NSF International

MEMORANDUM

TO: Joint Committee on Drinking Water Treatment Units

FROM: Dr. Robert Powitz, Chair of the Joint Committee

DATE: April 14, 2022

SUBJECT: Proposed revision to NSF/ANSI 53: *Drinking Water Treatment Units – Health Effects* (53i125r3) and NSF/ANSI 58: *Reverse Osmosis Drinking Water Treatment Systems* (58i90r3)

Revision 3 of NSF/ANSI 53, issue 125 and NSF/ANSI 58, issue 90 is being forwarded to the Joint Committee for consideration. Please review the proposal and **submit your ballot by May 5, 2022** via the NSF Online Workspace <www.standards.nsf.org>.

Please review all ballot materials. If adding comments, please include the applicable section number and add all comments under one comment number whenever possible. If you need additional space, please use the blank comment template in the referenced documents and upload it under Supporting Files.

Purpose

The proposed revision will add additional PFAS compounds to the chemical reduction claims under NSF/ANSI 53 and NSF/ANSI 58. **Revision 2** addressed two comments received in the r1 ballot (7/7/20), which requested successful completion of validation testing, which had taken place. **Revision 3** addresses three negative, two affirmative, and two non-voter comments received in the r2 ballot (3/9/22). It clarifies the two test methods for PFAS contaminant reduction claims (total PFAS and individual contaminants), corrects total PFAS for influent from 0.00205 to 0.00216 mg/L, and corrects PFHxS from 200 ppt to 300 ppt and PFNA from 40 ppt to 50 ppt.

Background

In 2017, a task group was formed to consider a reduction claim in the DWTU standards for PFOA and PFOS for activated carbon, reverse osmosis (RO), and anion exchange technologies. These protocols expanded on those originally developed for NSF P473, and were successfully balloted into NSF/ANSI 53 and 58 in 2018. At the 2019 DWTU JC meeting, the scope of the task group was expanded to consider other PFAS contaminants specified in EPA's UCMR 3. At the 2020 JC meeting, the task group reported that they had successfully completed their work to identify additional emergent PFAS contaminants, determine their relative toxicity and occurrence levels, and group them according to those criteria. In addition to developing influent and effluent levels for six individual compounds (PFOA + PFOS, PFNA, PFHxS, Gen X, and PFHpA), the task group originally recommended the option for a general PFAS reduction claim, which would include a mixture of eight PFAS contaminants with a total influent challenge level of 3,000 ppt. The original total PFAS challenge was made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (200 ppt), PFNA (40 ppt), PFHpA (40 ppt), GenX (900 ppt), PFBS (260 ppt), and PFDA (10 ppt). **Revision 2** removed GenX based on waiting for EPA to define an MCL. **Revision 3** now includes claims for either a general PFAS reduction claim, which includes a mixture of seven PFAS contaminants with a total influent challenge level of 2,160 ppt, or individual claims for any of the seven contaminants. The total PFAS challenge is now made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300 ppt), PFNA (50 ppt), PFHpA (40 ppt), PFBS (260 ppt), and PFDA (10 ppt).

This issue was originally presented at the 2020 DWTU JC meeting and unanimously approved for balloting, on the condition that validation testing be completed prior to final approval, which was subsequently successfully completed.

Approval of **Revision 3** will result in a first comprehensive and most up-to-date NSF/ANSI standard that takes all the information developed in UCMR 3 and also utilizes the latest individual state health advisories and MCLs in some instances. The resultant standard will also allow testing of PFAS compounds either individually or as a part of a mixture.

On December 21, 2021, EPA announced UCMR 5, which will develop occurrence data from US public water systems for a total of 29 PFAS compounds, which includes the six PFAS compounds from UCMR 3 that are the subject of this NSF/ANSI standard. There are 23 additional new PFAS compounds in this list. Generation of occurrence data for these 29 PFAS compounds from US public water systems will commence in 2023 and is required to be completed by 2025.

Approval of **Revision 3** will also set the stage for incorporating the 23 new PFAS compounds in a future edition of NSF/ANSI 53. To prepare for that edition, and since consideration of all these new 23 PFAS compounds in a health-based standard will be a Herculean task, we are proactively considering the possibility of proving a concept of developing a surrogate compound to represent all or at least a large group of these compounds. The surrogacy approach was successfully used in the case of volatile organic compounds (VOCs) in the past.

The Water Quality Research Foundation has recently approved a phased research project that will investigate the concept of surrogacy for PFAS compounds for the treatment technologies of activated carbon, anion exchange and reverse osmosis. The research project is expected to be completed in next three years, in time with when the occurrence data of UCMR 5 compounds will be available.

Please see the original issue paper (DWTU-2019-13); the 2019, 2020, and 2021 JC meeting summary excerpts; the 2020 and 2021 Task Group Chair reports; the r2 ballot comments and responses; and the January 2022 task group meeting summary under the referenced items for additional background information.

If you have any questions about the technical content of the ballot, you may contact me in care of:

Dr. Robert Powitz
Chair, Joint Committee on Drinking Water Treatment Units
c/o Monica Milla
Joint Committee Secretariat
NSF International
Tel: (734) 214-6223
Email: mmilla@nsf.org

[Note – the recommended changes to the standard which include the current text of the relevant section(s) indicate deletions by use of ~~strikeout~~ and additions by gray highlighting. R2 revisions are highlighted in yellow. R3 revisions are highlighted in blue. Rationale statements are in *italics* and only used to add clarity; these statements will NOT be in the finished publication.]

NSF/ANSI Standard
for Drinking Water Treatment Units —

Drinking Water Treatment Units —
Health Effects

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7 Elective performance claims – Test methods

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7.2 Chemical reduction claims

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Table 7.1
Chemical reduction requirements

Substance	Individual influent sample point limits[1] (mg/L)	Average influent challenge[2] (mg/L)	Maximum effluent concentration (mg/L)	US EPA Method(s)[3,4]
alachlor	0.04 ± 40%	0.04 ± 10%	0.002	505
atrazine	0.009 ± 40%	0.009 ± 10%	0.003	505
. . .				
pentachlorophenol	0.01 ± 30%	0.01 ± 10%	0.001	515.3

Substance	**Individual influent sample point limits[1] (mg/L)**	**Average influent challenge[2] (mg/L)**	**Maximum effluent concentration (mg/L)**	**US EPA Method(s)[3,4]**
per- and polyfluoroalkyl substances (PFAS)				
total PFAS[9]	0.00216~~0.00205~~~~0.0030~~ ± 30%	0.00216~~0.00205~~~~0.0030~~ ± ~~10%~~20%	0.00002[10]	537.1, 533, 8327
~~hexafluoropropylene oxide dimer acid (HFPO-DA) (GEN X)~~	~~0.0009 ± 30%~~	~~0.0009 ± 10%20%~~	~~0.00014~~	~~537.1, 533, 8327~~
perfluoroheptanoic acid (PFHpA)	0.00004 ± 30%	0.00004 ± ~~10%~~20%	0.00002[10]	537.1, 533, 8327
perfluorohexane sulfonic acid (PFHxS)	0.0003 ± 30%	0.0003 ± ~~10%~~20%	0.00002[10]	537.1, 533, 8327
perfluorononanoic acid (PFNA)	0.00005 ± 30%	0.00005 ± ~~10%~~20%	0.000006	537.1, 533, 8327
perfluorooctanoic acid (PFOA), and perfluorooctane sulfonate (PFOS)~~[10]~~[11]	0.0015 ± 30%	0.0015 ± ~~10%~~20%added as 1.0 µg/L PFOS and 0.5 µg/L PFOA	0.00002 ~~0.00007~~~~[11][12]~~[10]	537.1, 533, 8327 or refer to Annex I-5~~[11]~~[12]
polychlorinated biphenyls (PCBs, Aroclor 1260)	0.01 ± 40%	0.01 ± 10%	0.0005	505
simazine	0.012 ± 40%	0.012 ± 10%	0.004	525.2
styrene	2.0 ± 30%	2.0 ± 10%	0.1	502.2, 524.2, 524.3
2,4,5-TP (silvex)	0.15 ± 30%	0. 15 ± 10%	0.05	515.3
tetrachloroethylene	0.015 ± 30%	0.015 ± 10%	0.005	502.2, 524.2, 524.3
toluene	3.0 ± 30%	3.0 ± 10%	1	502.2, 524.2, 524.3
toxaphene	0.015 ± 40%	0.015 ± 10%	0.003	505
1,2,4-trichlorobenzene	0.21 ± 30%	0.21 ± 10%	0.07	502.2, 524.2, 524.3
1,1,1-trichloroethane	0.6 ± 30%	0.6 ± 10%	0.2	502.2, 524.2, 524.3
1,1,2-trichloroethane	0.015 ± 30%	0.015 ±10%	0.005	502.2, 524.2, 524.3
trichloroethylene	0.300 ± 30%	0.300 ± 10%	0.005	502.2, 524.2, 524.3
TTHM~~[12]~~[13] (as chloroform)	0.45 ± 30%	0.45 ± 20%	0.080	502.2, 524.2, 524.3
xylenes	30 ± 30%	30 ± 10%	10	502.2, 524.2, 524.3

[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 US EPA Method.
2. Acceptable spike recoveries as stated in the appropriate US EPA Method.
3. Opinion of laboratory professionals – no guidance available in US EPA Method.

[2] Reason for influent challenge levels: challenge concentrations should be selected to simulate what a system will be challenged with in the field and/or to provide an accurate and reproducible indicator of performance. The following sequence of criteria is used to select challenge concentrations:

a) The upper percentile concentration of available occurrence data (the concentration for which there is high probability [$P < 0.05$] that 95% of the population will be exposed to waters of lower concentration). Occurrence data shall come from national monitoring programs administered by the US EPA or the USGS. Other occurrence data shall be accepted by the Joint Committee on Drinking Water Treatment Units.

b) The concentration obtained by multiplying the US EPA's published MCL by three. This concentration will not be adequate when US EPA MCL is very low.

[3] When more than one method is cited, either method may be used for analysis.

[4] The RL for the analytical method shall not exceed the pass/fail limit.

[5] It is recognized that the reported solubility of methoxychlor is 0.04 mg/L. Under simulated test conditions the highest influent concentration attainable shall be used.

[6] The maximum effluent value is based on the taste and odor threshold. Due to lack of occurrence data, the influent challenge has been set to three times the maximum effluent concentration.

[7] The first limits apply to analysis conducted according to the first US EPA Method, and the second limits apply to analysis conducted according to US EPA Methods 524.2 or 524.3.

[8] MTBE may be quantified using US EPA Method 502.2 when all quality control procedures for US EPA Method 502.2 are followed.

[9] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.2.6.1 for details). The test mixture for t~~T~~otal PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300~~200~~ ppt), PFNA (50~~40~~ ppt), PFHpA (40 ppt), ~~HFPO-DA (900 ppt),~~ PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

[10] This effluent value is based on the maximum contaminant levels or health advisories in force in several New England States for a total PFAS level of 0.00002 mg/L.

[~~10~~11] Influent challenge levels for PFOS were based on the upper percentile concentration per EPA's UCMR3 occurrence data (2013-2015) (the concentration for which there is high probability [$P < 0.01$] that 99% of the population will be exposed to waters of lower concentration). Influent challenge levels for PFOA were based on the upper percentile concentration of private well and public water supply sampling in Hoosick Falls New York (the concentration for which there is high probability [$P < 0.10$] that 90% of the population will be exposed to waters of lower concentration). This influent concentration is higher than the maximum concentration per US EPA's UCMR3 occurrence data (2013-2015). PFOS and PFOA will be added gravimetrically in a ratio of five parts PFOA to 10 parts PFOS by weight to achieve the total influent concentration.

~~[1112] Total of both PFOS and PFOA. Based on US EPA Health Advisory level which includes a margin of protection for the most sensitive populations.~~

[~~11~~ 12] Any needed modification / improvement on the method shal~~l~~ be performed as described and validated within the method. If alternate methods are used they shall be validated as equivalent or better in precision and accuracy than the specified method.

[~~12~~ 13] For test purposes, chloroform shall be added to the influent water and shall be analyzed in the influent and product waters.

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7.2.6 Nonregenerating ~~PFOA/PFOS~~ PFAS reduction testing

This protocol is designed for nonregenerable POU and POE devices using anion exchange media.

7.2.6.1 ~~PFOA/PFOS~~ PFAS reduction claim

Claims for ~~PFOA/PFOS~~ reduction of per- and polyfluoroalkyl substances (PFAS) are permitted when tested in accordance with Section 7.2.6 as long as maximum effluent concentrations in Table 7.7 are not exceeded.

There are two ways to make reduction claims for PFAS.

The first method is to make a mixture of seven PFAS compounds with the influent concentration of 2,160 ppt, made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300 ppt), PFNA (50 ppt), PFHpA (40 ppt), PFBS (260 ppt), and PFDA (10 ppt), and to reduce these by 99% to the effluent concentration of 20 ppt.

The second option is to reduce individual PFAS compounds from their respective influent concentrations to their individual health advisory effluent concentrations (as shown in Table 7.7). Two PFAS compounds, PFBS (perfluorobutanesulfonic acid) and PFDA (perfluorodecanoic acid), are excluded from the individual contaminant reductions because their occurrence level is less than their health advisory level. Therefore, they do not appear in Tables 7.1, 7.7, 7.8, or 8.1.

Table 7.7
~~PFOA/PFOS~~ PFAS reduction requirements

Substance	**Average influent challenge[1] (mg/L)**	**Maximum effluent concentration (mg/L)**	**US EPA Method(s)**	**~~Compound~~**
total PFAS[~~1~~2]	0.00216~~0.00205~~ ± 20% ~~0.0030 ± 10%~~	0.00002[3]	537.1, 533, 8327	
~~hexafluoropropylene oxide dimer acid (HFPO-DA) (GEN X)~~	~~0.0009 ± 10%20%~~	~~0.00014~~	~~537.1, 533, 8327~~	
perfluoroheptanoic acid (PFHpA)	0.00004 ± ~~10%~~20%	0.00002[3]	537.1, 533, 8327	
perfluorohexane sulfonic acid (PFHxS)	0.0003 ± ~~10%~~20%%	0.00002[3]	537.1, 533, 8327	
perfluorononanoic acid (PFNA)	0.00005 ± ~~10%~~20%	0.000006	537.1, 533, 8327	
PFOA (perfluorooctanoic acid CAS #335-67-1) PFOS (perfluorooctane sulfonate CAS # 1763-23-1)[~~2~~4]	0.0015 ± ~~10%~~20%	0.00002[3] ~~0.00007~~[~~2~~3]	537.1, 533, 8327 or refer to Annex I-5[~~3~~5]	~~PFOA and PFOS~~

[1] Individual influent tolerance is ± 30%.

[~~1~~2] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.2.6.1 for details). The test mixture for t~~T~~otal PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300~~200~~ ppt), PFNA (50~~40~~ ppt), PFHpA (40 ppt), ~~HFPO-DA (900 ppt),~~ PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

Table 7.7
~~PFOA/PFOS~~ PFAS reduction requirements

Substance	Average influent challenge[1] (mg/L)	Maximum effluent concentration (mg/L)	US EPA Method(s)	~~Compound~~

[3] This effluent value is based on the maximum contaminant levels or health advisories in force in several New England States for a total PFAS level of 0.00002 mg/L.

[~~2~~4] Influent challenge levels for PFOS were based on the upper percentile concentration per EPA's UCMR3 occurrence data (2013-2015) (the concentration for which there is high probability [P <0.01] that 99% of the population will be exposed to waters of lower concentration). Influent challenge levels for PFOA were based on the upper percentile concentration of private well and public water supply sampling in Hoosick Falls New York (the concentration for which there is high probability [P <0.10] that 90% of the population will be exposed to waters of lower concentration). This influent concentration is higher than the maximum concentration per US EPA's UCMR3 occurrence data (2013-2015). PFOS and PFOA will be added gravimetrically in a ratio of five parts PFOA to 10 parts PFOS by weight to achieve the total influent concentration.

[~~34~~] ~~Total of both PFOS and PFOA. Based on US EPA Health Advisory level which includes a margin of protection for the most sensitive populations.~~

[4] Any needed modification / improvement on the method shall be performed as described and validated within the method. If alternate methods are used they shall be validated as equivalent or better in precision and accuracy than the specified method.

7.2.6.2 Apparatus

Refer to Section 7.1.2, Figure 2 for an example of the test apparatus.

7.2.6.3 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referenced in Section 2 and Annex I-5.

7.2.6.4 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~~s~~ method are contained in Annex N-5, Sections N-5.1, N-5.2, N-5.3, and N-5.6.

7.2.6.5 ~~PFOA/PFOS~~ PFAS reduction test water

a) A water supply shall be treated by reverse osmosis, then shall be treated by deionization (RO/DI) water and shall have a conductivity of less than 2 μS / cm.

b) All chemical additions shall take place either after the test tank is filled with the RO/DI water, or while the test tank is being filled. Reagent grade chemicals shall be used for all additions to adjust the RO/DI water to meet the following specific characteristics:

Table 7.8
~~PFOA/PFOS~~ PFAS influent water characteristics

Parameter	Target value	Overall average tolerance	Single point tolerance[1]
SO_4^{2-}	200 mg/L	± 20%	± 30%
Cl^-	100 mg/L	± 20%	± 30%
alkalinity as $CaCO_3$	200 mg/L	± 20%	± 30%
total PFAS[2]	0.00216 ~~0.00205~~ ~~0.0030~~ mg/L	± ~~10%~~20%	± 30%
~~HFPO-DA (GEN X)~~	~~0.0009 mg/L~~	~~± 10%20%~~	~~± 30%~~
PFHpA	0.00004 mg/L	± ~~10%~~20%	± 30%
PFHxS	0.0003 mg/L	± ~~10%~~20%	± 30%
PFNA	0.00005 mg/L	± ~~10%~~20%	± 30%
PFOA	0.0005 mg/L	~~10%~~20%	± ~~40~~30%
PFOS	0.0010 mg/L	~~10%~~20%	± ~~40~~30%
temperature	20 °C (68 °F)	± 2.5 °C (± 5 °F)	—
turbidity	< 1 NTU	—	—
pH	7.5	± 0.5	—

[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 US EPA Method.
2. Acceptable spike recoveries as stated in the appropriate US EPA Method.
3. Opinion of laboratory professionals – no guidance available in US EPA Method.

[2] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.2.6.1 for details). The test mixture for t~~T~~otal PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300~~200~~ ppt), PFNA (50~~40~~ ppt), PFHpA (40 ppt), ~~HFPO-DA (900 ppt),~~ PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

c) Dissolve enough sodium bicarbonate ($NaHCO_3$) in RO/DI water to achieve a test tank concentration of 200 mg/L of alkalinity expressed as $CaCO_3$.

d) Adjust the pH of the test tank solution using hydrochloric acid (HCl) or sodium hydroxide (NaOH) to 7.5 ± 0.5. Record the amount HCl used.

e) Dissolve enough magnesium sulfate ($MgSO_4{\cdot}7H_2O$) in RO/DI water to achieve a test tank concentration of 200 mg/L as sulfate. Sodium Sulfate ($NaSO_4{\cdot}7H_2O$) may be substituted for 75% of the magnesium sulfate if the presence of hardness interferes with the proper operation of the device under test.

f) Dissolve enough of the applicable PFAS compound(s) ~~or perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS)~~ in RO/DI water to achieve the required test tank concentration ~~of 0.0005 mg/L of PFOA and 0.0010 mg/L of PFOS.~~ as specified in Table 7.8.

g) Mix and measure the final pH, and adjust as needed. Mixing shall be minimized thereafter throughout the duration of the test.

h) Dissolve enough sodium chloride (NaCl) in RO/DI water to achieve a test tank concentration of100 mg/L of chloride. Balance this number with the amount of chlorides added from the HCl for pH control to maintain a target of 100 mg/L. Stir and transfer to the test tank.

i) Each tank of water prepared shall have all of the parameters specified in Table 7.8 verified by analytical methods.

7.2.6.6 Cycle time

The systems shall be operated on a 50%-on / 50%-off cycle basis with a 15 to 40 min cycle, up to 16 h per 24 h period, followed by an 8 h rest under pressure (a 10%-on / 90%-off cycle may be used if requested by the manufacturer for POU systems but for POE systems only 50%-on / 50%-off cycle shall be used).

7.2.6.7 Method – POU

Two systems shall be conditioned using the ~~PFOA / PFOS~~ PFAS reduction water specified in Section 7.2.6.5 with the test contaminant present. The conditioning volume shall be excluded from the volume measured as the influent challenge volume for capacity and sample point determination.

7.2.6.7.1 Plumbed-in systems without reservoirs and all faucet-mounted systems

Two systems shall be conditioned in accordance with the manufacturer's instructions and Section 7.2.6.7.

The systems shall be tested using the influent challenge water at the maximum flow rate attainable by setting an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psi). The pressure shall not be readjusted although the system may experience some change in dynamic pressure. The operating cycle specified in Section 7.2.6.6 shall be used.

7.2.6.7.1.1 Refrigerator filters without integral flow control

Chemical reduction testing for refrigerator filters without an integral automatic fixed flow rate control shall be performed at a controlled flow rate that is equal to or greater than the rated service flow of the refrigerator filter system and refrigerator plumbing.

7.2.6.7.1.2 Refrigerator filters without integral flow control, with water dispenser and ice maker

If the refrigerator filter does not include an integral automatic fixed flow rate control, and supplies water to both a water dispenser and an ice maker, then any chemical reduction testing shall be performed at a controlled flow rate equal to or greater than the tested flow rate of the icemaker or the tested flow rate of the water dispenser, whichever is greater.

7.2.6.7.2 Plumbed-in systems with reservoirs

Two systems shall be conditioned in accordance with the manufacturer's instructions and Section 7.2.6.7.

The system shall be tested using the influent challenge water at the maximum flow rate attainable by setting an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psi). The pressure shall not be readjusted although the system may experience some change in dynamic pressure. Where the design of the system does not lend itself to the operating cycle specified in Section 7.2.6.6, the operating cycle shall be a repetitive complete filling and emptying of the reservoir. It is acceptable to run this cycle continuously for 24 h per day.

7.2.6.7.3 Nonplumbed pour-through-type batch treatment systems

Two systems shall be conditioned in accordance with the manufacturer's instructions and Section 7.2.6.7.

If the effluent reservoir capacity is equal or greater than two times the volume of the influent reservoir, multiple successive influent reservoir fills shall be performed until the remaining volume in the effluent reservoir is less than the influent reservoir volume. The resulting volume for each filling of the effluent reservoir shall be the batch volume. If the volume of the effluent reservoir is less than two times the volume of the influent reservoir, the batch volume shall be the influent reservoir volume.

Example:

Influent volume (L)	Effluent volume (L)	Batch (L)
1.0	1.8	1.0
1.2	2.5	2.4
1.4	4.0	2.8

7.2.6.7.3.1 Systems with a manufacturer's recommended use pattern

Two systems shall be tested using the appropriate influent challenge water using the manufacturer's use pattern. The use pattern shall include information about the rest period between the fillings. The rest period after the influent reservoir has drained given by the manufacturer shall not exceed 75 min and include a tolerance of at least ± 15 min. The systems shall be operated up to 16 h per 24 h period, followed by an 8 h rest period. Exceptions to the rest period are permissible for laboratory operational needs (e.g., water preparation, equipment malfunctions).

7.2.6.7.3.2 Systems without a manufacturer's recommended use pattern

Two systems shall be tested using the appropriate influent challenge water. The systems shall be operated up to 16 h per 24 h period, followed by an 8 h rest period. The test cycle shall include a rest period of 30 to 90 min after the influent reservoir has drained. The total volume per day shall be limited to 10 batches. Exceptions to the rest period are permissible for laboratory operational needs (e.g., water preparation, equipment malfunctions).

7.2.6.7.3.3 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 N-3.

Two systems shall be conditioned in accordance with the manufacturer's instructions and Section 7.2.6.7.

7.2.6.7.3.4 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 N-4.

Two systems shall be conditioned in accordance with the manufacturer's instructions and Section 7.2.6.7.

7.2.6.8 Method – POE – Full scale units

Two systems shall be conditioned in accordance with the manufacturer's instructions using the ~~PFOA / PFOS~~ PFAS reduction water specified in Section 7.2.6.5 with the test contaminant present. The conditioning volume shall be excluded from the volume measured as the influent challenge volume for capacity and sample point determination.~~.~~ The systems shall be tested using the influent challenge water (Section 7.2.6.5) at the rated service flow at an initial dynamic pressure of 410 ± 20 kPa (60 ± 3 psi). The pressure shall not be readjusted although the system may experience some change in dynamic pressure. The flow rate shall be controlled to the rated service flow or the maximum flow rate achievable through the entire test, but if the flow rate cannot be maintained at greater than 25% of the rated service flow, the test shall be terminated. The operating cycle specified in Section 7.2.6.6 shall be used.

7.2.6.9 Sampling

The effluent of the test system shall be sampled after a minimum of one bed volume has passed through the column or half of the cycle “on” time has passed, whichever is greater.

7.2.6.9.1 ~~PFOA and PFOS~~ PFAS

For systems with performance-indication devices, during the "on" portion of the cycle, influent and effluent samples shall be collected for PFAS ~~PFOA and PFOS~~ analysis at the start of the test (after the passage of 10 unit volumes) and at 25%, 50%, 75%, 100%, and 120% of the estimated capacity. For systems without performance indication device, during the "on" portion of the cycle, influent and effluent samples shall be collected for PFAS ~~PFOA and PFOS~~ analysis at the start of the test (after the passage of 10 unit volumes) and at 50%, 100%, 150%, 180% and 200% of the estimated capacity.

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8 Instruction and information

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Table 8.1
Performance data sheet reduction claims

Substance	Influent challenge concentration (mg/L)	Maximum permissible product water concentration (mg/L)
alachlor	0.04 ± 10%	0.002
arsenic (pentavalent)	0.050 ± 10%	0.010
arsenic (pentavalent)	0.30 ± 10%	0.010
atrazine	0.009 ± 10%	0.003
barium	10 ± 10%	2
benzene	0.015 ± 10%	0.005
cadmium	0.03 ± 10%	0.005
carbofuran	0.08 ± 10%	0.04
carbon tetrachloride	0.015 ± 10%	0.005
chlordane	0.04 ± 10%	0.002
chlorobenzene	2.0 ± 10%	0.1
chromium (hexavalent)	0.3 ± 10%	0.1
chromium (trivalent)	0.3 ± 10%	0.1
chromium (hexavalent and trivalent)	0.3 ± 10%	0.05 (hexavalent) and 0.05 (trivalent)
copper	3.0 ± 10%	1.3
2,4-D	0.210 ± 10%	0.07
dibromochloropropane	0.004 ± 10%	0.0002
o-dichlorobenzene	1.8 ± 10%	0.6
p-dichlorobenzene	0.225 ± 10%	0.075

Table 8.1
Performance data sheet reduction claims

Substance	**Influent challenge concentration (mg/L)**	**Maximum permissible product water concentration (mg/L)**
1,2-dichloroethane	0.015 ± 10%	0.005
1,1-dichloroethylene	0.021 ± 10%	0.007
cis-1,2-dichloroethylene	1.4 ± 10%	0.07
trans-1,2-dichloroethylene	2.0 ± 10%	0.1
1,2-dichloropropane	0.015 ± 10%	0.005
dinoseb	0.021 ± 10%	0.007
endrin	0.006 ± 10%	0.002
ethylbenzene	2.1 ± 10%	0.7
ethylene dibromide	0.001 ± 10%	0.00005
fluoride	8.0 ± 10%	1.5
heptachlor (H-34, heptox)	0.08 ± 10%	0.0004
heptachlor epoxide	0.004 ± 10%	0.0002
hexachlorocyclopentadiene	0.15 ± 10%	0.05
lead	0.15 ± 10%	0.005
lindane	0.002 ± 10%	0.0002
mercury	0.006 ± 10%	0.002
methoxychlor	0.12 ± 10%	0.04
methyl *tert*-butyl ether	0.015 ± 20%	0.005
microcystins	0.004 ± 10%	0.0003
nitrate plus nitrite nitrate nitrite	30 ± 10% 27 ± 10% 3 ± 10%	10 10 1
pentachlorophenol	0.01 ± 10%	0.001
perchlorate	0.100 ± 10%	0.004
per- and polyfluoroalkyl substances (PFAS)[1]		
total PFAS[2]	0.00216 ~~0.00205~~ ± 20% ~~0.0030 ± 10%~~	0.00002[~~2~~3]
~~hexafluoropropylene oxide dimer acid (HFPO-DA) (GEN X)~~	~~0.0009 ± 10%20%~~	~~0.00014~~
perfluoroheptanoic acid (PFHpA)	0.00004 ± ~~10%~~20%	0.00002[~~2~~3]
perfluorohexane sulfonic acid (PFHxS)	0.0003 ± ~~10%~~20%	0.00002[~~2~~3]
perfluorononanoic acid (PFNA)	0.00005 ± ~~10%~~20%	0.000006
perfluorooctanoic acid (PFOA), and perfluorooctane sulfonate (PFOS)	0.0015 ± ~~10%~~20%	0.00002[~~2~~3] ~~0.00007~~
polychlorinated biphenyls (PCBs, Aroclor 1260)	0.01 ± 10%	0.0005
radon	4000 ± 1000 pCi/L	300 pCi/L
selenium	0.10 ± 10%	0.05
simazine	0.012 ± 10%	0.004
styrene	2.0 ± 10%	0.1

Table 8.1
Performance data sheet reduction claims

Substance	**Influent challenge concentration (mg/L)**	**Maximum permissible product water concentration (mg/L)**
2,4,5-TP (silvex)	0.15 ± 10%	0.05
tetrachloroethylene	0.015 ± 10%	0.005
toluene	3.0 ± 10%	1
toxaphene	0.015 ± 10%	0.003
1,2,4-trichlorobenzene	0.21 ± 10%	0.07
1,1,1-trichloroethane	0.6 ± 10%	0.2
1,1,2-trichloroethane	0.015 ± 10%	0.005
trichloroethylene	0.300 ± 10%	0.005
TTHM (as chloroform)	0.45 ± 20%	0.080
xylenes	30 ± 10%	10.0
turbidity	11 ± 1 NTU	0.5 NTU

[1] For PFAS, the individual influent tolerance is ± 30%.

[2] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.2.6.1 for details). The test mixture for total PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300 ppt), PFNA (50 ppt), PFHpA (40 ppt), PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

[~~2~~3] This effluent value is based on the maximum contaminant levels or health advisories in force in several New England States for a total PFAS level of 0.00002 mg/L.

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Rationale: Added PFAS compounds per 2020 DWTU JC meeting discussion (May 13, 2020).

R2:

1. ***Updated maximum influent tolerances/maximum influent challenge concentrations to ±20 and individual influent tolerances to ±30% based on lab validation testing as a result of r1 comments***
2. ***Removed all references to GEN X and HFPO-DA based on awaiting EPA's MCL (see "PFAS TG Meeting Summary_011422.pdf" under Reference Documents for details)***
3. ***Corrected maximum effluent concentration for PFOA & PFOS from 0.00007 to 0.00002 in Tables 7.1, 7.7, and 8.1***
4. ***Removed a footnote in Tables 7.1 & 7.7 to match 0.00002 level set by several New England states***
5. ***Added a footnote to Tables 7.1, 7.7, and 8.1 to explain the 0.00002 value***
6. ***Corrected total PFAS from 0.0003 to 0.00205 in Tables 7.1, 7.7, 7.8, and 8.1***
7. ***Removed an extra period in section 7.2.6.8***
8. ***Changed "tests method" to "test method" in section 7.2.6.4***

R3 now:

1. ***Adds clarification on the two ways to make PFAS reduction claims to Section 7.2.6.1 and to the footnotes of Tables 7.1, 7.7, 7.8, and 8.1***
2. ***Corrects total PFAS for influent from 0.00205 mg/L to 0.00216 mg/L in Tables 7.1, 7.7, 7.8, and 8.1***
3. ***Corrects PFHxS from 200 ppt to 300 ppt and PFNA from 40 ppt to 50 ppt in footnotes of Tables 7.1, 7.7, and 7.8***

NSF/ANSI Standard
for Drinking Water Treatment Units —

Reverse Osmosis
Drinking Water Treatment Systems

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7 Elective performance claims – Test methods

7.1 Chemical reduction claims

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7.1.2 PFAS reduction claims

Claims for reduction of per- and polyfluoroalkyl substances (PFAS) are permitted when tested in accordance with Section 7.1.2 as long as maximum effluent concentrations in Table 7.2 are not exceeded.

There are two ways to make reduction claims for PFAS.

The first method is to make a mixture of seven PFAS compounds with the influent concentration of 2,160 ppt, made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300 ppt), PFNA (50 ppt), PFHpA (40 ppt), PFBS (260 ppt), and PFDA (10 ppt), and to reduce these by 99% to the effluent concentration of 20 ppt.

The second option is to reduce individual PFAS compounds from their respective influent concentrations to their individual health advisory effluent concentrations (as shown in Table 7.2). Two PFAS compounds, PFBS (perfluorobutanesulfonic acid) and PFDA (perfluorodecanoic acid), are excluded from the individual contaminant reductions because their occurrence level is less than their health advisory level. Therefore, they do not appear in Tables 7.2 or 8.1.

7.1.~~2~~3 Inorganic chemical reduction claims

Claims for inorganic chemical reduction may be made for the specific contaminants shown in Table 7.2. To qualify for a specific contaminant reduction claim, the system shall reduce the level of the contaminant from the influent challenge level so that all product water sample results are less than or equal to the maximum allowable product water concentration in Table 7.2 when tested in accordance with Section 7.1.~~2~~3.

7.1.~~2~~3.1 Pentavalent arsenic reduction claims

Arsenic reduction by RO is species dependent. Pentavalent arsenic (also known as As(V), As(+5), and arsenate) can be removed by RO. It has been shown that trivalent arsenic (also known as As(III), As(+3), and arsenite) will be oxidized to pentavalent arsenic in the presence of a detectable free chlorine residual or in the presence of other effective oxidants.[1] Some water supplies may contain only pentavalent arsenic. Claims for pentavalent arsenic reduction shall only be made on water supplies meeting one of the following criteria:

- — a residual free chlorine concentration is detectable at the RO system inlet; or
- — the water at the RO system inlet has been demonstrated to contain only pentavalent arsenic.

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[1] EPA-600/R-01-021, *Laboratory Study on the Oxidation of Arsenic III to Arsenic V*, March 2001.

Table 7.2
Contaminant reduction requirements

Contaminant	**Individual influent sample point limits[1] (mg/L)**	**Average influent challenge level (mg/L)**	**Maximum allowable product water level (mg/L)**	**US EPA Method(s)~~[1]~~[2]**	**Compounds**
arsenic (pentavalent)[3]	0.30 ±20%, 0.30 ±25%[4]	0.30 ± 10%	0.010	200.7[5], 200.8	$Na_2HAsO_4 \cdot 7H_2O$
arsenic (pentavalent)[3]	0.050 ±20%, 0.050 ±25%[4]	0.050 ± 10%	0.010	200.7[5], 200.8	$Na_2HAsO_4 \cdot 7H_2O$
barium	10.0 ±20%, 10.0 ±25% [4]	10.0 ± 10%	2.0	200.7, 200.8	$BaCl_2 \cdot 2H_2O$
cadmium	0.03 ±25%	0.03 ± 10%	0.005	200.8, 200.9	$CdCl_2 \cdot 2.5\ H_2O$ or $Cd(NO_3)_2$
chromium (hexavalent)[6]	0.3 ± 20%, 0.3 ± 25% [7]	0.3 ± 10% (added as hexavalent)	0.1	200.7, 200.8, 200.9	$Na_2Cr_2O_7$ 2 H_2O
chromium (trivalent)[6]	0.3 ± 30%[8]	0.3 ± 10% (added as trivalent)	0.1	—	$CrCl_3 \cdot 6\ H_2O$
chromium (hexavalent and trivalent)	0.3 ±25%	0.3 ± 10% (added as 0.15 mg/L hexavalent and 0.15 mg/L trivalent)	0.05 (for each species)	SM3500-CrD and 200.8	—
copper	3.0 ± 20%, 3.0 ± 25%[4]	3.0 ± 10%	1.3	200.7, 200.8	$CuSO_4 \cdot 5\ H_2O$
fluoride	8.0 ± 25%	8.0 ± 10%	1.5	340.2	NaF
lead	0.15 ± 25%	0.15 ± 10%	0.005	200.8, 200.9	$PbCl_2$ or $Pb(NO_3)_2$
mercury	0.006 ±25%	0.006 ± 10% (added as mercuric chloride)	0.002	200.8, 245.1	$HgCl_2$
perchlorate	0.10 ± 25%	0.10 ± 10%	0.006	314.0	$NaClO_4$
per- and polyfluoroalkyl substances (PFAS)					
total PFAS[9]	0.00216 ~~0.00205~~~~0.0030~~ ± 30%	0.00216 ~~0.00205 ±~~ 20% ~~0.0030 ± 10%~~	0.00002[10]	537.1, 533, 8327	PFOA, PFOS, PFHxS, PFNA, PFHpA, ~~HFPO-DA,~~ PFBS, PFDA
~~hexafluoropropylene oxide dimer acid (GEN X)~~	~~0.0009 ± 30%~~	~~0.0009 ± 10%20%~~	~~0.00014~~	~~537.1, 533, 8327~~	~~HFPO-DA~~
perfluoroheptanoic acid (PFHpA)	0.00004 ± 30%	0.00004 ± ~~10%~~20%	0.00002[10]	537.1, 533, 8327	PFHpA
perfluorohexane sulfonic acid (PFHxS)	0.0003 ± 30%	0.0003 ± ~~10%~~20%	0.00002[10]	537.1, 533, 8327	PFHxS
perfluorononanoic acid (PFNA)	0.00005 ± 30%	0.00005 ± ~~10%~~20%	0.000006	537.1, 533, 8327	PFNA
perfluorooctanoic acid (PFOA) and perfluorooctane	0.0015 ± 30%	0.0015 ± ~~10%~~20% added as 1.0 µg/L PFOS and 0.5 µg/L	0.00002 ~~0.00007~~~~[1011]~~[10]	537.1, 533, 8327 or refer to	PFOA and PFOS

Table 7.2
Contaminant reduction requirements

Contaminant	**Individual influent sample point limits[1] (mg/L)**	**Average influent challenge level (mg/L)**	**Maximum allowable product water level (mg/L)**	**US EPA Method(s)~~[1]~~[2]**	**Compounds**
sulfonate (PFOS)~~[10]~~[11]		PFOA		Annex I-4~~[11]~~[12]	
selenium	0.10 ± 25%	0.10 ± 10% (added as 0.05 mg/L selenite and 0.05 mg/L selenate)	0.05	200.8, 200.9	50/50 mix of Na_2SeO_3 and Na_2SeO_4
radium 226/228~~[12]~~[13]	N/ A	25 pCi/L	5 pCi/L	—	—
uranium	0.10 ± 30% or 0.40 ± 30%	0.10 ± 10% or 0.40 ± 10%	0.02	200.7, 200.8	$UO_2(NO_3)_2$

[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 US EPA method.
2. Acceptable spike recoveries as stated in the appropriate US EPA method.
3. Opinion of laboratory professionals – no guidance available in US EPA method.

[2] The reporting limit for the analytical method shall not exceed the pass/fail limit.

[3] Arsenic shall be added in the pentavalent form and analyzed for total arsenic. Arsenic reduction is species-dependent; therefore, reduction claims shall only be made on chlorinated water supplies where trivalent arsenic has been oxidized to the pentavalent form, as indicated by the presence of a detectable residual of free chlorine at the system inlet.

[4] The first limits apply to analysis conducted according to the first US EPA method, and the second limits apply to analysis conducted according to the second US EPA method.

[5] For arsenic, US EPA Method 200.7 shall be used for analysis of influent sample concentrations only.

[6] Chromium shall be added as chromate for hexavalent chromium reduction and measured as total chromium. Trivalent chromium reduction may be claimed only after additional testing.

[7] The first limits apply to analysis conducted according to US EPA method 200.7, and the second limits apply to analysis conducted according to US EPA method 200.8 or 200.9.

[8] Trivalent chromium is a calculated parameter. The range is based on the propagated error of two analyses.

[9] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.1.2 for details). The test mixture for t~~T~~otal PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300~~200~~ ppt), PFNA (40 ppt), PFHpA (50~~40~~ ppt), ~~HFPO-DA (900 ppt),~~ PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

[10] This effluent value is based on the maximum contaminant levels or health advisories in force in several New England States for a total PFAS level of 0.00002 mg/L.

~~[9]~~~~[10]~~[11] Influent challenge levels for PFOS were based on the upper percentile concentration per EPA's UCMR3 occurrence data (2013-2015) (the concentration for which there is high probability [P <0.01] that 99% of the population will be exposed to waters of lower concentration). Influent challenge levels for PFOA were based on the upper percentile concentration of private well and public water supply sampling in Hoosick Falls New York (the concentration for which there is high probability [P <0.10] that 90% of the population will be exposed to waters of lower concentration). This influent concentration is higher than the maximum concentration per US EPA's UCMR3 occurrence data (2013-2015). PFOS and PFOA will be added gravimetrically in a ratio of five parts PFOA to 10 parts PFOS by weight to achieve the total influent concentration.

~~[10] [11] Total of both PFOS and PFOA. Based on US EPA Health Advisory level which includes a margin of protection for the most sensitive populations.~~

Table 7.2
Contaminant reduction requirements

Contaminant	Individual influent sample point limits[1] (mg/L)	Average influent challenge level (mg/L)	Maximum allowable product water level (mg/L)	US EPA Method(s)[~~1~~2]	Compounds

[~~11~~ 12] Any needed modification / improvement on the method shall be performed as described and validated within the method. If alternate methods are used they shall be validated as equivalent or better in precision and accuracy than the specified method.

[~~12~~13] For test purposes, barium shall be added to the influent challenge water and shall be analyzed in the influent challenge water and product water. The reduction of radium is not concentration-dependent; therefore, barium shall be added at 10 mg/L with a maximum product water level of 2.0 mg/L. Barium is used as a surrogate based on its relationship with radium on the periodic table and the difficulty in using radium for routine testing.

7.1.~~2~~3.2 Apparatus

A test apparatus capable of providing specified flow rates and pressures shall be used. An example of an appropriate test apparatus appears in figure 2.

7.1.~~2~~3.3 Analytical methods

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

7.1.~~2~~3.4 Test water

7.1.~~2~~3.4.1 TDS reduction test water

Chlorine free deionized water shall be used with the following specific characteristics maintained throughout the test:

turbidity	≤1 NTU
pH	7.5 ± 0.5
temperature	25 ± 1 °C (77 ± 2 °F)
conductivity	1 µS/cm

Sodium chloride (NaCl) shall be added to the test water to achieve a challenge concentration of 750 ± 40 mg/L TDS.

7.1.~~2~~3.4.2 Chemical reduction test water

A public water supply shall be used with the following specific characteristics maintained throughout the test for chemical reduction claims:

total dissolved solids (TDS)	200 – 500 mg/L
turbidity	≤ 1 NTU
pH	7.5 ± 0.5
temperature	25 ± 1 °C (77 ± 2 °F)

NOTE — The test water shall not contain interfering substances that cause false positive or false negative performance results (e. g., flocculating iron may adsorb the contaminants being tested).

7.1.~~2~~3.5 Challenge water

For pentavalent arsenic, barium, chromium, radium, perchlorate, ~~perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS)~~ per- and polyfluoroalkyl substances (PFAS), the test compound listed in Table 7.2 shall be added to the TDS influent challenge water (see Section 7.1.~~2~~3.4.1) to achieve the influent concentration specified in Table 7.2.

For uranium, the test compound listed in Table 7.2 shall be added to the TDS influent challenge water (see Section 7.1.~~2~~3.4.1) to achieve the influent concentration specified in Table 7.2 with the following modification:

- sodium bicarbonate (targeted addition of 50 mg/L- $NaHCO_3$) shall be added to the test water and the TDS increased to a challenge concentration of 750 ± 10% using sodium chloride (NaCl).

For the remaining inorganic substances, the test compound listed in Table 7.2 shall be added to either the TDS influent challenge water (see Section 7.1.~~2~~3.4.1) or the chemical reduction test water (see Section 7.1.~~2~~3.4.2) to achieve the influent concentration specified in Table 7.2.

7.1.~~2~~3.6 Method

Two systems shall be conditioned in accordance with the manufacturer's instructions using the test contaminant specified in Table 7.2 and the appropriate general test water specified in Section 7.1.~~2~~3.4.1 or 7.1.~~2~~3.4.2. The systems shall be tested using the appropriate influent challenge water at an initial dynamic pressure of 350 ± 18 kPa (50 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. Premembrane and postmembrane filters shall be removed prior to testing.

7.1.~~2~~3.7 Sampling

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, the storage tank shall be emptied after each collection at 4 h and 12 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. A test contaminant sample shall be collected and analyzed from the tank. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~2~~3.7.1 Systems with storage tank and automatic shutoff

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, the storage tank shall be emptied after each collection at 4 h and 12 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~2~~3.7.2 Countertop systems with storage tanks or reservoirs

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1, the storage tank shall be emptied after each collection at 4 h and 8 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~2~~3.7.3 Systems without storage tanks

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, samples shall be collected at 4 h and 8 h. On Days 2 to 4 of testing, samples shall be collected at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a test contaminant sample shall be collected and analyzed. A final sample shall be collected and analyzed on Day 7 for the first 4-h period.

7.1.~~2~~3.7.4 Systems with no shutoff provisions

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for test contaminants. On Day 1 of testing, samples will be collected in 4 h intervals including 4 h, 8 h, 12 h, and 16 h. The storage tank shall be emptied after each collection and the product water volume shall be recorded in liters (gallons). On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~3~~4 Nitrate / nitrite reduction claims

Claims for nitrate / nitrite reduction shall be tested at a system pressure applicable to the intended end use in accordance with Section 7.1.~~3~~4. To qualify for a nitrate / nitrite reduction claim, the system shall reduce the level of the contaminant from the influent challenge level so that all product water sample results are less than or equal to the maximum allowable product water concentration in Table 7.3.

Table 7.3
Contaminant reduction requirements

Contaminant	Individual influent[1] sample point limits (mg/L)	Average influent challenge level (mg/L)	Maximum allowable product water level (mg/L)	US EPA Method(s)	Compounds
nitrate plus nitrite (as N)[2]	30.0 ± 20%	30.0 ± 10% (added as 27 mg/L as N of nitrate and 3 mg/L as N of nitrite) OR 70 ± 10% (added as 65mg/L as N of nitrate and 5 mg/L as N of nitrite)	10.0[3]	300	$NaNO_3$ $NaNO_2$

[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 US EPA Method.
2. Acceptable spike recoveries as stated in the appropriate US EPA Method.
3. Opinion of laboratory professionals – no guidance available in US EPA Method.

[2] Some public and private water supplies may exceed indicated influent nitrate (NO_3) and nitrite (NO_2) levels. Additional treatment or individual design, or both, shall be applied to ensure that the product water level consistently meets the MCLs for such water supplies.

[3] Of the 10 mg/L maximum product water level, no more than 1.0 mg/L shall be in the form of NO_2 as N.

7.1.~~3~~4.1 Apparatus

A test apparatus capable of providing specified flow rates and pressures shall be used. An example of an appropriate test apparatus appears in Figure 2.

7.1.~~3~~4.2 Analytical methods

All analyses shall be conducted in accordance with the applicable methods referred to in Section 2.

7.1.~~3~~4.3 Test water

Chlorine free deionized water shall be used with the following specific characteristics maintained throughout the test:

turbidity	≤ 1 NTU
pH	7.5 ± 0.5
temperature	25 ± 1 °C (77 ± 2 °F)
TDS[1]	750 ± 40 mg/L

[1] Added as NaCl.

7.1.~~3~~4.4 Method

Two systems shall be conditioned in accordance with the manufacturer's instructions using the test contaminant specified in Table 7.3 and the appropriate general test water specified in Section 7.1.~~3~~4.3.

The method specified in Section 6.9.6 shall be followed, except that the initial dynamic pressure shall be applicable to the intended end use. The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. Premembrane and postmembrane filters shall be removed prior to testing. Systems shall be tested at 350 ± 18 kPa (50 ±3 psig) or the manufacturer's minimum recommended inlet pressure, whichever is lower.

7.1.~~3~~4.5 Sampling

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, the storage tank shall be emptied after each collection at 4 h and 12 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~3~~4.5.1 Countertop systems with storage tanks or reservoirs

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1, the storage tank shall be emptied after each collection at 4 h and 8 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.~~3~~4.5.2 Systems without storage tanks

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing samples will be collected at 4 h and 8 h. On Days 2 to 4 of testing, samples shall be collected at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a test contaminant sample shall be collected and analyzed. A final sample shall be collected and analyzed on Day 7 for the first 4-h period.

7.1.~~3~~4.5.3 Systems with no shutoff provisions

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for test contaminants. On Day 1 of testing, sampling will take place in 4 h intervals including 4 h, 8 h, 12 h, and 16 h. The storage tank shall be emptied after each collection and the product water volume shall be recorded in liters (gallons) at each 4 h sample point. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.45 N-nitrosodimethylamine (NDMA) reduction testing

7.1.45.1 NDMA reduction claim

Claims for NDMA reduction may be made when tested in accordance with Section 7.1.45.1, so long as maximum effluent concentrations denoted in Table 7.4 are not exceeded.

Table 7.4
NDMA reduction requirements

Contaminant	**Individual influent sample point limits (ng/L)**	**Average influent challenge level (ng/L)**	**Maximum allowable product water level[1] (ng/L)**	**US EPA Method**	**Compound**
NDMA	40 ± 20%	40 ± 10%	6 ng/L	521[2]	NDMA

[1] Since n-nitrosamines (NDMA) are not yet regulated by EPA, the effluent level of 6 ng/L was chosen as it is the latest TAC value under NSF/ANSI/CAN 600. The influent challenge of 40 ng/L is based on the 90th percentile of occurrence data from UCMR-2.

[2] An alternate validated method of equivalent sensitivity to US EPA Method 521 is permissible.

7.1.45.2 Apparatus

A test apparatus capable of providing specified flow rates and pressures shall be used. An example of an appropriate test apparatus appears in Figure 2.

7.1.45.3 Analytical methods

All analysis shall be conducted in accordance with the applicable methods referred to in Table 7.4.

It is highly recommended that validation of US EPA Method 521 be undertaken prior to the actual testing, with the following precautions (an alternate validated method of equivalent sensitivity to US EPA Method 521 is permissible):

a) Use RO/UV water for preparing the challenge water for verification of the stability of the NDMA concentration. UV treatment of the RO water needs to be optimized to eliminate all NDMA background. Alternatively, any challenge water that has no NDMA background is acceptable.

b) In a 10-L tank, use 9 L of the above treated RO/UV water, add the chemicals in the modified (TOC > 1 ppm and TDS- 350 ± 50 mg/L) chemical test water given in Section 7.1.~~2~~3.4.2.

c) For pH adjustment use HCl, NaOH, and a small amount of Na_2CO_3 for stability. For TDS adjustment use NaCl and for TOC use tannic acid.

d) Add 40 ng/L NDMA to the RO/UV water. Test to see if this concentration can be maintained within ± 10% during a 24-h period, taking samples at 2, 4, 8, 12, 18, and 24 hours.

e) Make a 20× dilution of the sample at 2 and 24 hours and analyze to show that NDMA at 2 ng/L concentration can be detected in the presence of chemicals present in the test water.

7.1.45.4 Test water

A RO/UV treated water without any NDMA background described above shall be maintained throughout the test for NDMA reduction claim:

turbidity	≤ 1 NTU
pH	7.5 ± 0.5
temperature	25 ± 1 °C (77 ± 2 °F)
total dissolved solids (TDS)	350 ± 50 mg/L
total organic carbon (TOC)	> 1 mg/L

7.1.45.5 Challenge water

Using the test water described in Section 7.1.45.4, a solution of NDMA at a concentration of 40 ± 10% ng/L should be used as a challenge water.

7.1.45.6 Method

Two systems shall be conditioned in accordance with the manufacturer's instructions using the test contaminant specified in Table 7.4 and the appropriate test water specified in Section 7.1.45.4. The systems shall be tested using the appropriate influent challenge water at an initial dynamic pressure of 350 ± 18 kPa (50 ± 3 psig). The pressure shall not be readjusted, although the system may experience some change in dynamic pressure. Premembrane and postmembrane filters shall be removed prior to testing.

7.1.45.7 Sampling

7.1.45.7.1 Systems with storage tank and automatic shutoff

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, the storage tank shall be emptied after each collection at 4 h and 12 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.45.7.2 Countertop systems with storage tanks or reservoirs

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1, the storage tank shall be emptied after each collection at 4 h and 8 h. On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

7.1.45.7.3 Systems without storage tanks

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for all test contaminants. On Day 1 of testing, samples shall be collected at 4 h and 8 h. On Days 2 to 4 of testing, samples shall be collected at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a test contaminant sample shall be collected and analyzed. A final sample shall be collected and analyzed on Day 7 for the first 4-h period.

7.1.45.7.4 Systems with no shutoff provisions

Product water samples shall be collected from the first water out of the system in the amount of 250 mL or total volume needed for analysis, whichever is greater. Influent and product samples shall be analyzed for test contaminants. On Day 1 of testing, samples will be collected in 4 h intervals including 4 h, 8 h, 12 h, and 16 h. The storage tank shall be emptied after each collection and the product water volume shall be recorded in liters (gallons). On Days 2 to 4 of testing, 5% of the first day's production rate shall be withdrawn from the storage tank after each collection at the beginning of the day and after an elapsed time of 6 h and 12 h. Days 5 and 6 represent a 54-h stagnation period, under pressure, during which no product water shall be withdrawn. At the start of Day 7, 144 h into the test, a sample shall be collected and analyzed, followed by emptying of the storage tank. A final sample shall be collected and analyzed on Day 7 for the first 4-h period. After the last sample for test contaminants is collected, the storage tank shall be emptied.

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8 Instructions and information

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Table 8.1
Performance data sheet requirements

Substance	Influent challenge concentration (mg/L)	Maximum permissible product water concentration (mg/L)
arsenic (pentavalent)[1]	0.30 ± 10% 0.050 ± 10%	0.010
barium	10.0 ± 10%	2.0
cadmium	0.03 ± 10%	0.005
chromium (hexavalent)	0.3 ± 10%	0.1
chromium (trivalent)	0.3 ± 10%	0.1
chromium (hexavalent and trivalent)	0.3 ± 10%	0.05
copper	3.0 ± 10%	1.3
fluoride	8.0 ± 10%	1.5
lead	0.15 ± 10%	0.005
mercury	0.006 ± 10%	0.002
nitrate plus nitrite (both as N)[1]	30.0 ± 10%	10.0
nitrate (as N)	27.0 ± 10%	10.0
nitrite (as N)	3.0 ± 10%	1.0
nitrate plus nitrite (both as N)[1]	70 ± 10%	10.0
nitrate (as N)	65 ± 10%	10.0

Table 8.1
Performance data sheet requirements

Substance	**Influent challenge concentration (mg/L)**	**Maximum permissible product water concentration (mg/L)**
nitrite (as N)	5 ± 10%	1.0
n-nitrosodimethylamine	40 ± 10%	6 ng/L
perchlorate	0.10 ± 10%	0.006
per- and polyfluoroalkyl substances (PFAS)[2]		
total PFAS[3]	0.00216 ~~0.00205~~ ± 20% ~~0.0030 ± 10%~~	0.00002~~[3]~~[4]
~~hexafluoropropylene oxide dimer acid (HFPO-DA) (GEN X)~~	~~0.0009 ± 10%20%~~	~~0.00014~~
perfluoroheptanoic acid (PFHpA)	0.00004 ± ~~10%~~20%	0.00002~~[3]~~[4]
perfluorohexane sulfonic acid (PFHxS)	0.0003 ± ~~10%~~20%	0.00002~~[3]~~[4]
perfluorononanoic acid (PFNA)	0.00005 ± ~~10%~~20%	0.000006
perfluorooctanoic acid (PFOA), and perfluorooctane sulfonate (PFOS)	0.0015 ± ~~10%~~20%	0.00002[3] ~~0.00007~~
radium 226/228	25 pCi/L ± 10%	5 pCi/L
selenium	0.10 ± 10%	0.05
total dissolved solids	750 ± 40 mg/L	187
turbidity~~[2]~~~~[4]~~[5]	11 ± 1 NTU	0.5 NTU
uranium[1]	0.10 ± 10% 0.40 ± 10%	0.02

[1] Only one influent challenge concentration for a contaminant shall be listed on the performance data sheet.

[2] For PFAS, the individual influent tolerance is ± 30%.

[3] There are two test methods for PFAS contaminant reduction claims: total PFAS and individual contaminants (see Section 7.1.2 for details). The test mixture for total PFAS is made up of PFOA (500 ppt), PFOS (1000 ppt), PFHxS (300 ppt), PFNA (50 ppt), PFHpA (40 ppt), PFBS (260 ppt), and PFDA (10 ppt). However, PFBS and PFDA have not been included as individual contaminant reduction claims because current data indicate they do not occur at levels higher than their health advised levels established by states. Therefore, the average influent concentration for total PFAS is not equal to the sum of the average influent concentration values for the individual claims.

~~[3]~~[4] This effluent value is based on the maximum contaminant levels or health advisories in force in several New England States for a total PFAS level of 0.00002 mg/L.

~~[4]~~[5] The influent challenge concentration listed on the performance data sheet must be equivalent to the actual average influent turbidity.

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Rationale: Added PFAS compounds per 2020 DWTU JC meeting discussion (May 13, 2020).

R2:

1. ***Updated maximum influent tolerances/maximum influent challenge concentrations to ±20 and individual influent tolerances to ±30% based on lab validation testing as a result of r1 comments***
2. ***Removed all references to GEN X and HFPO-DA based on awaiting EPA's MCL (see "PFAS TG Meeting Summary_011422.pdf" under Reference Documents for details)***

3. ***Corrected maximum effluent concentration for PFOA & PFOS from 0.00007 to 0.00002 in Tables 7.2 and 8.1***
4. ***Removed footnote in Table 7.2 to match 0.00002 level set by several New England states***
5. ***Added a footnote to Tables 7.2 and 8.1 to explain the 0.00002 value***
6. ***Corrected total PFAS from 0.0003 to 0.00205 in Tables 7.2 and 8.1***

R3 now:

1. ***Adds clarification on the two ways to make PFAS reduction claims by adding the new section 7.1.2 and by adding footnotes to Tables 7.2 and 8.1***
2. ***Corrects total PFAS for influent from 0.00205 mg/L to 0.00216 mg/L in Tables 7.2 and 8.1***
3. ***Corrects PFHxS from 200 ppt to 300 ppt and PFNA from 40 ppt to 50 ppt in footnote of Table 7.2***
4. ***Adds missing title to existing Table 7.4***
5. ***Updates section numbers and section references to reflect insertion of new section 7.1.2***