



*NSF International Standard /
American National Standard*

NSF/ANSI 42 - 2013

Drinking Water Treatment Units -
Aesthetic Effects



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NSF International Standard/
American National Standard
for Drinking Water Treatment Units –

**Drinking water treatment units –
Aesthetic effects**

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Standard Developer

NSF International

NSF International

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Foreword²

The purpose of this Standard is to establish minimum requirements for materials, design, construction, and performance of drinking water treatment units that are designed to reduce specific aesthetic-related contaminants in public or private water supplies. This Standard specifies the minimum product literature and labeling information that a manufacturer must supply to authorized representatives and system owners. Lastly, the Standard provides minimum service-related obligations that the manufacturer must extend to system owners.

This edition of the Standard contains the following revisions:

Issue 70

This revision addresses tentatively identified compounds (TICs) and unknown compounds that are found during extraction testing under section 4 and clarifies the analytical method(s) to be used to evaluate these compounds under Annex C.

Issue 74

This issue incorporates test protocols to evaluate personal hand held DWTUs under all applicable sections of elective performance claims methods under section 7. The test method for evaluating mouth drawn DWTUs has been added under Annex D and the method for evaluating squeeze-type bottles has been added under Annex E. A structural integrity test method for all personal hand held devices has also been added under section 5.

Issue 78

This revision addresses premature clogging of filters during testing under section 7 and clarifies what is and is not allowed with regards to pre-filtering the challenge water of products if requested by the manufacturer. Annex F specifies acceptable procedures that may be used.

This Standard was developed by the NSF Joint Committee on Drinking Water Treatment Units using the consensus process described by the American National Standards Institute.

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 Treatment Units at standards@nsf.org, or c/o NSF International, Standards Department, P.O. Box 130140, Ann Arbor, Michigan 48113-0140, USA.

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NSF/ANSI Standard for Drinking Water Treatment Units –

Drinking water treatment units – Aesthetic effects

1 General

1.1 Purpose

It is the purpose of this Standard to establish minimum requirements for materials, design and construction, and performance of drinking water treatment systems that are designed to reduce specific aesthetic-related (non-health effects) contaminants in public or private water supplies. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners as well as the minimum service-related obligations that the manufacturer shall extend to system owners.

1.2 Scope

The point-of-use and point-of-entry systems addressed by this Standard are designed to be used for the reduction of specific substances that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality. Systems covered under this Standard are intended to reduce substances affecting the aesthetic quality of the water or to add chemicals for scale control, or both. Substances may be soluble or particulate in nature at concentrations influencing public acceptance of the drinking water. It is recognized that a system may be effective in controlling one or more of these substances but is not required to control all. Systems with components or functions covered under other NSF or NSF/ANSI standards or criteria shall conform to the applicable requirements therein.

1.3 Alternate materials, designs, and construction

While specific materials, designs, and construction may be stipulated in this Standard, systems that incorporate alternate materials, designs, and construction may be acceptable when it is verified that such systems meet the applicable requirements stated herein.

1.4 Chemical and mechanical reduction performance claims

1.4.1 All NSF/ANSI 42 performance claims shall be verified and substantiated by test data generated under the requirements of NSF/ANSI 42.

1.4.2 When performance claims are made for substances not specifically addressed in the scope of this Standard or for substances not specifically addressed but falling under the scope of NSF/ANSI 42, such claims shall be identified as not specifically addressed in the Standard.

1.5 Minimum requirements

This Standard establishes minimum requirements.

A system as defined in this Standard shall meet the applicable requirements of 4, 5, 6, and 8, and at least one performance claim as described in 7.

A component as defined in this Standard shall meet the requirements of 4 and 8. If the component is pressure-bearing, it shall also meet the applicable requirements of 5.

A commercial modular system as defined in this Standard shall meet the applicable requirements of 4, 5, 6, and 8, and at least one performance claim as described in 7. Manifolds of commercial modular systems shall meet the requirements of 4, 5 (if pressure bearing), and 8, and shall be evaluated as stand-alone components. Manifolds shall have a minimum internal diameter such that the water velocity in the manifold will not exceed 3 m (10 ft) per second (which can be calculated based upon the system flow rate and the manifold internal diameter). Individual modular elements evaluated as a manifold and modular element combination shall meet the applicable requirements of 4, 5, 6, and 8, and at least one performance claim as described in 7.

2 Normative references

The following documents contain requirements that, by reference in this text, constitute requirements of this Standard. At the time of publication, the indicated editions were valid. All of the 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.

ANSI/NFPA 70, 1999. *National Electrical Code*³

APHA, *Standard Methods for the Examination of Water and Wastewater*, twentieth edition⁴

NSF/ANSI 51 – *Food Equipment Materials*

NSF/ANSI 53 – *Drinking water treatment units – Health effects*

NSF/ANSI 60 – *Drinking water treatment chemicals – Health effects*

NSF/ANSI 61 – *Drinking water system components – Health effects*

ISO 12103-1:1997. *Road Vehicles – Test dust for filter evaluation – Part 1: Arizona test dust*⁵

USEPA-600/4-79-020. *Methods for the Chemical Analysis of Water and Wastes*, March 1983⁶

USEPA-600/4-84/053. *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, June 1984⁶

³ National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269 <www.nfpa.org>.

⁴ American Public Health Association (APHA), 800 I Street, NW, Washington, DC 20001 <www.apha.org>.

⁵ International Organization for Standardization (ISO), Case postale 56, CH-1211 Geneve 20, Switzerland <www.iso.org>.

⁶ USEPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 <www.epa.gov>.

USEPA-600/R-94/111. *Methods for the Determination of Metals in Environmental Samples*, Supplement 1, May 1994⁶

USEPA-90/020. *Methods for the Determination of Organic Compounds in Drinking Water*, Supplement 1, July 1990⁶

USEPA *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, 40 CFR Part 136⁷

USEPA *National Primary Drinking Water Regulations*, 40 CFR Part 141⁷

USEPA *National Secondary Drinking Water Regulations*, 40 CFR Part 143⁷

USFDA Code of Federal Regulations, Title 21, (*Food and Drugs*) *Direct Food Additive Substances Parts 170 through 199*, April 1, 1992⁷

3 Definitions

The following are definitions of terms used in this document:

3.1 active agent: A substance or medium added to or involved in a drinking water treatment process that requires direct or sacrificial release of the agent or its degradation product(s) to reduce specific contaminants in the water.

3.2 additive: A substance added to water, directly or indirectly, during a drinking water treatment process.

3.3 advisory concentration: The minimum concentration attainable for a given substance using good manufacturing practices and appropriate process controls. In some cases, the advisory concentration is equal to the limit of detection of the preferred analytical method for the substance.

3.4 aesthetic: Pertaining to factors that affect drinking water, such as taste, odor, color, and appearance, which may in turn affect acceptance of public or private drinking water.

3.5 air gap: The unobstructed vertical distance through the free atmosphere between the outlet of the waste pipe and the flood level rim of the receptacle into which it is discharging.

3.6 bacteriostatic system: A drinking water treatment system designed to limit the passage or growth, or both, of heterotrophic bacteria so that the bacterial population of the product water is not larger than that of the influent water.

3.7 bypass: A valve system that allows water to flow around the water treatment system while the system is being regenerated or serviced.

3.8 capacity: The rated service cycle, expressed as a function of time or volume of water treated by the system between manufacturer-specified servicings (cleaning, regeneration, or replacement) of the medium (media).

3.9 chemical feeder: A mechanism or device intended for use in the controlled introduction of chemicals into water.

3.10 chemical reduction: The reduction in the quantity of one or more specified contaminants in drinking water.

⁷ Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402 <www.gpo.gov>.

- 3.11 clean system:** A system that has not been subjected to an influent challenge containing specified contaminant(s).
- 3.12 component:** A separate or distinct part of the drinking water treatment system including, but not limited to, appurtenant accessories such as membranes, filters, housing, tubing, storage tanks, faucets, valves, and connectors to the feed water supply.
- 3.13 commercial modular system:** A system consisting of multiple modular elements attached to a manifold, produced specifically for food service applications, installed by an authorized plumber or authorized agent of the manufacturer, and not intended for use in residential applications.
- 3.14 contaminant:** A physical, chemical, biological, or radiological substance or matter that has a beneficial or detrimental effect on the potability of water.
- 3.15 degradation product:** A product of an active agent or additive that has been altered by biological, chemical, or physical interaction.
- 3.16 disposable pressure vessel:** A pressure vessel that is to be replaced at the end of each rated service cycle and has an estimated service life of one year or less.
- 3.17 drinking water:** Water that is intended for human consumption.
- 3.18 exposure water:** Water having definitive characteristics prior to contact with a system or component(s) in extraction procedures.
- 3.19 extractant water:** Water that has been in contact with a system or component(s) for a specified duration.
- 3.20 filter:** (verb) To pass water through a semi-permeable medium to separate particles from the water. (noun) A unit for carrying out the process of filtration consisting of the medium and suitable hardware for constraining and supporting the medium in the path of the water.
- 3.21 filtration:** The process by which particles are separated from water by passing water through a semi-permeable material.
- 3.22 flow rate:** The volume of water that passes through the system in a specified time period.
- 3.23 influent challenge:** The mixture of water and contaminants entering the system.
- 3.24 initial dynamic pressure:** The pressure as measured at a pressure gauge immediately preceding connection to the system being tested (see figure 1) when the system is filled with water and flowing.
- 3.25 maximum contaminant concentration (MCC):** The maximum permissible concentration of a contaminant in drinking water as established by a recognized regulatory agency, such as the USEPA or Health Canada.
- 3.26 maximum contaminant level (MCL):** The maximum permissible concentration of a contaminant in drinking water as established in the USEPA *National Primary Drinking Water Regulations*.
- 3.27 maximum drinking water level (MDWL):** The maximum concentration of a contaminant in drinking water that a system is allowed to contribute to the product water as established in this Standard.
- 3.28 media migration:** The entrainment of a fraction of the media into the product water.
- 3.29 medium (media):** The selected material(s) in a system that forms a water-permeable barrier to the passage of certain contaminants or otherwise contributes to the reduction of contaminants in water.

- 3.30 microbiologically unsafe water:** Water that (1) is known to contain disease-causing bacteria, viruses, protozoa, or other disease-causing microbiological agents, (2) shows a positive test for an indicator organism or protozoa, or (3) is determined unsafe by an appropriate health or regulatory agency.
- 3.31 modular element:** A replaceable filtration or treatment element designed and sold as a component for use in commercial modular systems.
- 3.32 open discharge system:** A system not subject to line pressure during the off mode.
- 3.33 particulate reduction:** The process for clarifying water by passing it through a semi-permeable medium to reduce particles of a specific size. Particulate reduction may be combined with other processes to accomplish the removal of undesirable particles (e.g., adsorption, oxidation, neutralization).
- 3.34 point-of-entry (POE) system:** A drinking water treatment unit with a minimum initial clean-system flow rate of not less than 15 L/min at 103 kilopascals 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 and for washing, flushing, or other non-consumption water supply purposes in addition to the drinking water supply.
- 3.35 point-of-use (POU) system:** A plumbed-in or faucet-mounted drinking water treatment unit 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 non-consumption purposes at a building or facility. Any batch system or device not connected to the plumbing system is considered a point-of-use system.
- 3.36 pressure drop:** The difference between the inlet and outlet pressures of the system at the rated service flow.
- 3.37 pressure vessel:** A component of the system, intended to hold water under pressure higher than atmospheric pressure.
- 3.38 product water:** Water that has been treated by the system.
- 3.39 rated service flow:** The manufacturer-specified flow rate at which a system will deliver treated water of acceptable quality, as claimed by the manufacturer. Flow rate is expressed as liters (gallons) per minute or liters (gallons) per day.
- 3.40 raw water:** Untreated water or any influent water before it enters a specific water treatment component or system.
- 3.41 readily accessible:** Fabricated to be exposed for cleaning and inspection without the use of tools.
- 3.42 readily removable:** Capable of being detached from the system without the use of tools.
- 3.43 regeneration:** The maintenance process that restores the medium (media) thereby enabling it to perform its water treatment function(s).
- 3.44 replacement component:** A replaceable, preformed, or prepackaged component containing medium (media).
- 3.45 scale:** A deposit on the surface of materials in contact with water resulting from the precipitation of salts from the water.

3.46 secondary maximum contaminant level (SMCL): The maximum permissible level of a contaminant in drinking water as established in the USEPA *National Secondary Drinking Water Regulations*.

3.47 system: A series of components and appurtenant accessories intended to be assembled together as a single water treatment device.

3.48 total dissolved solids (TDS): The remaining solids from a filtrate evaporated to dryness and dried to a constant weight at 180 °C (356 °F) after passing through a 0.45 mm glass fiber filter.

3.49 turbidity: A condition caused by the presence of suspended matter, colloidal matter, or both, which results in the scattering and absorption of light rays.

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

3.51 unit volume: Total water-holding volume without the medium (media) or components in place.

3.52 watertight: A condition existing in equipment and material of such precision of construction and fit as to be impermeable to water.

3.53 weepage: The formation of bubbles or droplets of water on the outside of a fiber glass tank during the initial phase of a pressure test due to the expression of water that was trapped between the tank liner and the fiber glass wrap during the tank manufacturer's testing.

3.54 working pressure: Feedwater or inlet water pressure to a system.

3.54.1 maximum working pressure: The maximum operating pressure recommended by the manufacturer.

4 Materials

4.1 Materials in contact with drinking water

4.1.1 POE drinking water treatment units shall conform to the protocol and criteria in NSF/ANSI 61.

4.1.2 POU drinking water treatment units shall conform to the protocol and criteria in this section.

4.1.3 Acceptance criteria

4.1.3.1 Materials in contact with drinking water shall not impart levels of target compounds or Tentatively Identified Compounds (TICs) that exceed the Total Allowable Concentration (TAC), Maximum Contaminant Levels (MCL), or Maximum Acceptable Concentration (MAC) criteria specified in tables 1, 2 and 3 or specified in NSF/ANSI 61 Annex D and E. Any extractable contaminants not listed in the referenced tables shall be reviewed and shall not exceed criteria developed in accordance with NSF/ANSI 61 Annex A.

4.1.3.2 TIC identification and quantitation shall be conducted in accordance with section 4.3.1.2. Additional TIC identification and quantitation should be verified using a standard of the compound in question or an alternate approved analytical method. Additional TIC identification and quantitation is recommended when the contaminant is a health risk or when the "Probability Based Matching" process in section 4.3.1.2 is inconclusive. When possible, the product manufacturer should assist and support the testing laboratory in the identification of a standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed. If a standard and an adequate alternative analytical method are not available to verify the identification and quantitation of the compound, the TIC shall be evaluated according to section 4.3.1.2.

NOTE: Manufacturers may not be privy to formulation information, so they may not be able to assist a testing laboratory to identify a standard for the compound that extracted. Refer to Section 4.3.1.2 when the manufacturer does not have material formulation information.

4.1.3.3 Unknown contaminants detected by GC/MS analysis for which identification is unable to be made after performing the steps in 4.3.1 shall be reported in accordance to 4.1.4.2.

4.1.3.4 The concentration of active agents or additives used in the drinking water treatment process shall be evaluated in the product water as specified in 6.10. The concentration of active agents or additives used in the drinking water treatment process shall not be evaluated during extraction testing.

4.1.3.5 Whole-system or component assembly extraction testing may be waived if components, when separately tested, meet the requirements of this Standard and are assembled in a manner that does not introduce any new components or materials, increase the surface area-to-volume ratio of previously evaluated components, or present potential concern based on cumulative factors. The reported extractable concentrations for components shall be arithmetically added to ensure that the whole-system or component assembly meets the allowable levels in accordance with tables 1, 2, and 3 and Annex A, D, and E of NSF/ANSI 61.

4.1.4 Data reporting

4.1.4.1 All contaminants identified and detected at or above the reporting limit shall be reported with the identification of the contaminant, the concentration, and whether it exceeds the acceptance criteria as required in Section 4.1.3. Contaminants detected below the reporting limit shall be reported to the manufacturer as less than the reporting limit's value.

Example: If the lab's reporting limit is 1.0 mg/L for analyte "X" and the concentration was detected at 0.5 mg/L, the lab shall report less than 1.0 mg/L or <1.0 mg/L.

4.1.4.2 If the extractable contaminant cannot be identified following the procedures in 4.3.1 the laboratory shall supply the manufacturer with the approximate molecular weight along with any additional information about the compound.

4.2 Materials evaluation

Complete formulation information on any material not certified as specifically compliant with the sections of the U. S. Code of Federal Regulations, Title 21, listed in table 4, shall be reviewed to determine whether the material presents a health effects concern in contact with drinking water and to assess the material's potential for contributing contaminants to the drinking water. As a minimum level of information for those materials requiring submission of formulation information, the complete chemical identity and proportion by weight (in some cases approximate weights or proportions may suffice) and ingredient sources of supply shall be provided.

The following additional information is required 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;
- the water solubility, hydrolysis products, and extraction rates of chemicals within the product or material; and
- a list of toxicological studies relevant to the chemicals and impurities present in the product, component, or material.

4.2.1 Analytical methods

All analyses shall be conducted in accordance with the applicable method(s) referenced in 2.

4.2.1.1 The laboratory shall validate the analytical method to the reporting limit (RL) concentration following the procedures established in the referenced method. The laboratory shall evaluate its method detection limit (MDL) in reference to the RL. In all cases, the RL shall be equal or greater than the MDL. When preparing its calibration standards, the lowest calibration point shall be at or less than the RL.

4.2.1.2 For extracted techniques (e.g., USEPA Method 625), regarding the concentration of the lowest calibration point, the laboratory shall apply the concentration factor due to sample preparation. For example, a sample one liter extracted, and the extract concentrated to 1.0 milliliter, for a factor of 1000, if the RL is set to 0.2 ug/L, then the lowest calibration point would be at or less than 0.2 mg/L.

NOTE – See Annex C for additional information on GC/MS and other alternative methods.

4.2.2 Exposure water

Systems and components shall be exposed to locally available tap water that has been adjusted to contain 50 ± 5 mg/L total dissolved solids and 0.5 ± 0.05 mg/L free available chlorine, and to have a pH of 6.75 ± 0.25 . Exposure water used to evaluate systems or components shall be 23 ± 2 °C (73 ± 3 °F). Any existing concentrations of extraction testing parameters listed in tables 1, 2, and 3 found to be present in the exposure water shall be subtracted from the values obtained in the analysis of the extractant water.

4.2.3 Exposure

4.2.3.1 The system or component(s) of a system shall be installed, flushed, and conditioned in accordance with the manufacturer's instructions using the exposure water specified in 4.2.2 at an initial inlet static pressure of 340 kPa (50 psig).

4.2.3.2 The system or component(s) shall be refilled with the exposure water specified in 4.2.2 and maintained for 24 h at a temperature of 23 ± 2 °C (73 ± 3 °F). A 2-L water sample shall then be collected in accordance with 4.2.3.3. The system or component(s) shall be flushed according to the manufacturer's instructions, refilled, and maintained for another 24 h at a temperature of 23 ± 2 °C (73 ± 3 °F). A second 2-L water sample shall be collected in accordance with 4.2.3.3. The system or component(s) shall again be flushed according to the manufacturer's instructions, refilled, and maintained for a third period of 24 h at a temperature of 23 ± 2 °C (73 ± 3 °F). A third 2-L water sample shall be collected in accordance with 4.2.3.3.

4.2.3.3 A minimum sample volume of 2 L shall be collected at each sample point. If the water-holding volume of the product is greater than 2 L, the entire volume shall be collected in a suitable collection vessel, and a 2-L subsample obtained from this volume. If the water-holding volume of the product is less than 2 L, sufficient samples shall be exposed to provide the required 2-L volume of extractant water.

4.2.3.4 All samples collected shall be composited and analyzed in accordance with 4.2.1.

4.2.3.5 Systems with adsorptive or absorptive media shall be tested with and without the media. Testing without media shall include removal of any granular adsorptive or absorptive media, and removal of any adsorptive or absorptive replacement elements.

4.3 Gas chromatography/mass spectroscopy (GC/MS) analysis

4.3.1 General requirements for GC/MS analysis

When determined to be required following a product-specific formulation review, USEPA Analytical Methods for semi-volatiles and volatiles that include mass spectral libraries shall be performed on products or components, and shall include full-range mass spectral libraries to monitor for non-target

compounds.

Testing for semi-volatiles (e.g. USEPA Method 625 or 528 or 525.2) and volatiles (e.g. USEPA Method 524.2 or 524.3) shall be conducted using the required target compounds in Tables 2 and 3 and the laboratory's RL shall be no greater than the RL's listed in Tables 2 and 3.

4.3.1.1 Target compounds shall be validated in accordance with the requirements of the referenced method. USEPA Methods 524.2 and 625 have specific validation requirements including precision and accuracy requirements as well as demonstration of sensitivity (Method Detection Limit Study or MDL).

For USEPA Method 625, the minimum instrument operation requirements for GC/MS analysis shall be in accordance with those protocols as defined by the method with the following modifications:

- To guard against significant drift from an initial instrument calibration to subsequent instrument batches, 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;
- Due to the number of characteristics of the analytes associated with method 625, 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, 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.

NOTE - At the laboratory's discretion, a calibration may be performed specifically for the compound in question, with the reporting of its data from this second calibration. It should be understood, that if the laboratory utilizes this approach (calibrating for the specific analyte) all method requirements as specified by 625 shall be achieved.

4.3.1.2 TICs are identified by comparison of the spectrum of the unknown to the mass-spectral reference library utilizing "Probability Based Matching" (as available from instrument manufacturers) as well as interpretation by the analyst. The laboratory shall report the TIC with the best match factor (the match factor shall not be reported) except in the following circumstances:

- a) Due to the complex nature of GCMS interpretation and identification, when reviewing the list of possible matches for any particular TIC peak, the laboratory has the authority to assign the identification to a compound "hit" with a lower numeric match factor from the library search algorithm.
- b) The laboratory may determine that none of the returned compounds by the automated search algorithm is a good match for the unknown peak. In this case the compound is reported as a "Unknown."
- c) The laboratory may utilize manual spectral interpretation to identify the peak in question.
- d) All TICs detected at a concentration greater than or equal to 3.0 ppb shall be reported.

The library used during the analysis shall be NIST 2007 or most current version. Additional spectra libraries may be used to assist in the identification of unknown compounds. For TICs, the concentration is estimated by comparison of its total ion area response to the total ion area response of the nearest internal standard. For TIC's, a response factor of "1" (one) shall be utilized for the purposes of calculating the TICs estimated concentration.

NOTE - It should be understood that when utilizing mass-spectrometer library searches to identify unknown

chromatographic peaks (sometimes called “TICs”) that the concentration is estimated assuming that the response of the TIC is the same as the internal standard. However, for example, when analyzing for traditional semi volatile compounds by USEPA method 625, the range of response factors is typically 0.1 to 2. Because the response factor is used as a reciprocal, and assuming that the response for the TIC falls within the range of the compounds for which the system is typically calibrated, the true concentration for this TIC would range up to 10 times greater to one half the reported TIC concentration.

4.3.1.3 Unknown Compounds - contaminants detected by GC/MS analysis but are not identified and quantified against a known mass spectrum or standard shall be evaluated as follows:

- a) The molecular weight shall be reported or, if no molecular ion is identifiable, a minimum value for the molecular weight (for example, if the highest mass ion for the TIC has a m/z of 143, then report MW \geq 143).
- b) The chemical class information shall be reported if this determination is possible.
- c) The laboratory shall report the presence of the common halogens chlorine and bromine utilizing their characteristic “M+2” patterns.
- d) The product material formulation(s) shall be reviewed for potential identification of the unknown contaminant(s) as an ingredient or byproduct;
- e) The manufacturer shall be notified and requested to provide supporting information that enables identification of the unknown contaminant(s);
- f) Structure activity relationships (SAR) shall be utilized when sufficient structural identification of the unknown contaminant(s) can be made; and
- g) Alternative methods of analysis that may identify the unknown contaminant(s) shall be considered, such as classifying the unknown into a chemical class.

Contaminants that are identified after performing one or more of the above steps shall be evaluated in accordance with 4.1.3.2 and 4.1.3.3. The product manufacturer, laboratory toxicologist and laboratory chemist shall assist the testing laboratory in the identification of a standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed when needed. Standard validation is needed when the identified compound is not reported in the formulation review conducted in 4.2

NOTE – Items “b” and “c” above may be automated utilizing software available from NIST with their mass-spectral database

4.3.1.4 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.

4.4 Materials in contact with the user’s mouth

Materials not in contact with water but in contact with the user’s mouth during normal use shall meet the requirements of NSF/ANSI Standard 51 for food zone materials.

Table 1 – Extraction testing parameters

| Parameter | Total Allowable Concentration (TAC) mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | USEPA method(s) |
|-----------|--|--|-----------------------------------|---------------------|
| aluminum | 0.5 | | 0.1 | 200.7, 200.8 |
| antimony | | 0.006 | 0.001 | 200.8, 200.9 |
| arsenic | | 0.010 | 0.001 | 200.8, 200.9 |
| barium | | 2 | 0.2 | 200.7, 200.8 |
| beryllium | | 0.004 | 0.001 | 200.7, 200.8, 200.9 |
| cadmium | | 0.005 | 0.001 | 200.8, 200.9 |
| chromium | | 0.1 | 0.01 | 200.7, 200.8, 200.9 |
| copper | | 1.3 | 0.1 | 200.7, 200.8 |
| lead | | 0.010 | 0.001 | 200.8, 200.9 |
| manganese | 0.3 | | 0.01 | 200.7, 200.8 |
| mercury | | 0.002 | 0.001 | 200.8, 245.1 |
| nickel | 0.1 | | 0.01 | 200.7, 200.8 |
| selenium | | 0.05 | 0.005 | 200.8, 200.9 |
| thallium | | 0.002 | 0.001 | 200.8, 200.9 |

– concluded –

Table 2 – Extraction testing parameters (Semi-Volatiles)

| Analyte | CAS Number | TAC ¹ mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | Reference Method(s) |
|--|----------------------|--------------------------|---|---|---------------------|
| 2,4,6-Trichlorophenol | 88-06-2 | 0.005 | | 0.001 | 525.2, 528, 625 |
| 2,4-Dichlorophenol | 120-83-2 | 0.003 | | 0.001 | 525.2, 528, 625 |
| 2,4-Dimethylphenol | 105-67-9 | 0.1 | | 0.01 | 525.2, 528, 625 |
| 2,6-Di-tert-butyl-4-methoxyphenol | 489-01-0 | 0.003 | | 0.003 | 525.2, 528, 625 |
| 2-Methylnaphthalene | 91-57-6 | 0.03 | | 0.003 | 525.2, 528, 625 |
| 2-Nitrophenol | 88-75-5 | 0.003* | | 0.001 | 525.2, 528, 625 |
| 2-Phenyl-2-propanol | 617-94-7 | 0.05 | | 0.005 | 525.2, 528, 625 |
| 3,3-Dichlorobenzidine | 91-94-1 | 0.0008 | | 0.001 | 525.2, 528, 625 |
| 3-and 4-Methylphenol, m&p-cresol | 106-44-5 108-39-4 | 0.003* | | 0.001 | 525.2, 528, 625 |
| 4-Chloro-3-methylphenol | 59-50-7 | 0.7 | | 0.07 | 525.2, 528, 625 |
| 4-tert-Butylphenol or p-tert-Butylphenol | 98-54-4 | 0.5 | | 0.05 | 525.2, 528, 625 |
| Acenaphthene | 83-32-9 | 0.003* | | 0.004 | 525.2, 528, 625 |
| Acenaphthylene | 208-96-8 | 0.003 | | 0.0004 | 525.2, 528, 625 |
| Acetophenone | 98-86-2 | 0.2 | | 0.02 | 525.2, 528, 625 |
| Anthracene | 120-12-7 | 0.003* | | 0.0003 | 525.2, 528, 625 |
| Benzo(a)pyrene | 50-32-8 | | 0.002 | 0.0002 | 525.2, 528, 625 |
| Benothiazole | 95-16-9 | 0.003 | | 0.003 | 525.2, 528, 625 |
| Bis(2-ethylhexyl)adipate | 103-23-1 | | 0.4 | 0.04 | 525.2, 528, 625 |
| Bis(2-ethylhexyl)phthalate | 117-81-7 | | 0.006 | 0.001 | 525.2, 528, 625 |
| Butyl benzyl phthalate | 85-68-7 | 1* | | 0.1 | 525.2, 528, 625 |
| Chrysene | 218-01-9 | 0.003* | | 0.003 | 525.2, 528, 625 |
| Diethyl phthalate | 84-66-2 | 6 | | 0.6 | 525.2, 528, 625 |
| Dimethyl phthalate | 131-11-3 | 0.003 | | 0.001 | 525.2, 528, 625 |
| Di-n-butyl phthalate | 84-74-2 | 0.7 | | 0.07 | 525.2, 528, 625 |
| Fluoranthene | 206-44-0 | 0.003 | | 0.0003 | 525.2, 528, 625 |
| Isophorone | 78-59-1 | 0.4 | | 0.04 | 525.2, 528, 625 |
| Naphthalene | 91-20-3 | 0.4 | | 0.04 | 525.2, 528, 625 |
| N-Nitroso-di-n-butylamine | 924-16-3 | 0.00006 | | 0.0006 | 525.2, 528, 625 |

| Analyte | CAS Number | TAC ¹ mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | Reference Method(s) |
|--|------------|--------------------------|---|---|---------------------|
| N-Nitroso-di-n-propylamine | 621-64-7 | 0.00005 | | 0.0005 | 525.2, 528, 625 |
| N-Nitrosodiphenylamine | 86-30-6 | 0.07 | | 0.007 | 525.2, 528, 625 |
| o-Cresol or 2-methylphenol | 95-48-7 | 0.003* | | 0.001 | 525.2, 528, 625 |
| Pentachlorophenol | 87-86-5 | | 0.001 | 0.0005 | 525.2, 528, 625 |
| Phenanthrene | 85-01-8 | 0.003 | | 0.0003 | 525.2, 528, 625 |
| Phenol | 108-95-2 | 2 | | 0.2 | 525.2, 528, 625 |
| Phenyl sulfone | 127-63-9 | 0.003* | | 0.002 | 525.2, 528, 625 |
| Pyrene | 129-00-0 | 0.003 | | 0.0006 | 525.2, 528, 625 |
| ¹ TAC values have been evaluated using qualitative or quantitative risk assessment methods. If contaminants extract above these levels, an evaluation in accordance of with Annex A of NSF/ANSI 61 may be used to determine a higher allowable level. | | | | | |

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Table 3 – Extraction testing parameters (Volatiles)

| Analyte | CAS Number | TAC ¹ mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | Reference Method(s) |
|---|------------|-----------------------|--|-----------------------------------|---------------------|
| 1,1,1,2-Tetrachloroethane | 630-20-6 | 0.01 | | 0.001 | 524.2, 524.3 |
| 1,1,1-Trichloroethane | 71-55-6 | | 0.2 | 0.02 | 524.2, 524.3 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 0.002 | | 0.0005 | 524.2, 524.3 |
| 1,1,2-Trichloroethane | 79-00-5 | | 0.005 | 0.0005 | 524.2, 524.3 |
| 1,1-Dichloroethene | 75-35-4 | | 0.007* | 0.0007 | 524.2, 524.3 |
| 1,1-Dichloropropene | 563-58-6 | 0.003* | | 0.0005 | 524.2, 524.3 |
| 1,2,3-Trichlorobenzene | 87-61-6 | 0.003 | | 0.0005 | 524.2, 524.3 |
| 1,2,3-Trichloropropane | 96-18-4 | 0.04 | | 0.004 | 524.2, 524.3 |
| 1,2,4-Trichlorobenzene | 120-82-1 | | 0.07 | 0.007 | 524.2, 524.3 |
| 1,2-Dibromo-3-chloropropane | 96-12-8 | | 0.0002 | 0.0002 | 524.2, 524.3 |
| 1,2-Dibromoethane | 106-93-4 | 0.0002 | | 0.0002 | 524.2, 524.3 |
| 1,2-Dichlorobenzene | 95-50-1 | | 0.6 | 0.06 | 524.2, 524.3 |
| 1,2-Dichloroethane | 107-06-2 | | 0.005 | 0.0005 | 524.2, 524.3 |
| 1,2-Dichloropropane | 78-87-5 | | 0.005 | 0.0005 | 524.2, 524.3 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.003* | | 0.0005 | 524.2, 524.3 |
| 1,3-Dichlorobenzene | 541-73-1 | | 0.6 | 0.06 | 524.2, 524.3 |
| 1,4-Dichlorobenzene | 106-46-7 | | 0.075 | 0.007 | 524.2, 524.3 |
| 2-Butanone | 78-93-3 | 4 | | 0.4 | 524.2, 524.3 |
| 2-Chlorotoluene | 95-49-8 | 0.1* | | 0.01 | 524.2, 524.3 |
| 2-ethyl-1-hexanol | 104-76-7 | 0.05 | | 0.005 | 524.2, 524.3 |
| 4-Chlorotoluene | 106-43-4 | 0.003 | | 0.0005 | 524.2, 524.3 |
| 4-Isopropyltoluene | 99-87-6 | 0.003 | | 0.0005 | 524.2, 524.3 |
| 4-Methyl-2-pentanone | 108-10-1 | 7 | | 0.7 | 524.2, 524.3 |
| Acetone | 67-64-1 | 6 | | 0.6 | 524.2, 524.3 |
| Acetophenone | 98-86-2 | 0.2 | | 0.02 | 524.2, 524.3 |
| Acrylonitrile | 107-13-1 | 0.0006* | | 0.0006 | 524.2 SIM |
| Benzene | 71-43-2 | | 0.005 | 0.0005 | 524.2, 524.3 |
| bis(2-Chloroethyl)ether or Di-(2-chloroethyl) ether | 111-44-4 | 0.0003 | | 0.0003 | 524.2, 524.3 |
| Bromobenzene | 108-86-1 | 0.003 | | 0.0005 | 524.2, 524.3 |

| Analyte | CAS Number | TAC ¹ mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | Reference Method(s) |
|--|---------------------------------|-----------------------|--|-----------------------------------|---------------------|
| Bromochloromethane | 74-97-5 | | 0.09 | 0.009 | 524.2, 524.3 |
| Bromodichloromethane | 75-27-4 | | See TTHMs | 0.001 | 524.2, 524.3 |
| Bromoform | 75-25-2 | | See TTHMs | 0.001 | 524.2, 524.3 |
| Bromomethane | 74-83-9 | 0.01 | | 0.001 | 524.2, 524.3 |
| Carbon disulfide | 75-15-0 | 0.7 | | 0.7 | 524.2, 524.3 |
| Carbon tetrachloride | 56-23-5 | | 0.005 | 0.0005 | 524.2, 524.3 |
| Chlorobenzene | 108-90-7 | | 0.1 | 0.01 | 524.2, 524.3 |
| Chloroform | 67-66-3 | | See TTHMs | 0.001 | 524.2, 524.3 |
| Chloromethane | 74-87-3 | 0.03* | | 0.003 | 524.2, 524.3 |
| cis-1,2-Dichloroethene | 156-59-2 | | 0.07 | 0.007 | 524.2, 524.3 |
| Cyclohexanone | 108-94-1 | 30 | | 1.0 | 524.2, 524.3 |
| Dibromochloromethane | 124-48-1 | | See TTHMs | 0.001 | 524.2, 524.3 |
| Dichlorodifluoromethane | 75-71-8 | | 0.003 | 0.0005 | 524.2, 524.3 |
| Ethyl acrylate | 140-88-5 | 0.01 | | 0.001 | 524.2, 524.3 |
| Ethylbenzene | 100-41-4 | | 0.7 | 0.07 | 524.2, 524.3 |
| Methyl acrylate | 96-33-3 | 0.003 | | 0.001 | 524.2, 524.3 |
| Methyl methacrylate | 80-62-6 | 10 | | 0.1 | 524.2, 524.3 |
| Methyl tert-butyl ether | 1634-04-4 | 0.002 | | 0.0005 | 524.2, 524.3 |
| Methylene chloride | 75-09-2 | | 0.005 | 0.0005 | 524.2, 524.3 |
| n-Butyl acrylate | 141-32-2 | 0.01 | | 1.0 | 524.2, 524.3 |
| n-Butylbenzene | 104-51-8 | 0.003 | | 0.0005 | 524.2, 524.3 |
| sec-Butylbenzene | 135-98-8 | 0.003 | | 0.0005 | 524.2, 524.3 |
| Styrene | 100-42-5 | | 0.1 | 0.01 | 524.2, 524.3 |
| t-Butyl alcohol or t-butanol or tert-butanol | 75-65-0 | 9 | | 0.1 | 524.2, 524.3 |
| Tetrachloroethene | 127-18-4 | | 0.005 | 0.0005 | 524.2, 524.3 |
| Tetrahydrofuran | 109-99-9 | 0.05 | | 5.0 | 524.2, 524.3 |
| Toluene | 108-88-3 | | 1 | 0.1 | 524.2, 524.3 |
| Xylenes (Total) o-Xylene ² or 1,2-Xylene, m-xylene, p-xylene | 95-47-6 106-42-3 108-38-3 | | 10 | 0.1 | 524.2, 524.3 |

| Analyte | CAS Number | TAC ¹ mg/L | Drinking water regulatory level (MCL/MAC) mg/L | Maximum Reporting Limit (RL) mg/L | Reference Method(s) |
|--|--------------------------------------|-----------------------|--|-----------------------------------|---------------------|
| trans-1,2-Dichloroethene | 156-60-5 | | 0.1 | 0.01 | 524.2, 524.3 |
| Dichloropropene (Total) Cis-1,3- Trans-1,3 | 542-75-6 10061-01-5 10061-02-6 | 0.004 | | 0.0005 | 524.2, 524.3 |
| Trichloroethene or Trichloroethylene | 79-01-6 | | 0.005 | 0.0005 | 524.2, 524.3 |
| Trichlorofluoromethane | 75-69-4 | 2 | | 0.2 | 524.2, 524.3 |
| Total Trihalomethanes (TTHMs) Bromodichloromethane Bromoform Chloroform Dichlorobromomethane | | | 0.080 | 0.001 | 524.2, 524.3 |
| Vinyl chloride | 75-01-4 | | 0.002 | 0.0002 | 524.2, 524.3 |
| TAC values have been evaluated using qualitative or quantitative risk assessment methods. If contaminants extract above these levels, an evaluation in accordance with Annex A of NSF/ANSI 61 may be used to determine a higher allowable level. | | | | | |

**Table 4 – Materials listed in U. S. Code of Federal Regulations,
Title 21, not requiring formulation review**

| Sections | Material |
|---------------------|---|
| 172.880 178.3700 | petrolatum |
| 172.888 178.3720 | synthetic petroleum wax |
| 172.878 | white mineral oil |
| 172.884 | odorless white petroleum hydrocarbons |
| 172.886 178.3710 | petroleum wax |
| 173.25 | ion exchange resins – provided that the sub-section stating the composition of the resin is specified |
| 173.65 | divinyl benzene copolymer |
| 178.3620 | mineral oil |
| Part 184 | Direct food substances affirmed as generally recognized as safe – when used in accordance with any conditions of use specified for the substance. |
| solvents | <p>Solvents that may be considered for solvent bonding without review are limited to acetone, methyl ethyl ketone, cyclohexanone, and tetrahydrofuran. Mixtures such as solvent cements shall be evaluated against NSF/ANSI 61 or shall be subject to formulation review.</p> <p>NOTE – Solvent bonding is not recommended, as solvents soak into synthetic materials and leach back out into water at relatively high levels for long periods of time. In addition, solvents can contaminate the work area and can be adsorbed by carbon in the work area. Solvents, which have been reprocessed or recycled, shall not be used.</p> |

5 Structural performance

5.1 Structural integrity

The purpose of testing structural integrity performance is to evaluate the materials, design, and fabrication quality of the complete water treatment system.

5.2 Acceptance

Each test of structural integrity (cyclic pressure and hydrostatic pressure) shall be performed on a separate system. If the complete water treatment system is tested, a separate test of the system pressure vessel is not required.

Complete systems, pressure vessels, and components shall be tested for structural integrity in accordance with 5.4 at the pressures specified in table 5. When more than one pressure is specified in table 5, testing shall be done at the higher pressure.

Complete systems, pressure vessels, and components shall be watertight when tested for structural integrity under 5.4.

NOTE – Weepage shall be considered acceptable at the beginning of a test, but weepage shall not begin in the middle of a test.

5.3 Working pressure

5.3.1 The pressure vessel(s) and all other components of a water treatment system that are subject to line pressure shall be designed and constructed to maintain structural integrity at a pressure of 690 kPa (100 psig) or the maximum working pressure, whichever is greater.

5.3.2 Portable systems not designed for direct connection to a pressurized supply line shall be designed and constructed to maintain structure under the maximum pressure of the intended end use.

5.4 Structural integrity test methods

5.4.1 Apparatus

An enclosure shall be provided for each system tested to prevent injury to personnel or property damage if the system fails.

An apparatus that may be used for the cyclic and hydrostatic test is shown schematically in figure 1. Pressure measuring instruments shall have a precision and accuracy of 2% at the point of measurement.

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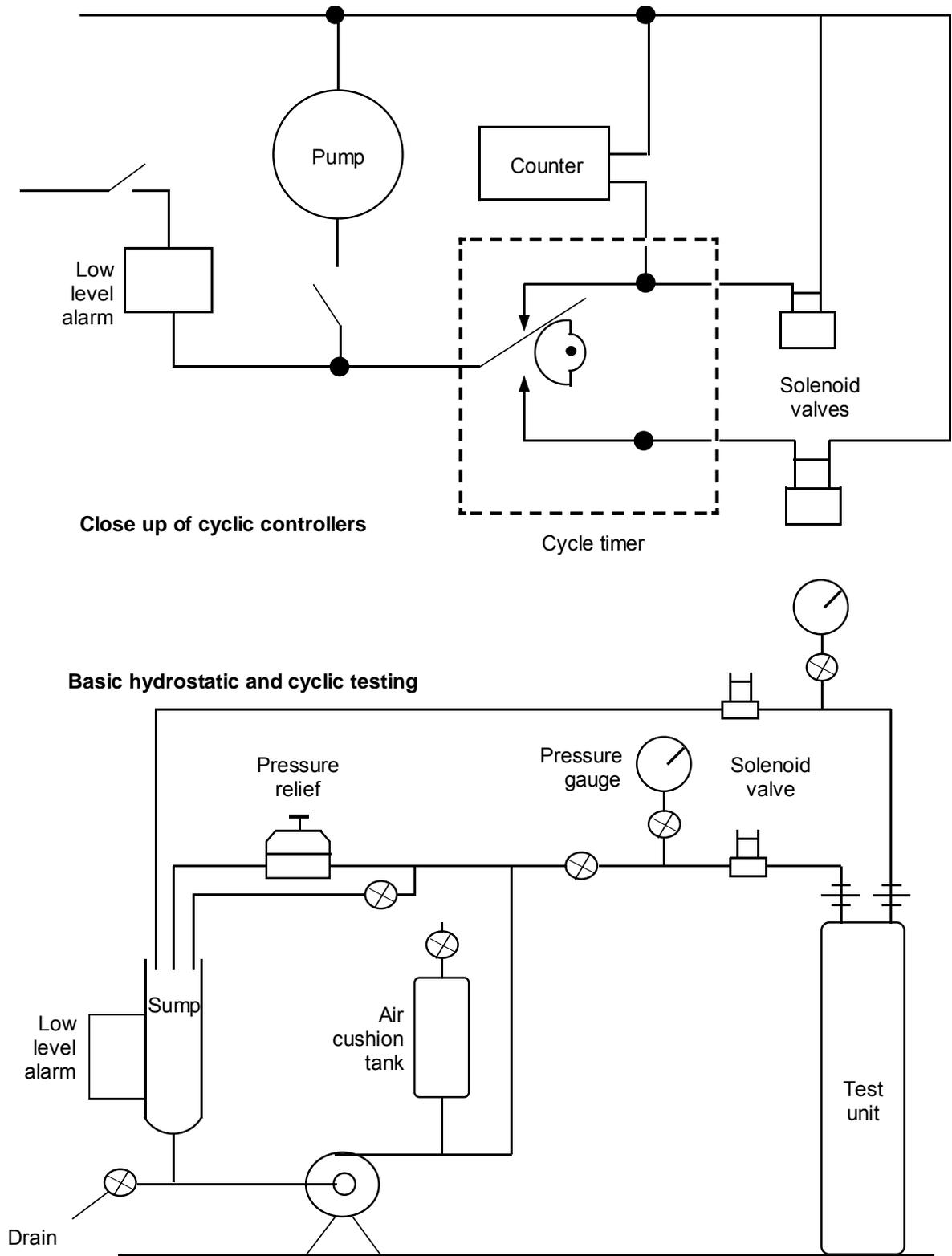


Figure 1 – Structural testing apparatus

5.4.2 Hydrostatic pressure test – complete systems

Systems designed to operate only at atmospheric pressure shall be exempt from the hydrostatic pressure test but shall be watertight in normal use. Components downstream of the system on/off valve that are not subject to pressure under the off mode, and that either contain no media subject to plugging or are not designed to contain media, shall be exempt from the hydrostatic pressure test but shall be watertight in normal use. Components that are downstream of the system on/off valve but upstream of media subject to clogging shall meet the requirements of this section. The following procedure shall be used for the hydrostatic pressure testing of other complete systems:

- a) A water temperature of 13 to 24 °C (55 to 75 °F) shall be used. The test water shall be adjusted to a temperature at which condensation will not form on the surface of the test unit.
- b) The inlet of the test system shall be connected to the apparatus as shown in figure 1. The system shall be in conformance with its normal state of use, with the option of plugging drain lines.
- c) The test system shall be filled with water and flushed to purge air from the system.
- d) The hydrostatic pressure shall be raised at a constant rate so that the test pressure specified in table 5 is reached within 5 min. The rate of pressure increase shall not be more than 690 kPa (100 psig) per second.
- e) The test pressure shall be maintained for 15 min. The system shall be inspected periodically through the end of the test period to check whether the system is watertight.

5.4.3 Hydrostatic pressure test – metallic pressure vessels

The permanent increase in the circumference of the pressure vessel shall not be more than 0.2% of the original circumference when the vessel is tested in accordance with the procedures below. The circumference shall be measured at the midpoint of the side wall of the vessel and at 30-cm (12 in) intervals. The top or bottom head deflection of the pressure vessel shall not exhibit a permanent deflection exceeding 0.5% of the vessel diameter.

The test rig for metal tanks shall allow the installation of instrumentation required to measure the change in tank circumference and the deflection of the top and bottom heads. This may require elevating the tank. Distance measuring instruments or methods shall be accurate to 0.0025 cm (0.001 in).

The following procedure shall be used for the hydrostatic pressure testing of metallic pressure vessels:

- a) The test unit shall be installed on the elevated rack or stand. The test unit shall be prepared and filled as specified in 5.4.2, steps a), b), and c).
- b) An appropriate measuring device, such as an extensometer or dial micrometer, shall be installed vertically against the tank bottom head and either the tank top head, the top-mounted control valve, or another component solidly mounted to the tank top.
- c) An appropriate measuring device, such as an extensometer or periphery tape, shall be installed around the tank perpendicular to its axis and 15 cm (6 in) above its bottom. Additional measurement devices shall be placed, vertically spaced not more than 30 cm (12 in) apart, up the side sheet of the tank. The uppermost device shall be within 30 cm (12 in) of the tank top head. If the tank length is less than 61 cm (24 in), a measuring device should be placed at the midsection. When extensometers are used, the flexible wire shall be wrapped once around the tank perpendicular to its axis and 15 cm (6 in) above its bottom. One end of the wire shall be fastened to a solid post at the same elevation. The other end shall be fastened to a second post at the same elevation by means of a spring so as to maintain the wire taut. The blocks shall be fastened to each end of the wire,

adjacent to the tank, so that they are spaced 15 to 20 cm (6 to 8 in) apart. For larger tanks, the spacing shall be permitted to be increased to avoid contact between the blocks and the tank. Blocks shall be attached to each wire wrap as previously specified.

- d) Initial readings shall be taken from the measurement devices before the test unit is pressurized. When extensometers are used, the distance between the blocks on each wire shall be measured with a micrometer caliper.
- e) The test unit shall be pressurized as specified in 5.4.2, steps d) and e).
- f) Final readings shall be taken from the extensometers or measurement devices with no pressure on the unit.
- g) The difference between the readings of each measurement device is the measure of permanent deformation of either the tank bottom or top head. The difference in measurement around the tank is the increase in tank circumference.

5.4.4 Cycle test

The following procedure shall be used for the cyclic testing:

- a) A water temperature of 20 ± 3 °C (68 ± 5 °F) shall be used throughout the test. The test water shall be adjusted to a temperature at which condensation will not form on the surface of the test unit.
- b) The inlet of the test system shall be connected to the test apparatus as shown in figure 1. The system shall be in conformance with its normal state of use, with the option of plugging drain lines.
- c) The test system shall be filled with water and flushed to purge air from the system.
- d) The counter shall be set to zero, or its initial reading shall be recorded and pressure cycling initiated. The pressure rise shall be ≥ 1 s and the pressure in the test unit shall return to < 14 kPa (2 psig) before the initiation of another cycle.
- e) The pressure shall be cycled as specified in table 5. The system shall be inspected periodically through the end of the test period to check whether the system is watertight.

5.4.5 Personal Hand Held Devices

Personal hand held devices that do not meet the definition of a squeeze bottle shall be exempt from structural integrity testing but shall be watertight during all testing.

5.4.5.1 Cycle test – squeeze bottles

Structural integrity performance for squeeze bottles shall be evaluated by applying 20 ± 1 kg of force in 5 second intervals. The outlet of the bottle shall be plugged.

The following procedure shall be used for testing:

- 1) Use a water temperature of 20 ± 3 °C (68 ± 5 °F) throughout the test. Adjust the test water to a temperature at which condensation will not form on the surface of the test unit.
- 2) The test bottle shall be evaluated at the following fill volumes: 95%, 75%, 50%, and 25% of the total unit void volume. For each fill volume, fill the test bottle with water and plug the outlet.
- 3) Connect the test bottle to the mechanical hand apparatus shown in figure 2. The apparatus shall be positioned around the center of the test bottle unless an alternate location to grip the bottle is

specified in the manufacturer's literature.

4) The volume (mL) per squeeze of the test bottle shall be measured to determine the number of squeezes that shall be applied to the bottle during the test (volume dispensed from a ½ full bottle during a 5 second squeeze with 20 ± 1 kg of force). The total number of squeezes shall be evenly divided among each fill volume, so that each fill volume is being run for 25% of the test. The test bottle shall be evaluated as follows:

a) For devices with replaceable cartridges, the test bottle shall be tested to 400% capacity of the cartridge life.

b) For single-use, disposable devices, the test bottle shall be tested to 200% capacity of the cartridge life.

5) The bottle shall be operated with 20 ± 1 kg of force applied by the mechanical hand for $5 \pm .5$ seconds. The force rise at the initiation of each cycle shall be $1.5 \pm .5$ second. Each squeeze shall be followed by a minimum 5 second rest period with <0.5 kg of force applied to the bottle. This operational cycle shall be performed for the required number of squeezes at each bottle fill volume.

6) The system shall be inspected for watertightness periodically throughout the test, prior to each change in fill volume, and at the end of the test.

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Table 5 – Structural integrity testing requirements

| Complete systems | Hydrostatic pressure test ¹ | Cyclic pressure test ¹ |
|---|--|--|
| complete systems with pressure vessels having a diameter < 203 mm (8 in) | 3 x maximum working pressure or 2,070 kPa (300 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| complete systems with pressure vessels having a diameter of ≥ 203 mm (8 in) | 1.5 x maximum working pressure or 1,040 kPa (150 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| complete systems designed for open discharge ² | 1.5 x maximum working pressure or 1,040 kPa (150 psig) | 10,000 cycles at 0 to 345 kPa (0 to 50 psig) |
| complete portable systems pressurized by user ³ | 1.5 x maximum working pressure | none |
| metallic pressure vessels having a diameter < 203 mm (8 in) ⁴ | 3 x maximum working pressure or 2,070 kPa (300 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| metallic pressure vessels having a diameter of ≥ 203 mm (8 in) ⁴ | 1.5 x maximum working pressure or 1,040 kPa (150 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| nonmetallic pressure vessels having a diameter < 203 mm (8 in) | 3 x maximum working pressure or 2,070 kPa (300 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| nonmetallic pressure vessels having a diameter of ≥ 203 mm (8 in) | 1.5 x maximum working pressure or 1,040 kPa (150 psig) | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| disposable metallic pressure vessels and components | 3 x maximum working pressure or 2,070 kPa (300 psig) | 10,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |
| valves and controls ⁵ | none | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure |

¹ When a choice is given in the table, testing shall be done at the greater pressure.

² Components downstream of the system on/off valve that are not subject to pressure under the off mode, and that either contain no media subject to plugging or are not designed to contain media shall be exempt from the hydrostatic pressure test, but shall be watertight in normal use. Components that are downstream of the system on/off valve but upstream of media subject to clogging shall meet the requirements of this section.

³ Portable systems designed to utilize only atmospheric pressure or gravity flow shall be exempt from the hydrostatic pressure test, but shall be watertight in normal use.

⁴ Metallic pressure vessels require measurement of circumference and head deflection. The pressure vessel circumference shall not exhibit a permanent increase of more than 0.2% when measured at the midsection and at 30 cm (12 in) intervals. The top and bottom head deflection of the pressure vessel shall not exhibit a permanent deflection exceeding 0.5% of the vessel diameter.

⁵ Subject to line pressure and tested as separate components.

6 Minimum performance requirements

6.1 Elements

Filters and similar replacement components shall be readily removable.

6.2 Waste connections

If provided, waste connections or drain outlets shall be designed and constructed to provide for connection to the sanitary waste system through an air gap of two pipe diameters or 25 mm (1 in), whichever is larger.

6.3 Product water dispensing outlets

Product water dispensing outlets, if provided, shall be designed, constructed, and located so that the discharge orifice is directed downward. The lower edge of the outlet shall be at an elevation not less than 51 mm (2 in) above the flood rim of the waste receptacle.

6.3.1 Drinking fountain outlets

6.3.1.1 The drinking water outlet shall be protected by a guard designed to (1) prevent a user from directly contacting the outlet while drinking from the system, and (2) prevent foreign matter from dropping vertically into the outlet. The guard shall be of such width, height, and design that the user's mouth or lips cannot readily touch the outlet. Spaces between the outlet and guard shall be readily accessible for cleaning.

6.3.1.2 The outlet and guard shall be designed to discourage hose connections or other improper uses.

6.3.1.3 The drinking fountain outlet shall be set to direct water flow at an angle from the vertical to prevent water in a jet from returning to the outlet. The flow from the outlet shall not touch the guard.

6.3.1.4 The lower edge of the drinking water outlet shall be at least 51 mm (2 in) above the flood rim of the waste receptacle.

6.4 Hazards

All components shall be free of nonfunctional rough or sharp edges or other hazards that may cause injury to persons adjusting, servicing, or using the system.

6.5 Operation temperature

The complete system shall be designed to operate at a maximum temperature no higher than 38 °C (100 °F).

6.6 Electrical safety and operation

Electrical controls and components of the system shall comply with the requirements of the *National Electrical Code*, or an equivalent where appropriate.

6.7 Rated service flow

For systems connected to a pressurized line, the rated service flow rate shall be equal to or less than the minimum, initial clean-system flow rate obtained during contaminant reduction testing at an inlet pressure of 410 ± 20 kPa (60 ± 3 psig) and a water temperature of 20 ± 3 °C (68 ± 5 °F). For systems with an internal pump, the rated service flow rate shall be equal to or less than the minimum, initial clean-system flow rate obtained during contaminant reduction testing. For manual fill or pour-through systems, the rated

service flow rate shall be equal to or less than the minimum, initial clean-system flow rate obtained during contaminant reduction testing.

A system shall not have a rated service flow that is less than the applicable value specified in Table 6.

6.8 POE rated pressure drop

6.8.1 Without built-in flow control

POE systems shall have no more than 105 kPa (15 psig) initial pressure drop at the rated service flow with an inlet pressure of 210 kPa (30 psig) and a water temperature of 20 ± 3 °C (68 ± 5 °F). The rated service flow shall be greater than or equal to 15 L/min (4 gpm).

6.8.2 With built-in flow control

POE systems with built-in flow control shall have no more than 103 kPa (15 psig) initial pressure drop at a flow rate equal to or greater than 15 L/min (4 gpm) with an inlet pressure of 210 kPa (30 psig) and a water temperature of 20 ± 3 °C (68 ± 5 °F).

6.9 Minimum service flow

The minimum, initial, clean-system flow rates specified in table 6 shall be attainable by the system at an inlet pressure of 210 kPa (30 psig) and a water temperature of 20 ± 3 °C (68 ± 5 °F), with a fully open outlet.

Table 6 – Minimum service flow

| Type of system | Minimum service flow rate |
|--|--|
| <p>Point of use systems connected to a pressurized line:</p> <ul style="list-style-type: none"> counter top connected to sink faucet with diverter faucet mount with diverter faucet mount without diverter plumbed in plumbed in to separate tap with reservoir plumbed in to separate tap without reservoir special systems (e.g., glass filler and ice maker for refrigerator, systems designed for non-home use) | <ul style="list-style-type: none"> 0.8 L/min (0.2 gpm) 0.8 L/min (0.2 gpm) 1.9 L/min (0.5 gpm) 1.9 L/min (0.5 gpm) 7.6 L/d (2 gpd) 0.8 L/min (0.2 gpm) exempt |
| <p>Point of use systems not designed for direct connection to a pressurized supply line (batch systems):</p> <ul style="list-style-type: none"> counter top manual fill with or without internal pump pour through | <ul style="list-style-type: none"> exempt exempt |

6.10 Active agents and additives

Where an active agent or additive is used in the drinking water treatment process, the product water shall not contain that substance (or its degradation products) at a concentration of toxicological significance as given by the USEPA *Primary Drinking Water Regulations*, by the Health Canada Maximum Acceptable Concentrations⁸, by any U. S. Federal regulatory agency, or at a concentration that exceeds constituent limits of the USEPA *Secondary Drinking Water Regulations* for all sample points. If the substance does not have a maximum drinking water concentration established by USEPA or Health Canada, a Total Allowable Concentration (TAC) shall be established according to the requirements of NSF/ANSI 61, annex A.

Collection of product water samples for the analysis of active agents or their degradation products, employed in the aesthetic improvement of drinking water, shall be in accordance with the sampling schedule(s) for the verification of specific reduction claims or as otherwise specified in this Standard. At least one sample shall be collected immediately after a rest period of at least 8-h duration.

Sampling for an active agent or additive shall be performed using the performance test procedure that is likely to result in the highest potential extraction of the active agent or additive. Determination of the appropriate test procedure shall consider the following parameters:

- the chemical composition of the challenge water used in the performance test; and
- the duration of rest periods prior to the specified sampling points in the performance test.

NOTE – The performance test used to evaluate extraction of an active agent or additive may be a test other than that performed to verify other performance claim(s) made by the manufacturer. Some examples are provided in the following table:

| Type of active agent | Recommended test protocol for active agent evaluation |
|----------------------|---|
| copper/zinc media | chlorine reduction |
| silver | bacteriostasis |

7 Elective performance claims – test methods

7.1 General requirements

7.1.1 Health effects claims

Claims for reduction of health effects contaminants (biological, chemical, physical, or radiological) shall not be verified under this Standard. Such claims shall be tested for conformance to NSF/ANSI 53.

7.1.2 Apparatus

A test apparatus capable of providing specified flow rates and static pressures shall be used. Refer to figure 2 for an example diagram.

⁸ http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/index_e.html

Any suitable pressure or delivery system

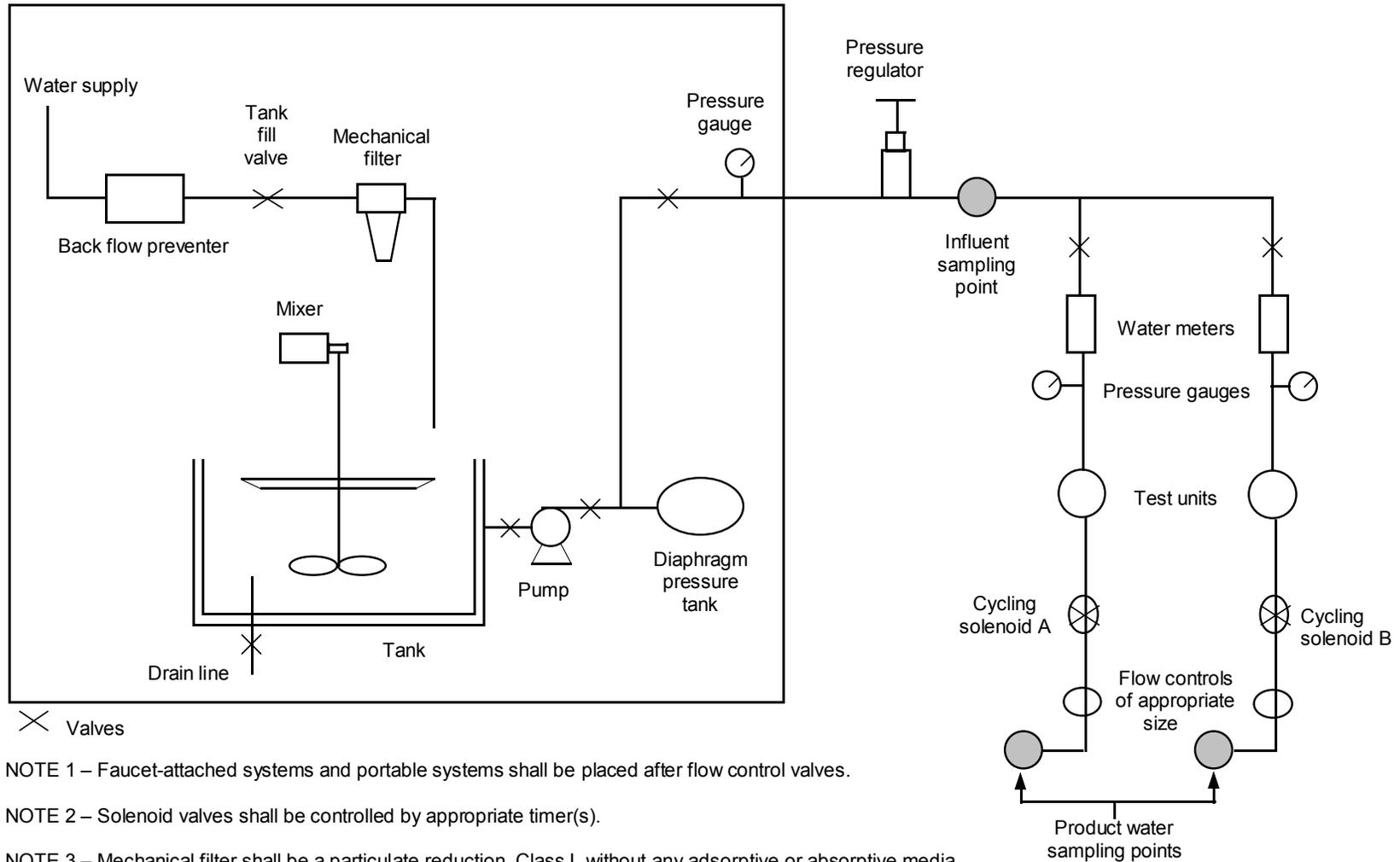


Figure 2 – Example test apparatus

7.2 Bacteriological performance

7.2.1 Bacteriostatic claims

Claims for bacteriostasis shall be secondary to, and used only in conjunction with, other claims for aesthetic effects in this Standard, when tested in accordance with 7.2. The geometric mean of the heterotrophic plate counts of the product water samples from each system shall be no greater than that of the influent challenge samples, within a measurement precision of $\pm 20\%$.

7.2.2 Analytical methods

All analyses shall be conducted in accordance with applicable methods referenced in 2. Bacteriological analysis shall be conducted using the membrane filter technique followed by a 5-d incubation at 28 ± 0.5 °C (82 ± 1 °F).

7.2.3 Influent challenge

A chlorinated public water supply with the following specific characteristics shall be used.

| | |
|------------------------------|--------------------------------|
| pH | 7.5 ± 0.5 |
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 600 mg/L |
| total organic carbon (TOC) | ≥ 2.0 mg/L |
| total residual chlorine | ≤ 0.2 mg/L |

The influent challenge shall also contain, on a continuous basis, a geometric average native bacteria challenge between 10^1 and 10^6 organisms (colony forming units, CFU)/mL, as measured by heterotrophic plate count.

7.2.3.1 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.2.3.2 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.2.3.3 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

NOTE – The test water shall be protected from light to minimize algal growth.

7.2.4 Methods

7.2.4.1 Plumbed-in systems without reservoir

Two systems shall be conditioned in accordance with the manufacturer's instructions using the influent challenge specified in 7.2.3. The systems shall be tested at an ambient temperature of 20 ± 3 °C (68 ± 5 °F) and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig) at the manufacturer's maximum recommended flow rate. The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 1-min on / 59-min off cycle for

16 h per 24-h period. This operation shall continue for 5 d followed by a 56-h stagnation period. The duration of the test shall be 100% of the manufacturer's replacement time but shall not be less than 6 weeks and shall not be longer than 13 weeks.

NOTE – The manufacturer's replacement time is specified in the installation, operation, and maintenance instructions in 8.1.1.

7.2.4.2 Nonplumbed pour-through and batch systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the influent challenge specified in 7.2.3. The systems shall be tested at an ambient temperature of 20 ± 3 °C (68 ± 5 °F). The systems shall be operated on a cycle of one unit volume per batch, with a 60-min rest period between batches, 16 h per 24-h period. This operation shall continue for 5 d followed by a 56-h stagnation period. The duration of the test shall be 100% of the manufacturer's replacement time but shall not be less than 6 weeks and shall not be longer than 13 weeks.

NOTE – The manufacturer's replacement time is specified in the installation, operation, and maintenance instructions in 8.1.1.

7.2.4.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.2.3 with the test contaminant present.

7.2.4.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.2.3 with the test contaminant present.

7.2.4.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 1-min on / 59-min off cycle for 16 h per 24-h period. This operation shall continue for 5 d followed by a 56-h stagnation period. The duration of the test shall be 100% of the manufacturer's replacement time but shall not be less than 6 weeks and shall not be longer than 13 weeks.

7.2.5 Sampling

7.2.5.1 Heterotrophic bacteriological analysis

Following conditioning, influent challenge and product water samples shall be collected for heterotrophic bacteriological analysis at the startup of the test, after 8 h of operation in the first 24-h cycle, and before and after each 56-h stagnation period. Product water sample size shall be 1 unit volume. An appropriate neutralizing agent shall be used during sample collection.

7.2.5.2 Active agents

Product water samples for the analysis of active agents or their degradation products shall be collected in conjunction with samples for bacteriological analysis at the startup of the test, after 8 h of operation in the first 24-h cycle, and after each 56-h stagnation period.

7.3 Chemical reduction testing

7.3.1 Chemical reduction claims

Claims for chemical reduction may be made for the substances shown in table 7 when tested in accordance with 7.3.1. To qualify for a specific chemical reduction claim, the system shall reduce the concentration of the substance from the influent challenge so that, prior to the 100% sample point, 90% of the product water sample concentrations are less than or equal to the maximum product water concentrations in table 7. Samples collected at the 100% sample point shall be less than or equal to the maximum product water concentrations in table 7.

Table 7 – Chemical reduction requirements

| Contaminant | Average influent challenge concentration | Individual influent sample point limits ¹ | Maximum product water concentration ² | Compound |
|------------------------------|--|--|--|-------------------------------------|
| chloride | 800 mg/L ± 10% | 800 mg/L ± 20% | 250 mg/L | sodium chloride |
| foaming agent | 5 mg/L ± 10% | 5 mg/L ± 30% | 0.5 mg/L | linear alkylbenzene sulfonate (LAS) |
| sulfate | 800 mg/L ± 10% | 800 mg/L ± 20% | 250 mg/L | sodium sulfate |
| total dissolved solids (TDS) | 1500 mg/L ± 10% | 1500 mg/L ± 25% | 500 mg/L | sodium chloride |

¹ Equals average influent challenge concentration variability plus one of the following, in order of availability:
 1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method.
 2. Acceptable spike recoveries as stated in the appropriate USEPA method.
 3. Opinion of laboratory professionals – no guidance available in USEPA method.

² Not all secondary substances are listed in this Standard because they are not normally found in drinking water or are not affected by drinking water treatment systems. Hydrogen sulfide and phenol are listed because they are found in water and may be aesthetically displeasing.

7.3.1.1 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.1.2 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.1.3 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, F.3, F.4, and F.6.

7.3.1.4 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.1.5 Influent challenge

7.3.1.5.1 General test water

A public water supply shall be used with the following specific characteristics maintained throughout the test.

| | |
|------------------------------|-----------------------|
| pH | 7.5 ± 0.5 |
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| turbidity | < 1 NTU |

7.3.1.5.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.1.5.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.1.5.4 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.1.6 Methods

7.3.1.6.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.1.5. The systems shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.1.6.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.1.6.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.1.5.1 with the test contaminant present.

7.3.1.6.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.1.5.1 with the test contaminant present.

7.3.1.6.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

7.3.1.7 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 20%, 40%, 60%, 80%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the "on" cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next "on" cycle.

7.3.2 Chloramine reduction testing

7.3.2.1 Chloramine reduction claims

Claims for the reduction of chloramine may be made for drinking water treatment systems when tested in accordance with 7.3.2. The system shall reduce an average influent challenge of 3.0 ± 0.3 mg/L monochloramine (measured as Cl_2/L) so that, prior to the 100% sampling point, 90% of the product water sample concentrations are less than or equal to 0.5 mg/L monochloramine (measured as Cl_2/L). Samples collected at the 100% sample point shall be less than or equal to 0.5 mg/L monochloramine (measured as Cl_2/L).

NOTE – The acceptable single point influent concentration is 3.0 ± 0.5 mg/L (measured as Cl_2/L).

Upon the determination of a reduction capacity for chloramine, systems may also claim reduction of chlorine to the same reduction capacity as that demonstrated for chloramine.

Table 8 – Chloramine reduction requirements

| | Average influent challenge concentration | Individual influent sample point limits ¹ | Percent reduction requirement | Compound |
|-------------------------|--|--|-------------------------------|----------------|
| chloramine ² | $3.0 \text{ mg/L} \pm 10\%$ | $3.0 \pm 0.5 \text{ mg/L}$ | 0.5 mg/L | monochloramine |

¹ Equals average influent challenge concentration variability plus one of the following, in order of availability:

1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method.
2. Acceptable spike recoveries as stated in the appropriate USEPA method.
3. Opinion of laboratory professionals – no guidance available in USEPA method.

² As monochloramine (measured as Cl₂/L)

7.3.2.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.2.3 Analytical methods

7.3.2.3.1 General

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.2.3.2 Monochloramine analysis

Analyses for monochloramine reduction testing shall be performed in accordance with either the DPD Ferrous Titrimetric Method (4500-Cl F) or the DPD Colorimetric Method (4500-Cl G) in *Standard Methods for the Examination of Water and Wastewater*. The method used for monochloramine analysis shall be validated for the challenge water used (see 7.3.2.5). A challenge water sample shall be split for analysis by both the selected method and the HPLC method defined in annex B. A minimum of seven analyses shall be generated from the split sample using both the selected analytical method and the HPLC method. The monochloramine results from both methods shall be compared using a Student's *t* test, and no significant difference shall be observed at the 95% confidence level. Subsequent monochloramine analysis shall be according to the selected method after successful validation.

NOTE 1 – When significant changes to the challenge water chemistry occur (e.g., change from municipal to synthetic water), revalidation of the selected monochloramine method shall be performed.

NOTE 2 – As an alternative, the HPLC method in annex B may be used for all monochloramine analyses.

7.3.2.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, F.3, and F.6.

7.3.2.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.2.6 Influent challenge

7.3.2.6.1 Chloramine reduction test water

A water supply with the following specific characteristics shall be used.

| | |
|----|------------|
| pH | 9.0 ± 0.25 |
|----|------------|

| | |
|--|--|
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| hardness | < 170 mg/L as CaCO ₃ |
| turbidity | < 1 NTU |
| organic nitrogen ¹ | < 0.2 mg/L ² |
| chloramine (analyzed as specified in 7.3.2.3) | 2.7 – 3.3 mg/L monochloramine (measured as Cl ₂ /L) |
| ¹ Measured as the difference between Kjeldahl nitrogen and ammonia nitrogen | |
| ² This requirement may be waived if the test water used during analytical validation (7.3.2.3.2) contains organic nitrogen >0.2 mg/L. | |

NOTE – mg/L monochloramine (as mg Cl₂/L) = mg/L NH₂Cl x 1.4.

The water characteristics shall be adjusted using the procedures in this section. In addition, the test water shall be prefiltered through a particulate reduction filter rated to the Class I requirements of NSF/ANSI 42.

7.3.2.6.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.2.6.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.2.6.4 Hardness adjustment

The hardness shall be decreased by blending with deionized water.

7.3.2.6.5 Chloramine formation

The following procedure is an example of a method used for the formation of chloramine in the challenge water. Other methods of mono-chloramine formation may be used if the resulting challenge water can be demonstrated to provide equivalent performance.

In order to ensure optimal monochloramine formation, the molar concentration of ammonium ion in the challenge water shall be greater than the molar concentration of chlorine in the challenge water.

WARNING – Monochloramine preparation procedures may produce hazardous reaction products. Adequate ventilation must be provided and appropriate safety precautions must be taken.

- a) The challenge water shall first be adjusted for all other water characteristics as specified in 7.3.2.5 before the formation of monochloramine.
- b) Ammonium chloride, NH₄Cl, shall be added to the challenge water to a concentration of 6 mg/L.
- c) A 12% w/w sodium hypochlorite, NaOCl, shall then be added to achieve a concentration of 0.037 mL/L in the challenge water. The sodium hypochlorite solution shall be diluted at least 10:1 prior to adding to the challenge water.

WARNING – Do not combine ammonium chloride and sodium hypochlorite directly. The ammonium chloride *must* be diluted into the challenge water before the addition of sodium hypochlorite. If this procedure is not followed, hazardous reaction products may be formed.

- d) The sodium hypochlorite addition shall be adjusted as needed to achieve a monochloramine concentration of 2.7 to 3.3 mg/L (measured as Cl_2/L).
- e) The challenge water shall be prepared at least 1 h before use to allow for the complete reaction of the sodium hypochlorite and the ammonium chloride.

7.3.2.6.6 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.2.7 Methods

7.3.2.7.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the test water specified in 7.3.2.5. The systems shall be tested at the manufacturer's rated service flow rate or a higher flow rate specified by the manufacturer. The systems shall be tested at an initial dynamic pressure of 410 kPa (60 psig), unless a higher pressure is required to attain the specified flow rate. The pressure shall be increased as necessary to a maximum of 620 kPa (90 psig) to maintain the specified flow rate. The flow rate shall be additionally controlled by a control valve installed downstream of the test systems.

NOTE – If the manufacturer's rated service flow rate cannot be maintained at 620 kPa (90 psig), the test shall be concluded.

The systems shall be operated 50%-on / 50%-off with a 20 min cycle for 16 h per 24-h period, followed by an 8-h rest under pressure. For single outlet systems with a flow rate of 3.8 Lpm (1 gpm) and below, the manufacturer may elect to use up to a 5%-on / 95%-off cycle.

7.3.2.7.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.2.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.2.6.1 without the test contaminant present.

7.3.2.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.2.6.1 without the test contaminant present.

7.3.2.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial

dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall be increased as necessary to a maximum of 620 kPa (90 psig) to maintain the specified flow rate. The flow rate shall be additionally controlled by a control valve installed downstream of the test systems. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

NOTE – If the manufacturer's rated service flow rate cannot be maintained at 620 kPa (90 psig), the test shall be concluded.

7.3.2.8 Sampling

Collection of the influent challenge and product water samples shall begin during the “on” portion of the cycle after one unit volume has passed through the test unit. Sampling shall occur after the passage of 10 unit volumes of the influent challenge and at 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the “on” cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected in the same manner during the next “on” cycle.

Influent challenge water shall be sampled and analyzed for conformance with 7.3.2.6.1 a minimum of once for each batch of challenge water or every 3785 L (1000 gal), whichever is greater.

7.3.3 Chlorine reduction testing

7.3.3.1 Claims

Claims for chlorine reduction may be made when tested in accordance with 7.3.3. To qualify for a chlorine reduction claim, the system shall reduce the concentration of chlorine from the influent challenge so that, prior to the 100% sample point, 90% of the product water sample concentrations are less than or equal to the maximum product water concentrations in table 9. Samples collected at the 100% sample point shall be greater than or equal to the percent reduction requirement in table 9.

7.3.3.1.1 Chlorine reduction claim

The systems shall reduce an influent challenge concentration of 2.0 mg/L free available chlorine (FAC) by a minimum of 50%.

7.3.3.1.2 Taste and odor reduction claims

Taste and odor reduction claims shall be allowed only for activated carbon systems that meet the requirements of 7.3.3 for chlorine reduction. For activated carbon systems that also contain an additional chlorine-reactive media, the chlorine reduction test shall be performed using a test system that does not contain the additional media in order to make the taste and odor reduction claim.

Table 9 – Chlorine reduction

| | Average influent challenge concentration | Individual influent sample point limits¹ | Percent reduction requirement | Compound |
|---|---|--|--------------------------------------|---------------------|
| chlorine | 2.0 mg/L \pm 10% | 2.0 mg/L \pm 20% | \geq 50% | sodium hypochlorite |
| ¹ Equals average influent challenge concentration variability plus one of the following, in order of availability: 1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method. 2. Acceptable spike recoveries as stated in the appropriate USEPA method. 3. Opinion of laboratory professionals – no guidance available in USEPA method. | | | | |

7.3.3.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.3.3 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.3.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, F.3, and F.6.

7.3.3.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.3.6 Influent challenge

7.3.3.6.1 Chlorine reduction test water

A water supply with the following specific characteristics shall be used.

| | |
|-------------------------------|-----------------------|
| pH | 7.5 ± 0.5 |
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| free available chlorine (FAC) | 2 mg/L ± 0.2 mg/L |
| turbidity | < 1 NTU |

NOTE – Superchlorination and subsequent dechlorination may be required prior to test water preparation in order to ensure the specified level of free available chlorine.

7.3.3.6.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.3.6.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.3.6.4 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.3.7 Methods

7.3.3.7.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.3.6. The systems shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.3.7.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.3.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.3.6.1 without the test contaminant present.

7.3.3.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.3.6.1 without the test contaminant present.

7.3.3.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

7.3.3.8 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the "on" cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next "on" cycle.

7.3.4 Hydrogen sulfide and phenol reduction testing

7.3.4.1 Hydrogen sulfide and phenol reduction claims

Claims for hydrogen sulfide or phenol reduction may be made when tested in accordance with 7.3.4. To qualify for a hydrogen sulfide or phenol reduction claim, the system shall reduce the concentration of the substance from the influent challenge so that, prior to the 100% sample point, 90% of the product water sample concentrations are less than or equal to the maximum product water concentrations in table 10. Samples collected at the 100% sample point shall be less than or equal to the maximum product water concentrations in table 10.

Table 10 – Hydrogen sulfide and phenol reduction requirements

| Contaminant | Average influent challenge concentration | Individual influent sample point limits ¹ | Maximum product water concentration ² | Compound |
|------------------|--|--|--|----------------|
| hydrogen sulfide | 1.0 mg/L ± 10% | 1.0 mg/L ± 20% | 0.05 mg/L | sodium sulfide |
| phenol | 5.0 mg/L ± 10% | 5.0 mg/L ± 20% | 0.25 mg/L | phenol |

¹ Equals average influent challenge concentration variability plus one of the following, in order of availability:
 1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method.
 2. Acceptable spike recoveries as stated in the appropriate USEPA method.
 3. Opinion of laboratory professionals – no guidance available in USEPA method.

² Not all secondary substances are listed in this Standard because they are not normally found in drinking water or are not affected by drinking water treatment systems. Hydrogen sulfide and phenol are listed because they are found in water and may be aesthetically displeasing.

7.3.4.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.4.3. Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.4.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, F.3, F.5, and F.6.

7.3.4.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.4.6 Influent challenge

7.3.4.6.1 Hydrogen sulfide and phenol reduction test water

A water supply with the following specific characteristics shall be used.

| | |
|----|-----------|
| pH | 7.5 ± 0.5 |
|----|-----------|

| | |
|------------------------------|-----------------------|
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| total chlorine | < 0.02 mg/L |
| turbidity | < 1 NTU |

NOTE – For hydrogen sulfide testing, the test water shall be protected from exposure to air.

7.3.4.6.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.4.6.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.4.6.4 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.4.7 Methods

7.3.4.7.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.4.6. The systems shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.4.7.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.4.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.4.6.1 without the test contaminant present.

7.3.4.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.4.6.1 without the test contaminant present.

7.3.4.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure

7.3.4.8 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 20%, 40%, 60%, 80%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the "on" cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next "on" cycle.

7.3.5 Iron and manganese reduction testing

7.3.5.1 Iron and manganese reduction claims

Claims for iron or manganese reduction may be made when tested in accordance with 7.3.5. To qualify for an iron or manganese reduction claim, the system shall reduce the concentration of the substance from the influent challenge so that, prior to the 100% sample point, 90% of the product water sample concentrations are less than or equal to the maximum product water concentrations in table 11. Samples collected at the 100% sample point shall be less than or equal to the maximum product water concentrations in table 11.

Table 11 – Iron and manganese reduction requirements

| Contaminant | Average influent challenge concentration | Individual influent sample point limits ¹ | Maximum product water concentration ² | Compound |
|---|--|--|--|--------------------------|
| iron (Fe ⁺²) | 3-5 mg/L | 3-5 mg/L \pm 15% | 0.3 mg/L | appropriate water source |
| manganese (Mn ⁺²) | 1-2 mg/L | 1-2 mg/L \pm 15% | 0.05 mg/L | appropriate water source |
| ¹ Equals average influent challenge concentration variability plus one of the following, in order of availability: 1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method. 2. Acceptable spike recoveries as stated in the appropriate USEPA method. 3. Opinion of laboratory professionals – no guidance available in USEPA method. | | | | |
| ² Not all secondary substances are listed in this Standard because they are not normally found in drinking water or are not affected by drinking water treatment systems. Hydrogen sulfide and phenol are listed because they are found in water and may be aesthetically displeasing. | | | | |

7.3.5.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.5.3. Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.5.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, and F.6

7.3.5.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.5.6 Influent challenge

A water supply with the following specific characteristics shall be used.

| | |
|------------------------------|-----------------------|
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| turbidity | < 1 NTU |

7.3.5.7 Methods

One system shall be tested at a water source site providing an influent challenge meeting the requirements of 7.3.5.6. The system shall be conditioned in accordance with the manufacturer's instructions. If provisions are available for running product water to waste, the operating cycle shall be in accordance with 7.3.5.7.1 or 7.3.5.7.2. If an individual residential site is selected for system testing, actual usage cycle times may be used.

7.3.5.7.1 Plumbed-in systems and faucet-mounted systems

One system shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.5.6. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.5.7.2 Nonplumbed pour-through and batch systems

One system shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the system shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.5.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.5.6 without the test contaminant present.

7.3.5.7.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.5.6 without the test contaminant present.

7.3.5.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure

7.3.5.8 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, and 120% of the estimated capacity.

7.3.6 pH adjustment testing

7.3.6.1 pH adjustment claims

Claims for the adjustment of pH may be made for drinking water treatment systems. Such systems shall adjust the pH from the influent challenge pH value to the product water pH range shown in table 12 when tested in accordance with 7.3.6.

Table 12 – pH adjustment requirements

| | Average influent challenge pH value | Individual influent sample point limits ¹ | Product water pH value | Compound |
|---------|-------------------------------------|--|------------------------|-------------------|
| high pH | 11 ± 0.5 | 11 ± 0.6 | 6.5 – 8.5 | sodium hydroxide |
| low pH | 4 ± 0.5 | 4 ± 0.6 | 6.5 – 8.5 | hydrochloric acid |

¹ Equals average influent challenge concentration variability plus one of the following, in order of availability:

1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method.
2. Acceptable spike recoveries as stated in the appropriate USEPA method.
3. Opinion of laboratory professionals – no guidance available in USEPA method.

7.3.6.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.6.3 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.6.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.2, F.3, F.4, and F.6

7.3.6.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.6.6 Influent challenge

7.3.6.6.1 pH adjustment test water

A water supply with the following specific characteristics shall be used.

| | |
|------------------------------|-----------------------|
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| turbidity | < 1 NTU |

NOTE – If precipitation of heavy metals occurs, deionized water shall be substituted for the public water supply, magnesium or calcium salts shall be added to provide the desired TDS, the TOC requirements shall be waived, and the pH requirement shall be modified accordingly.

7.3.6.6.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.6.6.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.6.6.4 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.6.7 Methods

7.3.6.7.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.6.6. The systems shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.6.7.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.6.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.6.6.1 without the test contaminant present.

7.3.6.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.6.6.1 without the test contaminant present.

7.3.6.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

7.3.6.8 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 20%, 40%, 60%, 80%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the "on" cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next "on" cycle.

7.3.7 Zinc reduction testing

7.3.7.1 Zinc reduction claims

Claims for zinc reduction may be made when tested in accordance with 7.3.7. To qualify for a zinc reduction claim, the system shall reduce the concentration of the substance from the influent challenge so that, prior to the 100% sample point, 90% of the product water sample concentrations are less than or equal to the maximum product water concentrations in table 13. Samples collected at the 100% sample point shall be less than or equal to the maximum product water concentrations in table 13.

Table 13 – Zinc reduction requirements

| Contaminant | Average influent challenge concentration | Individual influent sample point limits ¹ | Maximum product water concentration ² compound |
|-------------|--|--|---|
| zinc | 10 mg/L \pm 10% | 10 mg/L \pm 25% | 5 mg/L |

¹ Not all secondary substances are listed in this Standard because they are not normally found in drinking water or are not affected by drinking water treatment systems. Hydrogen sulfide and phenol are listed because they are found in water and may be aesthetically displeasing.

² Equals average influent challenge concentration variability plus one of the following, in order of availability:

1. Acceptable Continuing Calibration Verification (CCV) limits stated in the appropriate USEPA method.
2. Acceptable spike recoveries as stated in the appropriate USEPA method.
3. Opinion of laboratory professionals – no guidance available in USEPA method.

7.3.7.2 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.3.7.3 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.3.7.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1, F.3, and F.6

7.3.7.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer's recommended interval with a minimum of one backwash at the midpoint of the test.

7.3.7.6 Influent challenge

7.3.7.6.1 Zinc reduction test water

A water supply with the following specific characteristics shall be used.

| | |
|------------------------------------|-----------------------|
| pH | 7.5 ± 0.5 |
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| alkalinity (as CaCO ₃) | 20 to 40 mg/L |
| turbidity | < 1 NTU |

NOTE – If precipitation of heavy metals occurs, deionized water shall be substituted for the public water supply, magnesium or calcium salts shall be added to provide the desired TDS, the TOC requirements shall be waived, and the pH requirement shall be modified accordingly.

7.3.7.6.2 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.3.7.6.3 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.3.7.6.4 POE test water

A public water supply or equivalent with a minimum temperature of 20 °C (68 °F) shall be used. Test water shall comply with USEPA *Primary and Secondary Drinking Water Regulations*.

7.3.7.7 Methods

7.3.7.7.1 Plumbed-in systems and faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions using the appropriate test water specified in 7.3.7.6. The systems shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing if requested by the manufacturer.

7.3.7.7.2 Nonplumbed pour-through and batch systems

Two systems shall be tested using the appropriate influent challenge after establishment of the manufacturer's use pattern. If there is not a recommended use pattern, the systems shall be operated on the basis of four times the unit volume per batch. The cycle shall include a rest period of 15 to 60 s between batches, timed from the cessation of streamed flow.

7.3.7.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.7.6.1 without the test contaminant present.

7.3.7.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.3.7.6.1 without the test contaminant present.

7.3.7.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

7.3.7.8 Sampling

Collection of influent challenge and product water samples shall begin during the "on" portion of the cycle after the passage of 10 unit volumes of the influent challenge and at 20%, 40%, 60%, 80%, and 100% of the estimated system capacity. The volume of water collected for each sample shall not exceed 1 L (0.26

gal) or four times the amount required for analysis, whichever is larger. If the “on” cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next “on” cycle.

7.4 Mechanical reduction testing

7.4.1 Nominal particulate reduction (85%) performance testing

7.4.2 Nominal particulate reduction (85%) claims

Claims for nominal particulate reduction (85%) shall be made using the classes specified in table 14. In order to receive a specific class rating, the system shall reduce the number of particles in the tested particle size range by at least 85% when tested in accordance with 7.4. The system’s rating shall be consistent with the smallest particle size effectively removed as determined by the test. A claim for a greater percent reduction, if made, shall be substantiated by testing.

NOTE – Nominal particulate reduction (85%) systems shall not claim a rated capacity or rated service cycle due to the broad variation in the quantity of particulate matter found in drinking water.

Table 14 – Nominal particulate reduction (85%) classes

| Class | Particle size |
|-------|---|
| I | $\geq 0.5 \mu\text{m}$ to $< 1 \mu\text{m}$ |
| II | $\geq 1 \mu\text{m}$ to $< 5 \mu\text{m}$ |
| III | $\geq 5 \mu\text{m}$ to $< 15 \mu\text{m}$ |
| IV | $\geq 15 \mu\text{m}$ to $< 30 \mu\text{m}$ |
| V | $\geq 30 \mu\text{m}$ to $< 50 \mu\text{m}$ |
| VI | $\geq 50 \mu\text{m}$ to $< 80 \mu\text{m}$ |

7.4.3 Apparatus

Refer to 7.1.2, figure 2, for an example diagram.

7.4.4 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2. Standard particle counting technologies as available from particle counter manufacturers shall be used.

7.4.5 Regeneration and backwash

Systems that use regeneration as part of the operating cycle shall pass the applicable requirements after the completion of a minimum of three operating/regeneration cycles. Non-regeneration systems that recommend backwashing over the life of the system shall be backwashed at the manufacturer’s recommended interval with a minimum of one backwash at the midpoint of the test.

7.4.6 General test water

A public water supply with the following specific characteristics shall be used. These characteristics relate to the water prior to adding the challenge for testing:

| | |
|------------------------------|---|
| hardness | $\leq 170 \text{ mg/L as CaCO}_3$ |
| pH | 7.5 ± 0.5 |
| temperature | $20 \pm 3 \text{ }^\circ\text{C}$ ($68 \pm 5 \text{ }^\circ\text{F}$) |
| total dissolved solids (TDS) | 200 – 500 mg/L |

| | |
|-----------|---------|
| turbidity | ≤ 1 NTU |
|-----------|---------|

7.4.6.1 pH adjustment

The pH shall be increased by adding 6 N sodium hydroxide (NaOH). The pH shall be decreased by adding 6 N hydrochloric acid (HCl).

7.4.6.2 TDS adjustment

The TDS concentration shall be increased by adding sodium chloride (NaCl). The TDS concentration shall be decreased by blending with deionized water.

7.4.6.3 Hardness adjustment

The hardness shall be decreased by blending with deionized water.

7.4.6.4 Influent challenge

Test dust conforming to the specifications in ISO 12103-1 Road Vehicles – Test Dust for Filter Evaluation⁹ shall be added to the general test water specified in 7.4.6 according to the requirements in table 15.

Table 15 – Test dust specifications for nominal particulate reduction (85%)

| Particulate class | Test dust | Size range (µm) | Specification | Challenge concentration ¹ |
|-------------------|-----------------------|-----------------|--|--------------------------------------|
| I, II | ISO fine test dust | 0 – 80 | ISO 12103-1,A2 | 10,000 /mL |
| III, IV | ISO coarse test dust | 1 – 120 | ISO 12103-1,A4 | 10,000 /mL |
| V, VI | Intermediate fraction | 30 – 80 | 90% of particles within specified size range | 1000 /mL |

¹ The stated challenge concentration is the minimum number of particles in the particle size range that is being tested.

7.4.7 Methods for nominal particulate reduction (85%)

7.4.7.1 Plumbed-in systems and faucet mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions, using the general test water specified in 7.4.6. The systems shall be tested using the appropriate influent challenge water specified 7.4.6.4, at the manufacturer's rated service flow and at an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis with a 1- to 3-min cycle, 16 h per 24-h period, followed by an 8-h rest under pressure. A 10%-on / 90%-off cycle of operation may be used in testing, if requested by the manufacturer.

7.4.7.2 Nonplumbed pour-through and batch systems

Two systems shall be conditioned by completely filling the raw water reservoirs with the general test water specified in 7.4.6 and allowing the water to filter until it reaches its natural level in the raw and treated water reservoirs. A filling cycle shall be established based on the time required for 50% of the volume of the water to filter through the initial cycle. The systems shall be tested using the appropriate influent

⁹ International Organization for Standardization (ISO), Case postale 56, CH-1211 Geneve 20, Switzerland <www.iso.org>.

challenge water specified 7.4.6.4. The filling schedule shall be maintained 16 h per 24-h period, followed by an 8-h rest period.

7.4.7.2.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.4.6 without the test contaminant present.

7.4.7.2.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.4.6 without the test contaminant present.

7.4.7.3 POE systems

One system shall be conditioned in accordance with the manufacturer's instructions. The system shall be tested using the appropriate influent challenge at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The system shall be operated on a 50%-on / 50%-off basis with a 1- to 3-min cycle for four cycles. Following the fourth cycle, the system shall be operated continuously 16 h per 24-h period followed by an 8-h rest under pressure.

7.4.8 Sampling

7.4.8.1 Plumbed-in systems, POE systems, and faucet-mounted systems

Influent challenge and product water samples shall be collected at the beginning of the "on" portion of the cycle at the start of the initial cycle after two unit void volumes have passed through the unit, at the start of the fourth cycle, and when the original flow rate of the system has decreased by 50%. Sample size shall be 500 mL or one unit void volume, whichever is larger. The volume of the system downstream of the mechanical filtration element shall be determined. The fourth cycle and final sample point shall be collected during the introduction of the influent challenge after the effluent from the previous cycle has been flushed from the system downstream of the mechanical filtration element and the sample collection line downstream from the unit. The samples shall be collected at the beginning of the flow to the test unit to include any particles that may be released from the sudden increase in flow to the test unit. Sampling from a second or multiple successive on-cycles without flushing the system downstream of the mechanical filtration element and the downstream line from the unit shall be permitted for collecting the required sample volume.

7.4.8.2 Non-plumbed pour-through and batch systems

Influent challenge and product water samples shall be collected at the beginning of the fourth filling cycle and following the 8-h rest period when the original flow from the system has decreased by 50%.

7.5 Scale control testing

7.5.1 Scale control claims

When a system incorporates a non-chemical, dissolution type chemical feeder for inorganic phosphates or silicates or both intended to control scale, the concentration of the agent(s) measured in the product water shall be within the ranges specified in table 16 when tested in accordance with 7.5.

Table 16 – Additives intended for scale control

| Additive | Product water concentration | |
|----------------------------------|-----------------------------|-----------|
| | Minimum | Maximum |
| phosphates (as PO ₄) | 0.5 mg/L | 10.0 mg/L |
| silicates (as SiO ₂) | 0.5 mg/L | 16.0 mg/L |

7.5.2 Apparatus

A test apparatus capable of providing specified flow rates and static pressures shall be used. Refer to 7.1.2, figure 2, for an example diagram.

7.5.3 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in 2.

7.5.4 Premature filter plugging

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Applicable actions to remediate premature filter plugging for this test method are contained in Annex F sections F.1 and F.3.

7.5.5 Scale control test water

A water supply with the following specific characteristics shall be used.

| | |
|------------------------------|-----------------------|
| pH | 7.5 ± 0.5 |
| temperature | 20 ± 3 °C (68 ± 5 °F) |
| total dissolved solids (TDS) | 200 – 500 mg/L |
| total organic carbon (TOC) | ≥ 1.0 mg/L |
| turbidity | < 1 NTU |

Test water shall be modified for systems requiring certain water quality.

NOTE 1 – If precipitation of heavy metals occurs, deionized water shall be substituted for the public water supply, magnesium or calcium salts shall be added to provide the desired TDS, the TOC requirements shall be waived, and the pH requirement shall be modified accordingly.

NOTE 2 – Appropriate labeling stating the specified use restrictions shall be provided, as specified in 8.

7.5.6 Method

Two systems shall be conditioned in accordance with the manufacturer's instructions. The systems shall be tested at the manufacturer's rated service flow rate and an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. The systems shall be operated on a 50%-on / 50%-off basis, 16 h per 24-h period, followed by an 8-h rest under pressure, 7 d per week except for the stagnation periods specified in 7.5.6. A 10%-on / 90%-off cycle of operation may be used in testing, if requested by the manufacturer.

7.5.6.1 Mouth drawn drinking water treatment units

Products meeting the definition for mouth drawn drinking water treatment unit shall be evaluated using the method specified in Annex D.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.5.5 without the test contaminant present.

7.5.6.2 Squeeze bottle drinking water treatment units

Products meeting the definition for squeeze drawn drinking water treatment unit shall be evaluated using the method specified in Annex E.

Two units shall be conditioned in accordance with the manufacturer's instructions using the appropriate general test water specified in 7.5.5 without the test contaminant present.

7.5.7 Sampling

Influent challenge and product water samples shall be collected at the beginning of the next "on" portion of the cycle after 5%, 10%, 45%, 50%, 95%, and 100% of the estimated system capacity has been reached. At 5%, 45%, and 95% of estimated system capacity, the flow shall be turned off and the system held stagnant for 48 h prior to sampling. At 10%, 50%, and 100% of capacity, the flow shall be turned off and the system held stagnant for 4 h prior to sampling. The volume of water collected for each sample shall not exceed 1 L (0.26 gal) or four times the amount required for analysis, whichever is larger. If the "on" cycle ends before the necessary sample volume has been collected, the remaining sample volume shall be collected at the beginning of the next "on" cycle after the specified period of stagnation.

8 Instruction and information

8.1 Installation, operation, and maintenance instruction

8.1.1 Information setting forth complete, detailed instructions for installation, operation, and maintenance shall be provided with each system. Specific information shall include:

- model number and trade designation;
- complete name, address, and telephone number of manufacturer;
- flushing and conditioning procedures;
- rated service flow in L/min or L/d (gpm or gpd);
- maximum working pressure in kPa (psig);
- maximum operating temperature in degrees C (degrees F);
- detailed installation instructions including an explanation or schematic diagram of proper connections to the plumbing system;
- general operation and maintenance requirements including, but not limited to, suggested frequency of filter replacement or service to the system, user responsibility, and parts and service availability;

- sources of supply for replaceable components;
- statement that the system and installation shall comply with applicable state and local regulations;
- statement that the system is to be supplied only with cold water; and
- statement that the system conforms to NSF/ANSI 42 for the specific performance claims as verified and substantiated by test data.

Where applicable and appropriate, the following information shall also be included:

- model number of replacement components;
- rated capacity / rated service life in liters (gallons);
 - NOTE – Each unique model designation shall claim a capacity no greater than the least reduction capacity that has been verified through testing to NSF/ANSI 42, NSF/ANSI 53, or NSF/ANSI 58 section for VOC reduction.
- minimum working pressure in kPa (psig);
- minimum operating temperature in degrees C (degrees F);
- electrical requirements;
- diagram showing proper air gap installation to waste connections;
- statement for activated carbon systems: "Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system.";
- statement for systems making bacteriostatic claims: "The term 'bacteriostatic' indicates that the system limits the passage or growth of bacteria that may already exist in the incoming water. It does not mean that the water leaving the system is safer to drink than the water entering the system."
- for products meeting the definition for personal hand held devices, a statement that these devices are for individual use only.

8.2 Data plate

8.2.1 Systems except commercial modular

8.2.1.1 A permanent plate or label shall be affixed in a readily accessible location on the system and shall contain, at a minimum, the following information:

- model number;
- name and address of manufacturer;
- functional description of the system (e.g., chemical reduction or mechanical reduction, or both);
- maximum working pressure in kPa (psig);
- maximum operating temperature in degrees C (degrees F); and
- statement noting that the system conforms to NSF/ANSI 42 for the specific performance claims as verified and substantiated by test data.

Components that have been evaluated only for design and construction, materials, or both, shall be exempt from this requirement.

8.2.1.2 Where applicable and appropriate, the following information shall also be included:

- model number of replacement components;
- electrical requirements; and
- statement for activated carbon systems: "Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system."

NOTE – Where the physical size of the system does not permit affixing the caution statement to the system, the statement shall be prominently displayed in the literature accompanying the system.

8.2.2 Commercial modular systems

8.2.2.1 Commercial modular manifolds shall have a permanent plate or label affixed in a readily accessible location on the system that shall contain, at a minimum, the following information:

- general system name;
- the statements "Not for residential use. Food service applications only. To be installed by an authorized plumber or an authorized representative of the manufacturer only.";
- statement that this modular element is NOT for use in residential applications;
- name and address of manufacturer;
- maximum working pressure in kPa (psig); and
- maximum operating temperature in degrees C (degrees F).

8.2.2.2 Modular elements shall have a permanent plate or label affixed in a readily accessible location on the modular element that shall contain, at a minimum, the following information:

- Modular element model number;
- functional description of modular element (e.g., chemical reduction or mechanical reduction, or both);
- statement that the modular element conforms to NSF/ANSI 42 or 53 for the specific performance claims as verified and substantiated by test data ;
- statement that this modular element is NOT for use in residential applications; and
- the manufacturer-specific standard head or manifold to which the element can be inserted.

8.2.2.3 Where applicable and appropriate, the following information shall also be included:

- rated capacity/rated service life in liters (gallons). If applicable rated capacity/rated service life in liters (gallons) is not included on the modular element data plate, a statement that rated capacity/rated service life in liters (gallons) may be found on the performance data sheet shall be included;

NOTE – Each unique model number designation shall claim a capacity or service life no greater than the least reduction capacity or service life that has been verified through testing to NSF/ANSI 42 or 53.

- operating or exchange steps; and
- statement for activated carbon systems: "Do not use with water that is microbiologically unsafe or unknown quality without adequate disinfection before or after the system."

8.3 Replacement components

8.3.1 The packaging of components, specifically for replacement purposes, shall be labeled with the following information:

- model number or name of component;
- model number(s) of system(s) in which the component is to be used; and
- name and address of manufacturer.

8.3.2 Where applicable, the following information shall also be included:

- rated capacity/rated service life in liters (gallons);

NOTE – Each unique model designation shall claim a capacity or service life no greater than the least reduction capacity or service life that has been verified through testing to NSF/ANSI 42.

- operating or exchange steps;
- statement that the system conforms to NSF/ANSI 42 for the specific performance claims as verified and substantiated by test data; and
- statement for activated carbon systems: "Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system."

NOTE – Where the physical size of the component does not permit affixing the caution statement to the component, the statement shall be prominently displayed in the literature accompanying the component.

8.4 Performance data sheet

8.4.1 A performance data sheet shall be available to potential buyers for each system and shall include the following information:

- model number and trade designation;
- complete name, address, and telephone number of manufacturer;
- rated service flow in L/min or L/d (gpm or gpd);
- rated capacity/rated service life in liters (gallons);

NOTE – Each unique model designation shall claim a capacity or service life no greater than the least reduction capacity or service life that has been verified through testing to NSF/ANSI 42.

- maximum working pressure in kPa (psig);
- maximum operating temperature in degrees C (degrees F);

- general installation conditions and needs;
- manufacturer's limited warranty;
- general operation and maintenance requirements including, but not limited to, suggested frequency of component replacement or service to the system, user responsibility, and parts and service availability;
- statement that the system conforms to NSF/ANSI 42 for specific performance claims that are not listed in tables 17 and 18 (e.g., bacteriostasis, pH adjustment, scale control) as verified and substantiated by test data;
- statement that while testing was performed under standard laboratory conditions, actual performance may vary; and
- statement for claims: "This system has been tested according to NSF/ANSI 42 for reduction of the substances listed below. The concentration of the indicated substances in water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI 42."

NOTE 1 – Minimum substance reductions per NSF/ANSI 42 shall be listed using the values in tables 17 and 18.

NOTE 2 – In addition to this statement, advertising materials may show the average percent reduction determined during verification.

NOTE 3 – Average concentrations shall be the arithmetic mean of all reported influent challenge or product water concentrations (the detection limit value shall be used for any nondetectable concentration). The specified average percent reduction shall not be greater than the reduction calculated using the arithmetic means of the influent challenge and the product water concentrations respectively.

8.4.2 Where applicable, the following information shall also be included:

- model number of replacement components;
- pressure drop of new system in kPa (psig) at rated flow (POE systems only);
- minimum working pressure in kPa (psig);
- minimum operating temperature in degrees C (degrees F);
- electrical requirements;
- statement for activated carbon system: "Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system.";
- statement for systems making bacteriostatic claims: "The term 'bacteriostatic' indicates that the system limits the passage or growth of bacteria that may already exist in the incoming water. It does not mean that water leaving the system is safer to drink than water entering the system.";
- for systems that claim chlorine reduction based on chloramine reduction as a surrogate, identification of the basis of the chlorine reduction claim. The chlorine influent concentration shall be specified as 2 mg/L, the chlorine product water concentration shall be calculated based on the percent reduction of chloramine, and the stated percent reduction for chlorine shall be equal to that achieved for chloramine; and

- systems making claims for nominal particulate reduction (85%) shall include the size range classification of the test particles as specified in table 18.

8.4.3 For commercial systems, in addition to the requirements set forth in 8.4.1, additional considerations are as follows:

- a performance data sheet may be developed for each modular element of the system, and/or for a group of modular elements; and
- the performance data sheet shall include all of the configurations, providing the following information for each:
 - tested performance claims;
 - rated service flow in L/min or L/d (gpm or gpd);
 - rated capacity/rated service life in L (gal) (if applicable);
 - maximum working pressure in kPa (psig); and
 - maximum operating temperature in degrees C (degrees F).

Table 17 – Performance data sheet reduction claims

| Substance | Influent challenge concentration | Maximum permissible product water concentration |
|------------------------------|----------------------------------|---|
| chloramine ¹ | 3.0 mg/L ± 10% | 0.5 mg/L |
| chloride | 800 mg/L ± 10% | 250 mg/L |
| foaming agent | 5 mg/L ± 10% | 0.5 mg/L |
| hydrogen sulfide | 1.0 mg/L ± 10% | 0.05 mg/L |
| iron | 3-5 mg/L | 0.3 mg/L |
| manganese | 1-2 mg/L | 0.05 mg/L |
| phenol | 5.0 mg/L ± 10% | 0.25 mg/L |
| sulfate | 800 mg/L ± 10% | 250 mg/L |
| total dissolved solids (TDS) | 1500 mg/L ± 10% | 500 mg/L |
| zinc | 10 mg/L ± 10% | 5 mg/L |

¹ As monochloramine (measured as Cl₂/L)

Table 18 – Performance data sheet reduction claims

| Substance | Influent challenge concentration | Reduction requirement |
|---|----------------------------------|-----------------------|
| chlorine | 2.0 mg/L ± 10% | ≥ 50% |
| particulate, Class I particles 0.5 to <1 µm | at least 10,000 particles/mL | ≥ 85% |
| particulate, Class II particles 1 to < 5 µm | at least 10,000 particles/mL | ≥ 85% |
| particulate, Class III particles 5 to <15 µm | at least 10,000 particles/mL | ≥ 85% |
| particulate, Class IV particles 15 to < 30 µm | at least 10,000 particles/mL | ≥ 85% |
| particulate, Class V particles 30 to < 50 µm | at least 1,000 particles/mL | ≥ 85% |
| particulate, Class VI particles 50 to < 80 µm | at least 1,000 particles/mL | ≥ 85% |

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Annex A¹⁰

Key elements of a certification program for drinking water treatment systems and components

A certification program for drinking water treatment systems and components should contain the following program elements:

A.1 Marking the product

Requirements for product marking including:

- certified systems should bear a registered trademark of the certifying organization;
- certified components intended to be used with other components to make a complete functional system, as defined by NSF/ANSI 42, should bear a component mark;
- each system should have a model designation; and
- each system should bear a statement of claims verified through the certifying organization and substantiated by test data.

A.2 Listing certified companies

A published listing of all certified systems and components. The listing format should include at least the following information:

- company name and address;
- product description;
- trademark/model designation;
- flow rate;
- rated capacity or service cycle; and
- each contaminant reduction claim that has been successfully evaluated and is supported by test data.

A.3 Annual audits

Actual physical audits of all facilities and production locations of the certified company at least annually.

¹⁰ The information contained in this Annex 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 Annex 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.

A.4 Testing

- testing in accordance with all applicable NSF/ANSI 42 requirements prior to certification; and
- a retest program that includes re-evaluation and retesting at least once every five years.

A.5 Toxicological evaluation of materials formulations

Formulation information of each material used in the fabrication of the system and/or components shall be provided to and maintained on file by the certifying organization. The formulation information should include, at a minimum:

- the complete chemical identity or proportion by weight;
- ingredient sources of supply;
- documentation regarding the health effects concern of each ingredient in the material; and
- documentation regarding the suitability of each ingredient for use in potable-water-contact material.

A.6 Corrective action

Corrective action for all items of noncompliance found during audits and re-evaluation including:

- provisions for review and authorization for modifications to designs;
- modifications to certified system and/or components; and
- documentation and authorization of the modification maintained on file.

A.7 Enforcement

To preserve the integrity of the registered trademark of the certifying organization and protect public health, enforcement action should be taken by the certifier for the following:

- use of the registered trademark of the certifying organization on a noncertified product;
- general noncompliance;
- unauthorized change to a certified product;
- unauthorized shipment or disposal of product placed on hold; and
- bribes.

A.8 Administrative review

Provisions for an administrative review as requested by any party directly affected by a decision or action of the certifier.

A.9 Appeals

Provisions for an appeals process as requested by any party directly affected by a decision or action of the certifier resulting from an administrative review.

A.10 Complaints

- provisions for investigation of complaints related to:
- certified products;
- misuse of the registered trademark of the certifying organization by a certified company; or
- use/misuse of the registered trademark of the certifying organization by a noncertified company; and
- certified company retention and disclosure of complaint records and remedial actions for certified products.

A.11 Advertising

Requirement of proper use of the registered trademark of the certifying organization on sales literature, technical publications, promotional materials, packaging, catalogs, and advertising.

A.12 Records

Provisions for verification of complete certified company records, including:

- installation and service for fabricators and distributors;
- purchased materials and components; and
- production, shipment, and inventory.

A.13 Public notice

Provisions for issuing a public notice for noncompliance with any requirement of certification.

A.14 Confidentiality

A strict policy of non-disclosure of any confidential information supplied to the certifier by the company regarding the product, including formulations, components, processes, ingredients, or the identity of the company's suppliers and distributors.

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Annex B (normative)

Procedure for the analysis of monochloramine by high performance liquid chromatography (HPLC)

B.1 Summary of method

This procedure is for the analysis of monochloramine in water by High Performance Liquid Chromatography (HPLC) using the reverse phase mechanism on C 18 columns and ultraviolet (UV) detection at 221 nm.

B.2 Equipment and materials

- HPLC system with gradient pump and eluent degas module;
- variable wavelength UV detector;
- spectrophotometer;
- analytical column reverse phase C18 5U;
- autosampler;
- pH-meter;
- analytical balance, accurate to 0.1 mg;
- 10-mL and 1000-mL volumetric flasks;
- 2000-mL Erlenmeyer flask;
- 1000-mL graduate cylinder;
- 1-mL autosampler vials with polytetra-fluoroethylene (PTFE) lined crimp cap;
- 5-mL and 10-mL disposable pipets;
- pasteur pipets, and
- microliter syringes.

B.3 Reagents and consumable materials

B.3.1 Reagents

- ammonium chloride;
- bleach, 5.25% sodium hypochlorite;
- hypochlorite solution;
- potassium phosphate monobasic 99.7% (KH_2PO_4);
- potassium phosphate dibasic 99.5% (K_2HPO_4);
- monochloramine reagent;
- 50% w/w sodium hydroxide;
- 10 mg/L nitrogen ammonia standard solution; and
- HPLC grade water.

B.3.2 Stock standard solutions

B.3.2.1 Preparation of 1.0 M ammonium chloride (NH_4Cl) solution at pH 10

The following procedure shall be used to prepare a 1.0 M NH_4Cl solution at pH 10:

- Fill a clean 2000-mL Erlenmeyer flask with 500 mL HPLC grade water;
- Place a weighing boat on the analytical balance and tare the balance;

- c) Weigh 53.49 g of ammonium chloride (NH_4Cl) and add to the 2000-mL Erlenmeyer flask;
- d) Adjust the pH to 10 with 50% NaOH, and dilute to the 1000-mL mark by adding 500 mL HPLC grade water;
- e) Add a PTFE stir bar to the volumetric flask and place on a stir plate; stir the solution until the NH_4Cl has dissolved; and
- f) Verify the pH value and re-adjust if necessary; the result is a 1.0 M NH_4Cl solution at pH = 10.

B.3.2.2 Preparation of 0.5 M sodium hypochlorite (NaOCl) solution

The following procedure shall be used to prepare a 0.5 M NaOCl solution:

- a) Fill a clean 1000-mL volumetric flask with 714 mL 5.25% NaOCl solution and dilute to the 1000-mL mark with HPLC grade water; and
- b) Invert gently three times to mix and adjust the pH to 10 with 50% sodium hydroxide (NaOH).

B.3.2.3 Preparation of 0.1 M potassium phosphate dibasic 99.5% (K_2HPO_4) solution

The following procedure shall be used to prepare a 0.1 M potassium phosphate dibasic 99.5% (K_2HPO_4) solution:

- a) Fill a clean 1000-mL volumetric flask with 500 mL HPLC grade water;
- b) Place a weighing boat on the analytical balance and tare the balance; and
- c) Weigh 17.418 g of potassium phosphate dibasic (K_2HPO_4) and add to the 1000-mL volumetric flask; mix well.

B.3.2.4 Preparation of 0.01 M potassium phosphate monobasic 99.7% (KH_2PO_4) mobile phase solution at pH 6.9

The following procedure shall be used to prepare a 0.01 M potassium phosphate monobasic 99.7% (KH_2PO_4) mobile phase solution at pH 6.9:

- a) Fill a clean 1000-mL volumetric flask with 500 mL HPLC grade water;
- b) Place a weighing boat on the analytical balance and tare the balance;
- c) Weigh 1.36 g of potassium phosphate monobasic (KH_2PO_4) and add to the 1000-mL volumetric flask; mix well;
- d) Adjust the pH to 6.9 with 0.1 M K_2HPO_4 solution (see annex B, section B.3.2.3); and
- e) Filter the mobile phase with a 0.45- μm filter on a suitable filtration apparatus and degas with helium.

B.3.2.5 Preparation of the standard stock solution

The following procedure shall be used to prepare the standard stock solution:

- a) Transfer 10 mL of 10 mg/L nitrogen ammonia standard solution into 25-mL volumetric flask and add 10 drops NaOCl; and

- b) Invert gently three times to mix, and determine the NH_2Cl concentration (see annex B, section B.3.2.8).

B.3.2.6 Preparation of calibration standards

Three calibration standards (0.2 mg/L, 1 mg/L, and 3 mg/L) shall be prepared from the stock standard solution (see annex B, section B.3.2.5) in 10-mL volumetric flasks and diluted to volume with HPLC grade water. The following equation shall be used to calculate the standards concentrations:

$$V_1 = V_2 C_2 / C_1$$

Where:

V_1 = volume of stock solution required (mL);

V_2 = the target volume of the curve standard (10 mL);

C_1 = the original concentration of the stock solution ($\mu\text{g/L}$); and

C_2 = the desired concentration of the curve standard ($\mu\text{g/L}$).

B.3.2.7 Preparation of the matrix spike solutions

The following procedure shall be used to prepare the matrix spike solution:

- Place 8 mL of a sample in a 10-mL volumetric flask;
- Add the needed amount of the stock standard by using a microliter syringe, using the formula $V_1 = V_2 C_2 / C_1$ to calculate the concentration;
- Fill the flask to the mark with the sample; invert gently three times to mix; and
- Repeat this procedure for the matrix spike duplicate. The spiked concentration of monochloramine is 1000 $\mu\text{g/L}$.

NOTE – Before preparing the matrix spike solutions, be certain to use a sample that has enough volume for the spike solution, the analysis, and any dilutions that would be necessary.

B.3.2.8 Preparation of the monochloramine (NH_2Cl) challenge

The chloramine (NH_2Cl) challenge shall be prepared according to 7.3.2.5.5.

To determine the concentration of the challenge, use ASTM 4500-Cl DPD Colorimetric Method or equivalent.

NOTE 1 – $\text{mg/L NH}_2\text{Cl} = \text{mg/L N NH}_2\text{Cl} \times 3.67$.

NOTE 2 – $\text{mg/L NH}_2\text{Cl (as mg Cl}_2\text{/L)} = \text{mg/L NH}_2\text{Cl} \times 1.4$.

B.4 Safety

Before attempting this procedure, the analyst shall be familiar with the proper operation of the HPLC systems, the spectrophotometer, and the data acquisition system or shall be closely supervised by an experienced analyst.

B.5 Procedure

B.5.1 HPLC hardware setup

The following hardware setup shall be established:

- a) Connect a 100- μ L sample loop to the injector;
- b) Connect the HPLC column to the column line leaving the injector; and
- c) Connect the analytical column to the UV detector.

B.5.2 HPLC run conditions

The following run conditions shall be established:

- a) The HPLC column shall be equilibrated with 100% 0.01M potassium phosphate monobasic mobile phase;
- b) The flow rate for the analysis shall be 1.0 mL/min;
- c) The column flow shall be started first and the pressure allowed to stabilize; and
- d) The UV detector shall be set at 221 nm.

B.5.3 Sample introduction

The samples shall be introduced according to the following:

- a) The standards shall be run first, followed by the method blank, matrix spike, and matrix spike duplicate, followed by the samples;
- b) A matrix spike and matrix spike duplicate shall be run for every 10 samples; and
- c) A check standard shall be analyzed every 10 samples.

NOTE – The check standard concentration is recommended to be equivalent to the second calibration standard or the middle of the calibration curve.

B.6 Data analysis

The sample data shall be analyzed using the external standard method. The estimated detection limit for the analysis is 100 μ g/L. The matrix spike limits and relative percent differences shall be established using methods set forth in the testing laboratory's quality assurance manual.

B.7 Quality control

B.7.1 Minimum requirements

Each laboratory that performs this method shall operate a formal quality assurance (QA) program. The minimum requirements of this program shall consist of an initial demonstration of laboratory capability, analysis of spiked samples to evaluate and document data quality, and analysis of blanks as tests of continued performance. Laboratory performance shall be compared to established performance criteria to determine whether the results of the analyses meet the performance characteristics of the method (see annex B, table B1).

B.7.2 Modifications

If modifications are made to this method, the analyst shall repeat the initial demonstration of laboratory capability test (see annex B, section B.7.3) to demonstrate that the modification produces results equivalent to or superior to results produced by this method. The laboratory shall maintain records of modifications made to this method.

B.7.2.1 The laboratory shall, on an ongoing basis, demonstrate through analysis of the effluent matrix spike sample (see annex B, section B.7.4) that the analysis system is in control. The laboratory shall maintain records to define the quality of data that is generated.

B.7.3 Initial demonstration of laboratory capability

B.7.3.1 Method detection limit (MDL)

To establish the ability to detect monochloramine, the laboratory shall determine the MDL in reagent water per the procedure in 40 CFR 136⁷, appendix B using the apparatus, reagent, and standard that will be used in the practice of this method.

B.7.3.2 Initial precision and recovery

To establish the ability to demonstrate control over the analysis system and to generate acceptable precision and accuracy, the laboratory shall perform the following operations.

B.7.3.2.1 Using results of the MDL analyses, the laboratory shall compute the average percent recovery (R) for monochloramine.

B.7.3.2.2 The MDL and R shall be compared with the corresponding limits for precision and recovery in annex B, table B1. If the MDL and R meet the acceptance criteria, system performance is acceptable and the analysis of blanks and samples may begin. If, however, any individual R falls outside the range for recovery or the MDL exceeds the precision limit, system performance is unacceptable for monochloramine. In this event, the problem shall be corrected and the test shall be repeated (see annex B, section B.7.3.1).

B.7.4 Matrix spike

The laboratory shall spike and analyze a separate sample aliquot to determine the effect of the matrix on the method's recovery efficiency. A duplicate effluent sample shall be spiked with the appropriate volume of the monochloramine stock solution as specified in annex B, section B.3.2.7, to obtain a monochloramine concentration of 1000 µg/L. The matrix spike shall be analyzed as described in annex B, section B.5.

B.7.4.1 Compute the percent recovery (R) of the monochloramine using the following equation:

$$R = \frac{\text{observed analyte concentration}}{\text{true analyte concentration}} \times 100$$

B.7.4.2 The recovery (R) shall be compared with the corresponding limits in annex B, table B1 until 20 recovery analyses are available, at which time the laboratory shall establish its own control limits. If the recovery for monochloramine falls outside its limit, method performance for that sample is unacceptable. Corrective action shall be taken and duplicate effluent samples shall be analyzed.

When 20 internal performance recovery data points are available, control limits shall be developed from the mean percent recovery (\bar{x}) and standard deviation (s) of the percent recovery. These data shall be used to generate upper and lower control limits:

$$\text{upper control limit} = \bar{x} + 3s;$$

$$\text{lower control limit} = \bar{x} - 3s.$$

These control limits shall not exceed those in annex B, table B1. After every 10 data points, new control limits shall be generated using the most recent 20 data points. If the recovery falls outside the control limits, method performance for that sample shall be considered unacceptable. Corrective action shall be taken, and duplicate effluent samples and an additional matrix spike shall be analyzed.

B.7.5 Blank (negative control sample)

If any monochloramine or any potentially interfering substance is found in the blank, analysis of additional samples shall be halted until the source of the contamination is eliminated and a blank shows no evidence of contamination. Any sample in a batch associated with a contaminated blank that shows the presence of monochloramine shall be assumed to be contaminated and shall be recollected. Any sample in which monochloramine is not detected shall be assumed to be uncontaminated.

B.7.6 Ongoing precision and recovery

The recovery shall be compared with the limits for recovery in annex B, table B1, until laboratory control limits are established as specified in annex B, section B.7.4.2. If the recovery meets the acceptance criteria, system performance shall be considered acceptable. If, however, the recovery falls outside the range given, system performance shall be considered unacceptable. Corrective action shall be taken, and duplicate effluent samples and an additional matrix spike shall be analyzed.

A minimum of one matrix spike sample shall be analyzed and shall meet the recovery criteria in annex B, table B1, for each performance test.

B.8 References

Brunett, M., C. Colin and R. Rosset, Liquid chromatography of chloramine, *Analysis*, 15(1987), 393-398.

Isaac, R. A. and J. C. Morris, Transfer of active chlorine from chloramine to nitrogenous organic compounds. 1 *Kinetics*, *Environ Sci Techn*, 17(12), 738-742. 1983.

Determination of trace amounts of chloramines by liquid chromatographic separation and amperometric detector. Elsevier Science Publishers B. V. Amsterdam. *Analytic Chimica Acta*, 273(1990, 149-153).

ASTM Method 4500-CI DPD Colorimetric Method.

Table B1 – Quality control acceptance criteria

| Performance test | Acceptance criteria |
|-------------------------|----------------------------|
| precision (as MDL) | ≤ 0.05 mg/L |
| recovery (percent) | 80% to 120% |

Annex C¹¹ (informative)

USEPA Method 625 is a GCMS method developed in the early 1980's for analysis of surface water samples for toxic chemical contamination from industrial discharges. In the early to mid '70's, the Agency was charged by Congress with the protection of the country's waterways from chemical contamination. In response to this mandate, the Agency developed a list of 65 chemicals and chemical classes. This original list was subdivided into 129 specific chemicals which shortly gained the moniker of the "Priority Pollutants". USEPA Method 625 was developed as part of this effort. A large part of the list were semivolatile organic chemicals. The "Priority Pollutants" which the technique was developed, ranged from chlorinated phenols (chloro, di-, tri-, and penta- chlorinated), nitrophenols (mono and di), nitrosoamines (dimethyl, dipropyl, dibutyl, and diphenyl), and aromatics. Further, the method has been demonstrated (by the USEPA) to be appropriate for pesticides, PCBs, and aromatic amines (benzidine and dichorobenzidine).

The use of GCMS should be understood as application of state of the art technology at that junction in time. GCMS, in the late '70's and early '80's was an instrument of research typically costing in excess of \$200,000; today, this is roughly equivalent to \$500,000. It should then be understood that the method was not "only" a wastewater procedure, but a technique employed for general applicability to surface waters for the analysis of a broad range of toxic organic chemicals.

For application of this method to NSF/ANSI DWTU applications, it is incumbent on the laboratory to demonstrate expertise in the technique through the analysis of method validation studies demonstrating capability to generate data of known and legally defensible quality. Further, as part of the standard, maximum contaminant levels are established to ensure public safety for the chemicals of concern. The laboratory must, through its validation studies have demonstrated capability to meet this sensitivity requirement.

This technique includes that capability to perform identification of unknown compounds detected in the 625 analysis as well as an estimation of concentration. This is performed through the use of spectral identification programs versus mass spectral libraries compiled by NIST (National Institute of Science and Technology). This library exceeds 100,000 spectra of different organic chemicals. The concentration estimation is done in accordance with USEPA established protocol as part of (and not solely exclusive to) its Contract Laboratory Program. This program was initiated in 1980 for the analysis of environmental samples (soil, water, and hazardous materials). Due to the nature of this work, all data was required to be legally defensible in a court of law. Though the concentrations are estimated, this is performed following a standardized protocol allowing data users to understand the likely range of concentration of the analyte and request quantitative analysis of any particular chemical if necessary.

This standard does allow alternative analytical techniques to be developed and employed by the analytical laboratory, particularly in those cases where the formulation would indicate chemical constituents or byproducts not amenable to methods 524.2 and 625. Most notably would be HPLC, HPLC-MS, and triple quadrupole techniques.

USEPA Methods 524.2 and 625, though applicable to a wide range of chemicals, compounds that are thermally labile or highly polar may not chromatograph at all (by GC) or too poorly to be a reliable technique. When faced with this situation, alternative techniques may be utilized to generate the necessary data. HPLC and HPLC-MS (an HPLC with a mass spectrometer as the detector rather than a typical HPLC detector) compliment well the referenced GCMS techniques. Where GCMS is most applicable to relatively smaller compounds (typically below a molecular weight of 500 but may be

¹¹ The information contained in this annex 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 annex 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.

extended up to around 700 to 800) of neutral to intermediate polarities, HPLC and HPLC-MS lends itself well to more polar compounds and those of greater molecular weight. Also, generally speaking, GCMS systems are capable of greater resolution than HPLC and HPLC-MS (though recent advances in HPLC column technology have diminished this differential). This is particularly important for samples with more complex chromatograms (more individual chemicals leached). Examples of chemicals particularly suited to HPLC and HPLC-MS would be carbamic acids, organic diacids, and compounds with mixed, opposing functional groups such as amino carboxylic acids (such as aminodecanoic acid).

When a reference is made to GC-MS and HPLC-MS it does not specify the type of mass-spectrometer coupled with the GC or HPLC. However, there can be significant advantages analytically to be gained here also. Typically, these instruments are single quadrupole “low-resolution” instruments. For instance, regardless if the system is a GC-MS or HPLC-MS, when the mass-spectrometer measures the mass of the ions from a compound, with a “low-resolution” instrument, they are typically capable of mass accuracy to $1/10^{\text{th}}$ of an AMU. When the atomic weight of an isotope of an element is obtained, it is discovered that rather than being whole numbers (except for carbon, whose primary isotope at “12” is used as the reference for the other elements) they all have some fractional component. For instance, chlorine whose primary isotope is typically considered to have a mass of 35AMU (or Daltons) is actually 34.96885AMU. Now if the mass spectrometer is capable of greater mass resolution (a high resolution mass spectrometer) advantage can be taken of these small differences in mass of the elements. With this approach, if an unknown peak is present in the GCMS or HPLC-MS analysis, if the molecular ion (the ion representing the intact molecule versus the fragment ions) can be identified, then the chemical formula of the peak of interest (or at minimum a fairly short list of possibilities) can be calculated. This information can then be used to add certainty to a library search match, or give the toxicologist at least chemical formula information when a peak does not give good library search information.

A final technique which has seen application in the screening of foods, particularly fruits and vegetables, for pesticides, is directly aspirating an aqueous sample into a triple quadrupole system. This approach utilizes the initial quadrupole to control which molecular ions are transmitted through to the rest of the instrument, where it is fragmented and identified. Though this technique cannot distinguish isomers, it has the advantage of avoiding the problem of potential chromatography issues.

Annex D (normative)

Test method for evaluating mouth drawn water treatment units

D.1 Scope and Purpose

It is the purpose of this protocol to evaluate mouth drawn drinking water treatment devices for elective performance claims. The product must be designed that the only method of generating treated water for consumption is by drawing from the unit by the users mouth (by creation of a vacuum). If the product can be squeezed to dispense water (squeeze bottle as defined by NSF 330) as well as mouth drawn, the squeeze bottle protocol shall be used.

D.2 Method

D.2.1 Set-up

An example of the test setup is presented in Figure 3.

Peristaltic pumps shall be plumbed into the outlet of the test units and shall be capable of achieving at least 800 ml/min at 20.5 kPa vacuum (6 inches of Hg, 3 psig). The volume of the plumbing downstream of the test unit shall be ≥ 10 ml and be measured to determine wait time and a port installed between the test unit and peristaltic pump with a pressure gauge to monitor draw vacuum. The test units shall be configured so that test water can be continually introduced.

For a bottle, a single 18mm (3/4") hole shall be drilled in the side of the bottle as close to the bottom as possible. The bottle shall be placed upright in a vessel with the bottle submerged adequately to cover the hole and prevent air from entering the bottle, but not far enough to cover any closures. The hole in the bottle shall remain covered with influent at all times. Each bottle shall have the influent tube (Fig. 3c) positioned into or immediately adjacent to the hole (Fig. 3e) placed in the bottle.

D.2.2 Flow Rate

The flow rate shall be maintained at 800 +/- 80 ml/min up to a maximum of 20.5 kPa (3 psig) average vacuum. If the average vacuum exceeds 20.5 kPa, the flow rate shall be reduced to maintain the average vacuum at 20.5 ± 3 kPa.

D.2.3 Operational Cycle

The on cycle time shall be 3.0 seconds or up to 30 seconds as requested by the manufacturer during normal operation. The cycle ratio shall be between 50/50 and 10/90 on/off with a minimum of 8 hours of test operation within a 24 hour period, followed by a minimum 8 hour rest.

D.3 Sampling

Due to the nature of overflow influent feeding to bottled devices, no effluent samples shall be collected after a 2 hour period of no flow through the test units until a minimum of a unit void volume (of the entire device) has passed through the test unit.

D.3.1 Influent Sampling

Influent samples shall be collected after all effluent samples have been collected. The samples shall be taken directly from the influent fill tube.

D.3.2 Effluent Sampling

Due to the small volume of each cycle, multiple cycles or an extended on time shall be used at each sample point as specified below.

D.3.2.1 Chemical Reduction Effluent Samples (chloramine, chlorine, hydrogen sulfide, phenol, scale control, pH, and zinc)

Collection of effluent shall commence after the down stream plumbing from the test unit has been purged (time to wait = volume of downstream plumbing/flow rate). The extended on period shall be only as long as needed to collect the required sample. The minimum sample volume collected shall be 50 ml and the maximum sample volume shall be the minimum required for analysis.

D.3.2.2 Mechanical Reduction Effluent Samples (particulate, bacteriostatic, iron, and manganese)

The sample shall be collected from sequential on/off cycles for as long as required to collect the entire sample volume. All samples shall be collected as the first water out of the unit for the multiple cycles. The minimum sample volume collected shall be 50 ml and the maximum sample volume shall be the minimum required for analysis.

D.3.3 Active Agent Sampling (when active agent is present)

All performance sample points shall include an active agent sample. Influent and effluent samples are collected for active agents for all samples. All active agent samples shall be collected with an extended on time. Active agent samples will be collected after the performance sample has been collected, with the exception of the Active Agent Stagnation Sample (see below).

D.3.3.1 Active Agent Stagnation Sample

During a performance test that includes active agent sampling, a minimum of one sample shall be an Active Agent Stagnation Sample. Typically this sample is scheduled for the morning of the second day of testing. Stagnation samples shall be collected after a minimum 8 hour rest with no flow through the test units. Stagnation samples shall be collected from the first water through the device after the stagnation period, immediately after the downstream plumbing has been purged (time to wait = volume of downstream plumbing/flow rate). The test unit shall be operated continuously until the required sample volume is collected. This volume shall be the minimum volume required for analysis or 50 ml, whichever is greater.

If a performance sample coincides with the Active Agent Stagnation sample, the system will be returned to cycling operation after the Active Agent Stagnation sample is collected until the required volume has passed through the test unit (1 unit volume of entire device) to allow the performance sample to be collected as required in the sampling procedures section of Annex D.

D.3.4 Back Pressure Test

A back pressure test shall be performed immediately prior to the 50% sample point. The peristaltic pump shall be reversed for 30 sec. without changing the pump speed. The pump shall then return to a forward flow under normal operation. An effluent sample shall be collected after the downstream plumbing of the device has cleared and analyzed for the presence of contaminants as specified in D.3.2.

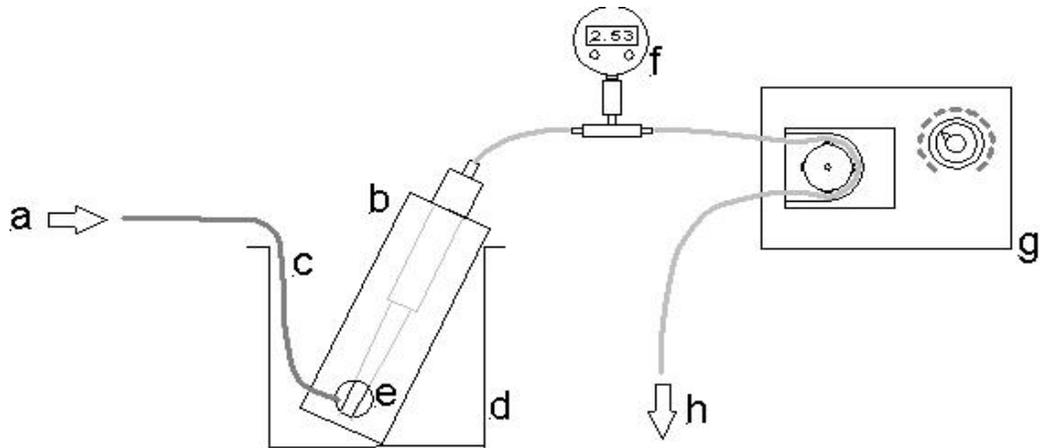


Figure 3 – Diagram of Test Configuration

- a. influent test water
- b. test unit
- c. influent fill tube
- d. influent containment vessel
- e. 18mm (3/4") hole in bottom of test unit
- f. pressure gauge (recommend digital gauge set to read average vacuum values, 0.5% accuracy)
- g. variable speed peristaltic pump (may be multiple pumps in parallel)
- h. test unit effluent (sampling location)

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Annex E (normative)

Test method for evaluating squeeze bottle drinking water treatment units

E.1 Scope and Purpose

It is the purpose of this protocol to evaluate squeeze bottle drinking water treatment devices for elective performance claims. The squeeze bottle shall maintain its structural integrity during performance testing. If the closure of the bottle develops a leak, it shall be corrected according to manufacturer's instructions and it shall not be considered a failure of structural integrity during performance claim testing unless the leak reoccurs within the unit void volume of the bottle.

Two methods are described for evaluating squeeze bottles, the mechanical gripper apparatus may be used for all performance claims, the alternate pressurized bottle method shall not be used for mechanical reduction or metals reduction testing if the system has any type of back-draw through the filter during normal use.

E.2 Method – Mechanical Gripper Apparatus

E.2.1 Set-up

An example of the test apparatus is provided in figure 4. The geometric arrangement and dimensions of the gripper including the size and orientation of the fingers and palm, the stroke length and pivot point are critical to generating reproducible test results and shall meet the specifications provided in figure 5. The control system should be capable of applying a consistent and specified pressure on the bottle for the specified time. The bottle shall be tilted at a minimum of 135 degrees from vertical when dispensing and no more than 50 degrees from the vertical when refilling.

The test bottle shall be attached to the test apparatus so the bottle shall remain in position, but not be under pressure when at rest. The gripper shall be positioned around the center of the test bottle to maximize the volume dispensed during each squeeze of the gripper unless a specific location to grip the bottle is specified in the manufacturer's literature.

E.2.2 Automatic Bottle Refilling

The squeeze bottle shall be refilled with the test water when the volume remaining in the bottle is no greater than 25% of the total unit void volume. The squeeze bottle shall be considered full when the test water volume has achieved greater than 75% of the total unit void volume.

E.2.3 Operational Cycle

The systems shall be operated with a 3 second on/ 5 second off cycle time (cycle time up to 3 second on/30 second off may be requested by the manufacturer). The systems shall be operated up to 16 hours per 24 hour period, followed by a minimum 8 hour rest. The on cycle time shall consist of a force rise at the initiation of each cycle of $1.5 \pm .5$ seconds to 20 ± 1 kg of force applied by the gripper for the remainder of the on cycle time. Each squeeze shall be followed by a minimum 5 second rest period in the vertical (or nearly vertical) position with <0.5 kg of force applied to the bottle. Total cycle time shall exceed 10 seconds due to the time required to tilt the bottle. The off cycle during refilling of the bottle may be extended as needed to complete the refilling operation.

E.3 Alternate Method – Pressurized Bottle

E.3.1 Set-up

The systems shall be plumbed onto a pressurized test rig in the same manner as an open discharge DWTU. If required to pressurize the device and generate flow, a port shall be installed in the influent reservoir of the test unit of adequate size so flow is not restricted ($< 1 \text{ Cv}$). The bottle shall be oriented to reflect normal usage (typically outlet downward). Air space in the bottle shall be minimized. The inlet pressure to the bottle shall be $52 \pm 3.5 \text{ kPa}$ ($7.5 \pm 0.5 \text{ psi}$) at startup and is not readjusted, although the system may experience some change during testing.

E.3.2 Operational Cycle

The systems shall be operated with a 3 second on/ 5 second off cycle time (cycle time up to 3 second on/30 second off may be requested by the manufacturer). The systems shall be operated up to 16 hours per 24 hour period, followed by a minimum 8 hour rest.

E.4 Sampling

For systems that include a performance indication device samples shall be collected from the first fill of the bottle, and at 25, 50, 75, 100, and 120% of claimed capacity. For systems that do not include a performance indication device samples shall be collected from the first fill of the bottle, and at 50, 100, 150, 180, and 200% of capacity. Effluent samples shall be collected from the entire volume dispensed during multiple sequential on/off cycles until the required volume for analysis is collected. Influent samples shall be collected from a sampling port located immediately prior to the test units connection.

E.4.1 Active Agent Sampling (when active agent is present)

All performance sample points shall include an active agent sample. Influent and effluent samples are collected for active agents for all samples. Active agent samples will be collected after the performance sample has been collected, with the exception of the Active Agent Stagnation Sample (see Figure 4).

E.4.2 Active Agent Stagnation Sample

During a performance test that includes active agent sampling, a minimum of one sample shall be an Active Agent Stagnation Sample. Typically this sample is scheduled for the morning of the second day of testing. Stagnation samples shall be collected after a minimum 8 hour rest with no flow through the test units. Stagnation samples shall be collected from the first water through the device after the stagnation period, immediately after the downstream plumbing has been purged (if any). The test unit shall be operated for multiple sequential on/off cycles, if required to collect the required sample volume. This required sample volume shall be the minimum volume required for analysis or 50 ml, whichever is greater.

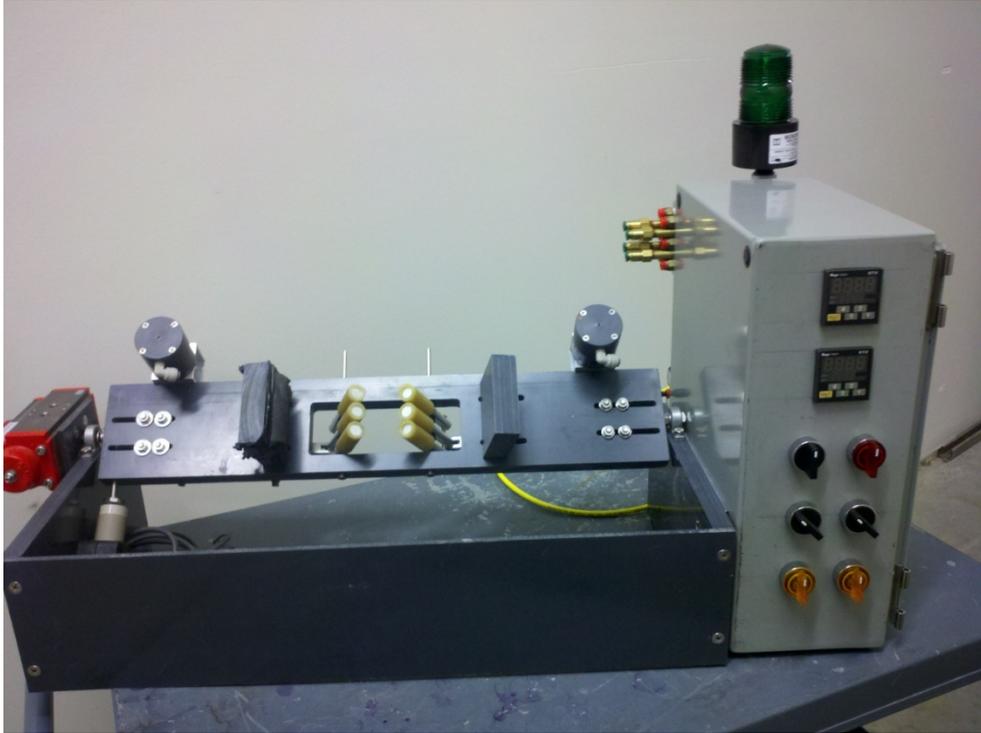


Figure 4. Photo of Example Test Apparatus using gripper

Annex F (normative)

Methods and procedures to minimize premature filter plugging

The methods and procedures within this annex shall be performed as required and referenced in the test methods. The intent is to allow the performance test to reach the desired test volume so performance claims are able to be substantiated and not prematurely plug due to common laboratory conditions. The test shall not be modified, however, in its nature by improving the performance of the test system. Influent samples and challenge levels shall be measured immediately prior to the system inlet and after any anti-plugging treatment to confirm that the actions performed to minimize premature filter plugging do not interfere with the influent challenge characteristics.

If a product prematurely plugs prior to the completion of the required test volume, the volume of the final sample point collected prior to plugging becomes the final test volume to determine capacity.

Example: A manufacturer desires to substantiate an 100 gallon alachlor claim for a point of use system that does not contain a performance indication device under NSF/ANSI Standard 53. This shall require the test to be performed to 200 gallons. The system flow rate for one of the systems falls to less than 25% of the initial clean system flow rate after the 180 gallon sample point but prior to the 200% sample point. The test is terminated and the total test volume for this test becomes 180 gallons instead of the originally desired 200 gallons which changes the maximum potential capacity claim to 90 gallons.

F.1 Mechanical filtration component of tested system

If a test system contains a separate mechanical filtration component that is not required for the successful reduction of the test contaminant and this mechanical filtration component causes premature clogging, this mechanical filtration component shall be replaced or excluded from the system to improve the flow rate.

F.2 Mechanical filtration of waters

The water source used to create test waters shall be filtered with mechanical filtration that meets or exceeds NSF/ANSI Standard 42 nominal particulate reduction class I performance. Carbon or other absorptive/adsorptive media shall not be used for source waters that require total organic carbon (TOC) unless an explicit addition of TOC is specified in the test method.

When the evaluation of the system is at an extended on/off cycle (10%-on/90%-off), extended test period (> 2 weeks) or the systems are known to plug, test waters shall be filtered with an on-absorptive/adsorptive media with a rating of 0.45 um or smaller. The filtration shall be performed prior to the addition of the contaminant and shall not alter or enhance the performance of the systems under test (with the exception of preventing premature plugging).

F.3 Disinfection and cleaning of test apparatus

Test equipment shall be cleaned and disinfected to minimize the presence of bacteria and particulate matter when the evaluation of the system is at an extended on/off cycle (10%-on/90%-off), extended test period (> 2 weeks) or the systems are known to plug. The testing laboratory shall evaluate the test equipment used to determine best practices for the equipment in use. The test systems shall not be exposed to the cleaning or disinfecting procedure and all disinfectants, cleaners, and rinse waters shall be purged from the test apparatus prior to connecting the test systems.

An example of a disinfection and cleaning procedure is as follows:

Procedure

1. Remove all test systems from the test rig.
2. Remove any test rig prefilters.
3. Plumb in any inline components that shall be used to test the systems (flow meters, UV disinfection units, etc).
4. Add the recommended concentration of quaternary ammonia disinfectant cleaner to the test apparatus and ensure all interior surfaces are exposed to the cleaner.
5. Flush and circulate (if applicable) the disinfectant for the time recommended by the cleaner manufacturer or longer.
6. Drain the test rig and install any prefilters and activate the UV disinfection units (if applicable).
7. Thoroughly rinse the test rig until all of the cleaner is removed from the apparatus.

F.4 Anti-microbial treatment

Anti-microbial procedures shall be performed when the evaluation of the system is at an extended on/off cycle (10%-on/90%-off), extended test period (> 2 weeks) or the systems are known to plug. One or more of the following procedures shall be performed. Additional or alternate procedures are acceptable to be used if they provide equivalent or improved microbial control.

1. Residual free available chlorine
The use of free available chlorine up to 3 mg/L is acceptable to limit the growth of microorganisms within a test apparatus if it does not interfere with the challenge contaminant or improve the performance of the system under test (with the exception of limiting microbial growth).

Exceptions: Free available chlorine shall not be used for carbofuran, nitrate/nitrite, arsenic(III), chromium, hydrogen sulfide, chloramines, iron, manganese or any microbiological testing unless required in the test method.

F.5 Methanol used as carrier solvent

If methanol is used as a carrier solvent for introducing a challenge contaminant, the amount of methanol added to the test water shall be minimized if the evaluation of the system is at an extended on/off cycle (10%-on/90%-off), extended test period (> 2 weeks) or the systems are known to plug. The amount of methanol required to achieve proper dispersal and solvation of the challenge contaminant shall be maintained, but when practical, the concentration of methanol in the test water shall be minimized.

F.6 Operational cycle

If a test system has demonstrated clogging when an extended operational cycle is used (other than 50%-on/50%-off), the system shall be operated at an 50%-on/50%-off cycle if a retest is performed due to plugging. Adjusting to a longer off cycle is acceptable during the test (ex. 10%-on/90%-off) after the test system has reached the test volume where the previous test had plugged, if requested by the manufacturer.

Standards¹²

The following standards established and adopted by NSF as minimum voluntary consensus standards are used internationally:

- 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 (HPDL) for surfacing food service equipment
- 36 Dinnerware
- 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
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¹² The information contained in this Standards page 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 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.



THE HOPE OF MANKIND rests in the ability of man to define and seek out the environment which will permit him to live with fellow creatures of the earth, in health, in peace, and in mutual respect.

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