*NSF International Standard / American National Standard*

# NSF/ANSI 62 - 2022

## Drinking Water Distillation Systems

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

# Drinking Water Distillation Systems

Standard Developer
**NSF International**

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**Abbreviations**

The following tables are provided as a reference for unit abbreviations for common forms of measurement used within NSF documents.

| | | |
|---|---|---|
| time | second | s |
| | minute | min |
| | hour | h |
| | day | d |
| | week | wk |
| | month | mo |
| | year | yr |
| length | inch | in |
| | foot | ft |
| | yard | yd |
| | micrometer | µm |
| | nanometer | nm |
| | millimeter | mm |
| | centimeter | cm |
| | meter | m |
| | kilometer | km |
| liquid measure | milliliter | mL |
| | liter | L |
| | liters per day | LPD |
| | liters per minute | LPM |
| | ounce | oz |
| | pint | pt |
| | quart | qt |
| | gallon | gal |
| | gallons per minute | GPM |
| | gallons per day | GPD |
| weight | microgram | µg |
| | picogram | pg |
| | nanogram | ng |
| | milligram | mg |
| | centigram | cg |
| | gram | g |
| | kilogram | kg |
| | pound | lb |
| | ton | t |
| | metric ton | mt |

| | | |
|---|---|---|
| miscellaneous | atomic mass unit | amu |
| | colony-forming unit | cfu |
| | Daltons | Da |
| | kilopascals | kPa |
| | kilowatt | kW |
| | kilowatt-hour | kWh |
| | mass-to-charge ratio | m/z |
| | microsiemens | µS |
| | molecular weight | MW |
| | nephelometric turbidity unit | NTU |
| | parts per billion | ppb |
| | pounds per square inch guage | psig |



Documents
Document Sharing Hub

Full document details: NSF 62 2022

**Contents**


1 General ... 1
1.1 Scope ... 1
1.2 Minimum requirements ... 1
1.3 Chemical and microbiological reduction performance claims ... 1
1.4 Treatment train ... 1
1.5 Reviews and revisions ... 1

2 Normative references ... 2

3 Definitions ... 2

4 Materials ... 3
4.1 Materials in contact with drinking water ... 3
4.2 Materials evaluation ... 4
4.3 Gas chromatography / mass spectroscopy (GC/MS) analysis ... 5

5 Structural performance ... 11
5.1 Structural integrity ... 11

6 Minimum performance requirements ... 15
6.1 TDS reduction ... 15
6.2 Performance indication ... 19
6.3 Flow control ... 23
6.4 Storage tanks ... 23
6.5 Evaporator chamber ... 23
6.6 Openings and rims (product water zone) ... 23
6.7 Entry ports ... 23
6.8 Waste connections ... 23
6.9 Product water dispensing outlets ... 24
6.10 Active agents and additives ... 24

7 Elective performance claims – Test methods ... 25
7.1 Inorganic chemical reduction claims qualified by TDS surrogate testing ... 25
7.2 Inorganic chemical reduction ... 25
7.3 In-place sanitization of the product water zone ... 29
7.4 Microbiological reduction ... 31
7.5 Production rate verification ... 33

8 Instruction and information ... 35
8.1 Installation, operation, and maintenance instructions ... 35
8.2 Data plate ... 36
8.3 Replacement components ... 37
8.4 Performance data sheet ... 37

Normative Annex 1 Evaluation methods for systems with multiple technologies – Treatment train ... 41
N-1.1 Requirements for the evaluation of a system containing multiple, sequential treatment technologies ... 41
N-1.2 Example application of treatment train option B ... 42
N-1.3 Example application of treatment train option C ... 43




Documents
Document Sharing Hub

Full document details: NSF 62 2022

Informative Annex 1 Evaluation of total dissolved solids as a surrogate parameter for the reduction of inorganic contaminants by distillation ..... 45
I-1.1 Executive summary ..... 45
I-1.2 Introduction ..... 46
I-1.3 Evaluation protocol ..... 46
I-1.4 Results ..... 49
I-1.5 Conclusions ..... 50

Informative Annex 2 Key elements of a certification program for drinking water treatment systems and components ..... 51
I-2.1 Marking the product ..... 51
I-2.2 Listing certified companies ..... 51
I-2.3 Annual audits ..... 51
I-2.4 Testing ..... 51
I-2.5 Toxicological evaluation of materials formulations ..... 52
I-2.6 Corrective action ..... 52
I-2.7 Enforcement ..... 52
I-2.8 Administrative review ..... 52
I-2.9 Appeals ..... 52
I-2.10 Complaints ..... 52
I-2.12 Records ..... 53
I-2.13 Public notice ..... 53
I-2.14 Confidentiality ..... 53

Informative Annex 3 Use of U.S. EPA Method 625 in testing drinking water treatment systems and components ..... 55

Interpretation Annex ..... 57



Documents
Document Sharing Hub

Full document details: NSF 62 2022

## Foreword[2]

The purpose of this standard is to establish minimum requirements for the materials, design and construction, and performance of point-of-use (POU) and point-of-entry (POE) drinking water distillation systems that are designed to reduce specific chemical and microbiological contaminants in public or private water supplies. NSF/ANSI 62 also specifies minimum product literature requirements that manufacturers shall provide to authorized representatives and consumers.

Water contact materials in drinking water treatment units listed under NSF/ANSI 42, NSF/ANSI 44, NSF/ANSI 53, NSF/ANSI 55, NSF/ANSI 58, and NSF/ANSI 62 are tested and evaluated under a separate protocol from NSF/ANSI/CAN 61, with criteria that were developed specifically for the intended end-use. NSF/ANSI/CAN 61 listing shall not be additionally required for acceptance of these listed units for water contact application.

This edition of the standard contains the following revisions:

**Issue 41**

This revision adds language to Sections 8.1.1 and 8.4.1 to allow installation, operation, and maintenance instruction manuals, as well as performance data sheets, to be provided online.

**Issue 44**

This revision updates normative references throughout the standard.

**Issue 45**

This revision adds NSF/ANSI/CAN 372 as a normative reference in Section 2, and its requirements for lead content in Section 4.1.2.

**Issue 46**

This revision updates normative references in Section 2 and the NIST mass spectral library version in Section 4.3.1.2, as well as corrects normative language in Section 4.3.1.1.

The Interpretations Annex contains responses to interpretation requests. The responses will be published in each version of the standard until such time that the interpretation response is no longer applicable.

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.

This standard and the accompanying text are intended for voluntary use by certifying organizations, regulatory agencies, and/or manufacturers as a basis of providing assurances that adequate health protection exists for covered products.

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, U.S.A.

[2] The information contained in this foreword 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 foreword 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.



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NSF/ANSI Standard
for Drinking Water Treatment Units –

# Drinking Water Distillation Systems

## 1 General

### 1.1 Scope

This standard establishes minimum materials, design and construction, and performance requirements for point-of-use (POU) and point-of-entry (POE) drinking water distillation systems and the components used in these systems. Distillation systems covered by this standard are designed to reduce specific chemical contaminants from potable drinking water supplies. Systems covered under this standard may also be designed to reduce microbiological contaminants, including bacteria, viruses, and cysts, from potable drinking water supplies. It is recognized that a system may be effective in controlling one or more of these contaminants, but systems are not required to control all.

Systems covered by this standard are not intended for the treatment of water that is visually contaminated (turbid) or has an obvious contamination source, such as raw sewage, nor are systems covered by this standard intended to convert wastewater to microbiologically potable water.

### 1.2 Minimum requirements

A system as defined in this standard shall meet the applicable requirements of Sections 4, 5, 6, and 8.

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

### 1.3 Chemical and microbiological reduction performance claims

**1.3.1** All NSF/ANSI 62 performance claims shall be verified and substantiated by test data generated under the requirements of NSF/ANSI 62.

**1.3.2** When performance claims are made for substances not specifically addressed in the scope of this standard or for those substances not specifically addressed but falling under the scope of NSF/ANSI 62, those claims not specifically addressed in the standard shall be so identified.

### 1.4 Treatment train

A system that contains multiple, sequential treatment technologies for a performance claim under this standard shall meet the applicable requirements as described in Annex N-1.

### 1.5 Reviews and revisions

This standard shall be reviewed at least every five y. The review shall be conducted by the NSF Joint Committee on Drinking Water Treatment Units.



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## 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 most recent editions of the documents indicated below. The most recent published edition of the document shall be used for undated references.

21 C.F.R., *Food and Drugs,* Subchapter B, *Food for Human Consumption,* Parts 170-199[3]

40 C.F.R. Part 141, *National Primary Drinking Water Regulations*[3]

40 C.F.R. Part 143, *Other Safe Drinking Water Act Regulations*, Subpart A, *National Secondary Drinking Water Regulations*[3]

APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater* (hereinafter referred to as *Standard Methods*)[4]

EPA 600/4-79-020, *Methods for the Chemical Analysis of Water and Wastes*, March 1983[5]

EPA 600/4-82-057, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, May 2002[5]

EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water*, December 1988[5]

EPA 600/4-90/020, *Methods for the Determination of Organic Compounds in Drinking Water – Supplement 1*, July 1990[5]

EPA 600/4-91/010, *Methods for the Determination of Metals in Environmental Samples*, June 1991[5]

NIST Standard Reference Database 1A (NIST/EPA/NIH Mass Spectral Library with Search Program), NIST20/NIST v20[6]

NSF/ANSI/CAN 61, *Drinking Water System Components – Health Effects*

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

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

## 3 Definitions

Terms used in this standard that have a specific technical meaning are defined in NSF/ANSI 330: *Glossary of Drinking Water Treatment Unit Terminology*.

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[3] National Archives and Records Administration, Office of the Federal Register. 7 G Street NW, Suite A-734, Washington, DC 20401. <www.ecfr.gov>

[4] American Public Health Association, American Water Works Association, and Water Environment Federation. <www.standardmethods.org>

[5] U.S. Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <www.epa.gov>

[6] National Institute of Standards and Technology, U.S. Department of Commerce.100 Bureau Drive, Gaithersburg, MD 20899-8930. <www.nist.gov>



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# 4 Materials

## 4.1 Materials in contact with drinking water

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

**4.1.2** POU drinking water treatment units shall conform to the protocol in this section and be evaluated for weighted average lead content in accordance with NSF/ANSI/CAN 372. The weighted average lead content of the contact materials and coated substrates shall be ≤ 0.25%.

### 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 NSF/ANSI/CAN 600, Table 4.1: *Drinking water criteria*. Any extractable contaminants not listed in the referenced tables shall be reviewed and shall not exceed criteria developed in accordance with NSF/ANSI/CAN 600, Section 3: *Toxicology review and evaluation procedures*.

**4.1.3.2** TIC identification and quantitation shall be conducted in accordance with Section 4.3.1.2. Additional TIC identification and quantitation shall 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 shall 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 Section 4.3.1 shall be reported in accordance to Section 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 Section 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 4.1, 4.2, 4.3, NSF/ANSI/CAN 61, and NSF/ANSI/CAN 600.

### 4.1.4 Data reporting

**4.1.4.1** All contaminants identified and detected at or above the reporting limit (RL) 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 RL shall be reported to the manufacturer as less than the RL's value.



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Example: If the lab's RL 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 Section 4.3.1 the laboratory shall supply the manufacturer with the approximate molecular weight (MW) 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 4.4, 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 Section 2.

**4.2.1.1** The laboratory shall validate the analytical method to the 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., U.S. EPA 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 1 L extracted, and the extract concentrated to 1.0 mL, for a factor of 1,000, if the RL is set to 0.2 µg/L, then the lowest calibration point would be ≤ 0.2 mg/L.

NOTE — See Annex I-3 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 (TDS), 0.5 ± 0.05 mg/L free available chlorine, and 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 4.1, 4.2, and 4.3 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 Section 4.2.2 at an



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initial inlet static pressure of 340 kPa (50 psig).

**4.2.3.2** The system or component(s) shall be refilled with exposure water specified in Section 4.2.2 and operated according to manufacturer's instructions (if the system does not include a product water reservoir, the unit shall not be operated until immediately prior to sample collection). The system or component(s) shall be maintained for 24 h at an ambient temperature of 23 ± 2 °C (73 ± 3 °F). A water sample shall then be collected in accordance with Section 4.2.3.3. This procedure (Section 4.2.3.2) shall be repeated two times for a total of three water sample collections.

**4.2.3.3** A daily 2-L collection volume is recommended to ensure there is sufficient volume in the composite sample to conduct the requested analyses. If the water holding volume of the product is > 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 < 2 L, sufficient samples shall be exposed to provide at least $^{1}/_{3}$ of the volume required for analysis of extractant water at each sample point. The maximum number of samples exposed shall not exceed 16 with 125 mL of extractant water drawn from each sample. If the components with a water-holding volume that is < 250 mL and is able to be identified as one that will only occur once in the flow path of dispensed treated water (such as diverters, faucets, RO shutoff valves, or specialty components) then a volume of 250 mL shall be drawn from each sample using a maximum number of eight samples.

**4.2.3.4** All samples collected shall be composited and analyzed in accordance with Section 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 carbon block 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, U.S. EPA Analytical Methods for semivolatiles 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 nontarget compounds.

Testing for semivolatiles (e.g., U.S. EPA Methods 625, 528, or 525.2) and volatiles (e.g., U.S. EPA Methods 524.2 or 524.3) shall be conducted using the required target compounds in Tables 4.2 and 4.3 and the laboratory's RL shall be no greater than the RLs listed in Tables 4.2 and 4.3.

**4.3.1.1** Target compounds shall be validated in accordance with the requirements of the referenced method. U.S. EPA 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 U.S. EPA 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 > 50% and not > 200% of that average;

— due to the number of characteristics of the analytes associated with Method 625, while performing a continuing calibration check (CCC), concentrations of 10% of the target compounds for each analysis (e.g., base/neutral, base/neutral/acid, acid) shall be allowed to fall outside of 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 to no longer be an outlier, the



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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. 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 shall be understood, that if the laboratory utilizes this approach (calibrating for the specific analyte) all method requirements as specified by Method 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:

— due to the complex nature of GC/MS 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;

— 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 an "Unknown";

— the laboratory may utilize manual spectral interpretation to identify the peak in question; and

— 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 National Institute of Standards and Technology (NIST) v20 (NIST20) or most current version. Additional spectral 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 TICs, a response factor of "1" (one) shall be utilized for the purposes of calculating the TICs estimated concentration.

It shall 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 U.S. EPA 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:

— the MW shall be reported or, if no molecular ion is identifiable, a minimum value for the MW (for example, if the highest mass ion for the TIC has a m/z of 143, then report MW ≥ 143);

— the chemical class information shall be reported if this determination is possible;

— the laboratory shall report the presence of the common halogens chlorine and bromine utilizing their characteristic "M+2" patterns;

— the product material formulation(s) shall be reviewed for potential identification of the unknown contaminant(s) as an ingredient or byproduct;

— the manufacturer shall be notified and requested to provide supporting information that enables identification of the unknown contaminant(s);

— structure activity relationships (SAR) shall be utilized when sufficient structural identification of the



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unknown contaminant(s) can be made; and

— 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 Sections 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 Section 4.2.

NOTE — The second and third bullets 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.

**Table 4.1**
**Extraction testing parameters (metals)**

| Analyte | CAS number | Maximum reporting limit (RL) (mg/L) | U.S. EPA Method(s) |
|---|---|---|---|
| aluminum | 7429-90-5 | 0.1 | 200.7, 200.8 |
| antimony | 7440-36-0 | 0.001 | 200.8, 200.9 |
| arsenic | 7440-38-2 | 0.001 | 200.8, 200.9 |
| barium | 7440-39-3 | 0.2 | 200.7, 200.8 |
| beryllium | 7440-41-7 | 0.001 | 200.7, 200.8, 200.9 |
| cadmium | 7440-43-9 | 0.001 | 200.8, 200.9 |
| chromium | 7440-47-3 | 0.01 | 200.7, 200.8, 200.9 |
| copper | 7440-50-8 | 0.1 | 200.7, 200.8 |
| lead | 7439-92-1 | 0.001 | 200.8, 200.9 |
| manganese | 7439-96-5 | 0.01 | 200.7, 200.8 |
| mercury | 7439-97-6 | 0.001 | 200.8, 245.1 |
| nickel | 7440-02-0 | 0.01 | 200.7, 200.8 |
| selenium | 7782-49-2 | 0.005 | 200.8, 200.9 |
| thallium | 7440-28-0 | 0.001 | 200.8, 200.9 |



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**Table 4.2**
**Extraction testing parameters (semivolatiles)**

| Analyte | CAS number | Maximum reporting limit (RL) (mg/L) | Reference Method(s) |
|---|---|---|---|
| 2,4,6-trichlorophenol | 88-06-2 | 0.001 | 525.2, 528, 625 |
| 2,4-dichlorophenol | 120-83-2 | 0.001 | 525.2, 528, 625 |
| 2,4-dimethylphenol | 105-67-9 | 0.01 | 525.2, 528, 625 |
| 2,6-di-tert-butyl-4-methoxyphenol | 489-01-0 | 0.003 | 525.2, 528, 625 |
| 2-methylnaphthalene | 91-57-6 | 0.003 | 525.2, 528, 625 |
| 2-nitrophenol | 88-75-5 | 0.001 | 525.2, 528, 625 |
| 2-phenyl-2-propanol | 617-94-7 | 0.005 | 525.2, 528, 625 |
| 3,3-dichlorobenzidine | 91-94-1 | 0.001 | 525.2, 528, 625 |
| 3-and 4-methylphenol, m&p-cresol | 106-44-5<br>108-39-4 | 0.001 | 525.2, 528, 625 |
| 4-chloro-3-methylphenol | 59-50-7 | 0.07 | 525.2, 528, 625 |
| 4-tert-butylphenol or p-tert-butylphenol | 98-54-4 | 0.05 | 525.2, 528, 625 |
| acenaphthene | 83-32-9 | 0.004 | 525.2, 528, 625 |
| acenaphthylene | 208-96-8 | 0.0004 | 525.2, 528, 625 |
| acetophenone | 98-86-2 | 0.02 | 525.2, 528, 625 |
| anthracene | 120-12-7 | 0.0003 | 525.2, 528, 625 |
| benzo(a)pyrene | 50-32-8 | 0.0002 | 525.2, 528, 625 |
| benzothiazole | 95-16-9 | 0.003 | 525.2, 528, 625 |
| bis(2-ethylhexyl)adipate | 103-23-1 | 0.04 | 525.2, 528, 625 |
| bis(2-ethylhexyl)phthalate | 117-81-7 | 0.001 | 525.2, 528, 625 |
| butyl benzyl phthalate | 85-68-7 | 0.1 | 525.2, 528, 625 |
| chrysene | 218-01-9 | 0.003 | 525.2, 528, 625 |
| diethyl phthalate | 84-66-2 | 0.6 | 525.2, 528, 625 |
| dimethyl phthalate | 131-11-3 | 0.001 | 525.2, 528, 625 |
| di-n-butyl phthalate | 84-74-2 | 0.07 | 525.2, 528, 625 |
| fluoranthene | 206-44-0 | 0.0003 | 525.2, 528, 625 |
| isophorone | 78-59-1 | 0.04 | 525.2, 528, 625 |
| naphthalene | 91-20-3 | 0.04 | 525.2, 528, 625 |
| n-nitroso-di-n-butylamine | 924-16-3 | 0.0006 | 525.2, 528, 625 |
| n-nitroso-di-n-propylamine | 621-64-7 | 0.0005 | 525.2, 528, 625 |
| n-nitrosodiphenylamine | 86-30-6 | 0.007 | 525.2, 528, 625 |
| o-cresol or 2-methylphenol | 95-48-7 | 0.001 | 525.2, 528, 625 |
| pentachlorophenol | 87-86-5 | 0.0005 | 525.2, 528, 625 |
| phenanthrene | 85-01-8 | 0.0003 | 525.2, 528, 625 |
| phenol | 108-95-2 | 0.2 | 525.2, 528, 625 |
| phenyl sulfone | 127-63-9 | 0.002 | 525.2, 528, 625 |
| pyrene | 129-00-0 | 0.0006 | 525.2, 528, 625 |



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**Table 4.3**
**Extraction testing parameters (volatiles)**

| Analyte | CAS number | Maximum reporting limit (RL) (mg/L) | Reference Method(s) |
|---|---|---|---|
| 1,1,1,2-tetrachloroethane | 630-20-6 | 0.001 | 524.2, 524.3 |
| 1,1,1-trichloroethane | 71-55-6 | 0.02 | 524.2, 524.3 |
| 1,1,2,2-tetrachloroethane | 79-34-5 | 0.0005 | 524.2, 524.3 |
| 1,1,2-trichloroethane | 79-00-5 | 0.0005 | 524.2, 524.3 |
| 1,1-dichloroethene | 75-35-4 | 0.0007 | 524.2, 524.3 |
| 1,1-dichloropropene | 563-58-6 | 0.0005 | 524.2, 524.3 |
| 1,2,3-trichlorobenzene | 87-61-6 | 0.0005 | 524.2, 524.3 |
| 1,2,3-trichloropropane | 96-18-4 | 0.004 | 524.2, 524.3 |
| 1,2,4-trichlorobenzene | 120-82-1 | 0.007 | 524.2, 524.3 |
| 1,2-dibromo-3-chloropropane | 96-12-8 | 0.0002 | 524.2, 524.3 |
| 1,2-dibromoethane | 106-93-4 | 0.0002 | 524.2, 524.3 |
| 1,2-dichlorobenzene | 95-50-1 | 0.06 | 524.2, 524.3 |
| 1,2-dichloroethane | 107-06-2 | 0.0005 | 524.2, 524.3 |
| 1,2-dichloropropane | 78-87-5 | 0.0005 | 524.2, 524.3 |
| 1,3,5-trimethylbenzene | 108-67-8 | 0.0005 | 524.2, 524.3 |
| 1,3-dichlorobenzene | 541-73-1 | 0.06 | 524.2, 524.3 |
| 1,4-dichlorobenzene | 106-46-7 | 0.007 | 524.2, 524.3 |
| 2-butanone | 78-93-3 | 0.4 | 524.2, 524.3 |
| 2-chlorotoluene | 95-49-8 | 0.01 | 524.2, 524.3 |
| 2-ethyl-1-hexanol | 104-76-7 | 0.005 | 524.2, 524.3 |
| 4-chlorotoluene | 106-43-4 | 0.0005 | 524.2, 524.3 |
| 4-isopropyltoluene | 99-87-6 | 0.0005 | 524.2, 524.3 |
| 4-methyl-2-pentanone | 108-10-1 | 0.7 | 524.2, 524.3 |
| acetone | 67-64-1 | 0.6 | 524.2, 524.3 |
| acetophenone | 98-86-2 | 0.02 | 524.2, 524.3 |
| acrylonitrile | 107-13-1 | 0.0006 | 524.2 SIM |
| benzene | 71-43-2 | 0.0005 | 524.2, 524.3 |
| bis(2-chloroethyl)ether or di-(2-chloroethyl) ether | 111-44-4 | 0.0003 | 524.2, 524.3 |
| bromobenzene | 108-86-1 | 0.0005 | 524.2, 524.3 |
| bromochloromethane | 74-97-5 | 0.009 | 524.2, 524.3 |
| bromodichloromethane | 75-27-4 | 0.001 | 524.2, 524.3 |
| bromoform | 75-25-2 | 0.001 | 524.2, 524.3 |
| bromomethane | 74-83-9 | 0.001 | 524.2, 524.3 |
| carbon disulfide | 75-15-0 | 0.7 | 524.2, 524.3 |
| carbon tetrachloride | 56-23-5 | 0.0005 | 524.2, 524.3 |
| chlorobenzene | 108-90-7 | 0.01 | 524.2, 524.3 |
| chloroform | 67-66-3 | 0.001 | 524.2, 524.3 |



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**Table 4.3**
**Extraction testing parameters (volatiles)**

| Analyte | CAS number | Maximum reporting limit (RL) (mg/L) | Reference Method(s) |
|---|---|---|---|
| chloromethane | 74-87-3 | 0.003 | 524.2, 524.3 |
| cis-1,2-dichloroethene | 156-59-2 | 0.007 | 524.2, 524.3 |
| cyclohexanone | 108-94-1 | 1.0 | 524.2, 524.3 |
| dibromochloromethane | 124-48-1 | 0.001 | 524.2, 524.3 |
| dichlorodifluoromethane | 75-71-8 | 0.0005 | 524.2, 524.3 |
| ethyl acrylate | 140-88-5 | 0.001 | 524.2, 524.3 |
| ethylbenzene | 100-41-4 | 0.07 | 524.2, 524.3 |
| methyl acrylate | 96-33-3 | 0.001 | 524.2, 524.3 |
| methyl methacrylate | 80-62-6 | 0.1 | 524.2, 524.3 |
| methyl tert-butyl ether | 1634-04-4 | 0.0005 | 524.2, 524.3 |
| methylene chloride | 75-09-2 | 0.0005 | 524.2, 524.3 |
| n-butyl acrylate | 141-32-2 | 1 | 524.2, 524.3 |
| n-butylbenzene | 104-51-8 | 0.0005 | 524.2, 524.3 |
| sec-butylbenzene | 135-98-8 | 0.0005 | 524.2, 524.3 |
| styrene | 100-42-5 | 0.01 | 524.2, 524.3 |
| t-butyl alcohol or t-butanol or tert-butanol | 75-65-0 | 0.1 | 524.2, 524.3 |
| tetrachloroethene | 127-18-4 | 0.0005 | 524.2, 524.3 |
| tetrahydrofuran | 109-99-9 | 5 | 524.2, 524.3 |
| toluene | 108-88-3 | 0.1 | 524.2, 524.3 |
| xylenes (total)<br>o-xylene or 1,2-xylene, m-xylene, p-xylene | 95-47-6<br>106-42-3<br>108-38-3 | 0.1 | 524.2, 524.3 |
| trans-1,2-dichloroethene | 156-60-5 | 0.01 | 524.2, 524.3 |
| dichloropropene (total)<br>cis-1,3-<br>trans-1,3 | 542-75-6<br>10061-01-5<br>10061-02-6 | 0.0005 | 524.2, 524.3 |
| trichloroethene or trichloroethylene | 79-01-6 | 0.0005 | 524.2, 524.3 |
| trichlorofluoromethane | 75-69-4 | 0.2 | 524.2, 524.3 |
| total trihalomethanes (TTHMs)<br>bromodichloromethane<br>bromoform<br>chloroform<br>dichlorobromomethane | — | 0.001 | 524.2, 524.3 |
| vinyl chloride | 75-01-4 | 0.0002 | 524.2, 524.3 |



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**Table 4.4**
**Materials listed in U.S. Code of Federal Regulations, Title 21, not requiring formulation review**

| Sections | Material |
|---|---|
| 172.880<br>178.3700 | petrolatum |
| 172.888<br>178.3720 | synthetic petroleum wax |
| 172.878 | white mineral oil |
| 172.884 | odorless white petroleum hydrocarbons |
| 172.886<br>178.3710 | petroleum wax |
| 173.25 | ion exchange resins – provided that the subsection 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 | Solvents which 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/CAN 61 or shall be subject to formulation review. Solvents that have been reprocessed or recycled shall not be used.<br>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. |

# 5 Structural performance

## 5.1 Structural integrity

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

### 5.1.1 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 Section 5.1.3 at the pressures specified in Table 5.1. When more than one pressure is specified in Table 5.1, testing shall be done at the higher pressure.

Complete systems, pressure vessels, and components shall be water-tight when tested for structural integrity under Section 5.1.3. Weepage shall be considered acceptable at the beginning of a test, but weepage shall not begin in the middle of a test.



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**Table 5.1**
**Structural integrity performance testing**

| Systems and components | Hydrostatic pressure test | Cyclic pressure test |
|---|---|---|
| complete systems and components [a] | 2,070 kPa (300 psig) or 3 × maximum working pressure, whichever is greater | 100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or 1.5 × maximum working pressure, whichever is greater |
| complete disposable systems and components | 2,070 kPa (300 psig) or 3 × maximum working pressure, whichever is greater | 10,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or 1.5 × maximum working pressure, whichever is greater |

[a] 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 305-mm (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.

### 5.1.2 Working pressure

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.

### 5.1.3 Structural integrity test methods

#### 5.1.3.1 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.

#### 5.1.3.2 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) Connect the inlet of the test system to the apparatus shown in Figure 1. The system shall be in conformance with its normal state of use, with the option of plugging drain lines.

c) Fill the test system with water. Flush to purge air from the system.



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