was the focal point for health concerns of all state environmental programs, including drinking water, wastewater, air, solid and hazardous wastes, radiology, occupational health, and food. A standing committee on water supply focused on drinking water issues and kept the membership informed. The Conference played an important role early in the program through two-way communication with state health and environmental program decision makers.

American Water Works Association

The purpose of the American Water Works Association (AWWA) is to promote public health, safety, and welfare by improving the quality and increasing the quantity of water delivered to the public, and to developing and furthering an understanding of the problems relating thereto by:

- advancing the knowledge of the design, construction, operation, water treatment, and management of water utilities;
- developing standards for procedures, equipment, and materials used by public water supply systems;
- advancing the knowledge of problems involved in the development of resources, production, and distribution of safe and adequate water supplies;
- educating the public on the problems of water supply and promoting a spirit of cooperation between consumers and suppliers in solving these problems; and
- conducting research to determine the causes of problems with providing a safe and adequate water supply, and proposing solutions thereto in an effort to improve the quality and quantity of the water supply provided to the public.

AWWA brings to the Consortium its established position as the largest public drinking water association in North America, with a broad membership that includes utilities, consultants, manufacturers / distributors / agents, contractors, and other organizations with a direct interest in drinking water.

NSF/ANSI/CAN Standard for Drinking Water Additives –

Drinking Water System Components – Health Effects

1 General

1.1 Purpose

This Standard establishes minimum health effects requirements for the chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems. This Standard does not establish performance, taste and odor, or microbial growth support requirements for drinking water system products, components, or materials.

1.2 Scope

1.2.1 This Standard is intended to cover specific materials or products that come into contact with: drinking water, drinking water treatment chemicals, or both. The focus of the Standard is evaluation of contaminants or impurities imparted indirectly to drinking water. The products and materials covered include, but are not limited to, process media (e.g., carbon, sand), protective materials (e.g., coatings, linings, liners), joining and sealing materials (e.g., solvent cements, welding materials, gaskets), pipes and related products (e.g., pipes, tanks, fittings), mechanical devices used in treatment / transmission / distribution systems (e.g., valves, chlorinators, separation membranes, point-of-entry (POE) drinking water treatment systems), and mechanical plumbing devices (e.g., faucets, endpoint control valves).

1.2.2 Point-of-use (POU) drinking water treatment devices are not covered by the scope of this Standard.

1.3 Normative references

The following documents contain requirements that, by reference in this text, constitute requirements of this Standard. At the time this Standard was balloted, the editions listed below were valid. All documents are subject to revision, and parties are encouraged to investigate the possibility of applying the recent editions of the documents indicated below. The most recent published edition of the document shall be used for undated references.

21 CFR Part 58, *Good Laboratory Practice for Nonclinical Laboratory Studies*³

40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*⁴

40 CFR Part 141, *National Primary Drinking Water Regulations*⁴

40 CFR Part 160, *Good Laboratory Practice Standards*⁴

³ US Department of Health and Human Services, Public Health Service, Food and Drug Administration. 10903 New Hampshire Ave, Silver Spring, MD 20993. <www.fda.gov>

⁴ US Government Publishing Office. 732 North Capitol Street NW, Washington, DC 20401. <www.govinfo.gov/app/collection/cfr>

40 CFR Part 798, *Health Effects Testing Guidelines*⁴

APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater*, twenty-second edition⁵

ASTM A240/A240M-05, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*⁶

ASTM A269-04, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*⁶

ASTM A312/A312M-05, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*⁶

ASTM A789/A789M-05, *Standard Specification for Seamless and Welded Ferritic / Austenitic Stainless Steel Tubing for General Service*⁶

ASTM A790/A790M-05, *Standard Specification for Seamless and Welded Ferritic / Austenitic Stainless Steel Pipe*⁶

ASTM A815/A815M-04, *Standard Specification for Wrought Ferritic, Ferritic / Austenitic, and Martensitic Stainless Steel Piping Fittings*⁶

ASTM C31/C31M-00e1, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*⁶

ASTM C109/C109M-99, *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars*⁶

ASTM C 183-02, *Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement*⁶

ASTM C192/C192M-00, *Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory*⁶

ASTM C511-98, *Standard Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes*⁶

ASTM C778-00, *Standard Specification for Standard Sand*⁶

ASTM D2855-96, *Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings*⁶

ASTM D3182-89 (1994), *Standard Practice for Rubber – Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets*⁶

ASTM E29-02, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*⁶

ASTM F493-97, *Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings*⁶

ANSI/AWWA B100-96, *AWWA Standard for Filtering Material*⁷

⁵ American Public Health Association. 800 I Street NW, 11th floor, Washington, DC 20001. <www.apha.gov>

⁶ ASTM International. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428. <www.astm.org>

⁷ American Water Works Association. 6666 W Quincy Avenue, Denver, CO 80235. <www.awwa.org>

ANSI/AWWA C652-92, *AWWA Standard for Disinfection of Water-Storage Facilities*⁷

NSF/ANSI/CAN 60, *Drinking Water Treatment Chemicals – Health Effects*

NSF/ANSI 372, *Drinking Water System Components – Lead Content*

NSF/ANSI/CAN 600, *Health Effects Evaluation and Criteria for Chemicals in Drinking Water*

OECD, *OECD Guidelines for the Testing of Chemicals*, May 1996⁸

SSPC-PA2– 2004, *Steel Structures Painting Manual Volume 2. Paint Application Specification*⁹

The Society for Protective Coatings, *Steel Structures Painting Manual. Volume 2. Reference Paint Application Specification No. 2 (SSPC-PA2)*⁹

US EPA-570-9-82-002, *Manual for the Certification of Laboratories Analyzing Drinking Water*, October 1982¹⁰

US EPA-600/4-79-020, *Methods for the Chemical Analysis of Water and Wastes*, March 1983¹⁰

US EPA-600/4-80-032, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*¹⁰

US EPA-600/4-84-053, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, June 1984¹⁰

US EPA-600/R-05/054, *Determination of Nitrosamines in Drinking Water By Solid Phase Extraction and Capillary Column Gas Chromatography With Large Volume Injection and Chemical Ionization Tandem Mass Spectrometry (MS/MS)*, September 2004¹⁰

US FDA, *Toxicological Principles for the Safety Assessment of Direct Food Additives and Color Additives in Food*⁶

1.4 Limitations

The requirements of this Standard are limited to addressing potential health effects, except where specific application and performance standards are referenced. This Standard does not establish taste and odor requirements for drinking water system products and materials. The criteria set forth in this Standard cover products created by good manufacturing practices (GMP) and generally recognized manufacturing processes. As the presence of unusual or unexpected impurities is frequently dependent upon the method of manufacture and the quality of raw material used, products prepared by other than recognized methods of manufacture or with unusual raw materials shall be fully evaluated in accordance with Section 3 of this Standard (General requirements). Products that have been evaluated and found to meet other NSF standards having health requirements equivalent to this Standard as indicated in each section shall be acceptable for drinking water applications without separate evaluation under this Standard.¹¹

⁸ Organization for Economic Cooperation and Development. 2 Rue Andre-Pascal, 75775 Paris Cedex 16, France. <www.oecd.org>

⁹ The Society for Protective Coatings. 40 24th Street, 6th Floor, Pittsburgh, PA 15222. <www.sspc.org>

¹⁰ US Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <www.epa.gov>

¹¹ Final acceptance of a product for drinking water application is the responsibility of the appropriate federal, state, or local regulatory agent.

1.5 Alternate products or materials

While specific materials are stipulated in this Standard, drinking water system products or components that incorporate alternate materials shall be acceptable when it is verified that the product or component meets the applicable requirements of the Standard based on its end use.

1.6 Significant figures and rounding

For determining conformance with the specifications in this Standard, the Absolute Method in ASTM E29 *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications* shall be used. When rounding data, the rounding procedure in Section 6.4 of ASTM E29 shall be used.

2 Definitions

Terms used in this Standard that have a specific technical meaning are defined here.

2.1 analytical summary: A list of the analytes and analytical procedures, both chemical and microbiological, that are selected to determine whether a product is conformant to the requirements of the Standard; analytes may be either product-specific or formulation-dependent.

2.2 at the tap: Referring to the point of delivery or point of use for drinking water.

2.3 cold water application: A product application that is not intended to result in exposure for extended periods to water in excess of ambient water temperature.

2.4 contaminant: A physical, chemical, biological, or radiological substance or matter in water.

NOTE — Consistent with the definition in the US Federal Safe Drinking Water Act, a contaminant can have either a beneficial or detrimental effect on the potability of water.

2.5 diluted surface area (DSA): The surface area / volume ratio of a product, component, or material calculated using its actual wetted surface area, the field static and/or field flow volumes directed by the standard for the end use for which the product is being evaluated. The calculation shall use the normalization equation specific to that end use. The values for lab surface area and lab volume in the normalization equation shall be entered as 1 for the purposes of this determination causing the DSA ratio to equal the calculated NF factor. The volume of chemical generated or water treated shall be for a 24 h period.

Example calculation: For a component of a chemical generator that has an actual surface area of 5 in² and the unit treats a minimum daily water volume of 500,000 L/d (refer to Annex N-1 for definition of normalization terms):

$$DSA \left(\frac{\text{in}^2}{\text{L}} \right) = NF = N1 \times N2 \times N4 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(\text{static})}} \times \frac{V_{F(\text{static})}}{V_{F(\text{flowing})}} \times \frac{V_{TC}}{V_{WT}} = \frac{5}{1} \times \frac{1}{500,000} = 0.00001 \frac{\text{in}^2}{\text{L}}$$

Where:

SA_F = surface area exposed in the field

SA_L = 1 (per DSA definition)

V_L = 1 (per DSA definition)

$V_{F(\text{static})}$ = cancels out of the equation for this example

$V_{F(\text{flowing})} = V_{TC}$ and the two cancel out of the equation in this example (i.e., the volume of solution leaving the chemical generator [$V_{F(\text{flowing})}$] is the same as that being used to treat the water [V_{TC}])

V_{WT} = volume of raw water treated with the concentrated chemical when dosed at the prescribed feed rate during a 24 h period.

2.6 direct additives: A treatment chemical and its contaminants directly added to water during the production of drinking water.

2.7 distribution system: The system of conduits or the network of pipelines (located primarily in the streets) through which a primary domestic water supply is distributed to consumers. In plumbing codes, this term is applied to all the hot and cold water piping installed in buildings.

2.8 drinking water: Water intended for human consumption.

2.9 drinking water treatment unit system: A complete water treatment device, including all components needed to connect the device to a potable water supply.

2.10 free available chlorine: The sum of hypochlorous acid and hypochlorite ions.

2.11 good manufacturing practices (GMP): The practice of maximizing the purity of products and materials by maintaining and practicing appropriate quality control (QC) and quality assurance (QA) procedures.

2.12 hot water application: A product application that is intended to result in exposure for extended periods to water that has been raised from ambient temperature.

2.13 indirect additives: Contaminants that are extracted into drinking water through contact with the surfaces of materials, components, or products used for its treatment, storage, transmission, or distribution.

2.14 manufacturer: A corporation, company, or individual that produces, formulates, packages, or repackages products, components, and materials that are intended to be in contact with drinking water.

2.15 maximum contaminant level (MCL): The maximum concentration of a regulated contaminant that is permitted in a public drinking water supply, as defined under the US Federal Safe Drinking Water Act.

NOTE — If the manufacturer requests review to relevant alternate regulatory requirements, the certifying agency can consider alternative regulatory levels, e.g., Canadian maximum acceptable concentrations (MACs).

2.16 normalization: The process of adjusting laboratory extraction results by accounting for differences between laboratory and field surface area-to-volume ratios to reflect the contaminant concentration at the tap.

2.17 normalized concentration: A value for a contaminant concentration from a laboratory extraction test that has been adjusted to reflect the potential contaminant concentration at the tap.

2.18 point-of-entry (POE) system: A system with a minimum initial clean-system flow rate of no less than 15 L/min at 103 kPa pressure drop and 18 ± 5 °C water temperature (not less than 4 gal/min at 15 psig pressure drop and 65 ± 10 °F water temperature) used to treat the water supply at a building or facility for drinking, washing, and flushing or for other nonconsumption water supply purposes.

2.19 point-of-use (POU) system: A plumbed-in or faucet-mounted system used to treat the drinking and/or cooking water at a single tap or multiple taps but not used to treat the majority of water used for washing and flushing or other nonconsumption purposes at a building or facility. Any batch system or device not connected to the plumbing system is considered a POU system.

2.20 short-term exposure level (STEL): A maximum concentration of a contaminant that is permitted in drinking water for an acute exposure calculated in accordance with NSF/ANSI/CAN 600 (previously Annex A).

2.21 single product allowable concentration (SPAC): The maximum concentration of a contaminant in drinking water that a single product is allowed to contribute as defined by NSF/ANSI/CAN 600 (previously Annex A).

2.22 total allowable concentration (TAC): The maximum concentration of a nonregulated contaminant allowed in a public drinking water supply as defined by NSF/ANSI/CAN 600 (previously Annex A).

2.23 transmission system: A system of conduits through which a primary water supply is transmitted to the distribution system.

2.24 unit void volume (UVV): Total water-holding volume with the medium (media) and internal components in place.

3 General requirements

3.1 General

3.1.1 Product and material information described in Section 3.2 shall be used to determine the specific section (4 through 9) under which a product or material shall be evaluated.

3.1.2 Products or materials whose intended uses fall under more than one section of this Standard shall be evaluated under the section with the most rigorous evaluation conditions.

3.1.3 Within the applicable section of this Standard, products shall be evaluated under the most rigorous conditions unless results from a less rigorous test can be mathematically extrapolated to ensure compliance with the most rigorous condition.

3.1.4 The most rigorous condition is associated with the shortest conditioning period, longest exposure period, highest surface area to volume ratio, and highest exposure temperature, unless demonstrated otherwise with empirical data.

3.2 Information and formulation requirements

The following information shall be obtained and reviewed for all materials with a water contact surface to determine the appropriate analytical testing and to ensure that the potential health effects of products and materials are accurately and adequately identified:

- the product section(s) under which the product, component, or material is covered and the intended function or end use of the product or the material;
- for assemblies, subassemblies, products or components, a list of all materials and their corresponding surface areas that come into direct contact with water;
- when appropriate, the total volume of water that the product can hold when filled to capacity;
- the anticipated minimum, maximum, and average volumes of water that come into contact with the product, component, or material during a 24 h period;

- complete formulation information (equal to 100.0%) for each water contact material. This shall include:
 - a complete formulation shall result in the identity by CAS number or chemical name of each component of the formulation including but not limited to the activators, antioxidants, antimicrobials, cosolvents, fillers, initiators, peroxides, pigments, plasticizers, process aids, solvents, stabilizer, surfactants and terminators; and
 - percent or parts by weight for each chemical in the formulation or reference to a national or international standardized material specification for metallic materials (e.g., UNS copper alloy specifications).

NOTE 1 — The complete formulation information may be omitted for a component material if:

- the generic material type is contained in Table 3.1 and its DSA in the application is ≤ 0.001 in²/L or 0.0001 in²/L for static or flowing conditions respectively; or
- the generic material type is contained in Table 3.1 and if the material is in a high flow device and used exclusively at public water treatment facilities. For the purposes of this Section, high flow devices are limited to chemical feeders, disinfectant generators (e.g., chlorine dioxide, hypochlorite, ozone and ultraviolet), electro dialysis technologies, microfiltration technologies, nanofiltration technologies, reverse osmosis and ultrafiltration technologies; or
- the generic material type is contained in Table 3.1 and if (1) used in a mechanical device or mechanical plumbing device, and (2) the material is not a coating, and (3) the component is not a process media; or
- if (1) the material is not listed in Table 3.1, and (2) it is used in a mechanical device or mechanical plumbing device, and (3) the material is not a coating, and (4) the component is not a process media, and (5) the material is tested to the requirements of Table 3.2.

If the product is to be considered compliant to a lead content standard, the lead content (percent by weight) and wetted surface area of each component that comes into contact with the direct flow of water under the normal operation of the product is required. Complete documentation shall be submitted in accordance with NSF/ANSI 372 – Drinking Water System Components – Lead Content.

NOTE 2 — A material is defined as a combination of ingredients used to manufacture (mold, extrude, stamp, cast, machine, mix, etc.) a part or component used in the assembly of a device. To include, but not be limited to, plastics, elastomers, metallic components, media, lubricants, adhesives, process aid, preservatives, coatings, and surface treatments.

- when the chemical composition of an ingredient or component cannot be determined based on the information submitted by the material supplier, the information shall be obtained by the certifier from the ingredient supplier prior to determining all formulation dependant analytes;
- the composition of the materials ingredients and their components shall be known to determine the identity of formulation specific analytes;
- the maximum temperature to which the product, component, or material is exposed during its intended end use;
- a description / classification of the manner in which the product or material is manufactured (including any process parameters that affect product surface areas in direct contact with water), handled, and packaged. The manufacturing process variability shall be verified by the manufacturer as to its effect on contaminant leachate levels, and the manufacturer shall establish and demonstrate appropriate ongoing process controls to ensure ongoing product conformance with this Standard;

NOTE — The methods used to alter the water contact surfaces of product components during manufacturing, either mechanically (e.g., metal cutting, molding, stamping) or chemically (e.g., washing, coating, plating, brite-dip cleaning), may have a significant effect upon contaminant leachate performance.

- when available, a list of the known or suspected impurities within the product or material and the maximum percent or parts by weight of each impurity;
- when available, the solubility, hydrolysis products, and extraction rates of chemicals within the product or material; and
- when available, a list of published and unpublished toxicological studies relevant to the chemicals and impurities present in the product, component, or material.

3.2.1 Information and formulation requirements for regenerated / reactivated media

In addition to the information formulation requirements of Section 3.2, the following information is required for the formulation review and preparation of the analytical summary for regenerated and reactivated media:

- a description of the regeneration / reactivation process and process controls, such as time, temperature, chemical regenerants, and any quality control (QC) tests associated with the regeneration / reactivation process to ensure contaminants are removed from the spent media so that it complies with the requirements of this Standard;
- a copy of the procedure detailing the evaluation, and conclusion associated with the review of data from spent media sources identifying all regulated contaminants, or other contaminants of concern that are removed from water and any contaminant spills or unusual water conditions; and
- a copy of the data, and a copy of the documentation associated with the evaluation of the data from the spent media source(s) associated with a specific lot of reactivated or regenerated media for which a retained sample is available for testing.

3.2.1.1 Incoming shipments of media to be regenerated / reactivated

The following information shall be provided by the water system and maintained by the processing plant for each shipment of spent media received for regeneration / reactivation:

- identification of the type of the spent media, spent media source, and application of use (e.g., production of drinking water);
- identification of the original media, including manufacturer or previous regeneration / reactivation facility, trade designation, mesh size and compliance with this Standard for each spent media source;
- regulated contaminants or other contaminants of concern removed from water, including any contaminant spills or unusual water quality conditions;
- statement as to whether the spent media has been knowingly exposed to:
 - activated carbon: polychlorinated biphenyls (PCBs), or dioxins; or
 - other media: herbicides, pesticides, PCBs, dioxins or 1,2 dibromo-3chloropropane (DBCP).
- statement to verify that the spent media source is from a public water system (publicly or privately owned) as defined by US EPA regulations (40 CFR § 141.2), or equivalent regulations in Canada and other countries, where applicable.

3.3 Identification of analytes

For all products and materials, the formulation information required in Section 3.2 shall be reviewed for completeness (e.g., all formulations total 100.0%), and to determine whether a minimum test battery has been established for each water contact material (see Table 3.1). In addition to selecting the minimum testing parameters described in Table 3.1, a formulation review to identify any formulation-dependent analytes shall be performed for all water contact materials (see Section 3.3.1).

In instances where the complete formulation has not been obtained for a material that is used in a component of a mechanical device or mechanical plumbing device as allowed through Note 1 of Section 3.2, testing shall include the material-specific analyses in Table 3.1, or as directed in Table 3.2.

3.3.1 Formulation-dependent analysis selection

For all water contact materials, the formulation information described in Section 3.2 shall be reviewed, and formulation-dependent analytes shall be identified for each water contact material. The criteria for selection of a formulation-dependent analyte shall include, but not be limited to, the following:

- known or suspected toxicity of the substance or its byproduct(s);
- high water solubility of the substance;
- monomer(s) of polymeric ingredients;
- solvents and cosolvents used in the polymerization process or those used in the material formulation;
- antioxidants, antimicrobials, curing agents, initiators, peroxides, pigments, plasticizers, process aids, stabilizer and terminators and their impurities, degradation and hydrolysis products;
- high probability of extraction of a substance or its byproduct(s) at toxicologically significant concentrations; and
- extraction or migration information for the substance provided by the manufacturer or that present in the public literature.

3.3.2 Established minimum test batteries

The materials listed in Table 3.1 or Table 3.2 shall be tested for the indicated analyses and any formulation-dependent analyses identified during the formulation-dependent analyte selection. Products, components, or materials made exclusively from materials in Table 3.1 shall not require testing if:

- their DSA-to-volume ratio in the application is ≤ 0.001 or 0.0001 for static or flowing conditions respectively, or
- the material is uncoated concrete for use in a water storage structure of 1.33×10^6 L (0.35×10^6 gal) or greater and any admixtures used have been evaluated to this Standard and found compliant within the use levels in the concrete, or
- the material is uncoated concrete or for use in applications with a DSA-to-volume ratio less than or equal to $0.8 \text{ in}^2/\text{L}$ or $0.08 \text{ in}^2/\text{L}$ for static or flowing conditions respectively, and any admixtures used have been evaluated to this Standard and found compliant within the use levels in the concrete; or

NOTE — The addition of the criteria for concrete water storage structures is in recognition of the diminishing value of investigations on those with high volumes (low surface area-to-volume ratios) where admixtures have separately been verified as compliant with this Standard and the water storage structure is separately monitored for regulated contaminants including radionuclides.

— the material is in a high flow device and used exclusively at public water treatment facilities. For the purposes of this Section, high flow devices are limited to chemical feeders, disinfection generators (e.g., chlorine dioxide, hypochlorite, ozone and ultraviolet), electro dialysis technologies, microfiltration technologies, nanofiltration technologies, reverse osmosis and ultrafiltration technologies.

3.4 Products manufactured from Annex N-2 acceptable materials

Products manufactured entirely from Annex N-2 materials shall not be required to undergo extraction testing for material-specific analytes of interest. However, extraction testing for contaminants contributed by processes specific to a production site shall be considered formulation-dependent analytes. Annex N-2 contains the evaluation requirements for qualification as an acceptable material.

Table 3.1
Material-specific analyses

| Material type | Required analyses |
|---|--|
| pipe / fitting / device materials | |
| aluminum | regulated metals, ¹ aluminum |
| aluminum oxide ceramics | regulated metals, ¹ aluminum |
| asphaltic-coated ductile iron | GC/MS, ² VOCs, regulated metals, ¹ polynuclear aromatic hydrocarbons (PNAs), molybdenum, vanadium, manganese |
| brass | regulated metals, ¹ zinc, nickel, bismuth ³ |
| carbon graphite nonimpregnated | GC/MS, ² VOCs, polynuclear hydrocarbons (PNAs), regulated metals ¹ |
| carbon graphite (phenol formaldehyde impregnated) | GC/MS, ² VOCs, polynuclear hydrocarbons (PNAs), formaldehyde, regulated metals ¹ |
| carbon steel | regulated metals ¹ |
| cast iron | regulated metals ¹ |
| chrome / nickel plating | regulated metals, ¹ nickel |
| concrete ⁴ | regulated metals ¹ |
| concrete aggregate ⁴ | regulated metals, ¹ radionuclides |
| copper | regulated metals ¹ |
| ductile iron | regulated metals ¹ |
| galvanized steel | regulated metals, ¹ zinc, nickel |
| magnets | regulated metals, ¹ metals ^{3,5} |
| nickel based alloys | regulated metals, ¹ nickel |
| platinum | regulated metals, ¹ platinum |
| quartz | regulated metals ¹ |
| ruby or sapphire (natural and synthetic aluminum oxide gemstones) | regulated metals, ¹ aluminum |
| silicon carbide ceramics | regulated metals, ¹ silicon |
| silver | regulated metals, ¹ silver |

Table 3.1
Material-specific analyses

| Material type | Required analyses |
|--|--|
| stainless steel | regulated metals, ¹ nickel |
| titanium | regulated metals, ¹ titanium |
| tungsten carbide | regulated metals, ¹ tungsten |
| zirconium oxide ceramics | regulated metals, ¹ zirconium |
| plastic materials | |
| acetal (AC) / polyoxymethylene (POM) | GC/MS, ² VOCs, regulated metals, ^{1,3} formaldehyde |
| acrylonitrile-butadiene-styrene (ABS), acrylonitrile-styrene (SAN) | GC/MS, ² VOCs, regulated metals, ^{1,3} acrylonitrile, 1,3-butadiene, styrene |
| cross-linked polyethylene (PEX) | GC/MS, ² VOCs, regulated metals, ^{1,3} methanol, <i>tert</i> -butyl alcohol ⁶ |
| nylon 6 | GC/MS, ² VOCs, regulated metals, ^{1,3} caprolactam |
| other nylons | GC/MS, ² VOCs, regulated metals, ^{1,3} nylon monomers |
| polybutylene (PB) | GC/MS, ² VOCs, regulated metals ^{1,3} |
| polycarbonate (PC) | GC/MS, ² bisphenol A, VOCs, regulated metals ^{1,3} |
| polyethylene (PE) | GC/MS, ² VOCs, regulated metals ^{1,3} |
| polyphenylene oxide (PPO) | GC/MS, ² dimethyl phenol, VOCs, regulated metals ^{1,3} |
| polyphthalamide (PPA) | GC/MS, ² VOCs, regulated metals, ^{1,3} hexamethylene diamine, terephthalic acid, isophthalic acid |
| polypropylene (PP) | GC/MS, ² VOCs, regulated metals ^{1,3} |
| polystyrene | styrene, GC/MS, ² VOCs, regulated metals, ¹ phenolics (by GC/MS base/acid scan) ² |
| polysulphone including poly[phenylene sulphone] (PPSU) | GC/MS, ² VOCs, regulated metals, ^{1,3} sulphone monomer |
| polyurethane (PUR) | GC/MS, ² VOCs, regulated metals ^{1,3} |
| polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) | regulated metals, ^{1,3} phenolics, ² VOCs, tin, ⁷ lead, antimony, ⁸ residual vinyl chloride monomer (RVCM) ⁹ |
| PVC (flexible) | GC/MS, ² VOCs, regulated metals, ^{1,3} lead, phthalates, ¹⁰ RVCM, ⁹ tin, ⁷ zinc ¹¹ |
| joining and sealing materials | |
| chloroprene | GC/MS, ² VOCs, and 2-chloro-1,3-butadiene, phthalates, ¹⁰ PNAs, ² nitrosoamines ¹² |
| ethylene-propylene-diene monomer (EPDM) | GC/MS, ² VOCs, phthalates, ¹⁰ PNAs, ² nitrosoamines ¹² |
| ethylene tetrafluoroethylene (ETFE) | GC/MS, ² VOCs, perfluorooctanoic acid |
| flux | GC/MS, ^{2,3} VOCs, regulated metals, ^{1,3} PNAs ^{2,3} |
| fluoroelastomer | GC/MS, ² VOCs, perfluorooctanoic acid |
| isoprene | GC/MS, ² VOCs, phthalates, ¹⁰ PNAs, ² isoprene monomer, nitrosoamines ¹² |
| nitrile-butadiene rubber (NBR, BUNA-N, HNBR) | GC/MS, ² VOCs, phthalates, ¹⁰ PNAs, ² 1,3-butadiene, acrylonitrile, nitrosoamines ¹² |

Table 3.1
Material-specific analyses

| Material type | Required analyses |
|---|--|
| PTFE | GC/MS, ² VOCs, perfluorooctanoic acid |
| PVDF | GC/MS, ² VOCs, vinylidene fluoride, hexafluoropropene |
| silicone | GC/MS, ² VOCs, 2,4-dichlorobenzoic acid |
| solder | regulated metals, ¹ aluminum, bismuth, nickel, silver, strontium, zinc |
| solvent cements | GC/MS, ² VOCs, ³ acetone, tetrahydrofuran, cyclohexanone, methyl ethyl ketone, dimethylformamide, methyl isobutyl ketone |
| styrene-butadiene rubber (SBR) | GC/MS, ² VOCs, phthalates, ¹⁰ PNAs, ² 1,3-butadiene, styrene, nitrosoamines ¹² |
| barrier materials | |
| asphaltic coatings | GC/MS, ² VOCs, regulated metals, ¹ molybdenum, vanadium, manganese, PNAs ² |
| epoxy coatings (liquid and powder) | GC/MS, ² VOCs, bisphenol A, bisphenol A-diglycidyl ether, ¹³ bisphenol A-diglycideryl ether, ¹³ bisphenol A-propoxylate, ^{3,13} epichlorohydrin, bisphenol F, ³ bisphenol F-diglycidyl ether, ^{3,13} bisphenol F-diglycideryl ether, ^{3,13} bisphenol F-propoxylate, ^{3,13} solvent and reactive diluent additives ^{3,14} |
| polyester coatings | GC/MS, ² VOCs, residual monomers ¹⁵ |
| polyurethane coatings | GC/MS, ² VOCs |
| portland and hydraulic cements ⁴ | GC/MS, ² regulated metals, ¹ dioxins and furans, radionuclides, glycols and ethanolamines ¹⁶ |
| <p>¹ Antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, thallium. Chromium shall be evaluated against the pass/fail criteria of chromium VI as a screening level. If the normalized result exceeds this criteria, the sample shall be tested according to the method described in Section N-1.7.3 and shall be evaluated against the pass/fail criteria listed in Table 4.1 of NSF/ANSI/CAN 600 (previously Table D.1) for the tested product. Regardless of chromium species, the total chromium pass/fail criteria shall not be exceeded.</p> <p>² See Section N-1.7</p> <p>³ The testing may be waived for a this specific analyte where formulation information indicates that it is not present. In instances where the complete formulation has not been obtained for the material as allowed through Note 1 of 3.2, testing shall include this analyte.</p> <p>⁴ Concrete aggregate sampling is required only if the method for testing for individual concrete components is used. Aggregate sampling is not required if concrete cylinders are tested for the constituents in Portland and hydraulic cements.</p> <p>⁵ Aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, cerium, cobalt, chromium, cesium, copper, dysprosium, erbium, europium, gallium, gadolinium, germanium, hafnium, indium, lanthanum, lead, lithium, lutetium, manganese, mercury, molybdenum, niobium, neodymium, nickel, palladium, praseodymium, platinum, rubidium, rhenium, rhodium, ruthenium, samarium, selenium, silver, strontium, tantalum, tellurium, thallium, tin, titanium, tungsten, uranium, vanadium, tungsten, ytterbium, zinc, zirconium. Chromium shall be evaluated against the pass/fail criteria of chromium VI as a screening level. If the normalized result exceeds this criteria, the sample shall be tested according to the method described in Section N-1.7.3 and shall be evaluated against the pass/fail criteria listed in Table 4.1 of NSF/ANSI/CAN 600 (previously Table D.1) for the tested product. Regardless of chromium species, the total chromium pass/fail criteria shall not be exceeded.</p> <p>⁶ <i>tert</i>-Butyl alcohol analysis is required for PEX materials except those crosslinked via e-beam methodology.</p> <p>⁷ The analysis for tin is required when tin-based stabilizers are used.</p> <p>⁸ The analysis for antimony is required when antimony-based stabilizers are used.</p> <p>⁹ The level of RVCM within the walls of PVC or CPVC products and materials shall be directly determined (Section N-1.7).</p> | |

Table 3.1
Material-specific analyses

| Material type | Required analyses |
|---------------|--|
| | <p>¹⁰ The analysis for phthalates is required when phthalate ester plasticizers are used. Analysis shall be for the specific phthalate ester(s) used in the formulation.</p> <p>¹¹ The analysis for zinc is required when zinc-based stabilizers are used.</p> <p>¹² Analysis for n-nitrosodimethylamine, n-nitrosomethylethylamine, n-nitrosodiethylamine, n-nitrosodi-n-propylamine, n-nitrosopyrrolidine, n-nitrosomorpholine, n-nitrosopiperidine, n-nitrosodi-n-butylamine and n-nitrosodiphenylamine are required when material is sulfur cured.</p> <p>¹³ Analysis shall be performed using liquid chromatography with ultraviolet detection (LC/UV).</p> <p>¹⁴ Analysis shall be performed for the specific solvent and reactive diluent additives used in the individual product formulation, such as benzyl alcohol.</p> <p>¹⁵ Analysis shall be performed for residual concentrations of the specific ester monomers used in the individual product formulation.</p> <p>¹⁶ Glycol and ethanolamine analyses shall be performed on cements containing these compounds as grinding aids.</p> |

NOT FOR
DISTRIBUTION
OR SALE

Table 3.2
Material specific analyses not listed in Table 3.1 or materials without formulation information
(excluding coatings and process media)

| Material type | Material specific analyses ¹ | Suggested Method ² |
|--|---|-------------------------------|
| metallic materials not listed in Table 3.1 | <p>aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, cerium, cobalt, chromium, hexavalent chromium, cesium, copper, dysprosium, erbium, europium, gallium, gadolinium, germanium, hafnium, indium, lanthanum, lead, lithium, lutetium, manganese, mercury, molybdenum, niobium, neodymium, nickel, palladium, praseodymium, platinum, rubidium, rhenium, rhodium, ruthenium, samarium, selenium, silicon, silver, strontium, tantalum, tellurium, thallium, tin, titanium, tungsten, uranium, vanadium, tungsten, ytterbium, zinc, zirconium</p> <p>Chromium shall be evaluated against the pass/fail criteria of chromium VI as a screening level. If the normalized result exceeds this criteria, the sample shall be tested according to the method described in Section N-1.7.3 and shall be evaluated against the pass/fail criteria listed in NSF/ANSI/CAN 600 Table 4.1 for the tested product. Regardless of chromium species, the total chromium pass/fail criteria shall not be exceeded.</p> | EPA 200.8 |
| plastic materials not listed in Table 3.1 | bisphenol A, caprolactam, dimethyl phenol, terephthalic acid, isophthalic acid, hexamethylene diamine, acrylic acid, methacrylic acid, bisphenol A-propylene oxide adducts, hydroquinone, phthalic acid, 1,4-butanediol, p-phenylenediamine, o-phenylenediamine, 1,6-hexanediol, m-phenylenediamine, melamine, triethylene diamine, trimethylolpropane | LC/UV |
| | nylon monomers = 11-aminoundecanoic acid, 1,10-diaminododecane, lauro lactam, adipic acid, 2-methyl-1,5-pentanediamine | LC/UV |
| | sulphone monomer, 4,4'-dichlorodiphenyl sulfone, and diphenyl sulfone | LC/UV |
| | formaldehyde | EPA 8315A |
| | RVCM, 1,2-dichloro-3-propanol, 1,3-dichloro-2-propanol, methyl butenol isomers, methylene bis-cyclohexylamine 4,4'-, cyclohexanamine methylenebis methyl propyl, methylenedianiline, methanol | GC/FID |
| | dimethylphthalate, diethylphthalate, bis(2-ethylhexyl)phthalate (DEHP), di-n-butylphthalate | EPA525.2 |
| | 1,3-butadiene, styrene, <i>tert</i> -butyl alcohol, VOCs, epichlorohydrin, methyl- <i>tert</i> -butyl ether (MTBE), vinylidene fluoride, hexafluoropropylene, acrylonitrile | EPA 524.2 |
| | <p>antimony, arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, copper, lead, mercury, selenium, thallium, tin</p> <p>Chromium shall be evaluated against the pass/fail criteria of chromium VI as a screening level. If the normalized result exceeds this criteria, the sample shall be tested according to the method described in Section N-1.7.3 and shall be evaluated against the pass/fail criteria listed in NSF/ANSI/CAN 600 Table 4.1 for the tested product. Regardless of chromium species, the total chromium pass/fail criteria shall not be exceeded.</p> | EPA 200.8 |
| phenolics, acetal oligomers, dimethyl terephthalate, diethylphthalate, diisobutylphthalate, di-n-butylphthalate, butylbenzylphthalate, di-n-octylphthalate | EPA 625 BNA | |
| perfluorooctanoic acid | LC/MS ES | |

Table 3.2
Material specific analyses not listed in Table 3.1 or materials without formulation information
(excluding coatings and process media)

| Material type | Material specific analyses¹ | Suggested Method² |
|--|--|-------------------------------------|
| elastomer materials not listed in Table 3.1 | phenolics (by GC/MS base/acid scan), PNAs, semivolatiles compounds, bisphenol F, bisphenol F – propylene oxide adducts, diisobutylphthalate diethylphthalate, dimethyl terephthalate, butylbenzylphthalate, di-n-butylphthalate, butylbenzylphthalate, di-n-octylphthalate | EPA 625 BNA |
| | VOCs, and 2-chloro-1,3-butadiene, isoprene monomer, chloroprene, 1,3-butadiene, acrylonitrile, vinylidene fluoride, hexafluoropropene, 2,4-dichlorobenzoic acid, alpha-methyl styrene, styrene, isobutylene | EPA524.2 |
| | aniline | GC/ECD |
| | perfluorooctanoic acid | LC/MS ES |
| | dimethylphthalate, diethylphthalate, di-n-butylphthalate, diphenylamine, bis(2-ethylhexyl)phthalate (DEHP), p-phenylenediamine, o-toluidine, o-phenylenediamine, m-phenylenediamine | EPA 525.2 |
| | n-nitrosodimethylamine, n-nitrosomethylethylamine, n-nitrosopiperidine, n-nitrosodiethylamine, n-nitrosodi-n-propylamine, n-nitrosopyrrolidine, n-nitrosomorpholine, n-nitrosodi-n-butylamine, n-nitrosodiphenylamine | EPA 521 |
| | metals | EPA 200.8 |
| adhesives | tetraethylene glycol, ethylene glycol, 2-ethyl-1,3-hexanediol | LC/MS |
| | m-phenylene diamine, methacrylic acid, bisphenol A, bisphenol A - propylene oxide adducts, melamine, maleic acid, hydroquinone, acrylic acid, ethyl-2-cyanoacrylate | LC/UV |
| | acetates and acrylates, 1,3-butylene glycol dimethacrylate, semivolatiles compounds | EPA 625 |
| | formaldehyde | EPA 8315A |
| | epichlorohydrin, 1,3-butadiene, acrylonitrile | EPA 524.2 |
| | 1,3-dichloro-2-propanol in water, methylenedianiline micro / derivatization, 1,3-dichloro-2-propanol, micro / derivatization, 1,2-dichloro-3-propanol, aniline | GC/FID |
| | *1,4- butanediol, cyanoacetic acid, benzyl alcohol | LC/MS |
| lubricants | phenolics | EPA 625 |
| | 2,4-dichlorobenzoic acid, acrylic acid | LC/UV |
| | perfluorooctanoic acid | LCMS/ES- |
| | propylene glycol; ethylene glycol | LC/MS |
| other materials not listed in Table 3.1 without formulation information (excluding coatings and process media) | chlorobenzenediamine, and dichlorobenzenediamine isomers | derivatization GC/ECD |
| | volatile organic compounds including 2-methylpropene (isobutylene), tetrahydrofuran, cyclohexanone, acetone, 1,3-butadiene, 2-chloro-1,3-butadiene (chloroprene), epichlorohydrin, methyl ethyl ketone, 2-methyl-1,3-butadiene (isoprene), divinyl benzene (vinyl styrene), 2,4-dichlorobenzoic acid, 2-methylpropene (isobutylene) methyl-tert-butyl ether (MTBE), alpha-methyl styrene, hexafluoropropylene, vinylidene fluoride, hydroquinone monomethyl ether, acrylonitrile | EPA 524.2 |
| | semivolatiles compounds, PNAs, acetates and acrylates, ethyl acetate, vinyl acetate, 1,4-dioxane, ethylhexyl acrylate, dimethyl terephthalate, diethylphthalate, diisobutylphthalate, di-n-butylphthalate, di-n-octylphthalate, butylbenzylphthalate | EPA 625 BNA |
| | gross alpha and beta radioactivity in drinking water | EPA 900.0 |

Table 3.2
Material specific analyses not listed in Table 3.1 or materials without formulation information
(excluding coatings and process media)

| Material type | Material specific analyses ¹ | Suggested Method ² |
|--|--|-------------------------------|
| | acrylamide by derivitization, captan, methylenedianiline aniline, micro / derivatization, methylene bis-cyclohexylamine 4,4'-, microextraction | GC/ECD |
| other materials not listed in Table 3.1 without formulation information (excluding coatings and process media) | methyl-2-propanol, 2-, (t-butylalcohol), methanol, n-butanol, sec-butyl alcohol, methyl butenol isomers, 1,2-dichloro-3-propanol, 1,3-dichloro-2-propanol in water, 1-propanol, 2-propanol | GC/FID |
| | aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, cerium, cobalt, chromium, hexavalent chromium, cesium, copper, dysprosium, erbium, europium, gallium, gadolinium, germanium, hafnium, indium, lanthanum, lead, lithium, lutetium, manganese, mercury, molybdenum, niobium, neodymium, nickel, palladium, praseodymium, platinum, rubidium, rhenium, rhodium, ruthenium, samarium, selenium, silicon, silver, strontium, tantalum, tellurium, thallium, tin, titanium, tungsten, uranium, vanadium, ytterbium, zinc, zirconium Chromium shall be evaluated against the pass/fail criteria of chromium VI as a screening level. If the normalized result exceeds this criteria, the sample shall be tested according to the method described in Section N-1.7.3 and shall be evaluated against the pass/fail criteria listed in NSF/ANSI/CAN 600 Table 4.1 for the tested product. Regardless of chromium species, the total chromium pass/fail criteria shall not be exceeded. | EPA 200.8 |
| | triethylene diamine, 1,6-hexanediol, 2-ethyl-1,3-hexanediol, trimethylolpropane, propylene glycol, perfluorooctanoic acid, diethylene glycol, ethylene glycol, hexalene glycol, tetraethylene glycol, triethylene glycol, dipropylene glycol | LC/MS |
| other materials not listed in Table 3.1 without formulation information (excluding coatings and process media) | benzyl alcohol, bisphenol A , bisphenol A - propylene oxide adducts, bisphenol F, diphenyl sulfone, 4,4'-dichlorodiphenyl sulfone, dimethylformamide, n,n-dimethylacetamide, diphenylamine, di-t-butyl-4-alkyl phenols, ethylenethiourea (2-imidazolidinethione), hydroquinone, methyl-2-pyrrolidinone, n,n-diethyl-p-toluidene, isomers of phenylene diamine, toluenediamine, 2,4-, toluenediamine, 2,6-, tetramethyl thiuram monosulfide, diethylene triamine, ethylene diamine, 2-methyl-1,5-pentanediamine, ethyl-2-cyanoacrylate, lauro lactam, 1,3-butylene glycol dimethacrylate, caprolactam, acrylic acid, adipic acid 11-aminoundecanoic acid, hexamethylene diamine, maleic acid, methacrylic acid, melamine trimellitic acid, cyanoacetic acid | LC/UV |
| | n-nitrosodimethylamine, n-nitrosomethylethylamine, n-nitrosodiethylamine, n-nitrosodi-n-propylamine, n-nitrosopyrrolidine, n-nitrosomorpholine, n-nitrosopiperidine, n-nitrosodi-n-butylamine, n-nitrosodiphenylamine | EPA 521 |
| | 1,4-butanediol | LC/MS |
| | formaldehyde | EPA 8315A |
| | 4,4'-methylenebis[N-(1 -methylpropyl)- cyclohexanamine, 2-methylimidazole | LC/MS |
| | isophthalic acid, phthalic acid, terephthalic acid, o-toluidine, n,n-diethyl-p-toluidene, dimethylphthalate, diethylphthalate, di-n-butylphthalate, bis(2-ethylhexyl)phthalate (DEHP) | EPA 525.2 |
| ¹ The testing may be waived for a specific analyte when partial information indicates that it is not present. | | |
| ² Refer to Section N-1.7 for analytical methods. Alternate methods that have been validated may be used. | | |

3.5 Restriction on use of lead containing materials

There shall be no lead added as an intentional ingredient in any product, component, or material submitted for evaluation to this Standard, with the following exceptions:

- brass or bronze used in products meeting the definition of “lead free” under the specific provisions of the Safe Drinking Water Act of the United States;
- solders and flux meeting the definition of “lead free” under the specific provisions of the Safe Drinking Water Act of the United States;
- brass or bronze used in products specifically identified as exemptions within Section (a)(4)(B) of the Safe Drinking Water Act of the United States;
- fire sprinklers (head);
- trace amounts required for operation of products used to monitor the characteristics of drinking water, such as the glass membranes used with some selective ion or pH electrodes; and
- materials or components exempted from formulation information requirements as allowed per Section 3.2, Note 1.

NOTE — To the maximum extent possible, lead should not be added as an intentional ingredient in any product covered by the scope of this Standard. The exception above relative to materials and components exempt from formulation information requirements has only been included in recognition that the use of lead as an intentional additive is unable to be identified in cases where formulation information is not obtained.

3.6 Lead content of products

With the exception of those exempted in the Safe Drinking Water Act of the United States, the wetted surfaces of products shall have a weighted average lead content $\leq 0.25\%$ when evaluated in accordance with NSF/ANSI 372, *Drinking Water System Components – Lead Content*. For the purpose of this Section, product shall refer to anything individually evaluated for compliance under the standard, including materials and components. Solders and fluxes shall have a lead content no more than 0.2%.

4 Pipes and related products

4.1 Scope

4.1.1 The requirements in this Section apply to pipes and pipe-related products and the water contact materials associated with these products. Pipe-related products include, but are not limited to, the following items: fittings, couplings, mini-manifolds, flexible and rigid tubing, riser tubing, dip tubes, hoses, well casings, drop pipes and well screens.

4.1.2 Coatings and other barrier materials requested to be evaluated on their own that are intended for application to pipes or pipe-related products shall be evaluated under Section 5.

NOTE — Coatings and other barrier materials, which meet the requirements of Section 5 at a specific surface area-to-volume ratio, shall be considered to meet the requirements of a pipe or pipe-related product application for a surface area-to-volume ratio less than or equal to the ratio accepted under the Section 5 evaluation.

4.1.3 Individual ingredients of cement-based pipes and related products (including Portland and blended hydraulic cement and admixtures) are evaluated under Section 5.

4.1.4 Products and materials intended to join or seal pipes or pipe-related products are evaluated under Section 6.

4.2 Definitions

4.2.1 cold water application: A product application that is intended to result in continuous exposure to water of ambient temperature. Products are tested for an end use temperature of $23 \pm 2 \text{ }^\circ\text{C}$ ($73 \pm 4 \text{ }^\circ\text{F}$).

4.2.2 commercial hot water application: A product application that is intended to result in continuous or intermittent exposure to water that has been raised from ambient temperature. Intermittent exposure is defined as any hot water contact that is not continuous. Products are tested for an end use temperature of $82 \pm 2 \text{ }^\circ\text{C}$ ($180 \pm 4 \text{ }^\circ\text{F}$).

4.2.3 domestic hot water application: A product application that is intended to result in continuous or intermittent exposure to water that has been raised from ambient temperature. Intermittent exposure is defined as any hot water contact that is not continuous. Products are tested for an end use temperature of $60 \pm 2 \text{ }^\circ\text{C}$ ($140 \pm 4 \text{ }^\circ\text{F}$).

4.2.4 fire sprinkler: A fast response fire suppression device for dwelling units that automatically opens when heat activated, allowing the discharge of water onto a fire.

4.2.5 nominal diameter: A designation system used to specify a pipe size, where the designation for a specific size is approximately equal to the average inside diameter of the pipe.

4.2.6 mini-manifold: A device with an inlet and less than four other openings used to connect tubing within a residence or building. This device shall be evaluated as a fitting under Section 4.

4.3 General requirements

4.3.1 The product size with the most conservative normalization condition shall be evaluated. Successful evaluation of such a product shall qualify all products of less conservative normalization conditions, provided that the materials of construction are identical as specified in Section 4.4.1.

NOTE — For products of 1.3 to 10 cm (0.5 to 4 in) nominal diameter and products of 10 cm (4 in) diameter and greater, the most stringent normalization condition is typically the smallest inner diameter product within the nominal diameter range. Products of less than 1.3 cm (0.5 in) nominal diameter are assumed to have limited exposure in the distribution system (see assumptions in Tables 4.4 and 4.5). Successful qualification of products of less than 1.3 cm (0.5 in) nominal diameter may not demonstrate the acceptability of all products 1.3 cm (0.5 in) nominal diameter and greater.

4.3.2 Residual vinyl chloride evaluation

Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) products and materials shall be evaluated for the level of residual vinyl chloride monomer (RVCM) in the product wall or in the material according to Section N-1.7.

4.4 Sample requirements

4.4.1 General

A sample can represent a product line of various sizes when:

- materials are of the same alloy, composition, or formulation;
- materials have undergone the same manufacturing process (e.g., casting or extrusion);
- designs and manufacturing processes are analogous; and/or
- it has the most stringent normalization requirements (see Section 4.3.1).

4.4.2 Materials

When a material is proposed for evaluation, a representative sample of the material shall be used. Material test samples (e.g., plaque or sheet) shall be used only if no chemical or physical difference exists between the material sample and the material as it is used in applications covered by Section 4. A material intended to be processed by more than one method (e.g., injection molding, extrusion, or stamping) shall be tested in each of its processed forms.

4.4.3 Finished products

When a finished product (e.g., pipe or fitting) is proposed for evaluation, a sample of the finished product shall be used for testing except in the following specific instances:

- concrete cylinders, cubes, or other concrete surrogate samples can be evaluated on behalf of concrete-lined pipes and other concrete-based products;
- coatings, applied to the appropriate substrate, can be evaluated on behalf of products whose entire water contact surface is covered by the coating; or
- finished products shall be permitted to be evaluated using material samples if a finished product evaluation is impractical for one or more of the following reasons:
 - an internal volume > 20 L (5.3 gal);
 - a weight > 34 kg (75 lb); or
 - *in situ* manufacture of the finished product.

Material samples shall be permitted to be evaluated on behalf of a finished product if the first and second criteria listed under Section 4.4.1 are satisfied.

4.5 Extraction procedures

4.5.1 Analytical summary

An analytical summary shall be prepared for each product or material. The analytical summary shall consist of the formulation-dependent analytes identified in Section 3.2 and the applicable material-specific analytes listed in Table 3.1.

4.5.2 Preparation of test samples

4.5.2.1 To the extent possible, test samples shall be prepared so that the laboratory surface area-to-volume ratio is equal to or greater than the surface area-to-volume ratio at which the product is intended to be used in the field. When the use of test assemblies is required, they shall be constructed in a manner as to not cover an otherwise wetted surface. Test assembly end closures that marginally increase the volume of the test assembly beyond the volume at which the product is intended to be used in the field may be used. Components and materials added to the test sample to form the test assembly shall be present in the control sample.

4.5.2.1.1 For the evaluation of metal and metal containing product samples that are connected to pipe or tubing products under normal installation conditions (e.g., fittings), the samples shall be attached to lengths of pipe or tubing of the appropriate nominal diameter. The exposed surface area-to-volume ratio of the fitting test sample shall represent a percentage of the total exposed surface area (test sample plus the attached pipe or tubing) that is equal to the percentage specified in the Table 4.5 normalization assumptions ($\pm 5\%$) (e.g., 94.2 to 189.0 cm²/L (55.3 to 110.9 in²/gal) for nominal 1/2 in pipe which is part of a flexible or rigid piping system respectively).

Assemblies should be made of relatively inert materials and designed in a manner which eliminates or minimizes the occurrence of the same contaminant being present in the control and the test sample whenever possible. The control shall be made of the same material and exposed at the same surface area to volume ratio as the test sample.

Threaded products shall be assembled by threading a pipe material which has been cut to an appropriate length equal to the $V_{F(static)}$. For products being tested which are less than a liter, the attached pipe volume combined with the product volume shall be equal to 1 L ($\pm 5\%$) for the test sample. When preparing a product which has a soldered joint, the control shall be prepared using the same solder and extension material as the test sample. Products with quick connect fitting ends are most easily assembled by attaching polyethylene tubing, cut to the appropriate length and diameter using the same polyethylene tubing for the control.

Nonmetal and copper (C12200) product samples that are connected to pipe or tubing products under normal installation conditions (e.g., fittings) may be prepared as described for metal and metal containing product samples. Nonmetal containing products and copper (C12200) may also be prepared so that the laboratory surface area-to-volume ratio is equal to or greater than the surface area-to-volume ratio at which the product is intended to be used in the field.

Components (e.g., gaskets or O-rings) of a fitting that are wetted under normal operating pressures but are not wetted under the conditions of a static exposure shall be tested separately from the assembly in an “in vessel” exposure. The laboratory surface area for the “in vessel” exposure shall be a minimum of ten-fold greater than the wetted surface area of the product to ensure that the reporting level of the analysis, when normalized, is equal to or less than the pass/fail criteria for all contaminants. The result of the “in vessel” exposure shall then be normalized to the applicable surface area of the product.

4.5.2.2 Unless the manufacturer’s instructions direct otherwise, test samples shall be rinsed in cold tap water until any extraneous debris or contamination that occurred during shipping and handling is removed. The samples shall then be rinsed in reagent water that meets the requirements of Section N-1.9.2.1.

4.5.2.3 If the exterior surface of a product is to be exposed, all markings that are not integral to the product (e.g., ink markings) shall be removed.

4.5.2.4 When the test sample contains internal threaded outlets, 75% of the threaded surface area shall be covered by insertion of a threaded component of the appropriate diameter to produce a watertight seal.

4.5.3 Exposure water

4.5.3.1 General

Exposure water selection shall be determined by the analytes of interest identified on the analytical summary (see Section 4.5.1). Exposure water(s) shall be selected in accordance with Section N-1.2.5.

4.5.3.2 Copper (C12200) pipe, tubing and fittings

Copper (C12200) pipe, tubing and fittings evaluated under Section 4 of this Standard shall not require analysis for regulated metals release under the pH 5 test condition provided the following use limitation statement is included in the manufacturer’s use instructions or product literature that references this Standard:

“Copper [tube, pipe, or fitting] (Alloy [alloy designation]) has been evaluated by [Testing Organization] to NSF/ANSI/CAN 61 for use in drinking water supplies of pH 6.5 and above. Drinking water supplies that are less than pH 6.5 may require corrosion control to limit leaching of copper into the drinking water.”

4.5.3.3 Copper and copper alloys other than C12200

Copper and copper alloy pipe and tubing comprised of alloys other than C12200 shall be exposed in either the pH 5 (Section N-1.9.3) or the pH 6.5 (Section N-1.9.4) exposure waters (at the discretion of the manufacturer) and in the pH 8 (Section N-1.9.8) exposure waters as described in Section N-1.9. Copper and copper alloy fittings comprised of alloys other than C12200 intended to be used with copper and copper alloy pipe and tubing shall be exposed in either the pH 5 (Section N-1.9.3) or the pH 6.5 (Section N-1.9.4) exposure waters (at the discretion of the manufacturer) and in the pH 8 (Section N-1.9.8) exposure water, as described in Section N-1.9. For all copper and copper alloy pipes, tubing, and fittings tested using the pH 6.5 exposure water, the manufacturer's literature shall indicate this use limitation by inclusion of the following statement in the use instructions or product literature that references this Standard:

“Copper [tube, pipe, or fitting] (Alloy [alloy designation]) has been evaluated by [Testing Organization] to NSF/ANSI/CAN 61 for use in drinking water supplies of pH 6.5 and above. Drinking water supplies that are less than pH 6.5 may require corrosion control to limit leaching of copper into the drinking water.”

4.5.4 Conditioning and exposure options

4.5.4.1 In-product conditioning and exposure

During in-product conditioning and exposure, the test sample shall be filled completely with exposure water. The product having the greatest surface area-to-volume ratio (typically the smallest diameter) shall be preferentially used. When necessary to prevent the loss of exposure water, samples shall be capped with inert materials (e.g., glass).

4.5.4.2 In-vessel conditioning and exposure

During in-vessel conditioning and exposure, samples shall be placed in containers composed of and covered with a material that is inert to the exposure water. The exposure water shall completely immerse the sample. All samples shall be exposed at a surface area-to-volume ratio that is equal to or greater than that of the intended end use. The actual wetted surface area-to-volume ratio achieved during the exposure shall be recorded.

NOTE — The stated duration of the conditioning period at the hot temperature does not include any time needed to elevate the product sample or exposure vessel to the required exposure temperature.

4.5.4.3 Multiple time point protocol

When the normalized concentration of a contaminant exceeds, or is expected to exceed, its acceptable level when evaluated as a single time point exposure, determination of the contaminant leaching rate using a multiple time point exposure shall be considered. For the purpose of contaminant concentration evaluation, Day 1 shall be defined as the time point at which extractant water is collected for analysis under the single time point exposure protocol. Day 90 shall be defined as 90 d after this time point. When over time data are used, the Day 1 concentration for the contaminant of concern shall meet the short term exposure level and Day 90 concentration shall meet the total allowable concentration (TAC) / single product allowable concentration (SPAC) respectively. When extrapolation is used, the relationship between contaminant concentration and time shall be determined and plotted using a minimum of five data points.

When a multiple time point protocol is employed in the evaluation of a contaminant, consideration shall be given to the availability of appropriate toxicity data to define an acute exposure limit for the contaminant, as required in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5). Consideration shall also be given to the leaching characteristics of the contaminant. Multiple time point analysis shall not be used for lead or any other metal contaminant listed as a regulated contaminant by US EPA or Health Canada.

4.5.5 Single time point conditioning protocols

A separate sample shall be conditioned for each type of exposure water selected in Section 4.5.3.

4.5.5.1 Single time point conditioning – Cold and intermittent hot applications

Products that are intended to be in contact with cold water or intermittent hot water shall be conditioned in the exposure water(s) selected in Section 4.5.3 at 23 ± 2 °C (73 ± 4 °F) for 14 d. During the 14 d period, the exposure water shall be changed at least 10 times with a minimum period of 24 ± 1 h between water changes. The free available chlorine concentration during the conditioning period shall be 2 mg/L. After the 14 d conditioning period, the exposure water in the product or in the vessel shall be decanted and discarded. Shortened conditioning periods shall be used at the request of the manufacturer. Exposure of the sample according to Section 4.5.6 shall immediately follow conditioning.

NOTE — Table 4.1 provides an example single time point conditioning protocol. Alternate protocols shall be permitted as long as the requirements of Section 4.5.5.1 are met.

4.5.5.2 Single time point conditioning – Continuous hot applications

Products that are intended to be in continuous contact with hot water shall be conditioned in the exposure water(s) selected in Section 4.5.3 at either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) for 14 d. During the 14 d period, the exposure water shall be changed at least 10 times with a minimum period of 24 ± 1 h between water changes. The free available chlorine concentration during the conditioning period shall be 2 mg/L. After the 14 d conditioning period, the exposure water in the product or in the vessel shall be decanted and discarded. Shortened conditioning periods shall be permitted at the request of the manufacturer. Exposure of the sample according to Section 4.5.6 shall immediately follow conditioning.

NOTE — Table 4.1 provides an example single time point conditioning protocol. Alternate protocols shall be permitted as long as the requirements of Section 4.5.5.2 are met.

4.5.6 Single time point exposure protocols

Products to be evaluated at a single time point shall be exposed according to the schedule in Table 4.2. The first two 24 h exposure periods shall be optional at the discretion of the manufacturer. A separate sample shall be exposed for each type of exposure water selected in Section 4.5.3. For each sample, the exposure water shall be of the same pH as the water used for conditioning of the sample.

4.5.6.1 Single time point exposure – Cold application

Immediately after conditioning, the product shall be exposed at 23 ± 2 °C (73 ± 4 °F) according to the schedule in Table 4.2.

4.5.6.2 Single time point exposure – Hot applications

4.5.6.2.1 Intermittent hot water exposure

Immediately after conditioning, the product shall undergo exposure according to the schedule in Table 4.2. Prior to each exposure, the product shall be exposed at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F), for 30 ± 5 min. The product shall then be exposed at 23 ± 2 °C (73 ± 4 °F) for the duration of the exposure period.

4.5.6.2.2 Continuous hot water exposure

Immediately after conditioning, the product (in-product exposures) or the exposure vessel (in-vessel exposures) shall be filled with fresh exposure water of the applicable pH (see Section 4.5.3). The product

shall then be exposed at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F), according to the schedule in Table 4.2.

4.5.7 Multiple time point conditioning / exposure protocols

For the purpose of determining a contaminant leaching rate as a function of time, extractant water samples shall be collected during the conditioning period of products for which multiple time point exposure has been elected, according to the protocols in Sections 4.5.7.1 and 4.5.7.2. A separate sample shall be conditioned and exposed for each type of exposure water selected in Section 4.5.3.

4.5.7.1 Cold application

Products that are intended to be in contact with only cold water shall be maintained at 23 ± 2 °C (73 ± 4 °F) for 19 d. During the 19 d period, the exposure water shall be changed at least 12 times, with a minimum period of 24 ± 1 h between water changes. At five of these water changes, extraction water shall be collected for analysis after a 24 h exposure. For extrapolation and normalization purposes, the number of hours elapsed since the most recent water change (or sample collection) and the number of days elapsed since the initiation of the exposure shall be recorded at the time of each extraction water collection.

NOTE — Table 4.3 provides an example multiple time point conditioning / exposure protocol. Alternate protocols shall be permitted as long as the requirements of Section 4.5.7.1 are met.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be maintained at 23 ± 2 °C (73 ± 4 °F). Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 (representing 14 d of conditioning and 1 d of acute exposure), and after the final exposure terminating on Day 90 (representing 14 d of conditioning, 1 d of acute exposure, and 90 d of chronic exposure). The exposure water shall be changed at least weekly during the interval between the initial and final exposures and on at least four days during the final week of exposure.

4.5.7.2 Hot applications

4.5.7.2.1 Intermittent hot water exposure

Products that are intended to be in intermittent contact with hot water shall undergo the cold application exposure according to Section 4.5.7.1. At the initiation of each exposure that will be collected for analysis, the product shall be exposed at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F), for 30 ± 5 min. The product shall then be exposed at 23 ± 2 °C (73 ± 4 °F) for the duration of the exposure period. The exposure water shall not be decanted prior to the completion of the exposure period.

NOTE 1 — Table 4.3 provides an example multiple time point conditioning / exposure protocol. Alternate protocols shall be permitted as long as the requirements of Section 4.5.7.2.1 are met.

NOTE 2 — The stated duration of the conditioning period at the hot temperature does not include any time needed to elevate the product sample or exposure vessel to the required exposure temperature.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. At the initiation of each exposure that will be collected for analysis, the products shall be exposed at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F), for 30 ± 5 min. The product shall then be exposed at 23 ± 2 °C (73 ± 4 °F) for the duration of the exposure period. The exposure water shall not be decanted prior to the completion of the exposure period. Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 (representing 14 d of conditioning and 1 d of acute exposure), and after the final exposure terminating on Day 90 (representing 14 d of conditioning, 1 d of acute exposure, and 90 d of chronic exposure). The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure.

4.5.7.2.2 Continuous hot water exposure

Products that are intended to be in continuous contact with hot water shall be maintained at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) for 19 d. During the 19 d period, the exposure water shall be changed at least 12 times with a minimum period of 24 ± 1 h between water changes. At five of these water changes, extraction water shall be collected for analysis after a 24 h exposure. For extrapolation and normalization purposes, the number of hours elapsed since the most recent water change (or sample collection) and the number of days elapsed since the initiation of the exposure shall be recorded at the time of each extraction water collection.

NOTE — Table 4.3 provides an example multiple time point conditioning / exposure protocol. Alternate protocols shall be permitted as long as the requirements of Section 4.5.7.2.2 are met.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be maintained at the selected elevated temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F). Extraction water shall be collected for analysis at at least two time points: after Day 1 (representing 14 d of conditioning and 1 d of acute exposure), and after the final exposure terminating on Day 90 (representing 14 d of conditioning, 1 d of acute exposure, and 90 d of chronic exposure). The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure.

4.5.8 Collection and preservation of extraction water

Immediately after exposure, extraction waters collected for analysis shall be poured into previously prepared sample containers for storage until analysis, as specified in Section N-1.6.

4.6 Analysis

4.6.1 Extraction waters shall be analyzed with the methods listed in Section N-1.7.

4.6.2 Samples requiring analysis for RVCM shall be evaluated according to the method in Section N-1.7.

4.7 Normalization of contaminant concentrations

4.7.1 General

The concentration of analytes detected in the extraction water shall be multiplied by a calculated normalization factor (*NF*) to account for differences between laboratory and field surface area-to-volume ratios. The normalization factor shall be based on calculations and assumptions relevant to the end use of the product.

The general formula for the derivation of the normalization factor is described in the following equations:

$$NF = N1 \times N2$$

$$N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}}$$

$$N2 = \frac{V_{F(static)}}{V_{F(flowing)}}$$

Where:

SA_F = surface area exposed in the field

SA_L = surface area exposed in the laboratory

V_L = volume of extraction water used in the laboratory

$V_{F(static)}$ = volume of water to which the product is exposed under static conditions

$V_{F(flowing)}$ = volume of water to which the product is exposed under flowing conditions during a period of time equivalent to the laboratory test

When the length of the exposure being normalized is other than 16 h in length, the normalized value shall be adjusted to reflect a 16 h exposure (e.g., multiply the normalized value by 0.7 when a 24 h exposure was used). The nominal diameter of the product shall determine which assumptions are used for normalization (see Tables 4.4 and 4.5). The actual inner diameter of the product shall be used for the normalization calculations of surface area and volume.

NOTE — Adjustment of the normalized contaminant concentration for the duration of the exposure period shall consider the extraction kinetics of the contaminant under evaluation. For contaminants that do not exhibit linear extraction kinetics, adjustment for the duration of exposure shall be done in accordance with the demonstrated kinetics of the contaminant or shall not be applied if this information is not available.

4.7.2 Products other than pipe

4.7.2.1 Fire sprinklers for multipurpose plumbing systems

Fire sprinklers intended for use in multipurpose plumbing systems (serving both drinking water and fire protection needs) shall be evaluated for acceptance based upon a use assumption of one unit per 0.43 L. Fire sprinkler fittings shall be evaluated in accordance with Section 4.7.2.2.

NOTE 1 — The evaluation of fire sprinkler system components is only intended to apply to those used in “multipurpose plumbing systems”. The evaluation of potential extractants from fire sprinkler components from nondrinking water systems is not addressed under this Standard.

NOTE 2 — Fire sprinkler use assumption based on system design requirements in NAPF 13 D¹² Criterion of one unit per 0.43 L based on use in a network of 1/2 in PEX piping and the volume of water contained in 12 ft of pipe. This assumes installation of fittings with three ports (minimum number) and 4 ft of pipe associated with each port (accounts for the one port on each side of an 8 ft pipe which is the minimum distance required between sprinklers).

4.7.2.2 Products other than fire sprinklers

The SA_F shall be calculated from the assumed length of pipe corresponding to the segment of the system in which the product is used (e.g., 100 ft of pipe in the service line or 280 ft of pipe in the residence). The $V_{F(static)}$ component of the N1 term shall be the volume of water contained within the assumed length of pipe. For fittings, the actual inner diameter of the pipe used with the fittings shall be used to calculate both SA_F and $V_{F(static)}$. PVC, CPVC and PP transition fittings with stainless steel or copper alloy inserts (except for stainless steel or copper alloy inserts intended for use with PEX tubing), unions and repair couplings are specifically excluded from this evaluation.

For PVC, CPVC and PP transition fittings with stainless steel or copper alloy inserts (except for stainless steel or copper alloy inserts intended for use with PEX tubing), unions and repair couplings, the SA_F shall be the wetted surface area of a single product. The $V_{F(static)}$ component of the N1 term shall be the volume of water a single product contains when filled to capacity, except that $V_{F(static)}$ shall equal 1 L (0.26 gal) for all products that contain less than 1 L (0.26 gal) of water when filled to capacity.

¹² NFPA 13D. *Installation of Sprinkler Systems: One and Two Family Dwellings and Manufactured Homes*, National Fire Protection Association, 2010. <www.nfpa.org>

NOTE — These products shall be evaluated in this manner because the materials (stainless steel or copper alloy or repair coupling material) will not repeat within the piping system. When a material does repeat within the system, it shall be evaluated as a pipe or fitting, as appropriate. PVC, CPVC and PP transition fittings with a stainless steel or copper alloy insert intended for use with PEX tubing are excluded because the remainder of the PEX system may also be plumbed with stainless steel or copper alloy fittings. Thus, the stainless steel or copper alloy material would repeat throughout the PEX system.

4.7.3 Sample calculations for normalization of products in 4 are provided in Table 4.6.

4.7.4 Selection of normalization conditions

Pipe and fitting products with a nominal diameter greater than or equal to 10 cm (4 in) shall be normalized to the flowing condition. Pipe and fitting products with a nominal diameter of less than 10 cm (4 in) shall be normalized to the static condition when the value of N_2 is ≤ 0.1 . Pipe and fitting products with a nominal diameter of < 10 cm (4 in) shall be normalized to the flowing condition when the value of N_2 is > 0.1 .

4.7.5 Multiple time point exposure calculations

Laboratory values from each time point at which extractant water was collected (a minimum of five data points shall be required for extrapolation) shall be normalized as indicated in Section 4.7.1, depending on product end use. A decay curve of these normalized contaminant concentrations in relation to elapsed exposure time shall be plotted. Contaminant concentrations shall be determined for two time points as follows: at Day 1 (representing 14 d of conditioning and 1 d of acute exposure) and at Day 90 (representing 14 d of conditioning, 1 d of acute exposure, and 90 d of chronic exposure) shall be extrapolated from this curve (see Section 4.5.7).

If direct measurement of a Day 90 exposure has been performed, laboratory values from each time point at which extractant water was collected (a minimum of two time points as defined in Sections 4.5.7.1 and 4.5.7.2) shall be normalized as indicated in Section 4.7.1, depending on product end use.

4.8 Evaluation of contaminant concentrations

4.8.1 Contaminants measured in a single time point extraction

For pipe and fitting products, normalized static contaminant concentrations shall be no greater than their respective MCLs or TACs, and normalized flowing contaminant concentrations shall be no greater than their respective SPACs calculated in accordance with NSF/ANSI/CAN 600 (previously Annex A).

4.8.2 Contaminants measured in a multiple time point extraction

Normalized Day 1 contaminant concentrations shall not exceed the STEL as defined in NSF/ANSI/CAN 600 (previously Annex A, Section A.5).

Normalized extrapolated or directly measured Day 90 contaminant concentrations shall not exceed the limits defined in Section 4.8.1.

4.8.3 Residual vinyl chloride monomer (RVCM)

The average RVCM concentration shall be less than or equal to 3.2 mg/kg as evaluated in the product wall.

Table 4.1
Example single time point conditioning schedule

| Conditioning time | Elapsed time | Comment |
|-------------------|--------------|---|
| 24 ± 1 h | 1 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 2 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 3 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 4 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 72 ± 1 h | 7 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 8 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 9 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 10 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 11 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 72 ± 1 h | 14 d | Exposure water is decanted and discarded; conditioning is terminated. |

Table 4.2
Single time point exposure schedule

| Exposure time | Elapsed time ¹ | Comment |
|------------------------|---|---|
| 24 ± 1 h (optional) | 15 d (optional) | Extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued. |
| 24 ± 1 h (optional) | 16 d (optional) | Extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued. |
| 16 h | 17 d (15 d if the two optional exposure periods are not elected) | Extraction water is collected for analysis. |

¹ Elapsed time indicated includes the 14 d of conditioning preceding the exposure.

Table 4.3
Example multiple time point conditioning / exposure schedule

| Exposure time | Elapsed time | Sample collection |
|---------------|--------------|--|
| 24 ± 1 h | 1 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 2 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 3 d | Extraction water is decanted and discarded; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 4 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 72 ± 1 h | 7 d | Extraction water is decanted and discarded; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 8 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 9 d | Extraction water is decanted and discarded; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 10 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 96 ± 1 h | 14 d | Extraction water is decanted and discarded; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 15 d | Extraction water is collected for analysis at completion of the exposure period; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 72 ± 1 h | 18 d | Extraction water is decanted and discarded; the product or exposure vessel is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | 19 d | Extraction water is collected for analysis at completion of the exposure period; the exposure is terminated. |

Table 4.4
Pipes – Normalization factors and assumptions

| Product nominal diameter | Assumptions | Exposure type | N1 | N2 (flowing condition) |
|--|---|---------------|---------------------------------------|---------------------------------------|
| noncopper pipe nominal ≥ 10 cm (4 in) | — water is exposed to the same material from the treatment plant to the service line; and — a 16 h exposure period is evaluated. | in-product | 1 | 1 |
| | | in-vessel | calculated according to Section 4.7.1 | 1 |
| 10 cm (4 in) > nominal ≥ 1.3 cm (0.5 in) | — a 16 h exposure period is evaluated; — residential water usage is 681 L (180 gal) per 24 h; and — 100 ft of service line from water main to residence. | in-product | 1 | calculated according to Section 4.7.1 |
| | | in-vessel | calculated according to Section 4.7.1 | calculated according to Section 4.7.1 |
| nominal < 1.3 cm (0.5 in) | — a maximum run of 7.6 m (25 ft) of small diameter product is installed; — for products with an internal volume less than 1 L (0.26 gal), $V_{F(static)}$ is set equal to 1 L; — a 16 h exposure period is evaluated; — residential water usage is 681 L (180 gal) per 24 h; and — 280 ft per residence (140 ft each for hot and cold sides). | in-product | 1 | calculated according to Section 4.7.1 |
| | | in-vessel | calculated according to Section 4.7.1 | calculated according to Section 4.7.1 |
| copper pipe ≥ 10 cm (4 in) | — utilized as main distribution lines within buildings ¹ ; — a 16 h exposure period is evaluated. | in-product | 1 | 0.55 |
| | | in-vessel | calculated according to Section 4.7.1 | 0.55 |

¹ The N2 value for copper products used as main distribution lines in buildings was calculated based on the static volume of a piping network of up to 20 mi and an average flow of 100 gpm.

Table 4.5
Fittings (installed at regular intervals) – Normalization factors and assumptions

| Product nominal diameter | Assumptions | Exposure type | N1 | N2 (flowing condition) |
|--|--|---------------|---|---------------------------------------|
| nominal ≥ 10 cm (4 in) | <ul style="list-style-type: none"> — water is exposed to the same material from the treatment plant to the service line; — fittings represent 2% of the distribution system surface area; and — a 16 h exposure period is evaluated. | in-product | 0.02 | 1 |
| | | in-vessel | calculated according to Section 4.7.1 and multiplied by 0.02 | 1 |
| 10 cm (4 in) > nominal ≥ 1.3 cm (0.5 in) | <ul style="list-style-type: none"> — fittings represent 2% of the piping system for products 10 cm (4 in) > nominal ≥ 2.5 cm (1.0 in) (rigid and flexible systems); — fittings represent 6% of the piping system surface area for products 2.5 cm (1.0) in > nominal ≥ 1.3 cm (0.5 in) (rigid systems)¹; — fittings represent 3% of the piping system surface area for products 2.5 cm (1.0) in > nominal ≥ 1.3 cm (0.5) in (flexible systems)¹; — a 16 h exposure period is evaluated; — residential water usage is 681 L (180 gal) per 24 h; and — 100 ft of service line from water main to residence. | in-product | 0.02, 0.06, or 0.03, depending on product diameter and end use (flexible or rigid system) | calculated according to Section 4.7.1 |
| | | in-vessel | calculated according to Section 4.7.1 and multiplied by 0.02, 0.06, or 0.03, depending on product diameter and end use (flexible or rigid system) | calculated according to Section 4.7.1 |
| nominal < 1.3 cm (0.5 in) | <ul style="list-style-type: none"> — a maximum run of 7.6 m (25 ft) of small diameter product is installed; — fittings represent 6% of the residential system surface area for rigid piping systems¹; — fittings represent 3% of the residential system surface area for flexible piping systems¹; — a 16 h exposure period is evaluated; — residential water usage is 681 L (180 gal) per 24 h; and — 280 ft of pipe per residence(140 ft) (each for hot and cold sides). | in-product | 0.06 or 0.03, depending on product end use (flexible or rigid system) | calculated according to Section 4.7.1 |
| | | in-vessel | calculated according to Section 4.7.1 and multiplied by 0.06 or 0.03, depending on product end use (flexible or rigid system) | calculated according to Section 4.7.1 |

¹ For products that may be used with either rigid or flexible systems, fittings shall be assumed to represent 6% of the piping system surface area.

Table 4.6
Example normalization calculations

| Parameters | Calculation |
|---|---|
| In-product exposure of a 30.5 cm (1 ft) length of 15.2 cm (6 in) i.d. pipe | |
| $SA_F = 1,459 \text{ cm}^2 (226 \text{ in}^2)$ $SA_L = 1,459 \text{ cm}^2 (226 \text{ in}^2)$ $V_{F(\text{static})} = 5.6 \text{ L (1.5 gal)}$ $V_L = 5.6 \text{ L (1.5 gal)}$ | normalized flowing concentration $= \frac{226 \text{ in}^2}{226 \text{ in}^2} \times \frac{1.5 \text{ gal}}{1.5 \text{ gal}} \times 1 \times \text{laboratory concentration}$ |
| In-vessel exposure of a 2.5 cm (1 in) i. d. pipe | |
| $SA_F / V_{F(\text{static})} = 1,575 \text{ cm}^2 / 1 \text{ L}$ $(924 \text{ in}^2 / 1 \text{ gal})$ $SA_L = 247 \text{ in}^2 (1,594 \text{ cm}^2)$ $V_L = 0.2 \text{ gal (0.8 L)}$ | normalized static concentration $= \frac{924 \text{ in}^2}{247 \text{ in}^2} \times \frac{0.2 \text{ gal}}{1 \text{ gal}} \times \text{laboratory concentration}$ |
| In-product exposure of a 63.5 cm (25 ft) length of 0.6 cm (0.25 in) i.d. pipe | |
| $SA_F = 1,520 \text{ cm}^2 (235.6 \text{ in}^2)$ $SA_L = 1,520 \text{ cm}^2 (235.6 \text{ in}^2)$ $V_{F(\text{static})} = 0.24 \text{ L (0.064 gal)}$ – default to 1 L (0.26 gal) $V_L = 0.24 \text{ L (0.064 gal)}$ | normalized static concentration $= \frac{235.6 \text{ in}^2}{235.6 \text{ in}^2} \times \frac{0.064 \text{ gal}}{0.26 \text{ gal}} \times \text{laboratory concentration}$ |
| In-product exposure of a 25.4 (10 in) long 15.2 (6 in) i.d. fitting | |
| $SA_F = 1,216.1 \text{ cm}^2 (188.5 \text{ in}^2)$ $SA_L = 1,216.1 \text{ cm}^2 (188.5 \text{ in}^2)$ $V_{F(\text{static})} = 4.6 \text{ L (1.2 gal)}$ $V_L = 4.6 \text{ L (1.2 gal)}$ | normalized flowing concentration $= \frac{188.5 \text{ in}^2}{188.5 \text{ in}^2} \times \frac{1.2 \text{ gal}}{1.2 \text{ gal}} \times 1 \times 0.02 \times \text{laboratory concentration}$ |
| In-vessel exposure of a 1.3 cm (0.5 in) i.d. fitting used with flexible piping systems | |
| $SA_F / V_{F(\text{static})} = 3,040 \text{ cm}^2 / 1 \text{ L}$ $(1,885 \text{ in}^2 / 1 \text{ gal})$ $SA_L = 1,594 \text{ cm}^2 (247 \text{ in}^2)$ $V_L = 0.8 \text{ L (0.2 gal)}$ | normalized static concentration $= \frac{1885 \text{ in}^2}{247 \text{ in}^2} \times \frac{0.2 \text{ gal}}{1 \text{ gal}} \times 0.03 \times \text{laboratory concentration}$ |
| In-vessel exposure of a 0.6 cm (0.25 in) i.d. fitting used with rigid piping systems | |
| $SA_F / V_{F(\text{static})} = 908 \text{ in}^2 / 1 \text{ gal}$ $(1,523 \text{ cm}^2 / 1 \text{ L})$ $SA_L = 865 \text{ in}^2 (5,581 \text{ cm}^2)$ $V_{F(\text{static})} = 0.064 \text{ gal (0.24 L)}$ – default to 0.26 gal (1 L) $V_L = 0.4 \text{ gal (1.3 L)}$ | normalized static concentration $= \frac{236 \text{ in}^2}{865 \text{ in}^2} \times \frac{0.4 \text{ gal}}{0.26 \text{ gal}} \times 0.06 \times \text{laboratory concentration}$ |
| In-vessel exposure of a 1.3 cm (0.5 in) i.d. fitting used as a repair coupling | |
| $SA_F / V_{F(\text{static})} = 3,040 \text{ cm}^2 / 1 \text{ L}$ $(1,885 \text{ in}^2 / 1 \text{ gal})$ $V_{F(\text{static})} = 0.003 \text{ L (0.0009 gal)}$ default to 1 L (0.26 gal) $SA_L = 5,581 \text{ cm}^2 (865 \text{ in}^2)$ $V_L = 1.3 \text{ L (0.4 gal)}$ | normalized static concentration $= \frac{1.6 \text{ in}^2}{865 \text{ in}^2} \times \frac{0.4 \text{ gal}}{0.26 \text{ gal}} \times \text{laboratory concentration}$ |
| NOTE — Definitions for SA_F , SA_L , $V_{F(\text{static})}$, $V_{F(\text{flowing})}$, and V_L are found in Section 4.7.1. | |

5 Barrier materials

5.1 Scope

The requirements of this Section apply to products and materials intended to form a barrier providing containment of drinking water or to prevent drinking water contact with another surface. The products and materials that are covered include, but are not limited to: coatings and paints applied to fittings, pipes, mechanical devices and nonresidential storage tanks including the interior surface of tank covers; linings, liners, bladders and diaphragms; and constituents of concrete and cement-mortar (e.g., Portland and blended hydraulic cements, admixtures, sealers, and mold release agents). These products and materials can be field-applied, factory-applied, precast, or cast-in-place.

Concrete aggregate sampling is required only if the method for testing for individual concrete components is used. Aggregate sampling is not required if concrete cylinders are tested for the constituents in Portland and hydraulic cements.

5.2 Definitions

5.2.1 admixture: A material other than water, aggregates, hydraulic cement, and fiber reinforcement used as an ingredient of concrete or mortar and added to the batch immediately before or during its mixing.

5.2.2 aggregate: Granular material, such as sand, gravel, or crushed stone used with a cementing medium to form hydraulic-cement concrete or mortar.

5.2.3 barrier material: A material in contact with drinking water that serves a containment or separation purpose.

5.2.4 blended hydraulic cement: A hydraulic cement consisting of two or more inorganic constituents (at least one of which is not Portland cement or Portland cement clinker) that separately or in combination contribute to the strength-gaining properties of the cement.

5.2.5 coating / paint: A material applied to a surface where a direct bond to the substrate is formed.

5.2.6 concrete: A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate; in hydraulic-cement concrete, the binder is formed from a mixture of hydraulic cement and water.

5.2.7 diaphragm / bladder: A flexible membrane that separates the surrounding media from the drinking water.

5.2.8 field applied paint / coating systems: A paint/coating applied to product after it is installed.

5.2.9 factory applied paint / coating systems: A paint/coating applied to to new product at a manufacturing site.

5.2.10 form / mold release agent: A material applied to the inside of a form or mold used to cast concrete or cement-mortar, which prevents adhesion of the concrete or cement-mortar to its surface.

5.2.11 hydraulic cement: A cement that sets and hardens by chemical interaction with water and that is capable of doing so under water.

5.2.12 immediate return to service paint / coating systems: immediate return to service paint / coating systems are intended to be applied to an existing pipe for rehabilitation purposes and intended to be returned to service 0 to 48 h following the final cure.

5.2.13 liners / linings: Prefabricated materials applied, bonded, or attached to a surface that is subject to direct / indirect contact with drinking water.

5.2.14 mortar: A mixture of water, cement, and sand.

5.2.15 Portland cement: A hydraulic cement (usually containing calcium sulfate) produced by pulverizing Portland cement clinker (a partially fused substance consisting primarily of hydraulic calcium silicates).

5.2.16 potable water contact area of tanks: The potable water contact areas of tanks shall include both the area normally submerged during use as well as the areas where water may condense and fall back into the tank such as ceilings.

5.2.17 sealer: A liquid that is applied as a coating to the surface of hardened concrete or cement-mortar, either to prevent or decrease the penetration of liquid or gaseous media during service exposure.

5.3 General requirements

5.3.1 Product labeling

Products or product containers shall be marked and include, at a minimum, product identification, batch number, or date of manufacture. When it is not feasible to mark the product or material, the manufacturer shall maintain identification records.

5.3.2 Paints and coatings

For all paints and coatings, the manufacturer shall submit detailed use instructions for the laboratory preparation and application that are representative of their published use instructions for factory or field applications. Use instructions shall specify the appropriate preparation and application procedures, including order of application for multiple layer systems, substrate preparation (including use of specific primer), subcomponent mixing ratio, induction time, thinning, application method, application thickness(es), curing schedule, and final cure time prior to water immersion. Coating systems that are composed of multiple products (e.g., primer, intermediate coat(s), and top coat, including any thinners) shall be evaluated as an applied system. Use instructions indicating the coating / paint will rehabilitate existing pipe and that the water system can be returned to service within 48 h following the final cure shall be evaluated as immediate return to service paint / coating systems.

Public listing for a coating / paint shall include application procedures including order of application for multiple layer systems, use of a specific primer if one is used, subcomponent mixing ratio, thinning, application method, application thickness(es), curing schedule and final cure time and temperature prior to water immersion. Paint / coating system intended to be applied to pipe shall be designated as “certified for use on new pipe” or “certified for use on pipe intended for immediate return to service”.

5.4 Sample requirements

When required for evaluation, a sample of the product or material equivalent to that used in field applications shall be obtained.

A single sample can represent a product line of similar formulations (e.g., different colors of the same coating product line) when:

- the sample selected for testing contains all of the formulation ingredients of toxicological concern (see Section 3.2) at concentrations equal to or greater than the products it is selected to represent;

- product application conditions for the sample selected for testing (e.g., application thickness(es), cure times, solvent concentrations) are equal to or more severe than the products it is selected to represent; and
- for multiple component formulations, the mixing ratio(s) of the selected sample is(are) identical to that of the products it represents.

5.4.1 Cement samples

Cement samples, weighing a minimum of 9 kg (20 lbs), shall be collected in accordance with the applicable sections of ASTM C 183. To minimize contamination, all sample collection tools shall be cleaned and wiped with isopropyl alcohol before use. Collected samples shall be placed in moisture-proof containers. To minimize organic contamination, sample containers shall not be filled near a running motor or any type of exhaust system.

5.4.2 Concrete cylinder samples

Concrete test cylinders for the evaluation of cast-in-place or precast concrete structures shall be submitted with specific information on the composition of the concrete mix design for the specific installation, including the specific sources of cement, aggregate, admixtures, and any other additives. Specific information on the tank dimensions and water storage capacity shall also be provided. Concrete batch tickets, collected at the site of production, shall serve as evidence of the concrete mix actually used in the structure being evaluated.

5.4.3 Other barrier materials

Samples of barrier materials shall be collected at the point of manufacture.

5.5 Extraction procedures

5.5.1 Analytical summary

An analytical summary shall be prepared for each product. The analytical summary shall consist of the formulation-dependent analytes identified through the formulation review (see Section 3.2) and the applicable product-specific analytes listed in Table 3.1.

5.5.2 Preparation of test samples

5.5.2.1 Test samples shall be prepared such that a minimum surface area-to-volume ratio of 50 cm²/L (29 in²/gal) is achieved during the exposure, and so that the entire surface to be exposed is covered by exposure water. For concrete aggregate evaluations, the media shall be tested at a laboratory evaluation ratio no less than the field use level calculated in accordance with Section 5.7.2. Samples shall be rinsed with cold tap water and then in reagent water, meeting the requirements of Section N-1.9.2.1 unless manufacturer's instructions direct otherwise.

5.5.2.2 Field-applied paint and coating systems

Field-applied paint and coating systems shall be applied in accordance with the detailed use instructions (see Section 5.3.2) under the supervision of the testing laboratory. Products shall be applied to a glass slide when appropriate. Products requiring a reactive substrate shall be applied to the appropriate alternate substrate. Coating products shall be applied using application conditions as specified by the manufacturer in the detailed use instructions, e.g., the highest recommended percentage of thinner, the shortest curing period between coats or layers, the maximum recommended film thickness per coat, and the shortest final curing period prior to immersion. Products shall be cured within ± 4 °C of the specified cure temperature. For exothermic coatings with a maximum field use thickness in excess of 120 mil (3.0 mm), an additional evaluation at the manufacturer's minimum recommended field use thickness shall be conducted. The maximum dry film thickness per coat attested to by the testing laboratory shall be based on the average

per coat dry film thickness evaluated. When samples are prepared using an airless plural component system the system shall be operated at the midpoint of the coating manufacturer's recommended pressure and temperature range.

NOTE — The practical application of coatings may result in spots of coating thicknesses in excess of the maximum dry film thickness per coat attested to by the testing laboratory. Guidance on acceptable variations from the maximum dry film thicknesses is provided in The Society for Protective Coatings *Steel Structures Painting Manual Volume 2*. Reference *Paint Application Specification No. 2 (SSPC-PA2)* where the average of spot measurements on each 10 m² (100 ft²) area shall not exceed the specified maximum thickness, and no single spot measurement shall be more than 120% of it. In that document, spot measurements are defined as the average of at least three gauge readings within a 1.5 in (4 cm) diameter circle.

Multiple layer paint and coating systems that require the application of distinct coating product formulations in sequence shall be applied in a stepped manner so as to expose all layers. Multiple coats of the same product (of the same color) applied in sequence shall not constitute multiple layers and shall not be applied in a stepped manner. Multiple coats of the same product (of different colors) applied in sequence shall not constitute multiple layers and shall not be applied in a stepped manner, unless deemed necessary by the testing laboratory to address potential health effects concerns from the differences in color formulations. Stepped coating systems shall be applied per the dimensions in Table 5.1.

5.5.2.3 Factory-applied paint and coating systems

Paint and coating systems requiring factory application, factory curing, or both shall be prepared and applied in accordance with the detailed use instructions (see Section 5.3.2) under the supervision of the testing laboratory. Products shall be applied to a glass slide when appropriate. Products requiring a reactive substrate shall be applied to the appropriate alternate substrate. Coating products shall be applied using application conditions as specified by the manufacturer in the product use instructions, e.g., the highest recommended percentage of thinner, the shortest curing period between coats or layers, the maximum recommended film thickness per coat. Products shall be cured within ± 4 °C of the specified cure temperature, however temperature control is not required between the end of cure and immersion for factory applied coatings. For exothermic coatings with a maximum field use thickness in excess of 120 mil (3.0 mm), an additional evaluation at the manufacturer's minimum recommended field use thickness shall be conducted. The maximum dry film thickness per coat attested to by the testing laboratory shall be based on the average per coat dry film thickness evaluated.

NOTE — The practical application of coatings may result in spots of coating thicknesses in excess of the maximum dry film thickness per coat attested to by the testing laboratory. Guidance on acceptable variations from the maximum dry film thicknesses is provided in The Society for Protective Coatings *Steel Structures Painting Manual Volume 2*. Reference *Paint Application Specification No. 2 (SSPC-PA2)* where the average of spot measurements on each 10 m² (100 ft²) area shall not exceed the specified maximum thickness, and no single spot measurement shall be more than 120% of it. In that document, spot measurements are defined as the average of at least three gauge readings within a 1.5 in (4 cm) diameter circle.

Multiple layer paint and coating systems, which require the application of distinct coating product formulations in sequence, shall be applied in a stepped manner so as to expose all layers. Multiple coats of the same product (of the same color) applied in sequence shall not constitute multiple layers and shall not be applied in a stepped manner. Multiple coats of the same product (of different colors) applied in sequence shall not constitute multiple layers and shall not be applied in a stepped manner, unless deemed necessary by the testing laboratory to address potential health effects concerns from the differences in color formulations. Stepped coating systems shall be applied per the dimensions in Table 5.1.

NOTE — It is recognized that a coating system may be applied using a combination of factory and field application techniques. This is considered acceptable as long as the coating system is tested to the manufacturer's recommended application conditions, as specified in Sections 5.5.2.2 and 5.5.2.3.

5.5.2.4 Products requiring cement mortar cubes

Test sample mortar cubes shall be prepared in accordance to the applicable sections of ASTM C 109. Mix water shall meet reagent water requirements (see Section N-1.9.2.1). Sand shall be washed in accordance with the procedures in ASTM C 778. Mixing tools and other items coming into contact with the mortar shall be washed with soap and water, rinsed with tap water, rinsed with reagent water, and rinsed with isopropyl alcohol. The mortar shall be placed in polyethylene or polypropylene lined molds; no form release agents shall be used. Specimens shall be removed from the molds after 24 h and placed in glass or polyethylene beakers and covered with an inverted watch glass supported on glass Rebel hooks (or other devices to prevent air seal of the vessel) and placed for $28 \text{ d} \pm 12 \text{ h}$, or fewer as specified by the manufacturer, in a moist cabinet meeting the requirements of ASTM C 511. The specimens shall be removed from the moist cabinet and air dried at $23 \pm 2 \text{ }^\circ\text{C}$ ($73 \pm 4 \text{ }^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for 7 d.

5.5.2.4.1 Portland and hydraulic cements

Test cubes for Portland and blended hydraulic cements shall be prepared in accordance with Section 5.5.2.4.

5.5.2.4.2 Admixtures

These products shall be added to the cement-mortar or concrete mixture using the manufacturer's highest recommended admixture dosage. The test samples shall be prepared as described in Section 5.5.2.4.

5.5.2.4.3 Sealers

These products shall be applied per manufacturer's recommendations to the test cubes prepared in accordance with Section 5.5.2.4. The coated cubes shall be allowed to cure for the manufacturer's recommended time period.

5.5.2.4.4 Form and mold release agents

These products shall be applied per manufacturer specifications to the mold used during the preparation of the test cubes (see Section 5.5.2.4).

5.5.2.5 Concrete water storage tanks

Concrete test cylinders (4 in x 8 in) shall be prepared according to ASTM C 31 or ASTM C 192, and moist cured in an ASTM C 511 cabinet for a minimum of 3 d. Cylinder molds shall be manufactured of virgin materials free of detectable concentrations of any interfering contaminants.

5.5.3 Exposure water

Exposure water selection shall be determined by the analytes of interest identified on the analytical summary (see Section 5.5.1). Exposure water(s) shall be selected in accordance with Section N-1.2.5.

5.5.4 Conditioning (optional)

Test samples shall be conditioned immediately after curing. This conditioning procedure simulates the disinfection of water mains and storage tanks prior to placing into service, and is based on AWWA Standards C651-05 and C652-02.

Coatings intended for pipes and fittings can be conditioned as follows:

- a) Prepare 50 mg/L free available chlorine solution using sodium hypochlorite (NaClO – reagent grade or equivalent).
- b) Using a spray bottle, spray the previously rinsed test samples, wetting all surfaces to be exposed.
- c) Let the test samples stand for at least 3 h.
- d) Place the test samples in racks, rinse with cold tap water, and rinse with reagent water, meeting the requirements of Section N-1.9.2.1.

Coatings intended for water storage tanks or multiple uses (tanks, pipes, other) may be conditioned as follows:

- a) Prepare 200 mg/L free available chlorine solution using sodium hypochlorite (NaClO – reagent grade or equivalent).
- b) Using a spray bottle, spray the previously rinsed test samples, wetting all surfaces to be exposed.
- c) Let the test samples stand for at least 30 min.
- d) Place the test samples in racks, rinse with cold tap water, and rinse with reagent water, meeting the requirements of Section N-1.9.2.1.

Products may also be disinfected per manufacturer's use instructions.

5.5.5 Exposure protocols

For all test samples, exposure shall commence immediately following the conditioning step. If immediate exposure is not possible, the test samples shall be dried in a laminar flow hood and exposed within 4 h. Successful evaluation at an elevated exposure temperature shall preclude testing at a lower exposure temperature. A separate sample shall be exposed for each type of exposure water selected in Section 5.5.3.

The exact surface area-to-volume ratio achieved during the exposure shall be recorded.

5.5.5.1 Cold application

Cold application product samples, as designated by the manufacturer, shall be placed in an exposure vessel and completely covered with exposure water of the applicable pH (see Section 5.5.3). The exposure vessel shall be placed in a 23 ± 2 °C (73 ± 4 °F) environment for the duration of the exposure period.

5.5.5.2 Domestic hot application

Products that are intended for domestic hot applications as designated by the manufacturer (e.g., for use in single-family dwellings) shall be placed in an exposure vessel and completely covered with exposure water of the applicable pH (see Section 5.5.3). The exposure vessel shall be placed in a 60 ± 2 °C (140 ± 4 °F) environment for the duration of the exposure period.

5.5.5.3 Commercial hot application

Products that are intended for commercial hot applications, as designated by the manufacturer, (e.g., for use in multiple-family dwellings, restaurants, hospitals) shall be placed in an exposure vessel and completely covered with exposure water of the applicable pH (see Section 5.5.3). The exposure vessel shall be placed in an 82 ± 2 °C (180 ± 4 °F) environment for the duration of the exposure period.

5.5.5.4 Single time point exposure protocol

When normalized contaminant concentrations from the product are expected to be less than their acceptable concentrations (see NSF/ANSI/CAN 600, Section 3 [previously Annex A of this Standard]) when tested at a single time point (e.g., flexible membrane liners), the product shall be exposed according to the single time point exposure protocols in Table 5.2, (tanks), and Tables 5.3 and 5.4 (pipes). Coatings intended for multiple uses for tank, pipe or other applications shall be exposed per Table 5.2. Extraction water samples shall be collected at the conclusion of the final exposure period. For paint / coating systems intended for immediate return to service, the first four days of the exposure for tanks and the first two days of the exposure for pipes will be eliminated and the water samples shall be collected at the conclusion of the first 24 h period for tanks, and the first 16 h period for pipes.

5.5.5.5 Multiple time point exposure protocol

When the normalized concentration of a contaminant exceeds, or is expected to exceed, its acceptable concentration (see NSF/ANSI/CAN 600, Section 3 [previously Annex A of this Standard]) when evaluated as a single time point (see Section 5.5.5.4), determination of the contaminant leaching rate as a function of time shall be considered. The relationship between contaminant concentration(s) and time shall be determined and plotted using a minimum of five data points. Table 5.5 summarizes the multiple time point exposure sequence. For contaminants of interest that do not require over time testing, extraction water shall be collected following the third exposure period (elapsed time 5 d). For paint / coating systems intended for immediate return to service, the first four days of the exposure will be eliminated and the water samples shall be collected at the conclusion of the first 24 h period following conditioning.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be exposed at the selected application temperature (e.g., 23 ± 2 °C; 60 ± 2 °C; 82 ± 2 °C) for the full duration of the exposure. Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 and after the final exposure terminating on Day 90. The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure.

NOTE — Day 1 is defined as the time point at which extractant water for all contaminants is collected for analysis (5 d of elapsed time). Day 90 is defined as 90 d following this time point (95 d of elapsed time).

5.5.6 Collection and preservation of extraction water

Immediately following the exposure period, the extraction water shall be poured into previously prepared sample containers for storage as detailed in Section N-1.6, until analysis. Extraction water for solvent analysis shall be collected in a sample bottle containing sodium thiosulfate in a quantity sufficient to neutralize any residual chlorine, if applicable.

5.6 Analysis of extraction water

Extraction waters shall be analyzed with the methods listed in Section N-1.8.

5.7 Normalization

5.7.1 Normalization for tanks / storage vessels

5.7.1.1 The following equation shall be used to calculate the normalized concentration of each contaminant for tanks or other storage vessels:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{SA_F}{V_F} \times \frac{V_L}{SA_L} \times \frac{24 \text{ h}}{\text{hours of exposure}}$$

Where:

$\frac{SA_F}{V_F}$ = surface area to volume ratio for the specified tank capacity, as defined in Table 5.6

SA_L = surface area exposed in the laboratory

V_L = volume of extraction water used in the laboratory

When the length of the exposure being normalized is other than 24 h in length, the normalized value shall be adjusted to reflect a 24 h exposure.

Products used as barriers for tanks or storage vessels shall use the surface area-to-volume ratios shown in Table 5.6. Surface area-to-volume ratios for products used as barriers in tanks or storage vessels with a capacity other than those shown in Table 5.6 shall be determined on a case-by-case basis, as described in Section 5.7.1.2.

NOTE — Due to the potential for condensation to form on the interior surfaces of water storage tank and reservoir covers, which may leach contaminants and then drip into the water tank or reservoir, the interior surface of these covers shall be considered water contact materials. Table 5.6 and Section 5.7.1.2 thus include the surface area of the roof (ceiling) in the calculation of the water contact surface area to volume ratio of the tank or storage vessel.

5.7.1.2 Calculation of the surface area-to-volume ratio for tanks or storage vessels

The following assumptions shall be used in determining the surface area-to-volume ratio for each nominal tank capacity:

- the tank has a smooth interior surface;
- the tank is cylindrical in shape;
- the tank is installed in a vertical position; and
- the roof (ceiling) of the tank is in contact with drinking water.

The following equation shall be used to calculate the surface area-to-volume ratio for tanks or storage vessels of capacities that do not appear in Table 5.6:

Volume in gallons:

$$\text{surface area-to-volume ratio (in}^2\text{/L)} = 119.5 \times \frac{\left(0.1702 \times \frac{Y}{X}\right)^{0.66} \times \left(X + \frac{1}{2}\right)}{Y}$$

Where:

X = the height / diameter ratio of the tank or storage vessel

Y = the volume (in gallons) of the tank or storage vessel

5.7.2 Normalization for concrete aggregate

The following equation shall be used to calculate the normalized concentration of each contaminant for concrete aggregate evaluations. Table 5.8 provides examples of calculated aggregate field use assumptions for several reservoir capacities.

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{\text{aggregate field use assumption (g/L)}}{\text{laboratory evaluation ratio (g/L)}}$$

Where:

$$\begin{matrix} \text{aggregate} \\ \text{field use} \\ \text{assumption} \\ \text{(g/L)} \end{matrix} = \begin{matrix} \text{ratio of concrete} \\ \text{structure's wetted} \\ \text{surface area to} \\ \text{structure's} \\ \text{volume (in}^2\text{/L)} \end{matrix} \times \begin{matrix} \text{correlation of} \\ \text{concrete volume to} \\ \text{evaluated concrete} \\ \text{surface area (in}^3\text{/in}^2\text{)} \end{matrix} \times \begin{matrix} \text{aggregate mass} \\ \text{per volume of} \\ \text{concrete (g/in}^3\text{)} \end{matrix}$$

— ratio of concrete structure's wetted surface area to structure's volume: The surface area-to-volume ratios shown in Table 5.6 shall be used. Surface area-to-volume ratios for products used as barriers in tanks or storage vessels with a capacity other than those shown in Table 5.6 shall be determined on a case-by-case basis, as described in Section 5.7.1.2;

— correlation of concrete volume to evaluated concrete surface area: 0.1 (in³/in²);

NOTE — The 0.1 in³/in² value accounts for 100% of the aggregate exposed within the top 0.1 in of concrete.

— aggregate mass per volume of concrete (g/in³): Concrete mix design specific value:

$$NF = N1 \times N2$$

$$N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}}$$

$$N2 = \frac{V_{F(static)}}{V_{F(flowing)}}$$

Where:

SA_F = surface area exposed in the field

SA_L = surface area exposed in the laboratory

V_L = volume of extraction water used in the laboratory

V_{F(static)} = volume of water to which the product is exposed under static conditions

V_{F(flowing)} = volume of water to which the product is exposed under flowing conditions during a period of time equivalent to the laboratory test

When the length of the exposure being normalized is other than 24 h in length, the normalized value shall be adjusted to reflect a 24 h exposure (e.g., multiply the normalized value by ²⁴/₇₂ when a 3 d exposure was used). Products used as barriers for pipes shall use the surface area-to-volume ratios shown in Table 5.7.

Pipe and fitting coatings with a nominal diameter ≥ 10 cm (4 in) shall be normalized to the flowing condition. Pipe and fitting coatings with a nominal diameter of < 10 cm (4 in) shall be normalized to the static condition when the value of N2 is ≤ 0.1. Pipe and fitting coatings with a nominal diameter of < 10 cm (4 in) shall be normalized to the flowing condition when the value of N2 is > 0.1.

5.7.3 Over time exposure calculations

Laboratory values from each time point for which extractant water was collected (minimum of five data points required) shall be normalized as indicated in Sections 5.7.1 or 5.7.2, depending on product end use. A decay curve of these normalized contaminant concentrations in relation to elapsed exposure time shall be plotted. A contaminant concentration at Day 90 of exposure shall be extrapolated from this data.

NOTE — Day 1 is defined as the time point at which extractant water for all contaminants is collected for analysis (5 d of elapsed time). Day 90 is defined as 90 d following this time point (95 d of elapsed time).

5.8 Evaluation of contaminant concentrations

5.8.1 Contaminants measured at a single time point

Normalized contaminant concentrations for tanks shall be no greater than their respective SPACs determined in accordance with NSF/ANSI/CAN 600 (previously Annex A). For pipe and fitting products, normalized static contaminant concentrations shall be no greater than their respective MCLs, or TACs, and normalized flowing contaminant concentrations shall be no greater than their respective SPACs calculated in accordance with NSF/ANSI/CAN 600 (previously Annex A).

5.8.2 Contaminants measured over time

Normalized Day 1 contaminant concentrations shall not exceed the STEL as defined in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5). Extrapolated Day 90 contaminant concentrations shall not exceed their respective SPACs for tank products determined in accordance with NSF/ANSI/CAN 600 (previously Annex A). For pipe and fitting products extrapolated Day 90 normalized static contaminant concentrations shall not exceed their respective MCLs, or TACs, and normalized flowing contaminant concentrations shall not exceed their respective SPACs determined in accordance with NSF/ANSI/CAN 600 (previously Annex A).

Table 5.1
Paint and coating system sample preparation

| Number of layers in system | Layer | Panel surface area exposed for each layer |
|----------------------------|---------------------------|---|
| one layer | — | entire panel |
| two layer | primer layer | $\frac{1}{3}$ |
| | top layer | $\frac{2}{3}$ |
| three layer | primer layer | $\frac{1}{6}$ |
| | intermediate layer | $\frac{1}{3}$ |
| | top layer | $\frac{1}{2}$ |
| four layer | primer layer | $\frac{1}{12}$ |
| | first intermediate layer | $\frac{1}{6}$ |
| | second intermediate layer | $\frac{1}{4}$ |
| | top layer | $\frac{1}{2}$ |

NOTE — A layer is one or more coats of the same coating material.

Table 5.2
Single time point exposure sequence for tank products

| Length of exposure | Elapsed time | Sample collection |
|--------------------|--------------|--|
| 24 ± 1 h | 1 d | discard extractant water and refill |
| 24 ± 1 h | 2 d | discard extractant water and refill |
| 48 ± 4 h | 4 d | discard extractant water and refill |
| 24 ± 1 h | 5 d | extractant water collected for analysis at conclusion of exposure period |

NOTE 1 — Sample exposures are sequential: decant and discard extraction water, refill container, and continue exposure.

NOTE 2 — For paint / coating systems intended for immediate return to service, the first four days of the exposure will be eliminated and the water samples shall be collected at the conclusion of the first 24 h period following conditioning.

Table 5.3
Example single time point conditioning schedule for pipes and related product coatings

| Conditioning time | Elapsed time | Comment |
|-------------------|--------------|---|
| 24 ± 1 h | 1 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 2 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 3 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 4 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 72 ± 1 h | 7 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 8 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 9 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 10 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 24 ± 1 h | 11 d | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and conditioning is continued. |
| 72 ± 1 h | 14 d | Exposure water is decanted and discarded, and conditioning is terminated. |

NOTE — For paint / coating systems intended for immediate return to service, the conditioning time is eliminated.

Table 5.4
Single time point exposure protocol for pipe and related product coatings

| Exposure time | Comment |
|--|---|
| 24 ± 1 h | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and the exposure is continued. |
| 24 ± 1 h | Exposure water is decanted and discarded; the exposure vessel or product is refilled with exposure water and the exposure is continued. |
| 16 ± 1 h | Exposure water is collected for analysis. |
| NOTE — For paint / coating systems intended for immediate return to service, the first two days of exposure are eliminated | |

Table 5.5
Multiple time point exposure sequence

| Length of exposure | Elapsed time | Sample collection |
|--|--------------|---|
| 24 ± 1 h | 1 d | extractant water collected for analysis |
| 24 ± 1 h | 2 d | extractant water collected for analysis |
| 48 ± 4 h | 4 d | discard extractant water and refill |
| 24 ± 1 h | 5 d | extractant water collected for analysis |
| 6 ± 1 d | 11 d | discard extractant water and refill |
| 24 ± 1 h | 12 d | extractant water collected for analysis |
| 6 ± 1 d | 18 d | discard extractant water and refill |
| 24 ± 1 h | 19 d | extractant water collected for analysis |
| 6 ± 1 d | 25 d | discard extractant water and refill |
| 24 ± 1 h | 26 d | extractant water collected for analysis |
| 6 ± 1 d | 32 d | discard extractant water and refill |
| 24 ± 1 h | 33 d | extractant water collected for analysis |
| NOTE — Sample exposures are sequential: decant required volume for analysis when indicated, discard any remaining extraction water, refill container, and continue exposure. | | |

Table 5.6
Surface area-to-volume ratios for tanks or storage vessels

| Nominal capacity (gal) ¹ | Surface area (ft ²) ² | Length / diameter ratio | Surface area-to-volume ratio (in ² /1 L) |
|-------------------------------------|--|-------------------------|---|
| 5 | 5.3 | 5.0 | 40.4 |
| 10 | 8.4 | 5.0 | 32.0 |
| 25 | 15.5 | 5.0 | 23.6 |
| 50 | 22.0 | 3.0 | 16.8 |
| 75 | 28.9 | 3.0 | 14.6 |
| 100 | 35.0 | 3.0 | 13.3 |
| 200 | 55.1 | 2.9 | 10.5 |
| 300 | 71.3 | 2.7 | 9.0 |
| 400 | 85.8 | 2.6 | 8.2 |
| 500 | 99.0 | 2.5 | 7.5 |
| 600 | 110 | 2.3 | 7.0 |
| 700 | 121 | 2.2 | 6.6 |
| 800 | 132 | 2.1 | 6.3 |
| 900 | 141 | 1.9 | 5.9 |
| 1,000 | 150 | 1.8 | 5.7 |
| 1,500 | 196 | 1.8 | 5.0 |
| 2,000 | 238 | 1.8 | 4.5 |
| 3,000 | 312 | 1.8 | 4.0 |
| 4,000 | 378 | 1.8 | 3.6 |
| 5,000 | 438 | 1.8 | 3.3 |
| 6,000 | 495 | 1.8 | 3.1 |
| 7,000 | 548 | 1.8 | 3.0 |
| 8,000 | 600 | 1.8 | 2.9 |
| 9,000 | 648 | 1.8 | 2.7 |
| 10,000 | 696 | 1.8 | 2.6 |
| 20,000 | 1,104 | 1.8 | 2.1 |
| 30,000 | 1,447 | 1.8 | 1.8 |
| 40,000 | 1,753 | 1.8 | 1.7 |
| 50,000 | 2,034 | 1.8 | 1.6 |
| 60,000 | 2,297 | 1.8 | 1.5 |
| 70,000 | 2,545 | 1.8 | 1.4 |
| 80,000 | 2,782 | 1.8 | 1.32 |
| 90,000 | 3,010 | 1.8 | 1.27 |
| 100,000 | 3,228 | 1.8 | 1.23 |
| 200,000 | 5,125 | 1.8 | 0.97 |
| 250,000 | 5,946 | 1.8 | 0.90 |
| 500,000 | 9,439 | 1.8 | 0.72 |
| 750,000 | 12,370 | 1.8 | 0.63 |
| 1,000,000 | 14,980 | 1.8 | 0.57 |

Table 5.6
Surface area-to-volume ratios for tanks or storage vessels

| Nominal capacity (gal) ¹ | Surface area (ft ²) ² | Length / diameter ratio | Surface area-to-volume ratio (in ² /1 L) |
|-------------------------------------|--|-------------------------|---|
| 1,500,000 | 19,630 | 1.8 | 0.50 |
| 2,000,000 | 23,780 | 1.8 | 0.45 |
| 5,000,000 | 43,810 | 1.8 | 0.33 |
| 7,500,000 | 57,400 | 1.8 | 0.29 |
| 10,000,000 | 69,530 | 1.8 | 0.26 |

¹ US gallons.

² Surface area calculations include the sides, floor, and roof (ceiling) of a tank.

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Table 5.7
Surface area-to-volume ratios for pipe

| Nominal pipe diameter (inches) | Surface area-to-volume ratio (in²/1 L) |
|---|--|
| 0.5 | 488 |
| 0.75 | 326 |
| 1 | 244 |
| 1.25 | 195 |
| 1.5 | 163 |
| 1.75 | 140 |
| 2 | 122 |
| 2.25 | 109 |
| 2.5 | 97.6 |
| 2.75 | 88.8 |
| 3 | 81.4 |
| 3.5 | 69.7 |
| 4 | 61.0 |
| 4.5 | 54.2 |
| 5 | 48.8 |
| 5.5 | 44.4 |
| 6 | 40.7 |
| 6.5 | 37.6 |
| 7 | 34.9 |
| 8 | 30.5 |
| 9 | 27.1 |
| 10 | 24.4 |
| 11 | 22.2 |
| 12 | 20.3 |
| 13 | 18.8 |
| 14 | 17.4 |
| 15 | 16.3 |
| 16 | 15.3 |
| 17 | 14.4 |
| 18 | 13.6 |
| 19 | 12.8 |
| 20 | 12.2 |
| 21 | 11.6 |
| 22 | 11.1 |
| 23 | 10.6 |
| 24 | 10.2 |
| 25 | 9.8 |
| 36 | 6.8 |
| 48 | 5.1 |

Table 5.7
Surface area-to-volume ratios for pipe

| Nominal pipe diameter (inches) | Surface area-to-volume ratio (in ² /1 L) |
|--------------------------------|---|
| 60 | 4.1 |
| 72 | 3.4 |
| 84 | 2.9 |
| 97 | 2.5 |
| 108 | 2.3 |
| 120 | 2.0 |

Table 5.8
Example aggregate field use assumptions

| Nominal reservoir capacity (gallons) | NSF/ANSI/CAN 61, Table 5.6 surface area-to-volume ratio (in ² /L) | Calculated field use ¹ assumption for mass aggregate per reservoir volume (g/L) |
|--------------------------------------|--|--|
| 1,000 | 5.7 | 18 |
| 10,000 | 2.6 | 8.2 |
| 100,000 | 1.23 | 3.9 |
| 250,000 | 0.90 | 2.8 |

¹ Based on example concrete with a designed weight of 150 lbs/ft³ and an aggregate content representing 80% of that weight.

6 Joining and sealing materials

6.1 Coverage

This Section covers materials that join or seal pipes and related products (e.g., tanks); protective (barrier) materials; and mechanical devices that contact drinking water.

6.2 Definitions

6.2.1 flux: A formulation intended to remove traces of surface oxides, to promote wetting, and to protect surfaces to be soldered or brazed from oxidation during heating.

6.2.2 gaskets and sealing materials: Materials used to fill a hole or joint to prevent leakage.

6.2.3 joining materials: Materials that form a bond when used to put parts together.

6.2.4 lubricant: A substance interposed between two surfaces for the purpose of reducing the friction or wear between them.

6.3 Material and extraction testing requirements

Samples for testing shall be prepared as specified by the manufacturer's written instructions, and exposed as outlined in Annex N-1. Any contaminants extracted shall have normalized concentrations no greater than the limits specified in NSF/ANSI/CAN 600 (previously Annex A).

6.4 Items of special significance

The manufacturer shall supply written information relative to the product's intended end uses and applications.

7 Process media

7.1 Scope

The requirements in this Section apply to process media products intended for the reduction of dissolved or suspended materials present in drinking water. The products that are covered include, but are not limited to, process media used in the following processes: ion exchange, adsorption, oxidation, aeration, and filtration.

Requirements in this Section for regenerated / reactivated media are intended to apply to regeneration / reactivation companies that provide services for water systems, and are not intended to apply to water systems that produce potable water, regenerate or reactivate their own media, and do not sell, barter, trade or pass their media to another water system. Products and facilities that are specifically covered by the requirements for regenerated / reactivated media include:

- off-site regeneration / reactivation facilities that are independent from the water utility; and
- on-site regeneration facilities that are not owned and controlled by the water utility.

Products and facilities that are specifically exempt from these requirements for regenerated / reactivated media include:

- off-site and on-site regeneration / reactivation facilities that are owned by the water utility and is processing media for only that water utility's use; and
- on-site regeneration by any party where the media is not removed from its original vessel, and the equipment is dedicated and the utility assumes responsibility for the maintenance of all supplies and equipment.

7.2 Definitions

7.2.1 adsorption: The retention of a gas, liquid, solid, or dissolved material onto the surface of a solid.

7.2.2 adsorption media: A process media material upon which a gas, liquid, solid, or dissolved material will be retained.

7.2.3 aeration: The process of bringing water into contact with air in order to expedite the transfer of gas between the two phases.

7.2.4 aeration packing media: Media used in aerators to increase the surface area of the liquid being processed, resulting in increased liquid-to-air contact and improved gas transfer.

7.2.5 commingled media: A mixture of spent media from different spent media sources. Reactivated / regenerated media from a single source that is mixed with virgin media is not considered to be commingled.

7.2.6 filtration: The process of passing a dilute liquid suspension through filter media to reduce the concentration of suspended or colloidal matter.

7.2.7 filtration media: Process media through which a liquid is passed for the purpose of filtration.

7.2.8 ion exchange: A chemical process in which ions are reversibly interchanged between a liquid and a solid.

7.2.9 ion exchange resins: Process media consisting of insoluble polymers having functional groups capable of exchanging ions.

7.2.10 low-density process media: Process media such as diatomaceous earth, perlite, or other media, which have a bulk density of < 500 g/L and are used for filtration purposes.

7.2.11 oxidative media: Process media that chemically facilitate oxidation on the media surface and thereby enhance removal of ions from water.

7.2.12 potable / food grade reactivation / regeneration facility: A reactivation / regeneration facility where all process equipment in contact with spent media is used exclusively to handle media used to treat products designated for human consumption, which does not include pharmaceutical related applications. If the facility is part of a larger media facility that handles nonpotable / nonfood grade media, the potable / food grade reactivation facility shall have separate entry and shall not allow transport between the facility and the nonpotable / nonfood grade portion. Any media classified as hazardous under the Resource Conservation and Recovery Act (RCRA) or by US state or Canadian provincial, or territorial regulations is excluded from reactivation / regeneration in a potable/food grade reactivation facility.

7.2.13 process media: Water insoluble material used to reduce the concentration of dissolved or suspended substances in water through such operations as ion exchange, aeration, adsorption, oxidation, and filtration.

7.2.14 reductive media: Process media that chemically facilitate reduction on the media surface and thereby enhance removal of ions from water.

7.2.15 reactivation: A controlled thermal process operating at a temperature and gas environment sufficient to pyrolyze adsorbates from spent activated carbon and restore adsorption capacity.

7.2.16 regeneration: The periodic restoration of an adsorptive media (excluding activated carbon) back to useable form by employing a chemical regenerant to displace contaminants removed during the treatment process.

7.2.17 spent media: Media that has been in service and is no longer able to produce a desired effluent quality.

7.3 General requirements

7.3.1 Manufacturer use instructions

Media that require conditioning, dosing, use of filtration aids or specific recommended use concentrations, shall contain manufacturer use instructions on the product packaging or other technical literature. For process media products that are dosed (e.g., powdered activated carbon [PAC]), use instructions shall include the maximum dose at which the product can be acceptably used (as determined by evaluation to the requirements of this Section).

7.3.2 Product labeling

Process media product containers shall facilitate traceability to the production location and shall, at a minimum, contain the following information:

- manufacturer's name and address;
- production location identifier;
- product identification (product type and, when applicable, trade name);

- net weight or net volume;
- when applicable, mesh or sieve size;
- lot number; and
- when appropriate, special handling, storage, and use instructions.

7.3.2.1 Additional labeling and literature requirements for reactivated / regenerated media

Product packaging, literature shipped with the product, and certification listings for reactivated / regenerated media shall explicitly identify the product as reactivated or regenerated. Labeling of media from commingled sources shall identify the product as commingled.

7.3.3 Additional requirements for reactivated / regenerated media

Only reactivation / regeneration facilities and equipment used to handle spent and reactivated / regenerated media, classified as potable and/or food grade, shall be used. Transportation containers, including storage vessels on vehicles, transfer hoses and other equipment in contact with the media, shall be suitably protected from environmental contamination and suitably cleaned, by evidence of wash-out tickets that are presented to the purchaser or certifying agency on demand.

Samples from each reactivated / regenerated batch of media shall be retained at the facility for a period of at least 2 yr, and be made available for analysis by the purchaser or a certification organization. Retained samples shall contain at least twice the weight in Table 7.2.

Commingled spent media shall be of comparable type and function.

Reactivation / regeneration facilities shall have written verification from each water system on a standardized form provided by the facility that each shipment of spent media to be processed meets the following criteria:

- the spent media shall have been used only for drinking water applications;
- the spent media supplier is a public water system as defined by US EPA regulations (40 CFR § 141.2), or equivalent regulations in Canada or other countries where applicable;
- the spent media shall not be a RCRA hazardous waste as defined by 40 CFR Part 261;
- the spent media is not classified as a hazardous waste in the facility's state, province, or territory; and
- the spent media shall not have knowingly been exposed to:
 - activated carbon: polychlorinated biphenyls (PCBs) or dioxins;¹³ or
 - other media: herbicides, pesticides, polychlorinated biphenyls (PCBs), dioxins or 1,2 dibromo-3 chloropropane (DBCP).

The form shall also contain:

- the name and address of the water system supplying the spent media;
- the identification of the type of media;
- manufacturer or previous regeneration / reactivation facility of the original media;

¹³ Criteria are derived from AWWA B605: *Reactivation of Granular Activated Carbon*.

- trade designation of the original media;
- mesh size;
- compliance of the original media with this Standard;
- characterization of all regulated contaminants and other contaminants of concern that the media was exposed to; and
- a signed statement of attestation of the above.

7.3.4 Product line evaluation

When a line of products is manufactured to the same material formulation and contains identical ingredients, product evaluation shall be preferentially conducted on the product form that has the highest surface area-to-volume ratio (smallest particle size). Products of a lower surface area-to-volume ratio (larger particle size) shall be considered to have met the requirements of this Section when a higher surface area-to-volume ratio product, belonging to the same line of products and having an identical use, has been demonstrated to meet the requirements of this Section.

7.4 Sample requirements

A representative sample of the media shall be reduced to three test samples, each of a sufficient quantity for the extraction procedures described in Section 7.5. The three test samples shall be placed and stored in airtight, moisture-proof, sealed glass containers. If a glass container is inappropriate, containers made from some other inert material recommended by the manufacturer shall be used. Each container shall be clearly labeled with product name, type of sample, manufacturer name, sampling data, production location, lot number, and the name of the individual who collected the sample. One sample shall be used for exposure and analysis; the remaining two samples shall be retained for re-evaluation purposes.

7.5 Extraction procedures

7.5.1 Analytical summary

An analytical summary shall be prepared for each product. The analytical summary shall consist of the formulation-dependent analytes identified in accordance with Section 3.3 and the applicable product-specific minimum test batteries listed in Table 7.1.

7.5.2 Wetting

POE system media receive wetting as specified in Section 7.5.5.4.

Process media that receive conditioning shall be immersed completely (wetted) in reagent water prior to conditioning and exposure. The weight of the sample to be wetted shall be at least equal to the amount of media required to perform the exposure at the specified weight-to-volume ratio (see Tables 7.2 and 7.3).

NOTE — For example, a media for which 2 L (0.53 gal) of extractant water is required to perform the selected analyses, and the media is exposed at 25 g/L, a minimum of 50 g of media is wetted.

For low-density process media, 0.5 L (0.13 gal) of the process media shall be wetted; the weight of this volume of media shall be measured and recorded prior to wetting.

Following the specified wetting period, the sample shall be completely drained and the water discarded.

7.5.2.1 Granular activated carbon (GAC)

GAC test samples shall be wetted for 16 ± 1 h.

7.5.2.2 Other process media products

All other process media that receive conditioning shall be wetted for 60 ± 10 min.

7.5.3 Conditioning (backwashing)

POE system media receive conditioning as specified in Section 7.5.5.4.

7.5.3.1 Filtration and adsorption media

Wetted filtration or adsorption media (excluding diatomaceous earth, perlite, and PAC products, and other media of < 0.25 mm diameter) shall be placed in a conditioning chamber (a glass column with a minimum inner diameter of 2 in). The amount of media conditioned shall be sufficient to meet or exceed its specific weight per volume ratio (see Table 7.2) and to generate sufficient exposure water to complete the selected analyses. Reagent water shall be directed slowly upward through the conditioning system until the entire amount of media is flooded. The media shall then be backwashed at a flow rate that fluidizes the media or attains sufficient transport velocities to remove extraneous particulate matter; the maximum wetted media expansion rates for various process media products are indicated in Table 7.3. Filtration and adsorption media shall be subjected to the prescribed backwash for 30 ± 2 min.

7.5.3.2 Diatomaceous earth, perlite, PAC, and other process media

Diatomaceous earth, perlite, PAC, and all other process media with functions other than filtration or adsorption shall not be conditioned unless the manufacturer's use instructions stipulate a specific conditioning protocol.

7.5.3.3 Special postconditioning procedures for sand and anthracite products

Upon completion of the backwash, 1% to 1.5% of the sand or anthracite column (by height) shall be scraped away and discarded.

7.5.4 Exposure water

All exposure water that is being used to determine compliance to this Standard shall be prepared fresh daily and stored in a closed container.

7.5.4.1 Adsorption media

Adsorption media shall be exposed in a pH 5 sodium dihydrogen phosphate buffer, prepared by mixing 0.1 M NaH_2PO_4 , 0.04 M MgCl_2 , and reagent water that meets the requirements of Section N-1.9.2.1, at a ratio of 1:1:18, respectively.

7.5.4.2 Nonadsorptive media used in POE devices

Media used in POE devices shall be exposed, based on a formulation review and determination of the most severe condition(s), to one or more appropriate extraction waters as detailed in Section N-1.9 and Table N-1.3.

7.5.4.3 All other process media

All other process media shall be exposed in reagent water, meeting the requirements of Section N-1.9.2.1.

7.5.5 Exposure protocols

Table 7.2 contains the weight per volume ratios for exposure of process media.

7.5.5.1 Adsorption media

7.5.5.1.1 Media of < 0.25 mm in diameter

Immediately after completion of wetting, the media sample shall be exposed in an appropriately sized vessel. The amount of media exposed per volume of exposure water (see Section 7.5.4.1) shall be sufficient to meet or exceed its specific weight per volume ratio according to Table 7.2, and to generate sufficient exposure water to complete the selected analyses. The vessel shall be covered and placed on a magnetic stirrer for 60 ± 5 min. Immediately after the exposure period, the liquid portion of the exposure shall be passed through a Whatman¹⁴ #41 filter and a 0.45μ filter, and the resulting filtrate shall be collected. The solid portion of the exposed sample remaining on the filter shall be dried and weighed, and used to calculate the evaluation dose.

7.5.5.1.2 Media of ≥ 0.25 mm in diameter

Immediately after completion of conditioning, the media sample shall be exposed in an appropriately sized vessel. The amount of media exposed per volume of exposure water (see Section 7.5.4.1) shall be sufficient to meet or exceed its specific weight per volume ratio in Table 7.2 and to generate sufficient exposure water to complete the selected analyses. The contents of the vessel shall be mixed to ensure that the entire sample is in contact with the exposure water. The vessel shall be sealed with polytetrafluoroethylene (PTFE), and the sample shall be exposed according to the schedule outlined in Table 7.4. The weight-to-volume ratio shall be recorded at the time of exposure and shall represent the evaluation dose.

7.5.5.2 Filtration media, ion exchange resins, synthetic media, and all other process media

Immediately after completion of wetting, or conditioning if applicable, the media sample shall be exposed in an appropriately sized vessel. The amount of media exposed per volume of exposure water (see Section 7.5.4) shall be sufficient to meet or exceed its specific weight per volume ratio in Table 7.2 and to generate sufficient exposure water to complete the selected analyses. The contents of the vessel shall be mixed to ensure that the entire sample is in contact with the exposure water. The vessel shall be sealed with PTFE, and the sample shall be exposed according to the schedule outlined in Table 7.4. The weight-to-volume ratio shall be recorded at the time of exposure and shall represent the evaluation dose.

7.5.5.3 Aeration packing media

Aeration packing media shall be exposed in appropriately sized vessels at a surface area-to-volume ratio greater than or equal to its manufacturer's recommended field surface area-to-volume ratio and in a volume of exposure water sufficient to complete the selected analyses. The vessel shall be sealed with PTFE, and the sample shall be exposed according to the schedule outlined in Table 7.4.

NOTE — The volume of extraction water can be proportionately increased if an additional amount of media was prepared in order to complete the selected analyses.

7.5.5.4 POE system media

POE system media shall be exposed at a weight to volume ratio greater than or equal to the maximum value recommended by the manufacturer for the ratio of the weight of media (as shipped) per unit void volume (UVV) of a POE system.

¹⁴Whatman PLC. 27 Great West Road, Brentford, Middlesex TW8 9BW, UK. <www.whatman.com>

7.5.5.4.1 POE system media shall be placed in a suitable exposure vessel and shall be installed, flushed, and conditioned in accordance with the manufacturer's instructions using the exposure water specified in Section 7.5.4 at an initial inlet static pressure of 340 kPa (50 psig).

7.5.5.4.2 After media are flushed and conditioned in accordance with Section 7.5.5.4.1, the exposure vessel shall be refilled with the exposure water specified in Section 7.5.4 and maintained for 24 h at a temperature of 23 ± 2 °C (73 ± 4 °F). The exposure vessel shall then be flushed with 5 unit volumes, refilled, and maintained for a second 24 h at an ambient temperature of 23 ± 2 °C (73 ± 4 °F). The exposure vessel shall again be flushed with 5 unit volumes, refilled, and maintained for a third period of 24 h at a temperature of 23 ± 2 °C (73 ± 4 °F). At the end of the third 24 h exposure, the extraction water sample shall be collected in accordance with Section 7.5.6. The volume collected from an exposure vessel shall be the UVV of the vessel. If a larger volume is required for analysis, multiple exposure vessels shall be used.

7.5.6 Collection and preservation of extraction water

Immediately after exposure, extraction waters shall be poured into previously prepared sample containers for storage until analysis, as specified in Section N-1.6.

7.6 Analysis

Extraction waters including exposure water samples and exposure water controls and reagent water used for wetting and conditioning shall be analyzed with the methods listed in Section N-1.7.

7.7 Normalization

The concentration of analytes present in the extraction water shall be multiplied by calculated normalization factors to account for differences between the actual laboratory evaluation ratio and the weight per volume ratio in Table 7.2.

7.7.1 Process media with manufacturer's recommended use concentration

The concentration reported by the laboratory shall be normalized with the following equation:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{\text{manufacturer's use concentration (mg/L)}}{\text{laboratory evaluation ratio (mg/L)}}$$

This equation shall be used to normalize media that is sold with use specifications indicating a maximum use concentration (MUC) which can be calculated as follows:

$$\text{MUC} = \frac{[(1\text{ft}^2) \times (\text{bed depth ft}) \times (\text{density g/cm}^3) \times (28,320 \text{ cm}^3/\text{ft}^3) \times (1000 \text{ mg/g})]}{[(\text{minimum flow rate gal/min})(60 \text{ min/hr})(1 \text{ h})]}$$

7.7.2 Process media except for activated carbon media and aeration packing media (without manufacturer's use concentration)

The concentration reported by the laboratory shall be normalized with the following equation:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{\text{weight per volume ratio (mg/L)}}{\text{laboratory evaluation ratio (mg/L)}}$$

This equation shall be used to normalize filtration media, ion exchange resins, synthetic media, and other media to the weight per volume ratios listed in Table 7.2.

7.7.3 Activated carbon media for non-POE system applications (without manufacturer's use concentration)

The concentration reported by the laboratory shall be normalized with the following equation:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{250 \text{ mg/L}}{\text{laboratory evaluation ratio (mg/L)}}$$

Equation 2 shall be used to normalize activated carbon media (granular or powdered) to a weight per volume ratio of 250 mg/L.

7.7.4 Filter precoat media (e.g., perlite, diatomaceous earth) for non-POE system applications

The concentration reported by the laboratory shall be normalized with the following equation:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{\text{manufacturer's use concentration (mg/L)}}{\text{laboratory evaluation ratio (mg/L)}}$$

Equation 3 shall be used to normalize dosed media (except PAC) to the manufacturer's recommended MUC.

7.7.5 Aeration packing media

The concentration reported by the laboratory shall be normalized with the following equation (Equation 4):

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{SA_F}{SA_L} \times \frac{V_F}{V_{F(\text{flowing})}}$$

Where:

SA_L = surface area attained during laboratory exposures;

V_L = volume of exposure water used during laboratory exposures;

SA_F = surface area of the product under field conditions; and

$V_{F(\text{flowing})}$ = minimum volume of water to which the product is exposed in the field under flowing conditions during a period of time equivalent to the laboratory evaluation.

NOTE — When manufacturer use instructions indicate that the aeration product can be subjected to static conditions in the field, normalized concentrations shall be modified to reflect the static condition. For the static condition, the $V_{F(\text{flowing})}$ parameter shall be substituted with $V_{F(\text{static})}$, which is equal to the volume of water contacting the media under static conditions in the field.

7.7.6 Process media for POE systems

The concentration reported by the laboratory shall be normalized with the following equation:

$$\text{normalized contaminant concentration} = \text{laboratory contaminant concentration} \times \frac{\text{manufacturer's recommended use concentration (mg/L)}}{\text{laboratory evaluation ratio (mg/L)}}$$

The concentration of contaminants known to be associated with any nonmedia materials or ingredients that could not be dissociated from the media, or materials that would have been released into the effluent of the system in the absence of the physical barrier provided by the media (e.g., the binder used to produce carbon blocks), shall require additional normalization to account for differences between laboratory exposed surface areas and those normally wetted under normal use conditions. This normalization adjustment shall be performed in accordance with Section N-1.8.

NOTE — For instance, carbon block end caps may have more wetted surface area exposed without the carbon block attached to normal system components.

7.8 Evaluation of contaminant concentrations

7.8.1 For process media, normalized contaminant concentrations shall be no greater than their respective SPACs, determined in accordance with NSF/ANSI/CAN 600 (previously Annex A).

7.8.2 For aeration packing media and POE media that require evaluation to the static condition, the normalized static contaminant concentrations shall be no greater than their respective MCLs or TACs, determined in accordance with NSF/ANSI/CAN 600 (previously Annex A).

Table 7.1
Product-specific minimum test batteries for process media products

| Product | Primary use | Analytes for virgin media | Analytes for regenerated / reactivated media |
|-------------------------------------|--------------|---|---|
| activated alumina | adsorption | metals, ¹ nickel, and aluminum | see footnote 2 |
| aluminum silicates (e.g., zeolites) | filtration | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | see footnote 2 |
| impregnated aluminum silicates | adsorption | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides |
| anthracite | filtration | metals, ¹ GC/MS (base neutral acid scans) | see footnote 2 |
| diatomaceous earth | filtration | metals ¹ and radionuclides | see footnote 2 |
| garnet | filtration | metals, ¹ GC/MS (base neutral acid scans) | see footnote 2 |
| granular activated carbon (GAC) | adsorption | metals, ¹ GC/MS ⁴ (base neutral acid scans) | metals, ³ GC/MS ⁴ (base neutral acid scans), and radionuclides |
| gravel | filtration | metals, ¹ GC/MS (base neutral acid scans) | see footnote 2 |
| ilmenite | filtration | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | see footnote 2 |
| ilmenite | adsorption | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides |
| ion exchange resins | ion exchange | residual monomer, other formulation dependent | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides, other formulation dependent |

Table 7.1
Product-specific minimum test batteries for process media products

| | | | |
|--|----------------------|--|---|
| impregnated ion exchange resins | adsorption | metals, ¹ GC/MS (base neutral acid scans), and radionuclides, residual monomer, other formulation dependent | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides, other formulation dependent |
| oxidative media (e.g., manganese green sand) | oxidation | metals, ¹ GC/MS (base neutral acid scans) | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides |
| perlite | filtration | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | see footnote 2 |
| powdered activated carbon (PAC) | adsorption | metals, ¹ GC/MS (base neutral acid scans) | see footnote 2 |
| metal-based media (e.g., granular iron, iron oxide, titanium dioxide, etc.) | adsorption | metals, ¹ GC/MS (base neutral acid scans), and radionuclides | metals, ³ GC/MS (base neutral acid scans), VOCs and radionuclides |
| sand | filtration | metals, ¹ GC/MS (base neutral acid scans) | see footnote 2 |
| synthetic media | aeration, filtration | formulation dependent | see footnote 2 |
| <p>¹ Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, thallium.</p> <p>² These products are not typically regenerated or reactivated at remote locations. Therefore a minimum test battery has not been established. A full formulation review would be required for these products if they are evaluated under this Standard.</p> <p>³ Metals (for reactivated and regenerated media): antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, thallium, aluminum, manganese, nickel, silver, tin, vanadium, zinc.</p> <p>⁴ GC/MS (base neutral acid scans) required if documentation identifying process controls intended to ensure complete activation/reactivation is not available.</p> | | | |

Table 7.2
Process media exposure weight per volume ratios

| Media type | Weight per volume ¹ |
|---|---|
| media with manufacturer's use instructions | ≥ manufacturer's recommended use concentration ² |
| adsorption media: | — |
| activated alumina | 625 ± 25 g/L |
| GAC and PAC | 25 ± 5 g/L |
| anthracite and gravel: ³ | — |
| ≤ 3/8" diameter particles | 625 ± 25 g/L |
| > 3/8" diameter particles | 1250 ± 25 g/L |
| filter precoat media (e.g., perlite, diatomaceous earth) | 10 times the manufacturer's recommended use concentration |
| filtration media other than anthracite or gravel | 625 ± 25 g/L |
| ion exchange resins | 625 ± 25 g/L |
| synthetic media | 625 ± 25 g/L |
| point-of-entry (POE) system media | manufacturer's recommended use concentration ⁴ |
| ¹ Weight per volume of the product on an "as shipped" basis. ² Media with manufacturer's recommended use concentration shall be exposed at this use concentration or higher. ³ For the size range specified, not more than 8% by weight shall be either finer than or coarser than the designated size limit (AWWA B100-96). ⁴ For POE application media, this shall be the maximum value recommended by the manufacturer of the ratio of the weight of media ¹ per 'unit void volume' of a POE system. | |

Table 7.3
**Maximum conditioning expansion rates for
filtration and adsorption media**

| Media type | Maximum laboratory expansion rate of wetted media (by height) (%) |
|------------------------------------|---|
| activated alumina | 25 ± 5% |
| aluminum silicates (zeolites) | 25 ± 5% |
| anthracite | 25 ± 5% |
| garnet | 30 ± 5% |
| granular activated carbon (GAC) | 30 ± 5% |
| gravel | 10 ± 5% |
| ilmenite | 30 ± 5% |
| manganese greensand | 30 ± 5% |
| sands | 20 ± 5% |

Table 7.4
Exposure schedule for process media of ≥ 0.25 mm in diameter

| Time | Temperature | Comment |
|----------------|-------------------------------|--|
| 60 \pm 5 min | 23 \pm 2 °C (73 \pm 4 °F) | Exposure water is drained / decanted and discarded; the exposure vessel is refilled and exposure is continued. |
| 60 \pm 5 min | 23 \pm 2 °C (73 \pm 4 °F) | Exposure water is drained / decanted and discarded; the exposure vessel is refilled and exposure is continued. |
| 60 \pm 5 min | 23 \pm 2 °C (73 \pm 4 °F) | Exposure water is collected and filtered for analyses. |

8 Mechanical devices

8.1 Coverage

This Section covers devices, components, and materials used therein, that are used in treatment / transmission / distribution systems, and are in contact with drinking water intended for human ingestion, drinking water treatment chemicals, or both. Examples are listed in Table 8.1. POU drinking water treatment devices are not covered by the requirements in this Section.

8.2 Definitions

8.2.1 cold water application: A product application that is intended to result in continuous exposure to water of ambient temperature. Products are tested for an end use temperature of 23 \pm 2 °C (73 \pm 4 °F).

8.2.2 commercial hot water application: A product application that is intended to result in continuous or intermittent exposure to water that has been raised from ambient temperature. Intermittent exposure is defined as any hot water contact that is not continuous. Products are tested for an end use temperature of 82 \pm 2 °C (180 \pm 4 °F).

8.2.3 domestic hot water application: A product application that is intended to result in continuous or intermittent exposure to water that has been raised from ambient temperature. Intermittent exposure is defined as any hot water contact that is not continuous. Products are tested for an end use temperature of 60 \pm 2 °C (140 \pm 4 °F).

8.2.4 in-line device: A device (used to measure or control the flow of water) installed on a service line or building distribution system downstream of the water main and upstream of endpoint devices.

8.2.5 manifold: A device with an inlet and four or more outlets used to direct water to multiple fixtures or end use devices within a residence. Manifolds are characterized by the number of ports, which are outlets perpendicular to the manifold trunk or body.

8.2.6 building distribution system: A continuous system of piping and related fittings, beginning at the tap on the main, that is intended to convey potable water to points of usage.

8.3 Device, component, or material requirements

8.3.1 General

Devices, components, or materials shall be considered to have met the requirements of this Section if at least one of the following conditions is met:

- the devices, components, or materials covered under this Section are tested and evaluated according to the procedures specified in Sections N-1.4 and N-1.8; or

- the devices, components, or materials meet the requirements of Section 8.3.2.

When all components or materials, or both, of a device meet the requirements of this Section, the device shall also meet the requirements of this Section. When all materials of a component meet the requirements of this Section, the component shall also meet the requirements of this Section.

8.3.2 Evaluation of devices, components, or materials tested to other sections of this Standard

Devices, components, or materials that have been tested to other sections of the Standard shall meet the following criteria:

- they shall be made of the same alloy(s), composition(s), or formula(s);
- they shall have undergone analogous manufacturing processes;
- they shall have been tested at a temperature that meets or exceeds the required exposure temperature in Section N-1.4;
- they shall have been conditioned for a period of time not more than 14 d, and exposed for a period of time not less than 12 h for in-line devices or 24 h for other mechanical devices; and
- the concentration(s) of the extracted contaminant(s) shall be normalized to the requirements of Section N-1.8.

8.3.3 Metallic contaminants

When a device or component is qualified through the separate testing of two or more components, the normalized concentrations for each specific metallic contaminant from individual components shall be summed. The total of the normalized metallic contaminant concentrations shall meet the requirements of Section N-1.8.

8.4 In-line devices, components, and materials

Samples for the testing of in-line devices, components, and materials (see Section 8.1) shall be selected according to the requirements of Sections N-1.2.3 and N-1.4.1. Extraction waters shall be selected according to Section N-1.2.5. In-line product samples shall be conditioned as indicated in Section N-1.4.3. After conditioning, the samples shall be exposed as indicated in Section N-1.4.4.1 and Table N-1.8. Normalization shall be as specified in Sections N-1.8.3 and N-1.8.4, as applicable.

8.4.1 Brass or bronze containing in-line devices

The evaluation of brass or bronze containing in-line devices for contaminants other than lead shall require exposure of at least one sample in accordance with Section 8.4.

The evaluation of brass or bronze containing in-line devices for lead under the conditions below shall be exposed in at least triplicate (more if specified by the manufacturer) if the test representative holds ≤ 2 L and has a dry weight ≤ 15 kg (33 lbs). If specified by the manufacturer, the test representative that holds more than 2 L, or has a dry weight in excess of 15 kg (33 lbs) may also be exposed in a quantity greater than 1:

- when the exposure water selection is per Table N-1.3a, the pH 10 condition shall be exposed in triplicate; or
- when the exposure water selection is per Table N-1.3b, the pH 8 condition shall be exposed in triplicate.

The extraction waters from triplicate exposures shall be either combined to one sample for all contaminant analysis or shall be analyzed individually and results averaged. If more than three samples are exposed, the waters from each sample shall be analyzed individually for lead and results averaged. Averaging of results shall be performed prior to normalization. When one or more of the individual results is found to be nondetectable, the reporting limit shall be used to represent the unit results when averaging.

The normalized average result for lead shall be less than or equal to the TAC (5 µg/L). In addition, the normalized lead results of individual units exposed shall not exceed 15 µg/L.

NOTE — With this procedure, the average result is used when determining compliance with the standard for all contaminants. It also assures no individual unit exposed exceeds the standards lead criteria in effect prior to 2012-07-01 for in-line devices (15 µg/L).

8.5 POE systems, components, and media

8.5.1 POE systems

Samples for the testing of POE systems shall be selected according to the requirements of Sections N-1.2.3 and N-1.4.1. Extraction waters shall be selected according to Section N-1.2.5. Samples shall be installed, conditioned, and exposed as indicated in Section N-1.4.4.2. Normalization shall be as specified in Sections N-1.8.3 and N-1.8.4, as applicable.

8.5.2 POE system components and materials

The evaluation of POE components that require exposure under pressure to ensure evaluation of all normally wetted surfaces shall be performed according to Section 8.5.1.

For all other POE components and materials, samples for the testing shall be selected according to the requirements of Sections N-1.2.3 and N-1.4.1. Extraction waters shall be selected according to Section N-1.2.5. Samples shall be conditioned as indicated in Section N-1.4.3. Following conditioning, the samples shall be exposed as indicated in Section N-1.4.4. Normalization shall be as specified in Sections N-1.8.3 and N-1.8.4, as applicable.

Brine systems and brine system components (e.g., brine tanks, salt grids float valves) of POE systems shall not require extraction testing.

8.5.3 POE system media

Media used in POE systems submitted for evaluation separately from a complete POE system shall be evaluated to the requirements of Section 7. Media used in POE systems submitted for evaluation as part of a complete POE system shall be evaluated to the requirements of Section 8.5.1.

Evaluations of softener regeneration salts are performed under NSF/ANSI/CAN 60 *Drinking Water Treatment Chemicals – Health Effects*.

8.6 Chemical feeders and generators

Samples for the testing of chemical feeders and generators shall be selected according to the requirements of Sections N-1.2.3 and N-1.4.1. Chemical feeder and generator samples shall be conditioned as indicated in Section N-1.4.3. Following conditioning, the samples shall be exposed as indicated Section N-1.4.4.3. Normalization shall be as specified in Section N-1.8.5.

8.6.1 Solid chemical feeders

Solid chemical feeders shall be evaluated only with the specific types of chemical formulations and forms that are recommended by the feeder manufacturer. The specific chemical formulation shall also comply

with the requirements of NSF/ANSI/CAN 60 – *Drinking Water Treatment Chemicals – Health Effects*. The manufacturer shall include information regarding the specific chemical and form for which the product is certified and shall also include a warning in their installation, maintenance and operating instructions or dataplate, regarding the dangers of misuse that could result from using the wrong chemical or form, and whether or not such use would render the warranty invalid.

8.6.2 Cu/Ag generator electrodes

In addition to the evaluation of the chemical generator under Section 8.6, the electrodes for Cu/Ag generator shall be evaluated for potential nonsilver and noncopper contaminants in accordance with Section N-1.4.4.3.3.

The normalized concentration of contaminants shall be calculated in accordance with Section N-1.8.5.1 and shall be no greater than their respective SPACs, determined in accordance with NSF/ANSI/CAN 600 (previously Annex A).

8.6.3 Chemical feeders and generators for building water systems

In addition to evaluating the contribution of chemical contaminants to drinking water, chemical feeders for building water systems shall be evaluated for the control of the intentionally dosed chemical(s) to prevent exceeding the manufacturers stated maximum use level (MUL), which shall not exceed the total allowable concentration of the chemical in accordance with NSF/ANSI/CAN 600 (previously Annex A):

- the device label shall identify the MUL for the dosage of the treatment chemical;
- a direct means of controlling chemical feed or generation shall be provided;
- the product use instructions shall identify a recommended monitoring frequency for measuring the concentration of the dosed chemical(s) at each representative outlet, or designated sample point(s) as indicated by the authority having jurisdiction; and
- product use instructions and literature referencing NSF/ANSI/CAN 61 shall specify that:

“NSF/ANSI/CAN 61 addresses health effects only and does not address the disinfection efficacy of the product.”

8.7 Other mechanical devices, components, and materials

Samples for the testing of all other mechanical devices, components, and materials shall be selected according to the requirements of Sections N-1.2.3 and N-1.4.1. Extraction waters shall be selected according to Section N-1.2.5. Other mechanical product samples shall be conditioned as indicated in Section N-1.4.3. Following conditioning, the samples shall be exposed as indicated in Section N-1.4.4.2 and Table N-1.9. Normalization shall be as specified in Sections N-1.8.3, N-1.8.4, and N-1.8.6, as applicable.

8.7.1 Fire hydrants

The evaluation and normalization of fire hydrants shall be based off of the products wetted surfaces while not in use for fire related uses and maintenance. For both wet barrel designs and base valve designs (dry barrel), the evaluation should only include those materials in contact with water when valve(s) are closed.

The following table is a generic listing of the types of devices covered in this Section of the Standard. This table is not intended to be a complete list of all types of mechanical devices. Inclusion of a product does not indicate either a use endorsement of the product or an automatic acceptance under the provisions of this Standard.

**Table 8.1
Examples of mechanical devices**

| | |
|--|---|
| chemical feeders — dry feeders (e.g., pellet droppers) | switches and sensors (e.g., water level, pressure, temperature, pH) |
| pressure gas injection systems pumps | |
| vacuum injection systems | valves and related fittings fire hydrants (transmission / distribution system) |
| disinfection / generators — chlorine dioxide — hypochlorite — ozone — ultraviolet | treatment devices used in water treatment facilities (excludes point-of-use (POU) devices) — aeration technologies — clarifiers — electro dialysis technologies — microfiltration technologies — mixers — point-of-entry (POE) drinking water treatment unit systems — reverse osmosis technologies — screens — strainers — ultrafiltration technologies |
| electrical wire (e.g., submersible well pump wire) | |
| pumps | |
| in-line devices – building distribution system — backflow preventers — building valves — check valves — compression fittings — corporation stops — curb stops — expansion tanks — meter couplings in-line devices specifically excluded — boiler feed valves — drilling and tapping machines — temperature and pressure relief valves — valves with hose thread outlets — water meter test benches | — meter stops — pressure regulators — pressure tanks — service saddles — strainers — valves and fittings — manifolds — water meters |
| example POE drinking water treatment systems for evaluation under this Standard — water softeners — iron filters — whole house/building mechanical sediment filters — whole house/building GAC chlorine reduction filters — whole house UV systems | |
| example drinking water treatment units that shall not be evaluated as POE under this Standard — faucet mount filters — plumbed-in to separate tap — pour-through pitchers — refrigerator filters | |

9 Mechanical plumbing devices

9.1 Coverage

This Section covers mechanical plumbing devices, components, and materials that are typically installed within the last liter of the distribution system (endpoint devices) and are intended to dispense water for human ingestion. In-line devices are excluded from this Section. POU and POE water treatment devices are excluded.

9.1.1 Endpoint devices specifically included in the coverage of this Section are:

- remote chillers;
- lavatory faucets (e.g., centersets, widespread, mini-spread, and basin cocks), except as exempted in Section 9.1.2;
- bar faucets;
- kitchen faucets (e.g., top mounts and wall mounts);
- hot and cold water dispensers;
- drinking fountains, drinking fountain bubblers, and water coolers;
- glass fillers;
- residential refrigerator ice makers;
- flexible plumbing connectors and flexible risers intended for potable water applications;
- supply stops and endpoint control valves; and
- commercial kitchen devices (see Section 9.2.3), limited to the following:
 - pot and kettle fillers (see Section 9.2.7);
 - devices with extended standpipes or risers (see Section 9.2.5); and
 - prerinse assemblies that include an auxiliary spout or other outlet.

NOTE 1 — Only the commercial kitchen devices listed above shall be evaluated using the 18.9 L (5 gal) normalization.

NOTE 2 — The base device to which the prerinse component is added shall be considered a commercial kitchen device only if it meets the definition of either a pot and kettle filler (see Section 9.2.7) or a device with extended standpipes or risers (see Section 9.2.5).

9.1.2 Endpoint devices specifically exempted from the coverage of this Section are:

- bath and shower valves, shower heads of all types, and Roman tub valves;
- all drains;
- backflow prevention devices;
- flexible plumbing connectors and flexible risers not intended for potable water applications (e.g., washing machines, dishwashers, etc.);

- prerinse assemblies that do not include an auxiliary spout or other outlet; and
- all endpoint devices that are not specifically intended to dispense water for human consumption, for example:
 - utility, laundry, laboratory, bidet, and shampoo faucets;
 - faucets with a hose thread spout end or with a quick disconnect end;
 - faucets that are self-closing or metering;
 - electronically activated nonkitchen faucets; or
 - hand wash stations.

9.1.3 Endpoint devices that are exempted from the scope of this Section shall be permitted to be evaluated at the option of the manufacturer. With the exception of exempted prerinse assemblies, all exempted devices shall be evaluated using the 1 L (0.26 gal) draw. Exempted prerinse assemblies shall be evaluated using the 18.9 L (5 gal) draw.

9.2 Definitions

9.2.1 cold mix volume adjustment factor (CMV): The cold water volume of a device divided by the total water volume of the device.

9.2.2 cold water volume: The volume of water contained within the portion of a device that is normally contacted by cold water (from inlet to outlet) when the device is connected to hot and cold water supplies under normal operating conditions. The volume excludes the volume of water contained within the portion of the device that is normally contacted only by hot water.

9.2.3 commercial kitchen device: An endpoint device whose sole application is the delivery of water for food preparation in commercial kitchens.

9.2.4 consumer-facing: The manner in which a product label feature is experienced, directed, or seen by a customer.

9.2.5 endpoint device: A single device typically installed within the last 1 L (0.26 gal) of the water distribution system of a building.

9.2.6 extended standpipe or riser device: An endpoint device that includes a vertical component having a minimum height of 41 cm (16 in) measured from the deck to the outlet of the endpoint device, and whose sole application is the delivery of water for food preparation in commercial kitchens.

9.2.7 in-line device: A device (used to measure or control the flow of water) installed on a service line or building distribution system downstream of the water main and upstream from endpoint devices.

9.2.8 pot and kettle filler: An endpoint device whose sole application is the delivery of water to fill pots and kettles in commercial kitchens.

9.2.9 prerinse assembly: An endpoint device with a hose and spray whose application is water delivery for the rinsing of tableware in commercial kitchens.

9.2.10 remote chiller: A device designed to deliver chilled water, typically installed in a remote location to enhance aesthetics, that is connected to the spigot(s) / spout(s) by pipe / tubing and is generally installed within the last 1 L (0.26 gal) of the water distribution system of a building.

9.2.11 water distribution system (building): A continuous system of piping, devices, and related fittings, beginning after the water meter and water meter setting equipment, that is intended to convey potable water in a building to points of usage.

9.3 Device, component, or material requirements

9.3.1 General

Devices, components, or materials shall be considered to have met the requirements of this Section if at least one of the following conditions is met:

- the devices, components, or materials covered under this Section are tested and evaluated according to procedures specified in Sections N-1.5 and N-1.8; or
- the devices, components, or materials meet the requirements of Section 9.3.2.

When all components or materials, or both, of a device meet the requirements of this Section, the device shall also meet the requirements of this Section. When all materials of a component meet the requirements of this Section, the component shall also meet the requirements of this Section.

9.3.2 Evaluation of devices, components, or materials tested to other sections of this Standard

Devices, components, or materials that have been tested to other sections of this Standard shall:

- be made of the same alloy(s), composition(s), or formula(s);
- have undergone analogous manufacturing processes;
- have been tested at a temperature that meets or exceeds the required exposure temperature in Section N-1.5;
- have been conditioned for a period of time not more than 19 d and exposed for a period of time not less than 16 h; and
- have the concentration(s) of the extracted contaminant(s) normalized to the requirements of Section N-1.8.

9.3.3 Metallic contaminants

When a device or component is qualified through the separate testing of two or more components, the normalized concentrations for each specific metallic contaminant from individual components shall be summed. The total of the normalized metallic contaminant concentrations shall meet the requirements of Section 9.5.

9.4 Exposure and normalization

Samples for testing shall be prepared and exposed, and the extractant water analyzed as required in Section N-1.5. The number of samples tested shall be determined as outlined in Section N-1.5.

Exposure of endpoint samples, except for hot water dispenser samples, shall be performed at 23 ± 2 °C (73 ± 4 °F).

For kitchen faucets with side spray components, the side spray component shall be prepared and exposed simultaneously with the remainder of the device. At the option of the manufacturer, a separate exposure may be performed for the side spray component.

The concentration of extracted contaminants shall be normalized to end use conditions according to the normalization procedure outlined in Section N-1.8 for endpoint devices, components, and materials. All endpoint devices, components, and materials other than commercial kitchen devices shall be evaluated using the highest surface area-to-volume product as the test sample, and shall be normalized using the

1 L (0.26 gal) first draw. Commercial kitchen devices shall be evaluated using the highest surface area-to-volume product as the test sample, and shall be normalized using the 18.9 L (5 gal) first draw.

9.5 Evaluation of normalized contaminant concentrations

9.5.1 Evaluation of lead

For endpoint devices other than commercial kitchen devices, supply stops, flexible plumbing connectors, and miscellaneous components, the lead test statistic Q shall not exceed $5 \mu\text{g}$ when normalized for the 1 L (0.26 gal) first draw sample. For commercial kitchen devices, the lead test statistic Q shall not exceed $5 \mu\text{g}$ when normalized for the 18.9 L (5 gal) first draw sample. For supply stops, flexible plumbing connectors, and miscellaneous components, the lead test statistic Q shall not exceed $3 \mu\text{g}$ when normalized for the 1 L (0.26 gal) first draw sample.

For kitchen faucets that have been exposed simultaneously with the side spray component, the lead test statistic Q value for the entire assembly shall not exceed $5 \mu\text{g}$. When the kitchen faucet and the side spray component have been exposed separately, the lead test statistic Q value for the faucet and side spray shall be added and shall not exceed $5 \mu\text{g}$.

9.5.1.1 Optional lower lead requirements

The following are optional evaluation criteria available for endpoint devices to demonstrate compliance with a lower lead leaching criteria. Product shall also comply with the full requirements of NSF/ANSI/CAN 61 to be deemed compliant to this Section.

9.5.1.1.1 Evaluation requirements

For endpoint devices other than supply stops, flexible plumbing connectors, and miscellaneous components, the test statistics Q or R calculated in accordance with Section N-1.8.9 shall not exceed $1 \mu\text{g}$. For supply stops, flexible plumbing connectors, and miscellaneous components, the lead test statistic Q shall not exceed $0.5 \mu\text{g}$.

9.5.1.1.2 Product labeling requirements

Attested compliance of product to the lower lead leaching criteria of this Section shall be noted in the certification listing. Consumer-facing product packaging or labeling shall also indicate this compliance by identifying the standard and Q level attested according to Section 9.5.1.1.1 (e.g., “NSF/ANSI/CAN 61: $Q \leq 1$ ” or “NSF/ANSI/CAN 61: $Q \leq 0.5$ ”).

9.5.2 Evaluation of nonlead contaminants

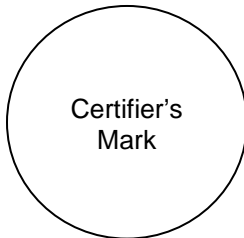
For endpoint devices other than commercial kitchen devices, the normalized concentration of a nonlead contaminant shall not exceed its SPAC (calculated in accordance with NSF/ANSI/CAN 600 (previously Annex A) when normalized for the 1 L (0.26 gal) first draw sample. For commercial kitchen devices, the normalized concentration of a nonlead contaminant shall not exceed its SPAC when normalized for the 18.9 L (5 gal) first draw sample.

For kitchen faucets that have been exposed simultaneously with the side spray component, the normalized concentration of a nonlead metal contaminant for the entire assembly shall not exceed its SPAC. When the kitchen faucet and the side spray component have been exposed separately, the normalized concentration of a nonlead metal contaminant for the faucet and side spray shall be added and shall not exceed its SPAC.

10 Instructions and information

When product literature, instructions, or information for a POE drinking water treatment unit system shows conformance with the materials safety requirements of this Standard as attested by a certification agency, and when the POE treatment system is not likewise certified by that same agency for drinking water contaminant reduction performances, such literature, instructions, and information shall state in comparable proximity and with comparable prominence either:

- the name of the entity that has tested and substantiated the claimed contaminant reduction performances for that water treatment product; or
- that the product is not certified for contaminant reduction performance by the certification agency. The following is an example of an accepted option:



Point-of-Entry System Tested and Certified by [Name of Certifier]
under NSF/ANSI/CAN 61 for Materials Safety Requirements Only.
Not Certified for Contaminant Reductions or Structural Integrity by
[Name of Certifier]

NOT FOR
DISTRIBUTION
OR SALE

Normative Annex 1

Product / material evaluation

N-1.1 Background

Products / materials to be evaluated shall be prepared and exposed, and the extraction medium (e.g., water or chemical) analyzed, as described in this Annex. Examples of products / materials covered by this Annex are shown in Table N-1.1.

Table N-1.2 in this annex outlines the various preparation and exposure methods for the products / materials covered by the Annex.

The analytical methods included are based on contaminants that are likely to be present when established methods of production are used and the materials are derived from known sources. Modifications to the analytical procedures shall be permitted when products / materials are created with alternate methods or have originated from alternate sources.

N-1.2 General evaluation requirements

N-1.2.1 General

The requirements described in this Section are general requirements and apply to all products / materials covered by NSF/ANSI/CAN 61, Annex N-1. N-1.3 to N-1.5 describe specific preparation, conditioning, and exposure sequences unique to individual product/material categories.

N-1.2.2 Quality assurance (QA) and quality control (QC) and safety

The methods included in Sections N-1.3 to N-1.5 have been written for trained chemical laboratory personnel. Appropriate QA procedures and safety precautions shall be followed.

N-1.2.3 Samples

N-1.2.3.1 Material evaluation

A representative sample of the material (in either material sample or finished product form) shall be exposed.

N-1.2.3.2 Finished product evaluation

- samples of the finished product (e.g., pipe, fitting, or device) shall be exposed except in the following specific instances:
 - concrete cylinders, cubes, or other concrete surrogate samples shall be permitted to be evaluated on behalf of concrete lined pipes and other concrete-based products;
 - coatings, applied to an appropriate substrate, shall be permitted to be evaluated on behalf of products whose entire water contact surface is covered by the coating; and

- finished products shall be permitted to be evaluated using material samples if finished product evaluation is impractical for one or more of the following reasons:
 - an internal volume greater than 20 L (5.3 gal);
 - a weight greater than 34 kg (75 lbs); or
 - *in situ* manufacture of the finished product.

Material samples shall be permitted to be evaluated on behalf of a finished product if, and only if, no chemical or physical difference exists between the material sample and the material as represented in the finished product. All material samples shall be produced using all the same manufacturing processes as the finished product.

N-1.2.4 Washing

To remove any extraneous debris or contamination that occurred during shipping and handling, samples shall be rinsed with cold tap water prior to testing, followed by a rinse with reagent water meeting the requirements of Section N-1.9.2.1, unless the manufacturer's instructions direct otherwise. If the exterior of a product is exposed, any printed markings (e.g., ink markings) shall be removed.

N-1.2.5 Extraction waters

Samples shall be exposed, based on a formulation review and determination of the most severe condition(s), to the required extraction waters as detailed in Table N-1.3a, except for mechanical plumbing devices (see Section N-1.5.5). At the discretion of the manufacturer, the extraction waters detailed in Table N-1.3b shall be used as an alternate to those in Table N-1.3a. The characteristics and preparation of the waters are described in Section N-1.9.

The test water formulations as provided in Section N-1.9 shall be used without the addition of free available chlorine when testing high flow devices (or their components) exclusively used at public water treatment facilities and typically installed prior to chlorination.

NOTE — Some materials used in these devices may be damaged by chlorine and test waters that include chlorine would not be representative of field use conditions for this use type.

N-1.2.5.1 Exceptions

The manufacturer shall have the option specifically to request a change in the extraction water used, based on the intended application or the materials used in the device / product, provided that the manufacturer's use instructions indicate the use limitations.

N-1.2.5.2 Mechanical devices used in contact with drinking water treatment chemicals

These devices and materials shall be exposed to the chemicals and chemical mixtures that have been specified by the manufacturer.

N-1.2.6 Product exposure

Samples shall be evaluated either "in-the-product / device" or in an exposure vessel.

N-1.2.6.1 Exposure in the product / device

When practical, products / devices shall be evaluated so that only the (exposed) wetted surface is exposed to extraction medium.

N-1.2.6.2 Exposure in vessels

Samples that are not evaluated as described in Section N-1.2.6.1 shall be exposed to the extraction medium in containers composed of a material that is inert to the exposure water and with polytetrafluoroethylene (PTFE) lined lids, with no headspace.

Products exposed in vessels shall be exposed so that the surface area-to-volume ratio described in the appropriate section (N-1.3 to N-1.5) shall be maintained.

N-1.2.6.3 Residual vinyl chloride monomer (RVCM)

Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe products / materials shall be evaluated for RVCM. RVCM shall be determined in the product wall, rather than by extraction, in accordance with Section N-1.7.

N-1.2.7 Material exposure

Materials shall be exposed according to the protocol outlined for the materials' specified end use(s). If a material is intended for use in the manufacture of products covered under more than one section of this Standard, the most stringent exposure condition shall be followed (e.g., temperature or surface area-to-volume ratio). Materials intended to be processed by more than one method (e.g., injection molding, extrusion, or stamping) shall be tested in each of the processed forms.

N-1.2.7.1 Exposure of a material sample

A materials manufacturer shall have the option to request that a material be tested as a material sample (e.g., plaque, sheet) if, and only if, there is no chemical or physical difference in the material characteristics between the material sample and the material as it is used in covered applications. If the material is intended to be used only for the manufacture of products falling under the scope of a single section of this Standard, the material shall be exposed under the conditions set forth in the corresponding section of this Annex. The normalized contaminant concentrations shall meet the requirements of NSF/ANSI/CAN 600 (previously Annex A).

N-1.2.7.2 Exposure in product form

A materials manufacturer shall have the option to request that a material be tested in the form of a finished product according to the protocol set forth in the appropriate section(s) of this Annex.

N-1.2.7.3 Surface area-to-volume ratio (s/v)

When a material is tested in the form of a material sample or in product form, the dimensions of the material or the product sample tested, and the extraction medium volume, shall be recorded and the laboratory tested surface area-to-volume ratio calculated. When necessary, laboratory extraction results shall be adjusted to reflect the difference between laboratory and field surface-to-area volume ratios.

N-1.2.8 Exposure conditions

Exposure begins immediately after washing or the appropriate conditioning.

N-1.2.8.1 Control samples

Exposure controls shall be prepared using the same extraction water and in the same manner as product samples, but no product shall be added. Any uncoated substrate or other nonproduct components or materials of test assemblies shall be included. Exposure controls shall be processed with all samples.

The control samples shall be evaluated for all target analysis as the product samples. The results for the control samples analysis shall be subtracted from the results for the corresponding product sample analysis prior to normalization.

N-1.2.8.2 Sequential exposure

Tests for evaluation shall be conducted using a sequential exposure procedure. There shall be no significant time interval between exposures (decant, discard, fill, continue exposure). The products shall be exposed depending on the intended end use application, as described in the appropriate section (N-1.3 to N-1.5). Analyses shall be performed only on the final extraction medium, unless otherwise noted.

N-1.3 Joining and sealing materials

N-1.3.1 Sample requirements

Test samples of joining and sealing materials shall be prepared so that, upon exposure, a minimum surface area-to-volume ratio of 15 cm²/L (8.8 in²/gal) is obtained. Materials used at higher surface-to-volume ratios in the field shall be exposed at or above the actual use ratio. Test samples for the various types of joining and sealing materials are described in Table N-1.4.

N-1.3.2 Preparation

Samples shall be prepared so that the entire surface to be exposed is covered by extraction water. Products (as appropriate) shall be applied to a glass panel in a manner consistent with the manufacturer's published instructions. Products requiring a reactive substrate (i.e., where glass is inappropriate), shall be applied to an appropriate alternate substrate.

N-1.3.2.1 Gasket materials

Gasket materials shall be cut to the appropriate size as described in Section N-1.3.1.

N-1.3.2.2 Caulks, greases, lubricants, and sealants

Caulks, greases, lubricants, and sealants shall be applied to a glass panel in such a manner that an even film, consistent with end use, is exposed and the surface area-to-volume ratio described in Section N-1.3.1 is maintained. The slides shall be allowed to air dry or cure according to the manufacturer's published instructions.

N-1.3.2.3 Adhesives and cements

N-1.3.2.3.1 Adhesives and cements intended for joining pipe and fittings shall be prepared as pipe and fittings joints assembled in accordance with the manufacturer's use instructions. The joints shall be produced using 1/2 in nominal diameter pipe (or tubing) and fittings, or the minimum size specified by the manufacturer, if that size is greater. Unless the manufacturer's use instructions state otherwise, PVC pipe and fitting joints shall be assembled per ASTM D2855 and CPVC pipe and fitting joints assembled per Appendix XI of ASTM F493. If the manufacturer's use instructions recommend the use of a primer, testing shall incorporate the use of a primer. Unless the manufacturer's use instructions state otherwise, joints shall be allowed to air cure for 48 ± 2 h at room temperature prior to washing, conditioning, and exposure in-product.

N-1.3.2.3.2 Adhesives and cements not intended for joining pipes and fittings shall be prepared in a manner consistent with the manufacturer's use instructions. These products shall be applied to glass panels (or the manufacturer's intended substrate) so that an even film, consistent with end use, is exposed at a field surface area-to-volume ratio greater than or equal to that of a typical installation. Unless the

manufacturer's use instructions indicate otherwise, the slides shall be allowed to air cure for 48 ± 2 h at room temperature prior to washing, conditioning, and exposure in-vessel.

N-1.3.2.4 Solders

These products shall be prepared by placing the solder in a ceramic combustion boat (96 × 12 × 10 mm). The amount of solder used shall be sufficient to cover the bottom of the boat. The boat (with solder) shall then be placed in a muffle furnace that has been set to a temperature hot enough to melt the solder within 2 minutes). The boat shall be allowed to cool and the solder piece removed.

N-1.3.2.5 Fluxes

Fluxes shall be prepared by applying a thin film to a copper sheet of the appropriate size as described in Section N-1.3.1. The copper sheet shall then be placed on a hot plate that has been heated to $300 \text{ }^\circ\text{C}$ ($572 \text{ }^\circ\text{F}$) $\pm 15 \text{ }^\circ\text{C}$. The copper sheet (with flux) shall be allowed to heat for 90 ± 5 s. The copper sheet shall be allowed to cool prior to exposure.

NOTE — Placement of aluminum foil over the hot plate is recommended to minimize the potential for contamination during sample preparation. The foil should be placed carefully to not create creases or folds that might interfere with the heat transfer.

N-1.3.3 Conditioning for joining and sealing materials intended for joining pipe and fittings

After washing (see Section N-1.2.4), and prior to exposure, product / material samples shall be conditioned to simulate pre-use flushing and disinfection procedures. The samples shall be exposed for evaluation immediately after conditioning. Joining and sealing materials shall be conditioned at the temperature appropriate for the intended end use. The product samples shall be conditioned in accordance with Section 4.5.5 for single time point evaluations and Section 4.5.7 for multiple time point evaluations.

N-1.3.4 Conditioning for all other joining and sealing materials

After preparation, the test samples shall be washed as described in Section N-1.2.4.

N-1.3.5 Exposure for joining and sealing materials intended for joining pipe and fittings

Exposure shall begin immediately after conditioning. The samples shall be exposed to the appropriate extraction water according to Section N-1.2.5, based on end use or application. The product samples shall be exposed in accordance with Section 4.5.6 for single time point evaluations or in accordance with Section 4.5.7 for multiple time point evaluations. The extraction water shall be collected for analysis as described in Section N-1.6.

N-1.3.6 Exposure for all other joining and sealing materials

After conditioning, these materials shall be exposed in the appropriate extraction water (see Section N-1.2.5) in accordance with the intended end use application as described below. The extraction water samples shall be collected as described in Section N-1.6.

N-1.3.6.1 Cold application

Products to be evaluated for cold applications shall be exposed using the sequence in Table N-1.5.

N-1.3.6.2 Hot application samples

Products to be evaluated for hot applications shall be exposed using the sequence in Table N-1.6.

N-1.3.7 Multiple time point protocol

When the normalized concentration of a contaminant exceeds, or is expected to exceed, its acceptable level when evaluated as a single time point exposure, determination of the contaminant leaching rate using a multiple time point exposure shall be considered. For the purpose of contaminant concentration evaluation, Day 1 shall be defined as the time point at which extractant water is collected for analysis under the single time point exposure protocol. Day 90 shall be defined as 90 d after this time point. When over time data are used, the Day 1 concentration for the contaminant of concern shall meet the short term exposure level and Day 90 concentration shall meet the total allowable concentration (TAC) / single product allowable concentration (SPAC) respectively. When extrapolation is used, the relationship between contaminant concentration and time shall be determined and plotted using a minimum of five data points.

When a multiple time point protocol is employed in the evaluation of a contaminant, consideration shall be given to the availability of appropriate toxicity data to define an acute exposure limit for the contaminant, as required in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5). Consideration shall also be given to the leaching characteristics of the contaminant. Multiple time point analysis shall not be used for lead or any other metal contaminant listed as a regulated contaminant by US EPA or Health Canada.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be exposed at the selected application temperature (e.g., 23 ± 2 °C; 60 ± 2 °C; 82 ± 2 °C) for the full duration of the exposure. Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 and after the final exposure terminating on Day 90. The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure.

N-1.4 Mechanical devices

N-1.4.1 Samples

Samples shall consist of the entire device, portion(s) / component(s) of the device, or a specimen of the material(s). The manufacturer shall have the option to request that the samples represent a product line of varying sizes, as described below. When it is necessary to calculate normalization factor(s), the wetted exposed surface area of the sample shall be calculated and recorded prior to testing.

N-1.4.1.1 Entire device

A single device shall represent a product line of varying sizes when:

- materials are of the same alloy, composition, or formulation;
- materials have undergone the same manufacturing process (e.g., casting or extrusion);
- designs are analogous; and
- it has the greatest exposed wetted surface area-to-volume ratio.

The wetted surface area-to-volume ratio shall be calculated as $SA_F / V_{F(static)}$, with SA_F equal to the surface area exposed in the field, and $V_{F(static)}$ equal to the volume of water to which the device is exposed under the static condition. The surface area-to-volume ratio for a device with an internal volume of less than 1 L (0.26 gal) shall be calculated with the assumption that $V_{F(static)}$ is equal to 1 L (0.26 gal).

NOTE 1 — For a product line of varying sizes with volumes of less than 1 L (0.26 gal), the device with the largest wetted surface area will be the device with the greatest exposed surface area-to-volume ratio.

NOTE 2 — Design differences such as external and internal threaded outlets shall not be considered analogous.

NOTE 3 — For internal threaded products, SA_F shall be equal to the normally wetted surface area of the product including 25% of the threaded area(s). The capacity of the product shall be equal to the volume of

water contacted by the wetted surface area of the product including the volume contained within 25% of the threaded area(s). When the product capacity is less than 1 L (0.26 gal), $V_{F(static)}$ shall equal 1 L (0.26 gal). When the product capacity is equal to or greater than 1 L (0.26 gal), $V_{F(static)}$ shall be equal to the capacity.

N-1.4.1.2 Component

A component shall represent a product line of varying sizes when:

- materials are of the same alloy, composition, or formulation;
- materials have undergone the same manufacturing process, e.g., casting or extrusion;
- designs are analogous; and
- it has the greatest exposed wetted surface area-to-volume ratio.

The wetted surface area-to-volume ratio shall be calculated as $SA_F / V_{F(static)}$, with SA_F equal to the surface area exposed in the field, and $V_{F(static)}$ equal to the volume of water to which the component is exposed under the static condition. The surface area-to-volume ratio for a component with an internal volume of less than 1 L (0.26 gal) shall be calculated with the assumption that $V_{F(static)}$ is equal to 1 L (0.26 gal).

NOTE 1 — For a product line of varying sizes with volumes of less than 1 L (0.26 gal), the component with the largest wetted surface area will be the component with the greatest exposed surface area-to-volume ratio.

NOTE 2 — Design differences such as external and internal threaded outlets shall not be considered analogous.

NOTE 3 — For internal threaded products, SA_F shall be equal to the normally wetted surface area of the product including 25% of the threaded area(s). The capacity of the product shall be equal to the volume of water contacted by the wetted surface area of the product including the volume contained within 25% of the threaded area(s). When the product capacity is less than 1 L (0.26 gal), $V_{F(static)}$ shall equal 1 L (0.26 gal). When the product capacity is equal to or greater than 1 L (0.26 gal), $V_{F(static)}$ shall be equal to the capacity.

N-1.4.1.3 Material

The material shall be representative of that used in the component or device.

Materials shall be evaluated using a minimum surface area-to-volume ratio of 50 cm²/L.

N-1.4.2 Sample preparation

Prior to conditioning and exposure, the samples shall be washed as described in Section N-1.2.4, unless the manufacturer's instructions direct otherwise. When required, the device shall be properly prepared per the manufacturer's recommendations.

N-1.4.2.1 To the extent possible, test samples shall be prepared so that the laboratory surface area-to-volume ratio is equal to or greater than the surface area-to-volume ratio at which the product is intended to be used in the field. When the use of test assemblies is required, they shall be constructed in a manner as to not cover an otherwise wetted surface. Test assembly end closures that marginally increase the volume of the test assembly beyond the volume at which the product is intended to be used in the field may be used. Components and materials added to the test sample to form the test assembly shall be present in the control sample.

N-1.4.2.2 Metal and metal-containing product samples that are connected to pipe or tubing products under normal installation conditions shall be attached to lengths of pipe or tubing of the appropriate nominal diameter for the extraction test. When preparing a test sample in this manner, the assembly shall be designed such that the volume of the test sample plus the attached pipe or tubing is equal to the $V_{F(static)}$ for the product when the unit volume exceeds 1 L. If the unit volume of the product being tested is less than 1 L, the attached pipe volume combined with the product volume shall be equal to 1 L ($\pm 5\%$) for the test sample.

When the test sample contains internal threaded outlets, 75% of the threaded surface area(s) shall be covered by insertion of a threaded component of the appropriate diameter to produce a watertight seal. The threaded component shall also be present in the control sample.

Assemblies should be made of relatively inert materials and designed in a manner that eliminates or minimizes the occurrence of the same contaminant being present in the control and the test sample whenever possible. The control shall be made of the same material and exposed at the same surface area to volume ratio as the test sample.

Threaded products shall be assembled by threading a pipe material which has been cut to an appropriate length equal to the $V_{F(\text{static})}$. For products being tested that are less than 1 liter, the attached pipe volume combined with the product volume shall be equal to 1 L ($\pm 5\%$) for the test sample. When preparing a product which has a soldered joint, the control shall be prepared using the same solder and extension material as the test sample. Products with quick connect fitting ends are most easily assembled by attaching polyethylene tubing, cut to the appropriate length and diameter using the same polyethylene tubing for the control.

Nonmetal product samples that are connected to pipe or tubing products under normal installation conditions may be prepared as described for metal and metal-containing product samples. Nonmetal containing products may also be prepared so that the laboratory surface area-to-volume ratio is equal to ($\pm 5\%$) or greater than the surface area-to-volume ratio at which the product is intended to be used in the field.

Components (e.g., gaskets or O-rings) of a mechanical device that are wetted under normal operating pressures but are not wetted under the conditions of a static exposure shall be tested separately from the assembly in an “in vessel” exposure. The laboratory surface area for the “in vessel” exposure shall be, at a minimum, ten-fold greater than the wetted surface area of the product to ensure that the reporting level of the analysis, when normalized, is equal to or less than the pass/fail criteria for all contaminants. The result of the “in vessel” exposure shall then be normalized to the applicable surface area of the product.

N-1.4.3 Conditioning

Conditioning shall be conducted either in the device or in a vessel. Table N-1.7 provides examples of typical exposures for the various products covered by this Section. The test samples shall be conditioned in accordance with Section 4.5.5 for single time point evaluations and Section 4.5.7 for multiple time point evaluations. Chemical feeders and generators are conditioned per manufacturer’s instructions.

N-1.4.4 Exposure

N-1.4.4.1 In-line device samples

After conditioning, the samples shall be exposed as described in Table N-1.7 in the appropriate extraction media (Section N-1.2.5). Samples shall be exposed in accordance with Section 4.5.6 for single time point evaluations and Section 4.5.7 for multiple time point evaluations. The extraction water shall be collected for analysis as described in Section N-1.6.

N-1.4.4.1.1 Manifolds with a single water chamber are exposed as per Section N-1.4.4.1.

N-1.4.4.1.2 Dual chamber manifolds with two noncontiguous water chambers are functionally two separate devices. Dual chamber style manifolds may be exposed at two different temperatures, such that the cold water chamber is exposed at 23 °C (73 °F) and the hot water chamber is separately exposed at the appropriate hot water temperature.

N-1.4.4.1.3 For thermal expansion tanks, the exposure shall be at the selected temperature, either 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) unless the manufacturer’s use instructions restrict installation of the tank to the cold water side of the water heater. For cold-side restricted thermal expansion tanks,

the exposure water shall be preheated to 38 ± 2 °C (100 ± 4 °F) prior to initiating each of the exposures in Table N-1.8 and the product exposure allowed to cool to 23 ± 2 °C (73 ± 4 °F) over the course of the exposure period.

NOTE — Studies have shown that the maximum temperature observed in thermal expansion tanks placed on the cold water side of water heaters is approximately 38 °C (100 °F) and that the temperature declines during the static periods that follow.

N-1.4.4.2 POE systems and system components requiring exposure under pressure

N-1.4.4.2.1 The system or component(s) of a system shall be installed and flushed in accordance with the manufacturer's instructions using the exposure water specified in Section N-1.2.5 at an initial inlet static pressure of 340 kPa (50 psig).

N-1.4.4.2.2 After flushing, the system or component(s) shall be conditioned in accordance with the times and temperatures specified in Section N-1.4.3 and exposed in accordance with the times and temperatures specified in Section N-1.4.4.1, each using the exposure water specified in Section N-1.2.5 at an initial inlet static pressure of 340 kPa (50 psig).

N-1.4.4.2.3 At the conclusion of the third exposure period, the sample volume shall be collected. The entire unit volume shall be collected in a suitable collection vessel, and subsamples for analysis obtained from this volume. When additional extraction water is needed to complete all analyses, additional samples shall be exposed.

N-1.4.4.2.4 Systems with adsorptive or absorptive media shall be tested with and without the media. Testing without media shall include removal of the adsorptive or absorptive media from the system, as well as the removal of any nonmedia materials or ingredients that cannot be dissociated from the media or materials that would be released into the effluent of the system in the absence of the physical barrier provided by the media.

NOTE — An example is the binder used to produce carbon blocks. Normalization for changes in wetted surface area from the normal configuration should be taken into account. Carbon block end caps, for example, will have more wetted surface area exposed without the carbon block attached, and an appropriate adjustment in the end caps included in the exposure shall be made.

When these units are evaluated with the media removed, the evaluation shall be as specified in Sections N-1.4.4.2.1 through N-1.4.4.2.3. When these units are evaluated with the media, the evaluation shall be as specified in Section 7.5.5.4.

N-1.4.4.3 Chemical feeder and generator exposure

N-1.4.4.3.1 Complete devices

Complete devices shall be operated per manufacturer's instructions until target dose levels are achieved. The unit is then turned off for a minimum of a 4 h period at 23 ± 2 °C (73 ± 4 °F). If it will take longer than 1 h to collect a volume of chemical equivalent to the system volume, it is acceptable to reduce the 4 h exposure period so that the entire hold time and collection time is equivalent to 5 h. If it will take longer than 4 h to collect the system volume, the unit shall be turned off for a minimum of a 1 h period prior to collection of the entire system volume. For devices that normally operate at lower or higher temperatures, the exposure shall be at the normal operating temperature. The extractant shall be collected in a vessel appropriate for shipping and storage. For chemical feeders, a sample of the chemical prior to feeding shall be collected if possible. For chemical generators, samples of the raw precursor chemicals if applicable shall be collected. For all devices where the extractant is a mixture of water and the chemical(s), a sample of the influent water shall be collected and preserved as described in Section N-1.6. The extractant shall be prepared in accordance with the preparation methods in NSF/ANSI/CAN 60. Samples of the chemicals prior to feeding samples of raw materials, and influent water samples, shall be analyzed for background

levels of contaminants only if, after normalization, the concentration of a contaminant(s) exceeds the SPAC (see Section N-1.8.5).

N-1.4.4.3.2 Components of chemical feeders and generators exposure

The samples shall be exposed to the appropriate drinking water treatment chemical or chemical mixture for a minimum of 4 h (or for a longer period as recommended by the manufacturer) at 23 ± 2 °C (73 ± 4 °F). For devices that normally operate at lower or higher temperatures, the exposure shall be at the normal operating temperature. The extractant shall be collected in a vessel appropriate for shipping and storage. For chemical feeder component, a sample of the chemical prior to feeding shall be collected if possible. For chemical generators, samples of the raw precursor chemicals if applicable shall be collected. For all devices where the extractant is a mixture of water and the chemical(s), a sample of the influent water shall be collected and preserved as described in Section N-1.6. The extractant shall be prepared in accordance with the preparation methods in NSF/ANSI/CAN 60. Samples of the chemicals prior to feeding samples of raw materials, and influent water samples, shall be analyzed for background levels of contaminants only if, after normalization, the concentration of a contaminant(s) exceeds the SPAC (see Section N-1.8.5).

N-1.4.4.3.3 Cu/Ag generator electrodes

In addition to the evaluation of the chemical generator under Section N-1.4.4.3.1, the electrodes for a Cu/Ag generator shall be evaluated for potential nonsilver and noncopper contaminants.

N-1.4.4.3.3.1 Sampling

It is acceptable to obtain samples from components by various methods, such as drilling, turning, sawing, or milling. Where possible, blend material from a minimum of three areas taken at random locations across the electrode, so as to obtain a sample that is representative of the properties of the entire unit. With the exception of very large parts, test pieces should be drilled or sawn completely through in order to avoid over- or underrepresentation of the center portion.

N-1.4.4.3.3.2 Sample preparation

Dissolve a minimum of 1.0 g of sample in accordance with US EPA SW-8464 Method 3050B, Method 3052, or equivalent. It is permissible to employ other applicable sample preparation methods, provided that adequate performance is demonstrated for the analytes and matrices of interest.

Analysis of the dissolved sample for the analytes of interest shall be performed in accordance with Section 7.

N-1.4.4.4 Other mechanical devices

After conditioning, other mechanical devices shall be exposed using the appropriate extraction media (see Section N-1.2.5) as indicated in Table N-1.7. Samples shall be exposed in accordance with Section 4.5.6 for single time point evaluations and Section 4.5.7 for multiple time point evaluations with the exception of using Table N-1.9 in lieu of Table 4.2. The extraction water shall be collected for analysis as described in Section N-1.6.

N-1.4.5 Multiple time point protocol

When the normalized concentration of a contaminant exceeds, or is expected to exceed, its acceptable level when evaluated as a single time point exposure, determination of the contaminant leaching rate using a multiple time point exposure shall be considered. For the purpose of contaminant concentration evaluation, Day 1 shall be defined as the time point at which extractant water is collected for analysis under the single time point exposure protocol. Day 90 shall be defined as 90 d after this time point. When over time data are used, the Day 1 concentration for the contaminant of concern shall meet the short term exposure level and Day 90 concentration shall meet the TAC/SPAC respectively. When extrapolation is

used, the relationship between contaminant concentration and time shall be determined and plotted using a minimum of five data points.

When a multiple time point protocol is employed in the evaluation of a contaminant, consideration shall be given to the availability of appropriate toxicity data to define an acute exposure limit for the contaminant, as required in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5). Consideration shall also be given to the leaching characteristics of the contaminant. Multiple time point analysis shall not be used for lead or any other metal contaminant listed as a regulated contaminant by US EPA or Health Canada.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be exposed at the selected application temperature (e.g., 23 ± 2 °C; 60 ± 2 °C; 82 ± 2 °C) for the full duration of the exposure. Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 and after the final exposure terminating on Day 90. The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure

N-1.5 Mechanical plumbing devices

N-1.5.1 Samples

Samples shall consist of the entire device, portion(s) / component(s) of the device, or a specimen of the materials(s) of the device. The samples shall be permitted to represent a product line of varying sizes, as described in Sections N-1.5.1.1 and N-1.5.1.2. When it is necessary to calculate normalization factor(s), the wetted surface area of the sample shall be determined. When materials and components are tested using in-vessel exposure, the actual wetted surface area and the volume of water in the extraction vessel shall be determined.

N-1.5.1.1 Device

A single device shall represent a product line of varying sizes when the following requirements are met:

- materials are of the same alloy, composition, or formulation;
- design and manufacturing processes are analogous; and
- it has the greatest wetted surface area-to-volume ratio.

The surface area-to-volume ratio for an endpoint device, other than a commercial kitchen device, shall be calculated with the assumption that the device volume is 1 L (0.26 gal). The surface area-to-volume ratio for a commercial kitchen device shall be calculated with the assumption that the device volume is 18.9 L (5 gal).

N-1.5.1.2 Component

A component shall represent a product line of varying sizes when the following requirements are met:

- materials are of the same alloy, composition, or formulation;
- design and manufacturing processes are analogous; and
- it has the greatest wetted surface area-to-volume ratio.

The surface area-to-volume ratio for a regular endpoint component shall be calculated with the assumption that the component volume is 1 L (0.26 gal).

N-1.5.1.3 Material

The material shall be representative of that used in the component or device. Material samples not related to a specific component or device can also be evaluated.

N-1.5.2 Washing

The device shall be flushed for 15 min with tap water under pressure, then rinsed with three volumes of reagent water that meets the requirements of Section N-1.9.2. Alternate preparation of the device shall be performed when required by published manufacturer's instructions. Components and materials shall be washed according to Section N-1.2.4.

N-1.5.3 Conditioning

Conditioning of the sample shall be performed in the sample or in a vessel. Endpoint devices, components, and materials shall be conditioned by rinsing with three volumes of extraction water (specified in Section N-1.5.5) at room temperature 23 ± 2 °C (73 ± 4 °F). The units or exposure vessels shall be filled with extractant water and held until the start of the exposure sequence for a period not to exceed 72 h.

N-1.5.4 Exposure

After conditioning, the sample shall be exposed to extraction water according to the applicable scheme detailed in Sections N-1.5.4.1 through N-1.5.4.3. Reflecting the sample's intended use, samples shall be exposed to extraction waters at the specified temperatures for the entire duration of the exposure. Exposure shall be limited to 23 ± 2 °C (73 ± 4 °F) except for instant hot water dispensers, in which case the manufacturer's specified thermostat setting shall be used.

Evaluation of endpoint devices, components, and materials for contaminants other than lead shall require exposure of at least one sample according to the timetable of Figure 1. The number of products to be tested shall be specified by the manufacturer. When one sample is tested at a single time point, the normalized contaminant concentrations from exposure on Day 19 shall be compared to their respective SPACs. If more than one sample is tested at a single time point, the geometric mean of normalized contaminant concentrations from exposure on Day 19 shall be compared to their respective SPACs.

Evaluation of endpoint devices, components and materials for the contaminant lead shall require exposure of at least three devices (more if specified by the manufacturer), according to the timetable of Figure 1. It is recommended that product lines thought to be marginally acceptable, and those that leach levels of lead approaching the maximum allowable level, should be tested for more than the minimum number of products. The rationale for selecting a number greater than three products is provided in Section N-1.8.9. On Days 3, 4, 5, 10, 11, 12, 17, 18, and 19, the 16 h dwell extractant water shall be collected. The lead test statistic Q shall be determined as described in Section N-1.8.9.

When additional extraction water is needed to complete all analyses, additional samples shall be exposed.

N-1.5.4.1 Exposure sequence for endpoint devices

The device shall be inverted and filled with extraction water and held according to Figure 1 during the exposure sequence. Hot water dispensers shall be heated to operating temperature, then exposed following the sequence in Figure 1 at the elevated temperature.

The final exposure water shall be collected and preserved in accordance with applicable analytical methods. When tested at a single time point, only the contaminant levels present in the 16 h dwell samples shall be used to evaluate the product's leaching characteristics.

For endpoint devices, the exposure sequence in Figure 1 shall be conducted and the Days 3, 4, 5, 10, 11, 12, 17, 18, and 19 lead dosages shall be determined.

N-1.5.4.2 Exposure sequence for components and materials

The exposure procedures provided in Section N-1.5.4.1 shall be followed. Samples shall be tested at a surface area-to-volume ratio at least as high as the ratio that exists in the device.

N-1.5.5 Extraction water

The extraction water shall be prepared by combining:

- 25 mL of 0.4M sodium bicarbonate;
- chlorine stock solution per Section N-1.9.2.4;
- reagent water meeting the requirements of Section N-1.9.2.1 (make up to 1 L), and adjust pH as needed using 0.1M HCl; and
- This water shall have a pH of 8.0 ± 0.5 , alkalinity of 500 ± 25 ppm, dissolved inorganic carbon of 122 ± 5 ppm, and 2 ± 0.5 ppm of free available chlorine.

All exposure water that is being used to determine conformance to this Standard shall be prepared fresh daily and stored in a closed container.

N-1.5.6 Multiple time point protocol

When the normalized concentration of a contaminant exceeds, or is expected to exceed, its acceptable level when evaluated as a single time point exposure, determination of the contaminant leaching rate using a multiple time point exposure shall be considered. For the purpose of contaminant concentration evaluation, Day 1 shall be defined as the time point at which extractant water is collected for analysis under the single time point exposure protocol. Day 90 shall be defined as 90 d after this time point. When over time data are used, the Day 1 concentration for the contaminant of concern shall meet the short term exposure level and Day 90 concentration shall meet the TAC/SPAC respectively. When extrapolation is used, the relationship between contaminant concentration and time shall be determined and plotted using a minimum of five data points.

When a multiple time point protocol is employed in the evaluation of a contaminant, consideration shall be given to the availability of appropriate toxicity data to define an acute exposure limit for the contaminant, as required in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5). Consideration shall also be given to the leaching characteristics of the contaminant. Multiple time point analysis shall not be used for lead or any other metal contaminant listed as a regulated contaminant by US EPA or Health Canada.

At the discretion of the manufacturer, direct measurement of a Day 90 extraction shall be permitted. The products shall be exposed at 23 ± 2 °C with the exception for instant hot water dispensers, in which case the manufacturer's specified thermostat setting shall be used. Extraction water shall be collected for analysis at a minimum of two time points: after Day 1 and after the final exposure terminating on Day 90. The exposure water shall be changed at least weekly during the interval between the initial and final exposure and on at least 4 d during the final week of exposure.

N-1.6 Collection and preservation of extraction media after exposure

Immediately after the exposure period, the extraction media shall be poured into sample bottles previously prepared as detailed in Table N-1.10 for storage until analysis. The procedures described in Table N-1.10 are based on collection methods included in *Manual For The Certification of Laboratories Analyzing Drinking Water* (EPA-570/9-82-002) and *Standard Methods For The Examination of Water and Wastewater* (most recent edition).

N-1.7 Analysis methods

N-1.7.1 General

This Section is divided into five parts: metals, organics (other than RVCM and solvent), radionuclides, RVCM, and solvents analyses. The specific analyses performed shall be formulation-dependent.

Each testing organization shall periodically review the analytical methods it uses to ensure that applicable advances in analytical methodologies are instituted.

N-1.7.2 Definitions

N-1.7.2.1 identified compound with standard: A compound identification made based on the daily analysis (initial or continuing calibration) of an authentic standard of an analyte. Retention time and mass spectrum are used for qualitative determination of the analyte. A calibration curve is used for quantitative determination of the analyte.

N-1.7.2.2 identified compound without standard: A compound identification based on mass spectral matches between the analyte and mass spectral libraries (commercial or private), or on spectral interpretation by a qualified chemist, or both. The quantitative determination is made through direct correlation between the analyte response and the nearest internal standard response.

N-1.7.2.3 matrix spike: An aliquot of a sample matrix fortified with a known quantity of analyte.

N-1.7.2.4 method detection limit (MDL): As defined in 40 CFR Part 136, Appendix B, the minimum concentration of a substance that can be measured and reported with 99% confidence that the substance concentration is greater than zero. The MDL is determined from analysis of a minimum of seven aliquots of standard (known quantity of analyte in reagent matrix) at concentrations that are in the range of the estimated detection limit.

N-1.7.2.5 method validation: Verification of an analytical procedure performed by determining the method detection limit (see Section N-1.7.2.4).

N-1.7.2.6 reporting limit (RL): The lowest concentration of analyte that can be reliably reported.

N-1.7.2.7 unknown: An analyte for which an identification cannot be determined. Information on chemical class, functional group(s), and chemical structure may be determined by spectral interpretation.

N-1.7.3 Metals analysis

Analyses for metals shall be performed, except as otherwise provided for herein, in accordance with currently accepted US Environmental Protection Agency (EPA) Methods (see 40 CFR Part 141 and Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020). When no EPA Method is provided, analyses shall be performed in accordance with *Standard Methods for the Examination of Water and Wastewater* (most current edition). If neither of these two documents addresses the required parameters and matrix, or if an alternate method is desired, method validation shall be completed prior to the application of the method (see Section N-1.7.2.5).

N-1.7.4 Organics analysis

N-1.7.4.1 General requirements for analysis of organics

Analyses for organics shall be performed, except as otherwise provided for herein, in accordance with currently accepted EPA Methods (see 40 CFR Part 141 and Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020). When no EPA Method is provided, analyses shall be performed in accordance with *Standard Methods for the Examination of Water and Wastewater* (most current edition). If neither of

these two documents addresses the required parameters and matrix, or if an alternate method is desired, method validation shall be completed prior to the application of the method (see Section N-1.7.2.5).

N-1.7.4.2 Gas chromatography / mass spectroscopy (GC/MS) analysis

N-1.7.4.2.1 General requirements for GC/MS analysis

The minimum instrument operation requirements for GC/MS analysis shall be in accordance with US EPA Method 625 (US EPA-600/4-84-053. *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, June 1984⁹) with the following modifications:

- the average chromatographic peak area of each internal standard in the calibration curve shall be determined. The chromatographic peak area of each internal standard in the continuing calibration shall be greater than 50% and not more than 200% of that average;
- while a continuing calibration check (CCC) is performed, concentrations of 10% of the target compounds for each analysis (e.g., base/neutral, base/neutral/acid, or acid) shall be allowed to fall outside the range of 70% to 130% (outlier) of the true value. None of the concentrations shall be allowed to fall below 50% or above 200% of the true value. If a positive sample analyte result is identified for any outlier, a second CCC shall be performed. If the second CCC determines the sample analyte result no longer to be an outlier, the sample shall be reanalyzed. However, if the second CCC also determines the analyte to be an outlier, a new calibration curve shall be determined and the sample shall be reanalyzed;
- if commercially available mass spectral libraries are utilized, a minimum size of 100,000 compounds shall be required; and
- the testing laboratory shall report the compounds detected during GC/MS analysis as one of the following:
 - identified compound with standard (see Section N-1.7.2.1);
 - identified compound without standard (see Section N-1.7.2.2); or
 - unknown (see Section N-1.7.2.7).

N-1.7.4.2.2 Requirements for identified compounds with standards via GC/MS analysis

Contaminants that have been identified and quantified by comparison to authentic standards shall be normalized in accordance with the requirements of this Standard (see Section N-1.8). The normalized contaminant concentration shall be compared to the acceptable exposure concentration as determined in accordance with NSF/ANSI/CAN 600 (previously Annex A).

N-1.7.4.2.3 Requirements for identified compounds without standards via GC/MS analysis

Contaminants that have been identified and quantified by comparison to a known mass spectrum, or by spectral interpretation by a qualified chemist, or both, shall be normalized in accordance with the requirements of this Standard (see Section N-1.8). The normalized contaminant concentration shall be compared to the acceptable exposure concentration as determined in accordance with NSF/ANSI/CAN 600 (previously Annex A). In addition, the product manufacturer shall assist the testing laboratory in the identification of an authentic standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed.

N-1.7.4.2.4 Requirements for unknowns via GC/MS analysis

Contaminants that are detected by GC/MS analysis, but are not identified and quantified against a known mass spectrum or authentic standard, shall be evaluated as follows:

- a) The product material formulation(s) shall be reviewed for potential identification of the unknown contaminant(s) as an ingredient or byproduct.
- b) The manufacturer shall be notified and requested to provide supporting information that enables identification of the unknown contaminant(s).
- c) Structure activity relationships (SAR) shall be utilized when sufficient structural identification of the unknown contaminant(s) can be made.
- d) Alternative methods of analysis that may identify the unknown contaminant(s) shall be considered.

Contaminants that can be identified after performing one or more of the above steps shall be normalized in accordance with the requirements of this Standard (see Section N-1.8). The normalized contaminant concentration shall be compared to the acceptable exposure concentration as determined in accordance with NSF/ANSI/CAN 600 (previously Annex A). In addition, the product manufacturer shall assist the testing laboratory in the identification of an authentic standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed.

Contaminants detected by GC/MS analysis for which no identification can be made after performing the above steps shall not be considered in the determination of product compliance to this Standard. When unknown contaminants are detected in the extractant water, the testing laboratory shall report the analytical results to the product manufacturer.

NOTE — The product manufacturer should assist the testing laboratory in a continuing effort to identify the unknown contaminant(s) until specific identification is achieved.

N-1.7.4.3 Polynuclear aromatic hydrocarbon (PNA) analysis

Analysis for polynuclear aromatic hydrocarbons (PNAs) shall be in accordance with EPA Method 525.2 (US EPA-600/4-79-020, *Methods for the Chemical Analysis of Water and Wastes*, March 1983).

N-1.7.4.4 Phenol and minimally substituted phenols

Analysis for phenol and minimally substituted phenols shall be in accordance with EPA Method 420.2 (US EPA-600/4-79-020, *Methods for the Chemical Analysis of Water and Wastes*, March 1983). Analysis for maximally substituted phenols shall be performed by GC/MS base/acid scan (see Section N-1.7.4.2).

N-1.7.4.5 Nitrosamine analysis

Analysis for N-nitrosodimethylamine, N-nitrosomethylethylamine, N-nitrosodiethylamine, N-nitrosodi-n-propylamine, N-nitrosopyrrolidine, N-nitrosomorpholine, N-nitrosopiperidine, and N-nitrosodi-n-butylamine shall be in accordance with US EPA Method 521 (US EPA-600/R-05/054) or an alternate validated method with equivalent sensitivity.

Analysis for N-nitrosodiphenylamine shall be performed in accordance with US EPA Method 521 (US EPA-600/R-05/054) or in accordance with US EPA Method 625 (US EPA-600/4-84-053). Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, June 1984¹¹ as described in Section N-1.7.4.2.1.

N-1.7.5 Radionuclides analysis

Analyses for radionuclides shall be performed in accordance with *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA-600/4-80-032. When no EPA Method is provided, analyses shall be performed in accordance with *Standard Methods for the Examination of Water and Wastewater* (most current edition). If neither of these two documents addresses the required parameters and matrix, or if an alternate method is desired, method validation shall be completed prior to the application of the method (see Section N-1.7.2.5).

N-1.7.5.1 Potassium-40 correction for gross beta

If the normalized concentration for gross beta exceeds the health effects evaluation criteria, analysis shall be completed for the naturally occurring potassium-40 beta particle activity from the same or equivalent sample used for the gross beta particle activity. As indicated in the Code of Federal Regulations (CFR 40 § 141.26(b)(4)),¹⁵ the potassium-40 beta particle activity (pCi/L) is calculated by multiplying elemental potassium concentrations (in mg/L) by a factor of 0.82. The gross beta particle and photon activity attributable to potassium-40 is then subtracted from the total gross beta particle activity value. The potassium-40 corrected gross beta particle and photon activity shall be compared against the health effects evaluation criteria.

N-1.7.5.2 Requirements for gross beta speciation

When the potassium-40 corrected gross beta particle and photon activity exceeds a normalized concentration of 15 pCi/L, the beta emitting radioisotopes shall be speciated. Speciation testing is required for all radioisotopes at risk of exceeding the health effects evaluation criteria. Appendix I in US EPA *Implementation Guidance for Radionuclides* (2002) details a list of radioisotopes and associated doses (in pCi/L) to produce a 4 mrem/y dose.¹⁶ The US EPA *Implementation Guidance for Radionuclides* (2002)¹⁷ provides example calculations to determine the fractional contribution in mrem/yr dose for each speciated radioisotope. The fractional contributions shall be summed for comparison to the health effects evaluation criteria.

N-1.7.6 RVCM analysis

N-1.7.6.1 General requirements for RVCM analysis

This method covers the analysis of RVCM in PVC and CPVC potable water products using gas chromatography (GC). Method sensitivity is 0.5 ppm (mg/kg) when analyzing 0.5 g of plastic material, using flame ionization detector (FID).

N-1.7.6.2 Extraction of samples for RVCM analysis

PVC and CPVC products shall be evaluated for RVCM in the product wall. The RVCM concentration shall be determined in the wall, rather than in the extraction water, because very low levels of vinyl chloride cannot be as reliably detected in the extraction water.

¹⁵ Code of Federal Regulations, *Monitoring Frequency and Compliance Requirements for Radionuclides in Community Water Systems*, Title 40, Section 141.26.

¹⁶ US EPA *Implementation Guidance for Radionuclides, Appendices A – J, Appendix I Comparison of Derived Values of Beta and Photon Emitters*

¹⁷ US EPA *Implementation Guidance for Radionuclides, Section II-B.2 Violation/Compliance Determination of Gross Beta and Photon Emitters*

N-1.7.6.2.1 Sample preparation for RVCM analysis

PVC and CPVC samples shall be prepared as described in the following procedure. All samples shall be prepared in duplicate.

- a) Chop a section of PVC or CPVC product sample into coarse pieces.
- b) Weigh 0.500 ± 0.005 g of chopped sample pieces into a 20 mL glass vial.

NOTE — The weights of the sample and the duplicate should not differ by more than 0.005 g.

- c) Add 10 mL of N,N-dimethylacetamide (DMAC) (distilled in glass) to the sample bottle, seal and cap.
- d) Shake sample bottle at least 30 min on a reciprocating shaker.

N-1.7.6.2.2 Standards for RVCM analysis

Both a standard stock solution and a secondary dilution standard shall be prepared for the RVCM analysis, using vinyl chloride gas (99.9%) and DMAC.

N-1.7.6.2.3 Standard stock solution for RVCM

The standard stock solution shall be prepared as follows:

- a) Pipette approximately 9.8 mL of DMAC into a 10 mL volumetric flask.
- b) Allow the flask to stand unstoppered until the wetted surface has dried.
- c) Weigh the flask and stopper to the nearest 0.1 mg and record the weight.
- d) Fill a 50 mL valved gas-tight syringe with vinyl chloride gas to the 50 mL mark.
- e) Lower the needle to 5 mm above the meniscus of the DMAC and slowly introduce the standard above the surface.
- f) Immediately reweigh the flask and contents and record the weight.
- g) Dilute to volume with DMAC, stopper, and mix.
- h) Transfer the solution into a PTFE sealed screw-cap vial.
- i) Store at -10 °C to -20 °C (14 °F to -4 °F).
- j) Calculate stock standard solution with respect to a 0.500 g sample as follows:

$$\frac{(\text{gram of vinyl chloride}) (1 \times 10^6)}{0.500 \text{ g}} = \text{ppm (mg/kg)(mg/d)}$$

N-1.7.6.2.4 Secondary dilution standard for RVCM analysis

Using the stock standard solution, a secondary dilution in DMAC shall be prepared that is representative of a concentration suitable for making calibration standards and spikes.

N-1.7.6.3 Apparatus for RVCM analysis

The following apparatus shall be used for RVCM analysis:

- GC equipped with a mL headspace sampling system, 80 °C (176 °F) oil bath, FID, data recording system, and autosampler;
- column: 6 ft × 2 mm ID glass column packed with 1% SP-1000 on Carbowax B 60/80 mesh. Equivalent columns shall be permitted as long as the column provides maximum separation from interferences and the ability to meet established accuracy and precision;
- GC conditions: The analysis shall be performed using an oven temperature program whereby the initial temperature of approximately 70 °C (158 °F) is held for 5 min, increased at 70 °C/min (158 °F/min) to approximately 220 °C (428 °F), and held until DMAC elutes (total run time about 16 min);
- the injector, detector, and sample loop temperature shall be held at approximately 200 °C, 275 °C, and 80 °C, (392 °F, 527 °F, and 176 °F) respectively; and
- the helium carrier gas shall have a flow rate of 20 mL/min. The headspace shall have a flow rate of 5 mL/min. The hydrogen and air flows for the flame shall be approximately 30 and 400 mL/min, respectively.

NOTE — All of these flow rates will vary somewhat between GCs to optimize separation and response. The above are given only as guidelines.

N-1.7.6.4 RVCM analysis

The sample and standards prepared in Sections N-1.7.6.2.1 and N-1.7.6.2.2 shall be loaded into an auto sampler and equilibrated to 80 °C (176 °F) for 10 min prior to analysis.

N-1.7.6.5 Quality control (QC) for RVCM analysis

Duplicate analysis shall be performed on each sample. Duplicate spiked samples shall be run at the rate of one set per ten samples. An instrument standard shall be run with every ten analyses (fifth sample), and a reagent blank is required for each sample set. QC charts shall be developed and maintained and used as a check on the analytical system.

N-1.7.6.6 Evaluation and pass/fail criteria for RVCM analysis

PVC and CPVC products with an RVCM concentration of ≤ 3.2 mg/kg shall be considered acceptable. This acceptance criterion was determined using the equation described below:

$$M_W = 4/r [D/\pi]^{0.5} [(t + t_0)^{0.5} - t_0^{0.5}] M_P$$

Where:

M_W = RVCM diffused into water (mg/L)

M_P = RVCM concentration in the PVC wall (mg/kg)

NOTE — A factor of 1.4 corrects for the ratio of density of water to PVC.

r = pipe radius (cm)

D = diffusivity constant

Where:

$$D = D_0 \times e^{(-17,000/RT)}$$

$$R = \text{gas constant } 1.987 \text{ } ^\circ\text{K}^{-1}$$

$$T = \text{temperature (} ^\circ\text{K)}$$

$$D_0 = 3.7 \text{ cm}^2/\text{s (319680 cm}^2/\text{d)}$$

$$t_0 = \text{diffusion time period (d)}$$

$$t = \text{product age at beginning of the diffusion time (d)}$$

$$30 \text{ } ^\circ\text{C} = 303 \text{ } ^\circ\text{K}$$

The calculations shall be as follows:

$$M_W = 4/r [D/\pi]^{0.5} [(t + t_0)^{0.5} - t^{0.5}] (M_P \times 1.4 \text{ kg/L})$$

$$M_P = \frac{M_W}{4/r [D/\pi]^{0.5} [(t + t_0)^{0.5} - t^{0.5}] (1.4 \text{ kg/L})}$$

$$M_P = \frac{0.0002 \text{ mg/L}}{(3.15)(0.000235)(0.061)(1.4 \text{ kg/L})}$$

$$M_P = 3.2 \text{ mg/kg}$$

NOTE — The following assumptions were used in the preceding calculations:

- 30 d old product is tested equivalent to 1 in inner pipe diameter;
- $t_0 = 16 \text{ h (0.67 d)}$; and
- $M_W = 0.2 \text{ } \mu\text{g/L (0.0002 mg/L)}$.¹⁸

N-1.7.7 Solvent analysis

This Section outlines the general procedure for determining solvent levels in the extraction water. The method described below is based on direct injection GC with FID. In some instances, an enhancement step (e.g., purge and trap [cold or heated] or headspace analysis) shall be required to complete the analysis. The choice of enhancement shall be dependent on the desired detection levels of the solvent of interest. The method sensitivity for direct injection is approximately 100 $\mu\text{g/L [0.1 mg/L]}$ for selected solvents¹⁵).

N-1.7.7.1 General requirements for solvent-containing materials

These products shall be evaluated to determine the solvent leaching rates over time, if applicable. The relationship between contaminant concentration and time shall be determined by plotting a minimum of five points. In many instances, direct injection shall be sufficient only for the early testing period. When direct injection is no longer adequate for determining a concentration, a more sensitive method shall be required (i.e., purge and trap).

N-1.7.7.2 Apparatus for solvent analysis

The recommended apparatus shall be a GC equipped with an FID, temperature programming, data recording system, and an autosampler. A purge and trap (with and without heat) system and headspace sampling system shall also be available.

NOTE — The analysis conditions may require adjustment relative to the specific solvent or solvent system being evaluated.

¹⁸ This concentration is based on the US EPA MCL for vinyl chloride (2 $\mu\text{g/L}$ or 0.002 mg/L), and since the SPAC = $1/10$ MCL, the SPAC = 0.2 $\mu\text{g/L}$, or 0.0002 mg/L.

N-1.7.7.3 QC for solvent analysis

Duplicate matrix spike samples shall be run at the rate of one set per ten samples or fewer. An instrument standard shall be run with every ten samples, and a reagent blank shall be required for each daily analysis. QC charts shall be developed, maintained, and used as a check on the analytical system.

N-1.8 Normalization

N-1.8.1 General

This Section provides the calculations used to determine the level of contaminants projected "at the tap" based on the level of contaminants identified during laboratory analysis. The normalized contaminant concentration shall be compared to the requirements established in NSF/ANSI/CAN 600 (previously Annex A).

N-1.8.2 Definitions

N-1.8.2.1 residential products: Products used in buildings.

N-1.8.2.2 service line products: Products used from the water main to building plumbing systems.

N-1.8.2.3 multiple user service line products: Products used between the water main and multiple family residences or commercial buildings.

N-1.8.2.4 water main (distribution) products: Products used in locations other than buildings or service lines.

N-1.8.2.5 multiple-installation products: Products present in the drinking water system at regularly repeating intervals.

N-1.8.3 Normalization factor

To account for any differences in surface area-to-volume ratios between laboratory and actual field use conditions, an adjustment or conversion using the equation below may be needed:

$$NF = N1 \times N2$$

$$N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}}$$

$$N2 = \frac{V_{F(static)}}{V_{F(flowing)}}$$

Where:

SA_F = surface area exposed in the field

SA_L = surface area exposed in the laboratory

V_L = volume of extraction water used in the laboratory

$V_{F(static)}$ = volume of water to which the product is exposed in the field for the static condition

$V_{F(\text{flowing})}$ = volume of water to which the product is exposed in the field under flow conditions during a period of time equivalent to the laboratory test

N-1.8.3.1 Static condition

The contaminant concentration shall be adjusted to reflect differences in surface area-to-volume relationships between laboratory and field exposures under static conditions. This calculation shall use the N1 term defined in Section N-1.8.3. The N2 term shall always equal one when calculating normalized static concentrations.

For multiple-installation products (e.g., pipes, fittings, and joining and sealing products used with pipes and fittings), the $V_{F(\text{static})}$ component of the N1 term shall be the volume of water contained within the assumed length of pipe corresponding to the segment of the system in which the product is used (e.g., 100 ft of pipe in the service line or 280 ft of pipe in the residence).

For valves, water meters, service saddles, backflow preventers and other products not present in the system at regularly repeating intervals, the $V_{F(\text{static})}$ component of the N1 term shall be the volume of water a product holds (on its own) when filled to capacity; $V_{F(\text{static})}$ shall equal 1 L (0.26 gal) for all products that, when filled to capacity, hold (on their own) less than 1 L (0.26 gal) of water.

NOTE 1 —Table N-1.11 details the assumptions and resulting N1 factors for typical product categories.

NOTE 2 — For internal threaded products, SA_F shall be equal to the normally wetted surface area of the product including 25% of the threaded area(s). The capacity of the product shall be equal to the volume of water contacted by the wetted surface area of the product including the volume contained within 25% of the threaded area(s). When the product capacity is less than 1 L (0.26 gal), $V_{F(\text{static})}$ shall equal 1 L (0.26 gal). When the product capacity is equal to or greater than 1 L (0.26 gal), $V_{F(\text{static})}$ shall be equal to the capacity.

N-1.8.3.2 Flowing conditions

In addition to the static condition, the contaminant concentration shall also be adjusted to reflect differences between laboratory and field exposures under flowing conditions. For this calculation, N2 will vary depending on use. For those products not having specific flowing N2 factors outlined in Table N-1.11, product literature or operational procedures shall be consulted.

NOTE —Table N-1.11 details the assumptions and resulting N2 values for typical product categories.

N-1.8.4 Normalization of service line and residential products

N-1.8.4.1 For all service line and residential products, with the exception of mechanical plumbing devices covered under Section 9, a single normalized static concentration shall be determined for each contaminant.

NOTE — For residential and service line products, the static condition is the most conservative normalization, since the N2 values for these products are ≤ 0.1 .

N-1.8.4.2 For in-line devices, with the exception of expansion tanks, pressure tanks, and POE components, media, or systems, the static normalized contaminant concentration shall be multiplied by an additional normalization factor, N3. The factor $N3 = 1/DF$, where DF is equal to the ratio of the contaminant concentration in the device to the contaminant concentration at the tap. The value of N3 for in-line devices shall be 0.33.

N-1.8.4.3 Dual chamber manifolds with two noncontiguous water chambers shall be individually normalized for the hot and cold chambers when each chamber is separately exposed.

N-1.8.4.4 For all in-line devices, normalized contaminant concentrations shall be adjusted to a 12h exposure when the final exposure is other than 12 h in length.

NOTE — For example, when the final exposure for an in-line device is 16 h, the normalized contaminant concentrations shall be multiplied by a factor of $^{12}/_{16}$.

N-1.8.4.5 For POE systems, $V_{F(static)}$ shall be equal to system void volume.

N-1.8.4.6 For POE components, $V_{F(static)}$ shall be equal to $^{1}/_{3}$ the volume of the smallest tank for which the component is being evaluated for use, plus the volume of the component.

NOTE — POE system tanks hold media displacing much of the tanks' void volume. The $^{1}/_{3}$ is to account for a common design difference between a system's "unit void volume" and "void volume" (volume with and without media respectively) that provides "freeboard" or open space to allow the media to expand during the regeneration cycles of media use.

N-1.8.5 Normalization for chemical feeders and generators

Chemical feeders and generators, feeder components, and the materials used therein present a special case because the materials are in contact with a concentrated chemical, which is then diluted at the prescribed feed rate, rather than in direct contact with water.

In addition to the equation in Section N-1.8.3, the following normalization factor shall be used to estimate the normalized concentration of a contaminant in the finished drinking water:

$$NF = N1 \times N2 \times N4$$

Where:

$$N4 = V_{TC} / V_{WT}$$

V_{TC} = volume of concentrated treatment chemical contacted or generated by the device during a period of time equivalent to the laboratory test

V_{WT} = volume of raw water treated with the concentrated chemical when dosed at the prescribed feed rate during a period of time equivalent to the laboratory test

N-1.8.5.1 Normalization of Cu/Ag electrode contaminants

The following normalization equation shall be used to estimate the normalized concentration of a contaminant in finished drinking water (mg/L) based on the concentration of the contaminant in the electrode (mg/kg).

NOTE — This normalization uses a worst-case approach by assuming that all contaminants in the electrode are released to the treated drinking water and remain in solution. It also assumes that the contaminant is liberated from the electrode as the copper is being released and therefore proportionate to the electrodes copper content and dosage rate to water.

$$\text{normalized concentration (mg/L)} = \frac{\text{contaminant content of electrode (mg/kg)}}{\text{copper content of electrode (mg/kg)}} \times \text{copper maximum dose level of generator (mg/L)}$$

Example:

- manufacturer's recommended maximum dose level for copper = 0.80 mg/L
- analysis of 2 g coring = 1300 mg copper, 600 mg silver, 0.040 mg arsenic
- copper content = 1300 mg/0.00200 kg = 650000 mg/kg
- arsenic content = 0.040 mg/0.00200kg = 20 mg/kg
- arsenic contribution to water = 0.000020 mg/L

$$0.000020 = (20/650,000) \times 0.80$$

N-1.8.6 Normalization for other products

The normalization factors described below shall be applied to products and materials not covered in Sections N-1.8.4 and N-1.8.5. For these products, a single normalized concentration (either static condition or flowing condition, whichever is most conservative) shall be determined for each contaminant. For products that have a flowing N2 value ≤ 0.1 , the static condition shall be the most conservative condition. For products that have a flowing N2 value > 0.1 , the flowing condition shall be the most conservative condition. Normalization factors that are not included in Table N-1.11 shall be determined on a case-by-case basis using the equation in Section N-1.8.3. Where a product is available in various sizes, the product with the highest surface area-to-volume ratio (typically the smallest diameter) shall be evaluated. For products, components, or materials that may be used in any of the four end use categories in Table N-1.11, qualifying by use of the largest normalization factor shall qualify other use categories. Table N-1.11 in this Annex details the assumptions and resulting N1 and N2 values for various product categories.

N-1.8.6.1 Water main valves and fire hydrants

Water main valves and fire hydrants connected to water main ≥ 4 in shall be normalized with the assumption of twenty products per mile of pipe. An example normalization calculation is provided in Table N-1.11 for water main valves.

N-1.8.7 Normalized concentration

The concentration of a contaminant in the finished drinking water shall be estimated using the following calculation:

$$\text{normalized concentration} = (\text{laboratory concentration}) \times (\text{normalization factor})$$

N-1.8.7.1 Static condition

The normalized contaminant concentration under static conditions shall be compared to the EPA MCL or the calculated TAC (as specified in NSF/ANSI/CAN 600 [previously Annex A]), and shall be less than or equal to the MCL or TAC.

N-1.8.7.2 Flowing condition

The normalized contaminant concentration under flowing conditions shall be compared to the SPAC (as specified in NSF/ANSI/CAN 600 [previously Annex A]), and shall be less than or equal to the SPAC.

N-1.8.7.3 Barrier materials containing solvents

Products / materials containing solvents shall be exposed so that the solvent leaching rates over time are determined. The relationship between normalized contaminant concentrations and time shall be determined and plotted with a minimum of five points. The normalized contaminant concentrations shall be compared to the STEL as specified in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5).

N-1.8.7.4 Joining and sealing materials containing solvents

The manufacturer shall have the option of initiating additional exposure testing to determine contaminant concentrations over time for solvent-containing materials. The relationship between contaminant concentrations and time shall be determined, and plotted with a minimum of five points. The normalized contaminant concentrations shall be calculated and then compared to the STEL as specified in NSF/ANSI/CAN 600, Section 3.3 (previously Annex A, Section A.5).

N-1.8.8 Normalization for endpoint devices, components, and materials

N-1.8.8.1 Normalization for lead

For endpoint products other than commercial kitchen products, each laboratory concentration shall be normalized using the equation in Section N-1.8.3 where: $V_{F(static)} = 1$ L (0.26 gal) when the volume of the device is less than 1 L (0.26 gal), and $N_2 = 1$, and shall be multiplied by the cold mix volume adjustment factor (see Section 9.2.1).

For commercial kitchen products, each laboratory concentration shall be normalized using the equation in Section N-1.8.3 where $V_{F(static)} = 18.9$ L (5 gal) and $N_2 = 1$ and shall be multiplied by the CMV adjustment factor (see Section 9.2.1).

A parametric data evaluation (Section N-1.8.9) shall be used to evaluate the test results for lead.

When a device or component has been tested for lead through separate exposure of two or more components or materials, the values of the test statistic Q for each exposure shall be summed. The summed test statistic Q shall be evaluated against the criteria in Section N-1.8.9.

N-1.8.8.2 Normalization for all analytes except lead

For endpoint products other than commercial kitchen products, the laboratory concentration shall be normalized using the equation in Section N-1.8.3 where: $V_{F(static)} = 1$ L (0.26 gal) when the volume of the device is less than 1 L (0.26 gal), and $N_2 = 1$, and shall be multiplied by the CMV adjustment factor (see Section 9.2.1).

For commercial kitchen products, each laboratory concentration shall be normalized with the equation in Section N-1.8.3 where: $V_{F(static)} = 18.9$ L (5 gal) and $N_2 = 1$, and shall be multiplied by the CMV adjustment factor (see Section 9.2.1).

When one sample is tested, the normalized contaminant concentrations from exposure on Day 19 shall be compared to their respective SPACs. If more than one sample is tested, the geometric mean of normalized contaminant concentrations from exposure at Day 19 shall be compared to their respective SPACs.

N-1.8.9 Parametric data evaluation

The term "product" connotes "endpoint devices, components, and materials." The procedure for the evaluation of lead leaching from these products is based on testing a sampling of products to determine the lead leaching dosage of the product line. A derived test statistic determines whether the product line is acceptable under this Standard. The calculations assume that the lead dosage leached from the product is lognormally distributed.

The number of products to be tested shall be specified by the manufacturer, though a minimum of three is required. It is recommended that product lines thought to be marginally acceptable (those that leach higher, but acceptable, dosages of lead) be tested for more than the minimum number of products. For each of the products tested, the "product dosage" D_i is derived from the test data as detailed in Section N-1.8.9.2. These dosages are used to calculate the test statistic Q , which determines whether the product line is acceptable. Q is an exact 90% upper confidence bound on the 75th percentile product dosage.

In the event of a product failure, there is provision for a single retest. Retest results shall be combined with those from the initial test. The accumulated product dosages shall be used to calculate the retest statistic, R , which determines whether the product line is acceptable. R is an exact 99% upper confidence bound on the 75th percentile product dosage.

N-1.8.9.1 Test data

The analytical protocol described in Section N-1.5.4 generates nine measured lead dosages (on Days 3, 4, 5, 10, 11, 12, 17, 18, and 19) leached from each of the products sampled from a particular product line. The number of products tested is defined as n . The test data are described as $(9 \times n)$ data values of x_{ij} (i^{th} product measured on the j^{th} day) and are shown in Table N-1.12. These are used to calculate the product dosage D_i , for each of the tested products.

These data are used to calculate the statistics Q and R for the initial test and retest, respectively.

N-1.8.9.2 Calculations

The test statistic depends upon the log-dosage mean and standard deviation. These values are derived as follows. Calculate the natural log-transformed value $Y_{ij} = \ln(X_{ij})$ of the original data values. For each of the products tested, calculate the product dosage D_i across the nine measured days, where:

$$D_i = e^{Y_i}$$

and

$$Y_i = \frac{(Y_{i3} + Y_{i4} + Y_{i5} + Y_{i10} + Y_{i11} + Y_{i12} + Y_{i17} + Y_{i18} + Y_{i19})}{9}$$

Calculate the log-dosage mean of Y_i and the log-dosage standard deviation of Y_i for each product, where:

$$\text{log-dosage mean} = \frac{\sum_{i=1}^n Y_i}{n}$$

and

$$\text{log-dosage standard deviation} = \sqrt{\frac{\sum_{i=1}^n (Y_i - \bar{Y})^2}{(n-1)}}$$

N-1.8.9.3 Initial test statistic

The test statistic Q shall be determined as:

$$Q = e^{\bar{Y}} \cdot e^{k_1 \cdot S}$$

where the log-dosage mean, \bar{Y} , and the log-dosage standard deviation, S , are determined using the procedures described in Section N-1.8.9.2. The value of k_1 depends upon the sample size. Table N-1.13 in this Annex presents the value of k_1 for a range of sample sizes. The acceptability of the product line depends upon the value of the test statistic and product type.

For end-point devices other than supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $Q \leq 5 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $Q > 5 \mu\text{g}$, the product line has tested as unacceptable.

For supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $Q \leq 3 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $Q > 3 \mu\text{g}$, the product line has tested as unacceptable.

When a device or component has been tested for lead through separate exposure of two or more components or materials, the summed value of the test statistic Q shall be compared to the preceding criteria.

N-1.8.9.4 Retest statistic

The retest statistic R shall be determined as:

$$R = e^{\bar{Y}} \cdot e^{k_2 \cdot S}$$

where the log-dosage mean, \bar{Y} , and the log-dosage standard deviation, S , are determined using the procedures described in Section N-1.8.9.2. The value of k_2 depends upon the sample size. Table N-1.14 presents the value of k_2 for a range of sample sizes. The acceptability of the product line depends upon the values of the retest statistic and product type.

- case I: If $R \leq 5 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $R > 5 \mu\text{g}$, the product line has tested as unacceptable.

For supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $R \leq 3 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $R > 3 \mu\text{g}$, the product line has tested as unacceptable.

N-1.9 Extraction water preparation

N-1.9.1 Chemical characteristics

Five extraction waters shall be available for exposure:

- 1) pH = 5 ± 0.3 , with 2 ± 0.5 mg/L free available chlorine and 100 mg/L hardness
- 2) pH = 6.5 ± 0.3 , with 2 ± 0.5 mg/L free available chlorine and 100 mg/L hardness
- 3) pH = 8 ± 0.3 (organic analysis), with no chlorine added and 100 mg/L hardness
- 4) pH = 10 ± 0.3 , with 2 ± 0.5 mg/L free available chlorine
- 5) pH = 8 ± 0.3 , alkalinity of 500 ± 25 mg/L, dissolved inorganic carbon of 122 ± 5 mg/L, and 2 ± 0.5 mg/L of free chlorine.

All exposure water that is used to determine compliance to this Standard shall be used within 24 hours of preparation and stored in a closed container.

NOTE — The hardness values above are expected concentrations based on buffer additions and are not intended to be a specification.

N-1.9.2 Reagents

N-1.9.2.1 Reagent water

Reagent water shall be produced through one or more of the following treatment processes: distillation, reverse osmosis, ion exchange, or other equivalent treatment processes. The reagent water shall have the following general water characteristics:

- electrical resistivity, minimum 18 MΩ-cm at 25 °C (77 °F); and
- total organic carbon (TOC) maximum 100 µg/L.

For each specific analyte of interest, the reagent water shall not contain the target analyte at a concentration greater than half the designated analytical report limit of that analyte. If trace organic contaminants may be present at levels greater than half the designated analytical report limit of that target analyte, it is permissible to treat the reagent water with TOC destructive UV (185nm) to reduce those contaminants to acceptable concentrations. This UV treatment often results in a decrease in electrical resistivity of the reagent water to below 18 MΩ-cm, which is allowed in this circumstance.

N-1.9.2.2 Phosphate buffer stock solutions (0.1 M)

Phosphate buffer stock solutions shall be prepared as follows: Dissolve 13.89 g sodium dihydrogen phosphate monohydrate in reagent water, dilute to 1.0 L (0.26 gal), and mix thoroughly. Prepare fresh weekly. This buffer shall be used with only the magnesium hardness reagent.

N-1.9.2.3 Magnesium hardness stock solution (0.04 M)

Magnesium hardness stock solution shall be prepared by dissolving 8.13 g magnesium chloride hexahydrate in reagent water, diluting to 1.0 L (0.26 gal), and mixing thoroughly. The solution shall be prepared fresh weekly.

N-1.9.2.4 Chlorine stock solution (0.025 M)

Chlorine stock solution shall be prepared as follows: Dilute 7.3 mL reagent grade sodium hypochlorite (5% NaClO) to 200 mL with reagent water. Store in tightly stoppered amber reagent bottle protected from light and stored at 20 °C (68 °F). Prepare fresh weekly.

N-1.9.2.4.1 Determining chlorine stock solution strength

The strength of the chlorine stock solution shall be determined by diluting 1.0 mL to 1.0 L (0.26 gal) with reagent water. The solution shall be analyzed immediately for free available chlorine. This determination shall be referred to as *A*.

N-1.9.2.4.2 Determining amount of chlorine stock solution required to obtain 2 ppm residual chlorine

To determine the volume of the chlorine stock solution necessary to add to the extraction water to obtain 2.0 mg/L free available chlorine residual, the following formula shall be used:

$$\text{mL stock solution} = \frac{2.0 \times B}{A}$$

Where:

- A* = chlorine equivalent per mL of chlorine stock solution (determined above)
- B* = liters of extraction water

N-1.9.2.5 Calcium hardness stock solution (0.04 M)

Calcium hardness stock solution shall be prepared by dissolving 4.44 g anhydrous calcium chloride in reagent water, diluting to 1.0 L (0.26 gal), and mixing thoroughly. The solution shall be prepared fresh weekly.

N-1.9.2.6 Sodium bicarbonate buffer (0.04 M)

Sodium bicarbonate buffer shall be prepared by dissolving 3.36 g sodium bicarbonate in reagent water and diluting to 1.0 L (0.26 gal), mixing thoroughly. The solution shall be prepared fresh weekly.

N-1.9.2.7 Sodium hydroxide solution (0.1 M)

Sodium hydroxide solution shall be prepared by dissolving 4.0 g of sodium hydroxide in reagent water, diluting to 1.0 L (0.26 gal), and mixing well.

N-1.9.2.8 Sodium borate solution (0.05 M)

Sodium borate solution shall be prepared by dissolving 19.07 g of sodium borate decahydrate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O}$) in reagent water, diluting to 1.0 L (0.26 gal), and mixing well.

N-1.9.3 pH 5 water

pH 5 extraction water shall be prepared to contain 2 ± 0.5 mg/L free available chlorine. Stock reagent solutions in the amounts shown in Table N-1.15 shall be diluted to the desired water volume with reagent water. The pH shall be adjusted to $\text{pH } 5 \pm 0.3$ using 0.1M HCl or 0.1M NaOH as needed.

N-1.9.4 pH 6.5 water

pH 6.5 water shall be prepared to contain 2 ± 0.5 mg/L free available chlorine. Stock reagent solutions in the amounts shown in Table N-1.15 shall be diluted to the desired water volume with reagent water. The pH shall be adjusted to $\text{pH } 6.5 \pm 0.3$ using 0.1 M HCl.

NOTE — It is recommended that the pH 6.5 water be protected from exposure to air during its formulation and use to minimize pH drift. Unused exposure water should be maintained under a nitrogen blanket, and product samples should be plugged or tightly covered to minimize exposure to air.

N-1.9.5 pH 8 water (conditioning)

pH 8 conditioning water shall be prepared to contain 2 ± 0.5 mg/L free available chlorine. Stock reagent solutions in the amounts shown in Table N-1.15 shall be diluted to the desired water volume with reagent water. The pH shall be adjusted to $\text{pH } 8 \pm 0.3$ using 0.1M HCl or 0.1M NaOH as needed.

N-1.9.6 pH 8 water (organic analysis)

pH 8 organic extraction water shall be prepared to contain no chlorine added. Stock reagent solutions in the amounts shown in Table N-1.15 shall be diluted to the desired water volume with reagent water. The pH shall be adjusted to $\text{pH } 8 \pm 0.3$ using 0.1M HCl or 0.1M NaOH as needed.

N-1.9.7 pH 10 water

pH 10 extraction water shall be prepared to contain 2 ± 0.5 mg/L free available chlorine. Stock reagent solutions in the amounts shown in Table N-1.15 shall be diluted to the desired water volume with reagent water. The pH shall be adjusted to $\text{pH } 10 \pm 0.3$ using 0.1M HCl or 0.1M NaOH as needed.

N-1.9.8 pH 8 water (from Section 9)

The extraction water shall be prepared by combining:

- 25 mL of 0.4 M sodium bicarbonate;
- chlorine stock solution per Section N-1.9.2.4; and
- reagent water meeting the requirements of Section N-1.9.2.1 (make up to 1 L), and adjust pH as needed using 0.1 M HCl.

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Chemical concentrations, form, and amounts of ingredients can be adjusted such that the final pH 8 test water meets the extraction water characteristics as outlined in Section N-1.9.1, bullet 5.

| | Fri | Sat | Sun | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Mon | Tue | Wed | Thu | Fri |
|----------|-----|-----|-----|-----|-----------|-----------|-----------|-----------|-----|-----|-----|-----------|-----------|-----------|-----|-----|-----|-----------|-----------|-----------|-----------|-----|
| Test Day | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | | | | | | C | C | C | | | | | C | C | C | | | | | C | C | C |
| W/C | | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | |
| | | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | |
| | | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | |
| | | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | |
| < 72 | | | | 16 | <u>16</u> | <u>16</u> | <u>16</u> | <u>16</u> | 64 | | 16 | <u>16</u> | <u>16</u> | <u>16</u> | 64 | | 16 | <u>16</u> | <u>16</u> | <u>16</u> | <u>16</u> | |

Key

- W/C = washing and conditioning
- < 72 = dwell between conditioning and exposure sequence (maximum: 72 h)
- 2 = dump and fill 2 h intervals
- 16 = 16 h dwell (overnight)
- 16 = 16 h dwell for data
- C = collect prior day's 16 h dwell
- 64 = 64 h dwell (weekend)

Figure 1
Exposure sequence for mechanical plumbing device

Table N-1.1
NSF/ANSI/CAN 61 products

| Joining and sealing materials | Mechanical devices |
|--------------------------------------|--|
| adhesives | chemical feeders |
| brazing materials | dry feeders (e.g., pellet droppers) |
| fluxes | pressure gas injection systems |
| solders | pumps |
| caulks | vacuum injection systems |
| gaskets | disinfection / generators |
| lubricants | chlorine dioxide |
| O-rings | hypochlorite |
| packing | ozone |
| primers | ultraviolet |
| sealants | electrical wire |
| — | submersible well pumps |
| — | pumps |
| — | switches and sensors (e.g., water level, flow, pressure, temperature) |
| — | valves, related fittings, and fire hydrants (transmission / distribution system) |
| — | water process treatment devices |
| — | aeration equipment |
| — | clarifiers |
| — | electrodialysis |
| — | microfiltration |
| — | mixers |
| — | reverse osmosis |
| — | screens |
| — | strainers |
| — | ultrafiltration |

Table N-1.2
Exposure summary

| Category | Annex N-1 reference section | Type of samples (surface area) | Required preparation | Product exposure |
|-------------------------------|-----------------------------|---|--|---|
| joining and sealing materials | 3 | 15 cm ² /L | <ul style="list-style-type: none"> — some products applied to an appropriate substrate — some products cut to appropriate size — washed to remove debris accumulated during shipping and handling | cold exposure = 24, 24, 24 h at 23 °C (73 °F) hot exposure = 1, 1, 1 h at 82 °C (180 °F) |
| mechanical devices | 4 | entire device, component, or material specimen ¹ | wash to remove debris accumulated during shipping | conditioning period prior to exposure (2 wk maximum) cold exposure = 24, 24, 24 h at 23 °C (73 °F) |

¹ A material specimen shall be exposed using a minimum surface area-to-volume ratio of 50 cm²/L.

Table N-1.3a
Extraction water selection

| Analytes of interest | X = Required extraction water selection | | |
|----------------------|---|-------------------------------|--------------------------------|
| | pH 5 (see Section N-1.9.3) | pH 8 (see Section N-1.9.6) | pH 10 (see Section N-1.9.7) |
| metals | X | — | X |
| organics | — | X | — |

Table N-1.3b
Alternate extraction water selection

| Material type by Section | Analyte of interest | X = Required extraction water selection | | | | |
|---|---------------------|---|------------------------------|-------------------------------|-----------------------------|---|
| | | pH 5 (see Section 1.9.3) | pH 10 (see Section 1.9.7) | pH 6.5 (see Section 1.9.4) | pH 8 (see Section 1.9.8) | Reagent water ¹ (see Section 1.9.3) |
| Sections 4, 5, 6, and 8 | | | | | | |
| brass and bronze surfaces | all analytes | — | — | — | X | — |
| copper pipe other than C12200 and copper alloy fittings used exclusively to join copper pipe | metals | X ² | — | X ² | X | — |
| | organics | — | — | — | X | — |
| copper (C12200) pipe, tubing, and fittings | metals | X ³ | — | — | X | — |
| | organics | — | — | — | X | — |
| cementitious and asphaltic materials | metals | X | X | — | — | — |
| | organics | — | — | — | X | — |
| all other wetted surfaces | metals | X | — | — | X | — |
| | organics | — | — | — | X | — |
| ¹ Placeholder for eventual citing of test waters used for process media currently contained in Section 7. ² The pH 6.5 test water may be used in replacement of the pH 5 test water provided the requirements in Section 4.5.3.3 are also met. ³ Metals analysis with the pH 5 test water is not required provided the requirements in Section 4.5.3.2 are also met. | | | | | | |

Table N-1.4
Test samples joining and sealing materials

| Material | Typical form |
|--|---|
| adhesives and cements intended for joining pipe and fittings | applied to assembled pipe and fitting joints |
| adhesives and cements not intended for joining pipe and fittings | applied to glass panels |
| caulks, greases, lubricants, sealants | applied to glass panels |
| flux | applied to copper sheet and heated |
| gasket materials | ASTM D3182 tensile sheets or finished product |
| solders and solder / flux combinations | product heated in ceramic combustion boats |

Table N-1.5
Exposure sequence for cold applications

| Exposure temperature | Exposure time | Elapsed time | Comment |
|-----------------------|---------------|--------------|--|
| 23 ± 2 °C (73 ± °F) | 24 ± 1 h | 1 d | extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued |
| 23 ± 2 °C (73 ± 4 °F) | 24 ± 1 h | 2 d | extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued |
| 23 ± 2 °C (73 ± 4 °F) | 24 ± 1 h | 3 d | extraction water is collected for analysis |

Table N-1.6
Exposure sequence for hot applications

| Exposure temperature | Exposure time | Elapsed time | Comments |
|--|---------------|--------------|--|
| 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) | 60 ± 5 min | 1 h | extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued |
| 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) | 60 ± 5 min | 2 h | extraction water is decanted and discarded; the exposure vessel or product is refilled with exposure water and exposure is continued |
| 60 ± 2 °C (140 ± 4 °F) or 82 ± 2 °C (180 ± 4 °F) | 60 ± 5 min | 3 h | extraction water is collected for analysis |

Table N-1.7
Product exposure¹

| Product | In the product | In a vessel | Other |
|------------------------|----------------|-------------|-------------------------------|
| aeration equipment | X | — | material exposed in a vessel |
| chemical feeders | X | — | material exposed in a vessel |
| clarifiers | — | — | material exposed in a vessel |
| disinfection equipment | — | — | material exposed in a vessel |
| electrical wire | — | X | — |
| in-line devices | X | — | — |
| membranes/cartridges | X | — | — |
| mixers | — | — | materials exposed in a vessel |
| pumps | X | — | — |
| reverse osmosis | — | — | — |
| screens | — | X | — |
| strainers | X | — | — |
| switches/sensors | X | — | — |
| valves | X | — | — |

¹ For the purposes of this table, product may represent either the entire device or a component. These are the typical exposure conditions. However, products may be exposed in any fashion provided that the exposure is consistent with requirements in Section N-1.2.

Table N-1.8
In-line device exposure sequence

| Temperature | In-line device exposure time | Elapsed time ¹ in-line devices |
|-----------------------|------------------------------|---|
| 23 ± 2 °C (73 ± 4 °F) | 24 h | 24 h |
| 23 ± 2 °C (73 ± 4 °F) | 24 h | 48 h |
| 23 ± 2 °C (73 ± 4 °F) | 12 to 16 h | 60 to 64 h |

¹ Elapsed time does not include the initial 14 d conditioning period.

Table N-1.9
Other mechanical device exposure sequence

| Temperature | Exposure time other mechanical devices | Elapsed time ¹ other mechanical devices |
|-----------------------|--|--|
| 23 ± 2 °C (73 ± 4 °F) | 24 h | 24 h |
| 23 ± 2 °C (73 ± 4 °F) | 24 h | 48 h |
| 23 ± 2 °C (73 ± 4 °F) | 24 h | 72 h |

¹ Elapsed time does not include the initial 14 d conditioning period.

Table N-1.10
Extractant water collection and preservation

| Contaminant | Preservative | Container | Storage |
|-------------------------------------|--|---|--------------------------------|
| herbicide | none | 1 L (32 oz) amber glass bottles with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| metals, including mercury | Conc. HNO ₃ to pH < 2 (1.25 mL) | 125 mL (4 oz) HDPE bottles with PTFE lid | room temp |
| miscellaneous organics | none | 500 mL (16 oz) amber bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| pesticides | none | 500 mL (16 oz) amber glass bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| phenols | H ₂ SO ₄ to pH < 2 (2.50 mL) | 250 mL (8 oz) amber glass bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| phthalate | none | 1 L (32 oz) glass bottle with PTFE lid (in duplicate) | ≤ 6 °C (43 °F), but not frozen |
| polyaromatic hydrocarbon | none | 1 L (32 oz) glass bottle (in duplicate) | ≤ 6 °C (43 °F), but not frozen |
| radionuclides | 10.0 mL HNO ₃ | 1 L (32 oz) polyethylene bottle (in duplicate) | room temperature |
| solvents | none | 125 mL (4 oz) amber bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| total kjeldahl nitrogen | H ₂ SO ₄ to pH < 2 | 250 mL (8 oz) amber bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| total organic carbon | none | 250 mL (8 oz) amber bottle with PTFE lid | ≤ 6 °C (43 °F), but not frozen |
| non-Section 9 exposure for volatile | HCl | 40 mL amber glass vial with PTFE lid | ≤ 6 °C (43 °F), but not frozen |

Table N-1.10
Extractant water collection and preservation

| Contaminant | Preservative | Container | Storage |
|--|---|---|-----------------------------------|
| organic chemicals (VOCs) | | | |
| Section 9 exposure for volatile organic chemicals (VOCs) | sodium thiosulfate (a few grains to neutralize the chlorine) | 40 mL amber glass vial with PTFE lid | ≤ 6 °C (43 °F), but not frozen |

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Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) |
|---|---------------|-------------------------------|--|---|---------------------------------|
| n.d. > 4 in | in-the-vessel | water main | — water is exposed to the same material from the treatment plant to the service line | calculated in accordance with Section N-1.8.3 | 1 |
| <p>Example: In-the-vessel water main joining and sealing material</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — product is a joining and sealing material applied to a 6 in nominal diameter pipe and was exposed in a vessel; — 0.5 in joining and sealing material width is exposed to water; — 20 ft long pipe (used to derive $V_{F(static)}$ and SA_F) and 1 joint per 20 ft length; and — the ratio of SA_L to V_L was recorded and reported by the laboratory. $SA_F = 60.77 \text{ cm}^2 (9.42 \text{ in}^2) \quad SA_L = 15 \text{ cm}^2 (2.3 \text{ in}^2)$ $V_{F(static)} = 111 \text{ L (29.3 gal)} \quad V_L = 1 \text{ L (0.26 gal)}$ $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}} = \frac{9.42}{2.33} \times \frac{0.26}{29.4} = 0.036$ <p>$N2 = 1$</p> <p>Comments:</p> <p>Concentrations reported by the laboratory would be multiplied by 0.036 to obtain a normalized static concentration. The resulting normalized static concentration would be multiplied by 1 ($N2 = 1$) to obtain the normalized flowing concentration.</p> | | | | | |
| <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | |

Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) |
|--|---------------|-------------------------------|--|---|---------------------------------|
| n.d. = 4 in | in-the-vessel | multiple user service line | — two user connections per service line and 180 gal/d/user — distance from water main to residential connections = 72 ft and therefore $V_{F(static)} = 47$ gal; flow rate equals 360 gal/d and therefore $V_{F(flow)} = 360$ gal — five joints per multiple user service line | calculated in accordance with Section N-1.8.3 | 0.13 |
| <p>Example: in-the-vessel multiple user service line joining and sealing materials</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — product is a joining and sealing material applied to a 4 in nominal diameter pipe and was exposed in a vessel; — 0.5 in joining and sealing material width is exposed to water; — five joints per multiple user service line; — 72 ft of the pipe is present in the multiple user service line and therefore $V_{F(static)} = 47$ gal (178 L); and — the ratio of SA_L to V_L was recorded and reported by the laboratory. $SA_F = 40.6 \text{ cm}^2 (6.3 \text{ in}^2) \times 5 = 202.6 \text{ cm}^2 (31.4 \text{ in}^2) \quad SA_L = 15 \text{ cm}^2 (2.3 \text{ in}^2)$ $V_{F(static)} = 178 \text{ L (47 gal)} \quad V_L = 1 \text{ L (0.26 gal)}$ $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}} = \frac{31.4}{2.33} \times \frac{0.26}{47} = 0.076$ $N2 = \frac{V_{F(static)}}{V_{F(flow)}} = \frac{47}{360} = 0.13$ <p>Comments:</p> <p>Concentrations reported by the laboratory would be multiplied by 0.076 to obtain a normalized static concentration. The resulting normalized static concentration would be multiplied by 0.13 to obtain the normalized flowing concentration.</p> | | | | | |
| <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | |

Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) |
|---|---------------|-------------------------------|--|---|---------------------------------|
| 4 in > n.d. > 1 in | in-the-vessel | service line | <ul style="list-style-type: none"> — joining / sealing materials applied to 1 in nominal diameter pipe — 1 user connection per service line and 180 gal/d/user — distance from water main to residence = 100 ft and therefore $V_{f(static)} = 4.08$ gal — flow rate equals 180 gal/d and therefore $V_{f(flow)} = 180$ gal — 10 joints are present on the service line | calculated in accordance with Section N-1.8.3 | 0.023 |
| <p>Example: in-the-vessel service line joining and sealing materials</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — an in-the-vessel exposure was conducted; — product is used to join 1 in nominal diameter pipe; — 0.5 in width of the joining and sealing material comes in direct contact with water; — 100 ft of the pipe is present in the service line and therefore $V_{F(static)} = 4.08$ gal; — 10 joints are present on the service line; and — the ratio of SA_L to V_L was recorded and reported by the laboratory. <div style="display: flex; justify-content: space-around;"> <div style="text-align: left;"> $SA_F = 10.1 \text{ cm}^2 (1.57 \text{ in}^2) \times 10 = 101.3 \text{ cm}^2 (15.7 \text{ in}^2)$ $V_{F(static)} = 15.44 \text{ L (4.08 gal)}$ </div> <div style="text-align: left;"> $SA_L = 15 \text{ cm}^2 (2.3 \text{ in}^2)$ $V_L = 1 \text{ L (0.26 gal)}$ </div> </div> $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}} = \frac{15.7}{2.3} \times \frac{0.26}{4.08} = 0.44$ $N2 = \frac{V_{F(static)}}{V_{F(flow)}} = \frac{4.08}{180} = 0.023$ <p>Comments:</p> <p>Concentrations reported by the laboratory would be multiplied by 0.44 to obtain a normalized static concentration. The resulting normalized static concentration would be multiplied by 0.023 to obtain the normalized flowing concentration.</p> | | | | | |
| <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | |

Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) |
|--|---------------|-------------------------------|--|---|---------------------------------|
| 1 in > n.d. ≥ 0.5 in | in-the-vessel | residential | <ul style="list-style-type: none"> — joining / sealing materials applied to 0.5 in nominal diameter pipe — length of pipe in the residence = 280 ft (140 ft cold side and 140 ft hot side) and therefore $V_{F(static)} = 2.86$ gal (1.43 gal hot and 1.43 gal cold) — flow rate equals 180 gal/d and therefore $V_{F(flow)} = 180$ gal — 200 joints are present in the residential system | calculated in accordance with Section N-1.8.3 | 0.016 |
| <p>Example: in-the-vessel residential joining and sealing material</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — an in-the-vessel exposure was conducted; — product is a joining and sealing material used to join ½ in nominal diameter pipe; — 0.25 in width of the joining and sealing material comes in direct contact with water; — 280 ft of pipe is present in the residence (used to derive $V_{F(static)}$ and SA_F); — the ratio of SA_L to V_L was recorded and reported by the laboratory; and — 200 joints are present in the residential system. <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: left;"> $SA_F = 2.54 \text{ cm}^2 (0.393 \text{ in}^2) \times 200 = 507 \text{ cm}^2 (78.6 \text{ in}^2)$ $V_{F(static)} = 10.83 \text{ L (2.86 gal)}$ </div> <div style="text-align: left;"> $SA_L = 65 \text{ cm}^2 (10 \text{ in}^2)$ $V_L = 1 \text{ L (0.26 gal)}$ </div> </div> $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}} = \frac{78.6}{10} \times \frac{0.26}{2.86} = 0.73$ $N2 = \frac{V_{F(static)}}{V_{F(flow)}} = \frac{2.86}{180} = 0.016$ <p>Comments: Concentrations reported by the laboratory would be multiplied by 0.73 to obtain a normalized static concentration. The resulting normalized static concentration would be multiplied by 0.016 to obtain the normalized flowing concentration.</p> <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | |

Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) |
|---|----------------|-------------------------------|---|----|---------------------------------|
| n.d. ≥ 4 in | in-the-product | water main | — twenty 4 in valves per mile (5,280 ft) — a width of 6 in is exposed for each valve | 1 | 0.002 |
| <p>Example: in-the-product water main valve</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — product is a 4 in nominal diameter valve used on pipe with a nominal diameter of 4 in; — an in-the-product exposure was conducted; and — for each valve, a width of 6 in comes in direct contact with water. $SA_F = 484 \text{ cm}^2 (75 \text{ in}^2) \quad SA_L = 484 \text{ cm}^2 (75 \text{ in}^2)$ $V_{F(\text{static})} = 1.24 \text{ L (0.327 gal)} \quad V_L = 1.24 \text{ L (0.327 gal)}$ $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(\text{static})}} = \frac{75}{75} \times \frac{0.327}{0.327} = 1$ $N2 = \frac{\text{volume of 20 valves}}{\text{volume of 1 mi of pipe}} = \frac{6.52}{3,447} = 0.002$ <p>Comments:</p> <p>Laboratory concentrations would be multiplied by 0.002 and compared to the SPAC.</p> | | | | | |
| <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | |

Table N-1.11
Additional normalization factors, assumptions, and examples

| Product nominal diameter (n.d.) | Exposure type | Probable end use ¹ | Assumptions | N1 | N2 (flowing normalization only) | N3 |
|--|----------------|-------------------------------|--|---|---------------------------------|------|
| 4 in > n.d. ≥ 0.5 in | in-the-product | service line or residential | — when product holds less than 1 L (0.26 gal) under static conditions, $V_{F(static)} = 1 \text{ L} = 0.26 \text{ gal}$ — when product holds less than 1 L (0.26 gal) under static conditions and contains metal components, extensions are added to bring the exposure volume to 1 L. — $V_{F(flow)} = 180 \text{ gal}$ | calculated in accordance with Section N-1.8.3 | 0.0015 | 0.33 |
| <p>Example: in-the-product service line valve</p> <p>Assumptions:</p> <ul style="list-style-type: none"> — product is a 0.5 in nominal diameter valve with a length of 2 in; — an in-the-product exposure was conducted; — $V_{F(static)} = 1 \text{ L}$ because the valve holds less than 1 L of water when filled to capacity under static conditions; and — extensions are added to bring the exposure volume close to 1 L. $SA_F = 20.26 \text{ cm}^2 (3.14 \text{ in}^2) \quad SA_L = 20.26 \text{ cm}^2 (3.14 \text{ in}^2)$ $V_{F(static)} = 1 \text{ L} (0.26 \text{ gal}) \quad V_L = 0.98 \text{ L} (0.26 \text{ gal})$ $N1 = \frac{SA_F}{SA_L} \times \frac{V_L}{V_{F(static)}} \times \text{dispersion factor (N3)} = \frac{3.14}{3.14} \times \frac{0.98}{1} \times 0.33 = 0.32$ $N2 = \frac{V_{F(static)}}{V_{F(flow)}} = \frac{0.26}{180} = 0.0015$ <p>Comments: Laboratory concentrations would be multiplied by 0.32 to obtain the normalized static concentration. The resulting normalized static concentration would be multiplied by 0.0015 to obtain the normalized flowing concentration.</p> | | | | | | |
| <p>¹ Probable end use and corresponding assumptions are related to the nominal diameter of the product.</p> | | | | | | |

Table N-1.12
Data available for determination of lead test statistic

| Product # | Measured lead dosage on day | | | | | | | | |
|-----------|-----------------------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 3 | 4 | 5 | 10 | 11 | 12 | 17 | 18 | 19 |
| 1 | $X_{1\ 3}$ | $X_{1\ 4}$ | $X_{1\ 5}$ | $X_{1\ 10}$ | $X_{1\ 11}$ | $X_{1\ 12}$ | $X_{1\ 17}$ | $X_{1\ 18}$ | $X_{1\ 19}$ |
| 2 | $X_{2\ 3}$ | $X_{2\ 4}$ | $X_{2\ 5}$ | $X_{2\ 10}$ | $X_{2\ 11}$ | $X_{2\ 12}$ | $X_{2\ 17}$ | $X_{2\ 18}$ | $X_{2\ 19}$ |
| 3 | $X_{3\ 3}$ | $X_{3\ 4}$ | $X_{3\ 5}$ | $X_{3\ 10}$ | $X_{3\ 11}$ | $X_{3\ 12}$ | $X_{3\ 17}$ | $X_{3\ 18}$ | $X_{3\ 19}$ |
| n | $X_{n\ 3}$ | $X_{n\ 4}$ | $X_{n\ 5}$ | $X_{n\ 10}$ | $X_{n\ 11}$ | $X_{n\ 12}$ | $X_{n\ 17}$ | $X_{n\ 18}$ | $X_{n\ 19}$ |

Table N-1.13
Values of k_1 for determining test statistic Q

| Sample size | k_1 | Sample size | k_1 | Sample size | k_1 |
|-------------|---------|-------------|---------|-------------|---------|
| 3 | 2.60281 | 19 | 1.05769 | 35 | 0.94208 |
| 4 | 1.97224 | 20 | 1.04590 | 36 | 0.93783 |
| 5 | 1.69779 | 21 | 1.03510 | 37 | 0.93377 |
| 6 | 1.53987 | 22 | 1.02517 | 38 | 0.92990 |
| 7 | 1.43526 | 23 | 1.01598 | 39 | 0.92618 |
| 8 | 1.35984 | 24 | 1.00747 | 40 | 0.92262 |
| 9 | 1.30234 | 25 | 0.99954 | 41 | 0.91921 |
| 10 | 1.25672 | 26 | 0.99213 | 42 | 0.91592 |
| 11 | 1.21943 | 27 | 0.98520 | 43 | 0.91277 |
| 12 | 1.18824 | 28 | 0.97869 | 44 | 0.90973 |
| 13 | 1.16167 | 29 | 0.97256 | 45 | 0.90680 |
| 14 | 1.13870 | 30 | 0.96677 | 46 | 0.90397 |
| 15 | 1.11859 | 31 | 0.96130 | 47 | 0.90125 |
| 16 | 1.10080 | 32 | 0.95612 | 48 | 0.89861 |
| 17 | 1.08491 | 33 | 0.95120 | 49 | 0.89607 |
| 18 | 1.07063 | 34 | 0.94653 | 50 | 0.89361 |

Table N-1.14
Values of k_2 for determining retest statistic R

| Sample size | k_2 | Sample size | k_2 | Sample size | k_2 |
|-------------|---------|-------------|---------|-------------|---------|
| 6 | 2.84809 | 21 | 1.39862 | 36 | 1.18574 |
| 7 | 2.49072 | 22 | 1.37611 | 37 | 1.17721 |
| 8 | 2.25337 | 23 | 1.35548 | 38 | 1.16907 |
| 9 | 2.08314 | 24 | 1.33647 | 39 | 1.16130 |
| 10 | 1.95433 | 25 | 1.31889 | 40 | 1.15387 |
| 11 | 1.85297 | 26 | 1.30257 | 41 | 1.14676 |
| 12 | 1.77079 | 27 | 1.28738 | 42 | 1.13994 |
| 13 | 1.70259 | 28 | 1.27319 | 43 | 1.13340 |
| 14 | 1.64491 | 29 | 1.25989 | 44 | 1.12711 |
| 15 | 1.59536 | 30 | 1.24740 | 45 | 1.12107 |
| 16 | 1.55224 | 31 | 1.23565 | 46 | 1.11526 |
| 17 | 1.51431 | 32 | 1.22455 | 47 | 1.10966 |
| 18 | 1.48063 | 33 | 1.21407 | 48 | 1.10425 |
| 19 | 1.45048 | 34 | 1.20413 | 49 | 1.09904 |
| 20 | 1.42329 | 35 | 1.19470 | 50 | 1.09401 |

Table N-1.15¹
1 L volume of extraction water

| pH | Solution #1 | Solution #2 | Chlorine stock solution |
|------------------|---|---|-------------------------|
| 5 | 25 mL of 0.1 M NaH ₂ PO ₄ | 25 mL of 0.04 M MgCl ₂ | see Section N-1.9.2.4 |
| 6.5 | 25 mL of 0.04 M NaHCO ₃ | 25 mL of 0.04 M CaCl ₂ | see Section N-1.9.2.4 |
| 8 (conditioning) | 25 mL of 0.04 M NaHCO ₃ | 25 mL of 0.04 M CaCl ₂ | see Section N-1.9.2.4 |
| 8 (organic) | 25 mL of 0.04 M NaHCO ₃ | 25 mL of 0.04 M CaCl ₂ | — |
| 10 | 50 mL of 0.1 M NaOH | 50 mL of 0.05 M Na ₂ B ₄ O ₇ | see Section N-1.9.2.4 |

¹ Volumes are per 1.0 L of extraction water produced.

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Normative Annex 2

Acceptable materials

N-2.1 Purpose

This Annex defines the evaluation process for materials that have been submitted for qualification as acceptable materials.

N-2.2 Evaluation of acceptable materials

A material shall be designated as an “acceptable material” in Table N-2.1 if it has a standard material formulation or specification (e.g., ASTM); has undergone extraction testing that demonstrates that the material does not contribute any contaminant in excess of its acceptable level as determined by this Standard (see Section N-2.3); and is accompanied by adequate documentation (see Section 3.4).

N-2.3 Extraction testing

Thirty randomly selected samples from a variety of manufacturers of the material, in a specific form (e.g., pipe or tube), shall undergo extraction testing. All the samples shall have been manufactured using the same production process. Selection of analytical testing shall be performed in accordance with Section 3.3. The samples shall be exposed at the maximum surface area-to-volume ratio for which acceptance is being sought. Depending on the specific form of the material, the samples shall be evaluated with the extraction protocol, normalization formulas and assumptions, and evaluation criteria contained in the applicable sections of this Standard.

N-2.4 Documentation

The material’s evaluation shall be supported by the following documentation:

- the published material formulation or specification to which the material is fabricated;
- literature that comprehensively addresses the production process, raw material sources, and all other factors that could potentially affect the composition and variability of the material; and
- information and data that summarize the results from the laboratory extraction of the thirty randomly selected samples, including data from a detection limit study, quality control (QC) data run concurrently with the samples, a description of the methods and instrumentation used, and a verification that the laboratory in which the extraction testing was conducted is certified for drinking water analysis by the regulatory agency having authority.

A final report that outlines the manner in which these requirements have been met shall be prepared.

Table N-2.1
Acceptable materials

| Material | Specific designation | Standard (product) reference | Surface area-to-volume ratio | End use temperature | Composition |
|-----------------|---------------------------|--|--|--------------------------------|--|
| stainless steel | UNS S30400 (Type 304) | ASTM A312 ASTM A269 ASTM A240 | 3,484 cm ² /L (540 in ² /L) | 30 °C (86 °F) 23 °C (73 °F) | percent composition: carbon (0.08 max.) manganese (2.00 max.) phosphorus (0.05 max.) sulfur (0.030 max.) silicon (1.00 max.) nickel (8.00 to 11.0) chromium (18.0 to 20.0) iron (balance) |
| | UNS S30403 (Type 304L) | ASTM A312 ASTM A269 ASTM A240 | 3,484 cm ² /L (540 in ² /L) | 30 °C (86 °F) 23 °C (73 °F) | percent composition: carbon (0.035 max.) manganese (2.00 max.) phosphorus (0.05 max.) sulfur (0.030 max.) silicon (1.00 max.) nickel (8.00 to 13.0) chromium (18.0 to 20.0) iron (balance) |
| | UNS S31600 (Type 316) | ASTM A312 ASTM A269 ASTM A240 | 3,484 cm ² /L (540 in ² /L) | 30 °C (86 °F) 23 °C (73 °F) | percent composition: carbon (0.08 max.) manganese (2.00 max.) phosphorus (0.05 max.) sulfur (0.030 max.) silicon (1.00 max.) nickel (10.00 to 14.0) chromium (16.0 to 18.0) molybdenum (2.0 to 3.0) iron (balance) |
| | UNS S31603 (Type 316L) | ASTM A312 ASTM A269 ASTM A240 | 3,484 cm ² /L (540 in ² /L) | 30 °C (86 °F) 23 °C (73 °F) | percent composition: carbon (0.035 max.) manganese (2.00 max.) phosphorus (0.05 max.) sulfur (0.030 max.) silicon (1.00 max.) nickel (10.0 to 15.0) chromium (16.0 to 18.0) molybdenum (2.0 to 3.0) iron (balance) |
| | UNS S32205 (Type 2205) | ASTM A240 ASTM A789 ASTM A790 ASTM A815 | 3,484 cm ² /L (540 in ² /L) | 23 °C (73 °F) | percent composition: carbon (0.030 max.) manganese (2.00 max.) phosphorus (0.030 max.) sulfur (0.020 max.) silicon (1.0 max.) nickel (4.5 to 6.5) chromium (22.0 to 23.0) molybdenum (3.0 to 3.5) nitrogen (0.14 to 0.20) |

Table N-2.1
Acceptable materials

| Material | Specific designation | Standard (product) reference | Surface area-to-volume ratio | End use temperature | Composition |
|-----------------|---------------------------|--|--|---------------------|--|
| stainless steel | UNS S32003 (Type 2203) | ASTM A240 ASTM A789 ASTM A790 ASTM A815 | 3,484 cm ² /L (540 in ² /L) | 23 °C (73 °F) | percent composition: carbon (0.03 max.) manganese (2.0 max.) phosphorus (0.03 max.) sulfur (0.02 max.) silicon (1.00 max.) nickel (3.0 to 4.0) chromium (19.5 to 22.5) molybdenum (1.5 to 2.0) nitrogen (0.14 to 0.20) iron (balance) |
| | UNS S32101 (Type 2101) | ASTM A240 ASTM A789 ASTM A790 ASTM A815 | 3,484 cm ² /L (540 in ² /L) | 23 °C (73 °F) | percent composition: carbon (0.040 max.) manganese (4.0 to 6.0 max.) phosphorus (0.04 max.) sulfur (0.03 max.) silicon (1.0 max.) nickel (1.35 to 1.70) chromium (21.0 to 22.0) molybdenum (0.1 to 0.8) nitrogen (0.2 to 0.25) copper (0.10 to 0.80) |
| | UNS S32304 (Type 2304) | ASTM A240 ASTM A789 ASTM A790 ASTM A815 | 3,484 cm ² /L (540 in ² /L) | 23 °C (73 °F) | percent composition: carbon (0.030 max.) manganese (2.50 max.) phosphorus (0.040 max.) sulfur (0.030 max.) silicon (1.00 max.) nickel (3.0 to 5.5) chromium (21.5 to 24.5) molybdenum (0.05 to 0.60) nitrogen (0.05 to 0.20) copper (0.05 to 0.60) |
| | UNS S32202 (Type 2202) | ASTM A240 ASTM A789 ASTM A790 ASTM A815 | 3,484 cm ² /L (540 in ² /L) | 23 °C (73 °F) | percent composition: carbon (0.030 max.) manganese (2.00 max.) phosphorus (0.040 max.) sulfur (0.010 max.) silicon (1.00 max.) nickel (1.00 to 2.80) chromium (21.5 to 24.0) molybdenum (0.45 max.) nitrogen (0.18 to 0.20) iron (balance) |

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Informative Annex 1

Toxicology review and evaluation procedures

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The toxicological review and evaluation procedures for substances imparted to drinking water through contact with drinking water system components were removed from NSF/ANSI/CAN 61 Annex A and reestablished in NSF/ANSI/CAN 600. Annex A was retired from NSF/ANSI/CAN 61 in December 2018.

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Informative Annex 2

Normative drinking water criteria

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The drinking water evaluation criteria for the determination of product compliance with the health effects requirements were removed from NSF/ANSI/CAN 61 Annex D and reestablished in NSF/ANSI/CAN 600. Annex D was retired from NSF/ANSI/CAN 61 in December 2018.

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Informative Annex 3

Informational drinking water criteria

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The revisions and tables containing the informational drinking water criteria previously listed under Annex E are now listed under NSF/ANSI/CAN 600.

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Informative Annex 4

Revisions to the evaluation of lead

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In 2006, the DWA Lead Task Group developed proposed changes designed to increase the public health protection of the Standard relative to the evaluation of lead leaching. The requirements were approved by the Drinking Water Additives Joint Committee for inclusion in the Standard as normative requirements effective July 1, 2012. Details of the revisions were maintained in Annex F of the 2007a through 2011 versions of the standard and include:

- reduction of the TAC for lead from 15 µg/L to 5 µg/L;
- reduction of the SPAC for lead from 1.5 µg/l to 0.5 µg/L;
- reduction of Q (and R) Statistic criteria from 11 to 5 for all Section 9 devices other than supply stops, flexible plumbing connectors, and miscellaneous components; and
- reduction of Q (and R) Statistic criteria from 11 to 3 for than supply stops, flexible plumbing connectors, and miscellaneous components.

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Informative Annex 5

Weighted average lead content evaluation procedure to a 0.25% lead requirement

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The procedures for determining the lead content of drinking water system components were removed from NSF/ANSI 61 Annex G and reestablished in NSF/ANSI 372. Annex G was retired from NSF/ANSI 61 in October 2013 (i.e., three years after the initial adoption of NSF/ANSI 372, as outlined in Annex G).

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Informative Annex 6

Water quality criteria considerations for piping materials in contact with drinking water

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I-6.1 Background

While NSF/ANSI/CAN 61 is designed to provide standardized evaluation conditions for the assessment of drinking water products, the test waters used in the standard cannot represent all chemistries of actual drinking water that products may encounter during use. Metallic and nonmetallic materials in contact with some drinking water qualities can have interactions with surfaces accelerating leaching or byproduct release.

This Annex is supplemental to local building and plumbing codes and is intended to provide information to assist in identifying water chemistry conditions under which the various materials may experience leaching or byproduct release of regulated contaminants at or above acceptable levels in drinking water. Due to the numerous variables in water chemistry, premise plumbing design, and system interaction, waters having these characteristics do not always cause excessive leaching or byproduct release; however, the risk in these waters is elevated and the consumer / specifier should either:

- consult with local water provider / utility or public health authority to determine the local water quality (parameters such as pH, alkalinity, PO₄ dosage, etc.) that may impact materials in contact with drinking water; or
- perform testing or analyses to verify that such materials do not pose a risk of exceeding drinking water quality standards in the subject system; or
- put appropriate water chemistry modifications / treatment in place to remediate the water chemistry conditions.

The reader is advised to investigate suitable performance when products using these materials are being considered for use in water chemistries as provided in the following sections.

The materials listed below are not the only materials that under variable drinking water parameters may leach regulated contaminants in excess of regulatory guidelines. Criteria for additional materials may be added to this Annex as they become available.

I-6.2 Criteria (by material type)

I-6.2.1 Copper (C12200)

Copper leaching or by-product release would not be suspect if the pH is greater than or equal to 7.0 and if the water system is utilizing orthophosphate dosing for corrosion control with a PO₄ residual greater than 3.3 mg PO₄/L.

System operators, installers, and owners should install water treatment, adjust water quality, install alternate materials, or verify that copper leaching or by-product release is not exceeding acceptable levels when any of the following water quality conditions exist.

If the water system is using no orthophosphate treatment for corrosion control, or is maintaining an orthophosphate residual less than 3.3 mg PO₄/L, and:

- pH less than 6.5 in all systems;
- pH between 6.5 and 7.0 in a system with disinfection / oxidative treatment;
- pH between 7.0 and 7.5 in a system with disinfection / oxidative treatment and alkalinity greater than 200 mg CaCO₃/L; and
- pH greater than 7.5 in a system with disinfection / oxidative treatment and alkalinity greater than 250 mg CaCO₃/L.

For systems conveying waters that fall within these conditions, there is an increased risk of copper leaching or by-product release into the drinking water in excess of US EPA health-based maximum contaminant level goal (MCLG) of 1.3 mg/L (US EPA, 1991, 2015). These water chemistry conditions have been correlated with the potential for elevated copper release, based on a broad consensus of international research and observation (Schock and Lytle, 2011).

I-6.2.2 Galvanized steel

The following formula is provided as a means identifying water compositions where corrosion rates for galvanized steel may be acceptable (reference: 4MS Common Approach):

Criteria:

- pH ≥ 7.5 or free CO₂ ≤ 11 mg/L; and
- alkalinity ≥ 150 mg CaCO₃/L; and
- S₁ < 2; and
- calcium ≥ 20 mg/L; and
- conductivity ≤ 600 μS/cm at 25 °C; and
- S₂ < 1 or S₂ > 3.

Where:

$$S_1 = \frac{c[(\text{Cl}^-)/35] + c[(\text{NO}_3^-)/62] + 2 c[(\text{SO}_4^{2-})/96]}{c[(\text{HCO}_3^-)/61]}$$

$$S_2 = \frac{c[(\text{Cl}^-)/35] + 2 c[(\text{SO}_4^{2-})/96]}{c[(\text{NO}_3^-)/62]}$$

Notes:

- concentrations (c) in mg/L; and
- guidance on HCO₃⁻ derivation from pH & alkalinity follows the examples below.

Table I-6.1
Examples of galvanized steel calculation

| Example water #1 | | | | Example water #2 | | | |
|--|--|-------------------------------|---------|---|--|-------------------------------|----------|
| pH | 7.54 | Cl ⁻ | 34 mg/L | pH | 7.6 | Cl ⁻ | 53 mg/L |
| alkalinity | 192 mg CaCO ₃ /L | NO ₃ ⁻ | 9 mg/L | alkalinity | 245 mg CaCO ₃ /L | NO ₃ ⁻ | 1 mg/L |
| calcium | 62 mg/L | SO ₄ ²⁻ | 56 mg/L | calcium | 92 mg/L | SO ₄ ²⁻ | 106 mg/L |
| conductivity | 250 μS/cm at 25 °C | HCO ₃ ⁻ | 84 mg/L | conductivity | 340 μS/cm at 25 °C | HCO ₃ ⁻ | 78 mg/L |
| ✓ pH ≥ 7.5 or free CO ₂ ≤ 11 mg/L | | | | ✓ pH ≥ 7.5 or free CO ₂ ≤ 11 mg/L | | | |
| ✓ AND alkalinity ≥ 150 mg CaCO ₃ /L | | | | ✓ AND alkalinity ≥ 150 mg CaCO ₃ /L | | | |
| AND S ₁ < 2 ✓ S ₁ = 1.66 mg/L (S ₁ < 2) | $S_1 = \frac{\left(\frac{Cl^-}{35}\right) + \left(\frac{NO_3^-}{62}\right) + 2\left(\frac{SO_4^{2-}}{96}\right)}{\left(\frac{HCO_3^-}{61}\right)}$ | | | AND S ₁ < 2 ✗ S ₁ = 2.92 mg/L (S ₁ > 2) (Does not meet criteria) | $S_1 = \frac{\left(\frac{Cl^-}{35}\right) + \left(\frac{NO_3^-}{62}\right) + 2\left(\frac{SO_4^{2-}}{96}\right)}{\left(\frac{HCO_3^-}{61}\right)}$ | | |
| | $S_1 = \frac{\left(\frac{34}{35}\right) + \left(\frac{9}{62}\right) + 2\left(\frac{56}{96}\right)}{\left(\frac{84}{61}\right)}$ | | | | $S_1 = \frac{\left(\frac{53}{35}\right) + \left(\frac{1}{62}\right) + 2\left(\frac{106}{96}\right)}{\left(\frac{78}{61}\right)}$ | | |
| | $S_1 = \frac{(0.97) + (0.15) + (1.17)}{(1.38)}$ | | | | $S_1 = \frac{(1.51) + (0.016) + (2.21)}{(1.28)}$ | | |
| | $S_1 = \frac{2.29}{1.38}$ | | | | $S_1 = \frac{3.74}{1.28}$ | | |
| ✓ AND calcium ≥ 20 mg/L | | | | ✓ AND calcium ≥ 20 mg/L | | | |
| ✓ AND conductivity ≤ 600 μS/cm at 25 °C | | | | ✓ AND conductivity ≤ 600 μS/cm at 25 °C | | | |
| AND S ₂ < 1 or S ₂ > 3 ✓ S ₂ = 14.27 mg/L (S ₂ > 3) | $S_2 = \frac{\left(\frac{Cl^-}{35}\right) + 2\left(\frac{SO_4^{2-}}{96}\right)}{\left(\frac{NO_3^-}{62}\right)}$ | | | AND S ₂ < 1 or S ₂ > 3 ✓ S ₂ = 232.5 mg/L (S ₂ > 3) | $S_2 = \frac{\left(\frac{Cl^-}{35}\right) + 2\left(\frac{SO_4^{2-}}{96}\right)}{\left(\frac{NO_3^-}{62}\right)}$ | | |
| | $S_2 = \frac{\left(\frac{34}{35}\right) + 2\left(\frac{56}{96}\right)}{\left(\frac{9}{62}\right)}$ | | | | $S_2 = \frac{\left(\frac{53}{35}\right) + 2\left(\frac{106}{96}\right)}{\left(\frac{1}{62}\right)}$ | | |
| | $S_2 = \frac{(0.97) + (1.17)}{(0.15)}$ | | | | $S_2 = \frac{(1.51) + (2.21)}{(0.016)}$ | | |
| | $S_2 = \frac{2.14}{0.15}$ | | | | $S_2 = \frac{3.72}{0.016}$ | | |
| Water #1 has a composition where corrosion rates for galvanized steel may be acceptable. | | | | Water #2 has a composition where corrosion rates for galvanized steel may <u>NOT</u> be acceptable. | | | |

I-6.3 Determining HCO_3^- concentration from alkalinity using Standard Methods 4500-CO₂ Carbon Dioxide (Editorial revisions, 2011)

Applicable for waters which:

- have a total alkalinity due almost entirely to hydroxides, carbonates, or bicarbonates;
- do not contain the salts of weak acids (other than carbonic acid) or those acids are present in extremely small amounts; and
- do not exceed 500 mg/L of total dissolved solids.

Further some treatment processes such as superchlorination and coagulation can significantly affect pH and total alkalinity values of a poorly buffered water of low alkalinity and low total dissolved mineral content. This calculation is also limited for use at a single temperature of 25 °C. In such instances where the previously mentioned guidelines are exceeded this calculation may not be applicable (from Standard Methods 4500, Section D.2.a. bicarbonate alkalinity equation):

$$\text{HCO}_3^- \text{ as mg } \frac{\text{CaCO}_3}{\text{L}} = \frac{T - 5.0 \times 10^{(\text{pH}-10)}}{1 + 0.94 \times 10^{(\text{pH}-10)}}$$

Where:

T = total alkalinity, mg CaCO₃/L

| Example water | |
|--|---------|
| total alkalinity (as CaCO ₃) | 60 mg/L |
| pH | 8.7 |

$$\text{HCO}_3^- \text{ as mg } \frac{\text{CaCO}_3}{\text{L}} = \frac{T - 5.0 \times 10^{(\text{pH}-10)}}{1 + 0.94 \times 10^{(\text{pH}-10)}}$$

$$\text{HCO}_3^- = \frac{60 \text{ mg/L} - 5.0 \times 10^{(8.7-10)}}{1 + 0.94 \times 10^{(8.7-10)}}$$

$$\text{HCO}_3^- = \frac{60 \text{ mg/L} - 0.25}{1 + 0.047}$$

$$\text{HCO}_3^- = \frac{59.75 \text{ mg/L}}{1.047}$$

$$\text{HCO}_3^- = 57 \text{ mg/L}$$

References

4MS Common Approach: Acceptance of Metallic Materials used in Products in Contact With Drinking Water, 6th Revision, May 27, 2016. <www.umweltbundesamt.de/sites/default/files/medien/374/dokumente/6th_revision_4ms_scheme_for_metallic_materials_part_b.pdf>

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Informative Annex 7¹⁹

Revisions to the evaluation of lead

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I-7.1 Background

At the 2017 annual meeting of the Joint Committee on Drinking Water Additives – System Components, the issue was raised that many states and cities are now conducting aggressive monitoring programs for lead in schools and day care centers. The EPA and CDC have determined that no amount level of lead is acceptable. The American Academy of Pediatrics has called for regulations limiting exposure of lead in drinking water for schools and day care centers to no more than 1 part per billion. However, most school monitoring is done using the EPA 3Ts program guidance, which uses 250 mL first draw samples, not 1 L as is used by the Lead and Copper rule. This has been the basis for the Q value used for NSF/ANSI/CAN 61 Section 9, after normalization to 1 L. A task group was formed to investigate implementing a special higher-stringency certification level for products to be used in schools, day care centers, and for consumers desiring the additional level of protection. The task group considered the following approaches: a lower Q value, an additional requirement for the average lead release of test samples Day 3, or both. In 2018, a second task group was formed to develop proposed criteria for the option they decided to pursue.

After an initial ballot was proposed for the new, optional requirement, concerns were raised over actions that have been initiated by the state of California and possibly others to mandate a lower Q value. At the 2019 Joint Committee meeting, members concurred that the committee should take a proactive approach to make this optional requirement mandatory after a transition period to allow manufacturers sufficient time to comply.

NOTE — Due to the significant impact of these changes, the Joint Committee on Drinking Water Additives – System Components established an extended effective date for the current optional requirement to become mandatory. The 01/01/2024 effective date was selected provide manufacturers a reasonable time to reengineer products to meet the new requirements, to have them tested, and to make them available in the marketplace. Manufacturers and certifiers are encouraged to actively pursue conformance to the new requirement prior to 01/01/2024.

I-7.2 Incorporation of revisions into Standard

The optional requirements for lower lead leaching shall be removed and the revisions in this Annex shall be incorporated into the body of this Standard on January 1, 2024. This date is based on the date of product manufacture.

I-7.3 Revisions

9.5.1 Evaluation of lead

For endpoint devices other than commercial kitchen devices, supply stops, flexible plumbing connectors, and miscellaneous components, the lead test statistic Q shall not exceed $5 \pm 1 \mu\text{g}$ when normalized for the 1 L (0.26 gal) first draw sample. For commercial kitchen devices, the lead test statistic Q shall not exceed $5 \pm 1 \mu\text{g}$ when normalized for the 18.9 L (5 gal) first draw sample. For supply stops, flexible plumbing connectors,

¹⁹ The information contained in this Annex has been processed in accordance with ANSI and SCC requirements for public review and consensus ballot. The requirements were approved by the Joint Committee on Drinking Water Additives – System Components for inclusion in the Standard as normative requirements effective January 1, 2024.

and miscellaneous components, the lead test statistic Q shall not exceed ≤ 0.5 μg when normalized for the 1 L (0.26 gal) first draw sample.

For kitchen faucets that have been exposed simultaneously with the side spray component, the lead test statistic Q value for the entire assembly shall not exceed ≤ 1 μg . When the kitchen faucet and the side spray component have been exposed separately, the lead test statistic Q value for the faucet and side spray shall be added and shall not exceed ≤ 1 μg .

9.5.1.1 — Optional lower lead requirements

~~The following are optional evaluation criteria available for endpoint devices to demonstrate compliance with a lower lead leaching criteria. Products shall also comply with the full requirements of NSF/ANSI/CAN 61 in order to be deemed compliant to this Section.~~

9.5.1.1 — Evaluation requirements

~~For endpoint devices other than supply stops, flexible plumbing connectors, and miscellaneous components, the test statistics Q or R calculated in accordance with N-1.8.9 shall not exceed 1 μg . For supply stops, flexible plumbing connectors, and miscellaneous components, the lead test statistic Q shall not exceed 0.5 μg .~~

9.5.1.2 — 9.5.1.1 Product labeling requirements

Attested compliance of product to the lower lead leaching criteria of this Section Standard shall be noted in the certification listing. Consumer-facing product packaging or labeling shall also indicate this compliance by identifying the standard and Q level attested according to Section 9.5.1.1.1 (e.g., “NSF/ANSI/CAN 61: $Q \leq 1$ ” or “NSF/ANSI/CAN 61: $Q \leq 0.5$ ”).

Rationale: As product can remain in the marketplace for extended periods of time, the marking requirements in this section need to be maintained to enable differentiation between product meeting these requirements versus those in an earlier version of the standard and a higher Q criterion. When the NSF 61 Joint Committee has determined that sufficient time has passed and this labeling requirement for the Q is no longer warranted the ballot process can be followed to pursue its removal.

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N-1.8.9.3 Initial test statistic

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For end-point devices other than supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $Q \leq \leq 1$ μg , the product line has tested as acceptable; or
- case II: If $Q > \leq 1$ μg , the product line has tested as unacceptable.

For supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $Q \leq \leq 0.5$ μg , the product line has tested as acceptable; or
- case II: If $Q > \leq 0.5$ μg , the product line has tested as unacceptable.

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N-1.8.9.4 Retest statistic

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- case I: If $R \leq 5.1 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $R > 5.1 \mu\text{g}$, the product line has tested as unacceptable.

For supply stops, flexible plumbing connectors, and miscellaneous components:

- case I: If $R \leq 3.05 \mu\text{g}$, the product line has tested as acceptable; or
- case II: If $R > 3.05 \mu\text{g}$, the product line has tested as unacceptable.

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Interpretation Annex

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Normative Annex 2 (formerly Annex C) – Acceptable materials

Requestor's interpretation of the Section:

CDA is interested in performing testing on a number of 'lead-free' brass rod alloys for potential inclusion as 'acceptable materials' according to the requirements of NSF/ANSI/CAN Standard 61, 2019, Annex C for use as a material for Section 9 products. Prior to having the materials tested, there are a couple of points we need clarified to assure that if we proceed with this extensive testing that our approach would be acceptable. As such, I would greatly appreciate your assistance in providing an interpretation and answering a few questions outlined below.

Annex C is fairly straightforward with many of the requirements, but there are a few points that we would like to be confident that we understand:

- 1) Section C.3 states, "Thirty randomly selected samples from a variety of manufacturers of the material..." We consider the following variables to be most significant in manufacturing finished parts from lead-free brass rods: the manufacturer of the brass rods, the brass rod production lot, and the machine shop that machines the brass rods into finished parts.
 - a) If we selected a combination of the above variables for each alloy to make our 30 samples for testing, will it meet the requirement of "thirty randomly selected samples?"
 - b) Do we understand this requirement appropriately? For your benefit we would describe the variables as follows:
 - brass rod manufacturer: The company that converts raw materials (e.g., brass/copper scrap, virgin elements) into brass rods
 - production lot (per ASTM B249): Product of one cast bar from a single melt charge, or one continuous casting run that has been continuously processed and subject to inspection at one time
 - machine shop: The company that takes brass rods and machines them (e.g., drilling, lathing, milling) into finished parts
- 2) Section C.4 states in the second bulleted point, "literature that comprehensively addresses the production process..."
 - a) If we replaced the term "addresses" with "describes" does the requirement have the same meaning? If not, could you please clarify what is meant by "addresses?"
- 3) Our goal would be to have the materials tested and arrive at the greatest surface area to volume ratio that the test results would allow. To do so we would like to use a test sample that is 6 inches long with an inside diameter of 0.327 inches. If the Q result was 0.1 we would anticipate that we could list a surface area of 60 square inches/L for finished products and 30 square inches/L for components since the Q statistic calculated would be below the proposed criteria of 1 ug and 0.5 ug respectively.

- a) Can you please confirm this calculation is correct? The reason we chose 6 inches was for practical aspects of handling the samples and for the efficient use of raw materials.
- 4) We are intending to test 6 inch rod segments that have had the centers drilled out with one end machined with interior threads. The test samples would have a piece of plastic threaded with the sample exposing $\frac{1}{3}$ of the threads. Our reason for making the sample with an internal thread on one end is to simulate the worst-case processed sample with the hope that these materials would be exempt from testing if used within the approved surface area.
- a) Do you think this is necessary and would it help our manufacturers?

Interpretation decision:

The assumptions made for approved stainless steel materials under Annex N-2 (formerly Annex C noted above) cannot necessarily be applied to brass rod alloys due to differences in manufacturing. Of note, stainless steel does not contain lead and as such may not be subject to the same variability as brasses containing even small amounts of lead. The proposed testing method and sampling plan should be submitted to the Joint Committee as a separate issue paper prior to undertaking any testing.

1. The requirement as described above has not been interpreted correctly. Section 3.4 of NSF/ANSI/CAN 61 states that “Products manufactured... However, extraction testing for contaminants contributed by processes specific to a production site shall be considered formulation-dependent analytes.” The interpretation of this Section would indicate that qualification testing for inclusion in Annex N-2 would include samples from manufacturers of brass rods but exclude those from machine shops. Since machine shops include processes (machining, drilling, etc.) that could contribute to increased leaching of contaminants (i.e., lead), from the finished parts. Differences in machine shops would be covered under certification testing of the final machined parts.
2. It is agreed that the term “describes” is consistent with meaning of “addresses” in the context of the statement in section N-2.4 (formerly Section C.4 as described above).
3. Since NSF/ANSI/CAN 61 applies to the finished products and not raw materials, this calculation would need to be addressed in the testing proposal and agreed upon by the Joint Committee.
4. This methodology should be submitted to the Joint Committee along with the proposal (and in consideration of the response under #1) in an issue paper.



France Lemieux
Chair, Joint Committee on Drinking Water Additives – System Components

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Standards²⁰

The following Standards established and adopted by NSF as minimum voluntary consensus Standards are used internationally:

| Std. # | Standard title |
|--------|--|
| 2 | Food Equipment |
| 3 | Commercial Warewashing Equipment |
| 4 | Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transport Equipment |
| 5 | Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment |
| 6 | Dispensing Freezers |
| 7 | Commercial Refrigerators and Freezers |
| 8 | Commercial Powered Food Preparation Equipment |
| 12 | Automatic Ice Making Equipment |
| 13 | Refuse Processors and Processing Systems |
| 14 | Plastics Piping System Components and Related Materials |
| 18 | Manual Food and Beverage Dispensing Equipment |
| 20 | Commercial Bulk Milk Dispensing Equipment |
| 21 | Thermoplastic Refuse Containers |
| 24 | Plumbing System Components for Recreational Vehicles |
| 25 | Vending Machines for Food And Beverages |
| 29 | Detergent and Chemical Feeders for Commercial Spray-Type Dishwashing Machines |
| 35 | High Pressure Decorative Laminates for Surfacing Food Service Equipment |
| 37 | Air Curtains for Entranceways in Food and Food Service Establishments |
| 40 | Residential Wastewater Treatment Systems |
| 41 | Non-liquid Saturated Treatment Systems |
| 42 | Drinking Water Treatment Units – Aesthetic Effects |
| 44 | Residential Cation Exchange Water Softeners |
| 46 | Evaluation of Components and Devices Used in Wastewater Treatment Systems |
| 49 | Biosafety Cabinetry – Design, Construction, Performance, and Field Certification |
| 50 | Equipment for Swimming Pools, Spas, Hot Tubs, and Other Recreational Water Facilities |
| 51 | Food Equipment Materials |
| 52 | Supplemental Flooring |
| 53 | Drinking Water Treatment Units – Health Effects |
| 55 | Ultraviolet Microbiological Water Treatment Systems |
| 58 | Reverse Osmosis Drinking Water Treatment Systems |
| 59 | Mobile Food Carts |
| 60 | Drinking Water Treatment Chemicals – Health Effects |
| 61 | Drinking Water System Components – Health Effects |
| 62 | Drinking Water Distillation Systems |
| 140 | Sustainable Carpet Assessment |
| 169 | Special Purpose Food Equipment and Devices |
| 170 | Glossary of Food Equipment Terminology |
| 173 | Dietary Supplements |
| 177 | Shower Filtration Systems – Aesthetic Effects |

²⁰ The information contained in this list of Standards is not part of this American National Standard (ANS) / National Standard of Canada (NSC) and has not been processed in accordance with ANSI's / SCC's requirements for an ANS/NSC. Therefore, this Standards page may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

| Std. # | Standard title |
|---------|---|
| 184 | Residential Dishwashers |
| 223 | Conformity Assessment Requirements for Certification Bodies that Certify Products Pursuant to NSF/ANSI 60 Drinking Water Treatment Chemicals – Health Effects |
| 240 | Drainfield Trench Product Sizing for Gravity Dispersal Onsite Wastewater Treatment and Dispersal Systems |
| 244 | Drinking Water Treatment Units Supplemental Microbiological Water Treatment Systems – Filtration |
| 245 | Wastewater Treatment Systems – Nitrogen Reduction |
| 305 | Personal Care Products Containing Organic Ingredients |
| 321 | Goldenseal Root (<i>Hydrastis canadensis</i>) |
| 330 | Glossary of Drinking Water Treatment Unit Terminology |
| 332 | Sustainability Assessment for Resilient Floor Coverings |
| 336 | Sustainability Assessment for Commercial Furnishings Fabric |
| 342 | Sustainability Assessment for Wallcovering Products |
| 347 | Sustainability Assessment for Single-Ply Roofing Membranes |
| 350 | Onsite Residential and Commercial Water Reuse Treatment Systems |
| 350-1 | Onsite Residential and Commercial Greywater Treatment Systems for Subsurface Discharge |
| 358-1 | Polyethylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems |
| 358-2 | Polypropylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems |
| 358-3 | Cross-linked Polyethylene (PEX) Pipe and Fittings for Water-based Ground-Source (Geothermal) Heat Pump Systems |
| 358-4 | Polyethylene of Raised Temperature (PE-RT) Tubing and Fittings for Water-based Ground-Source (Geothermal) Heat Pump Systems |
| 359 | Valves for Cross-linked Polyethylene (PEX) Water Distribution Tubing Systems |
| 360 | Wastewater Treatment Systems – Field Performance Verification |
| 363 | Good Manufacturing Practices (GMP) for Pharmaceutical Excipients |
| 372 | Drinking Water Treatment System Components – Lead Content |
| 375 | Sustainability Assessment for Water Contact Products |
| 385 | Disinfection Mechanics |
| 401 | Drinking Water Treatment Units – Emerging Compounds / Incidental Contaminants |
| 416 | Sustainability Assessment for Water Treatment Chemical Products |
| 418 | Effluent Filters – Field Longevity Testing |
| 419 | Public Drinking Water Equipment Performance – Filtration |
| 426 | Environmental Leadership and Corporate Social Responsibility Assessment of Servers |
| 455-1 | Terminology for the NSF 455 Portfolio of Standards |
| 455-2 | Good Manufacturing Practices for Dietary Supplements |
| 455-3 | Good Manufacturing Practices for Cosmetics |
| 455-4 | Good Manufacturing Practices for Over-the-Counter Drugs |
| 457 | Sustainability Leadership Standard for Photovoltaic Modules and Photovoltaic Inverters |
| 600 | Health Effects Evaluation and Criteria for Chemicals in Drinking Water |
| 14159-1 | Hygiene Requirements for the Design of Meat and Poultry Processing Equipment |
| 14159-2 | Hygiene Requirements for the Design of Hand-held Tools Used in Meat and Poultry Processing Equipment |
| 14159-3 | Hygiene Requirements for the Design of Mechanical Belt Conveyors Used in Meat and Poultry Processing Equipment |

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