PFAS Leaching in Drinking Water System Components

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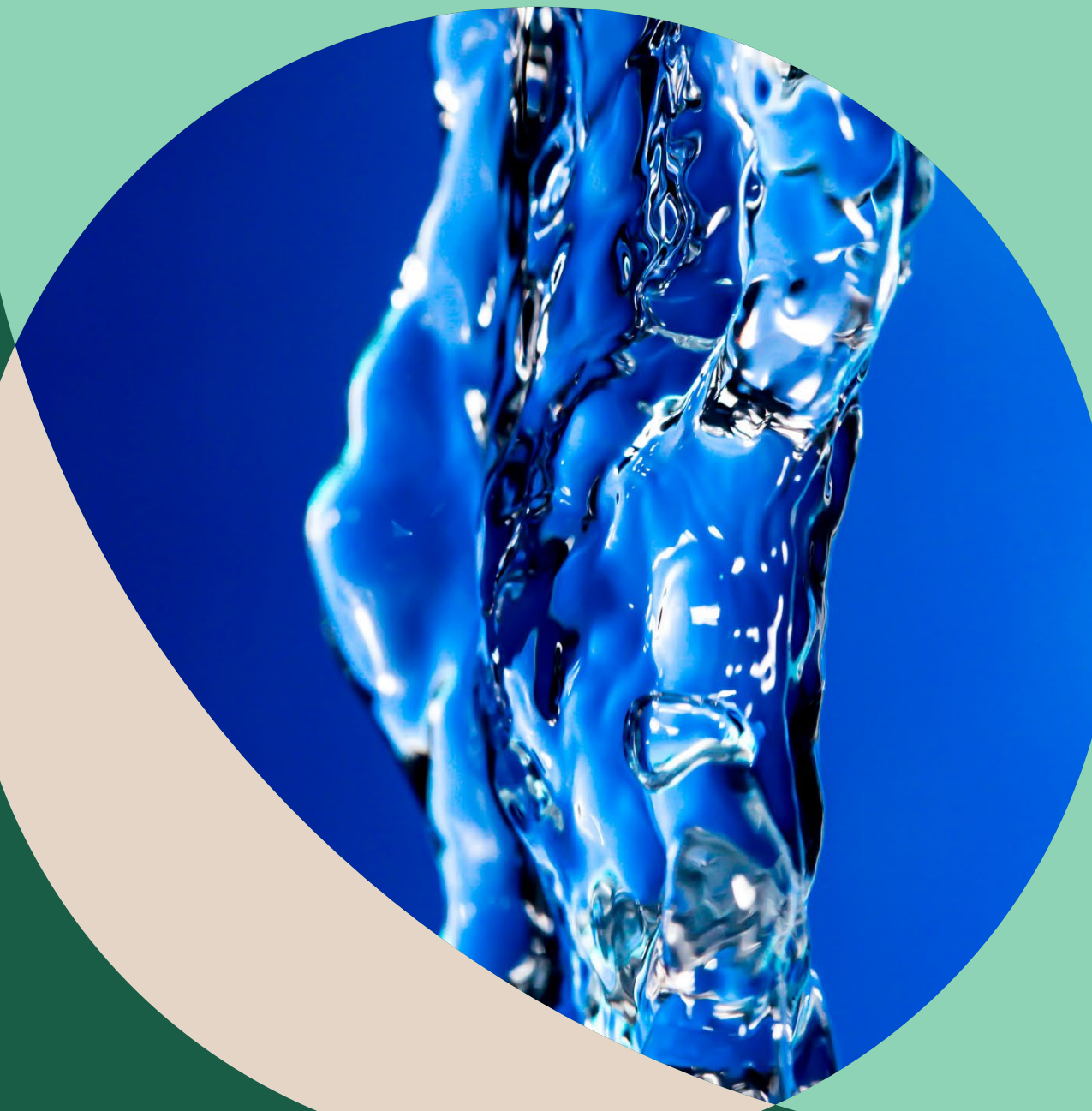
November 4, 2024

Agenda

1. About NSF
2. NSF/ANSI/CAN 61 Overview
3. PFAS Background
4. Updated PFAS Requirements for NSF 61



What is NSF?

NSF is an independent, not-for-profit,
non-governmental public health and safety organization.

Our mission is to improve human and planet health.

NSF/ANSI/CAN 61: Background

NSF 61: Drinking Water System Components-Health Effects

What it is:

- American National Standard and National Standard of Canada for evaluating health effects of products used in drinking water applications
- Covers all products with drinking water contact from source to tap
- Concerned with **all** potential extractants, **not just lead**
- Does not address product performance

NSF Standards Development Process

NSF Standards are approved by ANSI (American National Standards Institute) and SCC (Standards Council of Canada).

- Accreditation bodies ensure standards have been developed in accordance with a consensus process
- Includes addressing concerns of all stakeholders
- Requires a public review and comment period
- All standard meetings are open to the public
- Anyone can submit an issue paper to propose changes to the standard

Joint Committee on Drinking Water Additives

Balanced 3-part voting

Manufacturers

Producers Trade Associations

Public Health

EPA
CDC
Health Canada
Academia

Users

Consumers
Government
Certifiers & Test Labs
Retailers
NGOs

NSF Standards Process

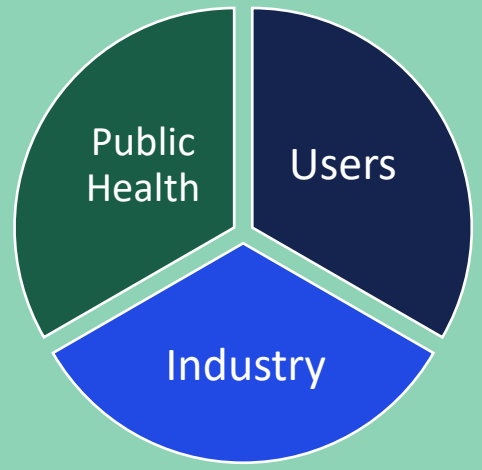
The Drinking Water Additives Joint Committee oversees NSF/ANSI/CAN 61 and 372

33 members

- Federal and State Regulators
- Water Utility and Plumbing Reps
- Manufacturers

The **Public Health Council (PHC)** is comprised of 50 regulators and user reps and oversees all NSF Standards.

Drinking Water Additives Joint Committee



Public Health Council

Recognition and Use of NSF Standards

In a survey conducted by Health Canada, it was found that 11/13 provinces/territories require compliance with NSF 61. NSF and the Association of State Drinking Water Administrators (ASDWA) conducted a survey of U.S. states to identify those states that currently have legislation, regulations, or policies in place for NSF-61.

NSF-61

Figure 4

Provincial/Territorial Adoption of NSF/ANSI/CAN 61

No Provincial/Territorial Adoption of NSF/ANSI/CAN 61*

*Local Requirements may still apply.

NSF-61

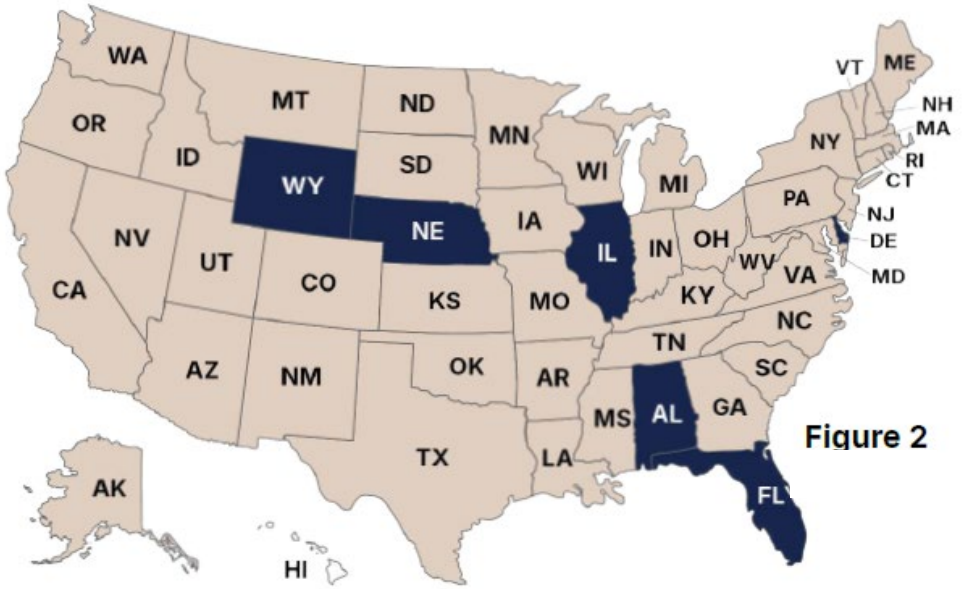


Figure 2

ANSI-Accredited Certification Required

Compliance with NSF/ANSI/CAN 61 Required or Recommended

No State Requirement for NSF/ANSI/CAN 61*

*Local Requirements may still apply.

Purpose and Scope of NSF/ANSI/CAN 61

Purpose

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

Scope

… intended to cover specific materials or products that come into contact with: drinking water, drinking water treatment chemicals, or both…

… Point-of-use drinking water treatment devices are not covered by the scope of the Standard.

NSF/ANSI/CAN 600

Purpose

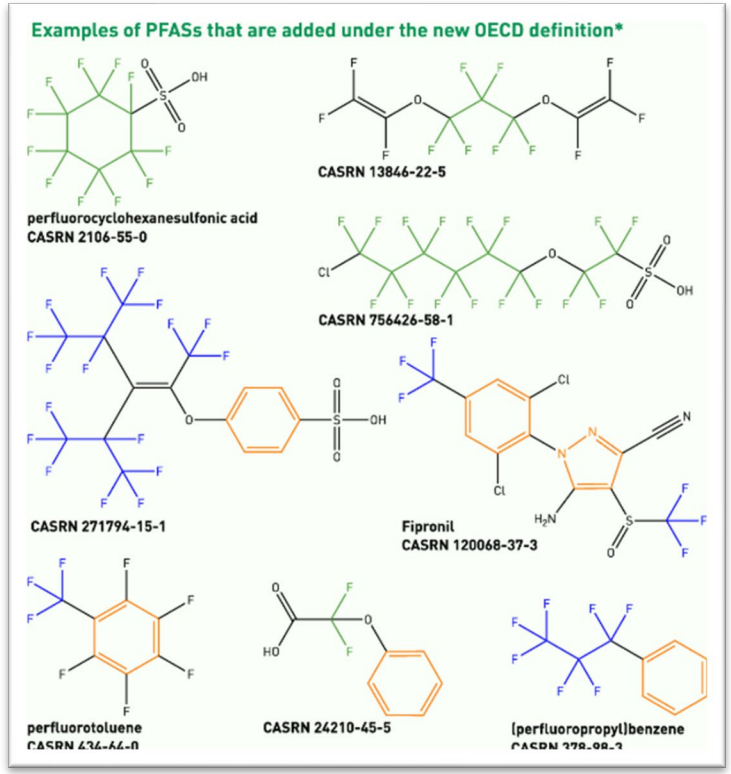
- *"…defines toxicological review and evaluation procedures for the evaluation of substances imparted to drinking water through contact with drinking water system components and drinking water additives…*
- *"…Table 4.1 of this standard contains evaluation criteria that have been determined according to the requirements of this standard."*

NSF 600 is a reference standard containing the health effects criteria for NSF 61 and other standards, and the procedures used to establish those criteria.

NSF 61 and PFAS

PFAS- Per & Polyfluoroalkyl Substances

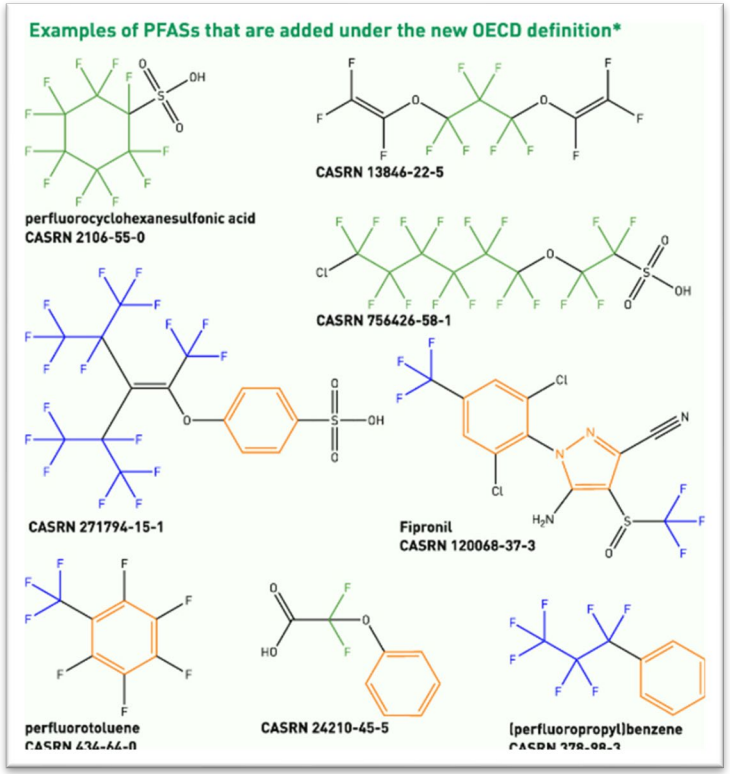
- Compounds with at least one fully fluorinated methyl ($-CF_3$) or methylene ($-CF_2-$) carbon atoms without any H/Cl/Br/I attached (OECD, 2021).
    - >10,000 PFAS compounds in existence using this definition
    - PFAS are widely used
        - Fire-fighting foams
        - Household products
        - Food Packaging
        - Fluoropolymers
        - Process Aids in manufacturing processes



- C-F bond is extremely strong, limiting the ability of these compounds to degrade in the environment.
    - “Forever chemicals”

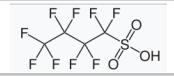
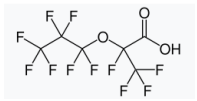
PFAS- Per & Polyfluoroalkyl Substances

- PFAS are known to bioaccumulate and/or bioconcentrate in organisms, including humans.
    - Found as pollutants in water (including drinking water), air, fish, and soil across the world.
        - Even in remote parts of Antarctica
    - Found to be present in the blood of people and animals worldwide.
        - Even in newborns
- Linked to many harmful health effects in humans and animals including cancer, developmental abnormalities, immune system deficiency, and thyroid and liver effects.
    - Even at very low concentrations



PFAS- Per & Polyfluoroalkyl Substances

- In April 2024, The United States Environmental Protection Agency (US EPA) finalized legal limits (MCLs) for six PFAS compounds in drinking water.

US EPA MCLs			
Compound	Structure	MCL (ng/L)	Health Based Water Concentration (ng/L)
Perfluorooctanoic acid (PFOA)		4	-
Perfluorooctane sulfonic acid (PFOS)		4	-
Perfluorononanoic Acid (PFNA)		10 ppt	10*
Perfluorohexane sulfonic acid (PFHxS)		10 ppt	10*
Perfluorobutane sulfonic acid (PFBS)		-	2000*
HFPO-DA and its ammonium salt (GenX)		10 ppt	10*
*Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS		1 (unitless) Hazard Index	

$$*\text{Hazard Index} = \left(\frac{[PFNA]}{10\ ppt}\right) + \left(\frac{[PFHxS]}{10\ ppt}\right) + \left(\frac{[PFBS]}{2000\ ppt}\right) + \left(\frac{[GenX]}{10\ ppt}\right)$$

Current NSF 600 Health Effects Criteria in NSF 600-2023

- NSF 600-2023 only contains criteria for PFOA and PFOS
  - Based on EPA Health Advisories from 2016
  - Other PFAS compounds not addressed

US EPA MCLs compared with NSF 600-2023 PFAS Criteria			
Compound	EPA Regulatory Criteria		NSF 600-2023 Criteria (TAC)
	MCL (ng/L)	HBWC (ng/L)	
Perfluorooctanoic acid (PFOA)	4	-	70 ppt (Summed)
Perfluorooctane sulfonic acid (PFOS)	4	-	
Perfluorononanoic Acid (PFNA)	10	10*	-
Perfluorohexane sulfonic acid (PFHxS)	10	10*	-
Perfluorobutane sulfonic acid (PFBS)	-	2000*	-
HFPO-DA and its ammonium salt (GenX)	10	10*	-
Perfluorohexanoic Acid (PFHxA)	-	-	-
*Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	-	1 (unitless) Hazard Index	-

*Hazard Index = $\left(\frac{[PFNA]}{10\ ppt}\right) + \left(\frac{[PFHxS]}{10\ ppt}\right) + \left(\frac{[PFBS]}{2000\ ppt}\right) + \left(\frac{[GenX]}{10\ ppt}\right)$

2024 Updates to Health Effects Criteria under NSF 600

- The 2024 version of NSF 600 will include updated health effects criteria to align with EPA regulations.
  - Individual criteria for PFOA and PFOS
  - Individual criteria for PFNA, PFHxS, PFBS, and GenX, as well as evaluation to hazard index when present in a mixture.
  - Criteria for PFHxA based on EPA IRIS assessment, with inclusion in Hazard Index

PFAS Criteria to be incorporated in NSF 600-2024			
Compound	EPA Regulatory Criteria		NSF 600-2024 Criteria (TAC)
	MCL (ng/L)	HBWC (ng/L)	
Perfluorooctanoic acid (PFOA)	4	-	4 ppt
Perfluorooctane sulfonic acid (PFOS)	4	-	4 ppt
Perfluorononanoic Acid (PFNA)	10	10*	10*
Perfluorohexane sulfonic acid (PFHxS)	10	10*	10*
Perfluorobutane sulfonic acid (PFBS)	-	2000*	2000*
HFPO-DA and its ammonium salt (GenX)	10	10*	10*
Perfluorohexanoic Acid (PFHxA)	-	-	2000*
**Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, PFBS and PFHxA		1 (unitless) Hazard Index	1 (unitless) Hazard Index

*Hazard Index = $\left(\frac{[PFNA]}{10\ ppt}\right) + \left(\frac{[PFHxS]}{10\ ppt}\right) + \left(\frac{[PFBS]}{2000\ ppt}\right) + \left(\frac{[GenX]}{10\ ppt}\right) + \left(\frac{[PFHxA]}{2000\ ppt}\right)$

Current PFAS Requirements in NSF 61-2023

- NSF 61-2023 only specifies testing for a single PFAS compound (PFOA) and only in a few material types
    - PTFE, ETFE, Fluoroelastomers
- These materials are known to use other PFAS as process aids during polymerization, including the EPA regulated PFAS

Table 3.1
Material-specific analyses

Material type	Required analyses
Joining and sealing materials	
chloroprene	GC/MS, [b] VOCs, and 2-chloro-1,3-butadiene, phthalates, [j] PNAs, [b] nitrosoamines [l]
ethylene-propylene-diene monomer (EPDM)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] nitrosoamines [l]
ethylene tetrafluoroethylene (ETFE)	GC/MS, [b] VOCs, perfluorooctanoic acid
flux	GC/MS, [b,c] VOCs, regulated metals, [a,c] PNAs [b,c]
fluoroelastomer	GC/MS, [b] VOCs, perfluorooctanoic acid
isoprene	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] isoprene monomer, nitrosoamines [l]
nitrile-butadiene rubber (NBR, BUNA-N, HNBR)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] 1,3-butadiene, acrylonitrile, nitrosoamines [l]
PTFE (polytetrafluoroethylene)	GC/MS, [b] VOCs, perfluorooctanoic acid
PVDF (polyvinylidene fluoride)	GC/MS, [b] VOCs, vinylidene fluoride, hexafluoropropene
silicone	GC/MS, [b] VOCs, 2,4-dichlorobenzoic acid
solder	regulated metals, [a] aluminum, bismuth, nickel, silver, strontium, zinc
solvent cements	GC/MS, [b] VOCs, [c] acetone, tetrahydrofuran, cyclohexanone, methyl ethyl ketone, dimethylformamide, methyl isobutyl ketone
styrene-butadiene rubber (SBR)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] 1,3-butadiene, styrene, nitrosoamines [l]

Updates to PFAS Requirements in NSF 61-2024

- NSF 61-2024 will include an expanded test battery of 7 PFAS compounds within the minimum required test batteries for PTFE, Fluoroelastomers, ETFE, and PVDF.
- Revision includes a **Jan 1, 2028** deadline for products to comply with updated/additional PFAS leaching requirements.

Table 3.1
Material-specific analyses

Material type	Required analyses
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Joining and sealing materials	
chloroprene	GC/MS, [b] VOCs, and 2-chloro-1,3-butadiene, phthalates, [j] PNAs, [b] nitrosoamines [l]
ethylene-propylene-diene monomer (EPDM)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] nitrosoamines [l]
ethylene tetrafluoroethylene (ETFE)	GC/MS, [b] VOCs, ~~perfluorooctanoic acid~~ PFAS[q]
flux	GC/MS, [b,c] VOCs, regulated metals, [a,c] PNAs [b,c]
fluoroelastomer	GC/MS, [b] VOCs, ~~perfluorooctanoic acid~~ PFAS[q]
isoprene	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] isoprene monomer, nitrosoamines [l]
nitrile-butadiene rubber (NBR, BUNA-N, HNBR)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] 1,3-butadiene, acrylonitrile, nitrosoamines [l]
PTFE (polytetrafluoroethylene)	GC/MS, [b] VOCs, ~~perfluorooctanoic acid~~ PFAS[q]
PVDF (polyvinylidene fluoride)	GC/MS, [b] VOCs, vinylidene fluoride, hexafluoropropene, PFAS[q]
silicone	GC/MS, [b] VOCs, 2,4-dichlorobenzoic acid
solder	regulated metals, [a] aluminum, bismuth, nickel, silver, strontium, zinc
solvent cements	GC/MS, [b] VOCs, [c] acetone, tetrahydrofuran, cyclohexanone, methyl ethyl ketone, dimethylformamide, methyl isobutyl ketone
styrene-butadiene rubber (SBR)	GC/MS, [b] VOCs, phthalates, [j] PNAs, [b] 1,3-butadiene, styrene, nitrosoamines [l]

[q] Perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), perfluorobutanesulfonic acid (PFBS), hexafluoropropylene oxide dimer acid and its ammonium salt (GenX), perfluorohexanoic (PFHxA). Refer to N-1.7.4.6 for compliance timelines for PFAS criteria.

Updates to PFAS Requirements in NSF 61

- NSF 61-2024 will include an expanded test battery of 7 PFAS compounds within the minimum required test batteries for PTFE, Fluoroelastomers, ETFE, and PVDF.
- Revision includes a **Jan 1, 2028** deadline for products to comply with updated/additional PFAS leaching requirements.

N-1.7 Analysis methods

N-1.7.4.6 Per- and Polyfluoroalkyl Substances (PFAS) Analysis

Analysis for perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), perfluorobutanesulfonic acid (PFBS), hexafluoropropylene oxide dimer acid and its ammonium salt (GenX), and perfluorohexanoic (PFHxA) shall be in accordance with U.S. EPA Method 533, U.S. EPA Method 537.1, or an alternate validated method with equivalent sensitivity.

NOTE — Testing for these compounds has been specified for the indicated materials in Tables 3.1 and 3.2 based on evidence of their potential presence in these materials.

Minimum reporting limits (RL) for these compounds shall be 4 parts per trillion for PFOA and PFOS; 5 parts per trillion for PFNA, PFHxS, GenX, and PFHxA; and 6 parts per trillion for PFBS.

The summed detections of PFOA and PFOS shall be evaluated to a TAC and SPAC of 70 and 7 ng/L, respectively, until Jan 1, 2028, after which they shall be evaluated to the criteria published in NSF/ANSI/CAN 600.

PFNA, PFHxS, PFBS, GenX, and PFHxA shall be tested in products as directed in Section 3, but detections of these compounds shall not be used to determine compliance with this standard until Jan 1, 2028. After this date, these compounds shall be evaluated to the criteria shown in NSF/ANSI/CAN 600.

Implementation of New Requirements

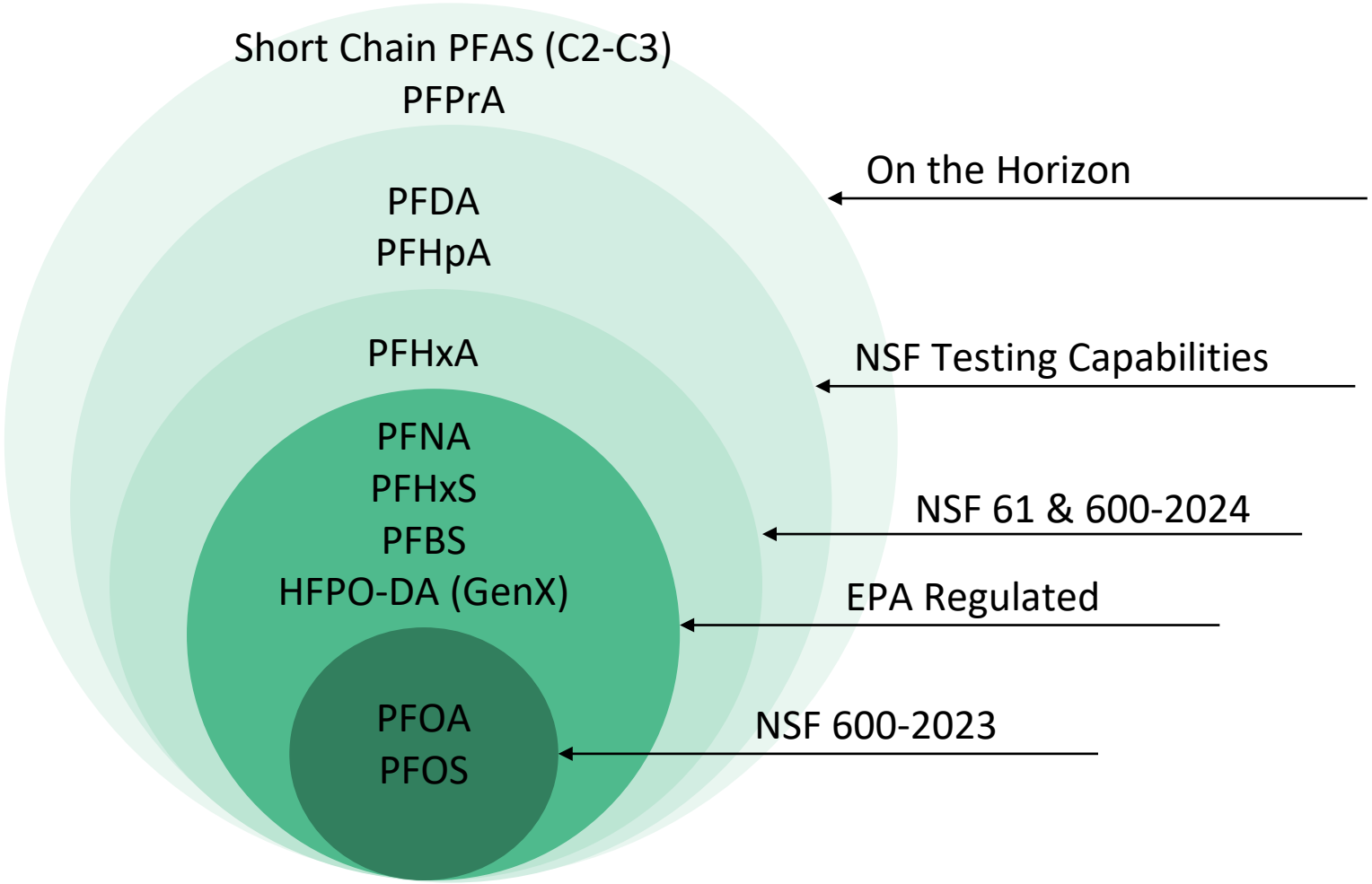
- Will differ between certifiers, however, certification bodies must ensure all certified products comply prior to Jan 1, 2028 deadline.
- At NSF, all product testing of fluoropolymer-containing materials will be conducted using updated PFAS test battery beginning in Q1 2025.
- Joint Committee on Drinking Water Additives requests that certification bodies periodically update the committee on trends in PFAS leaching from drinking water system components as they begin to accumulate test data.

Next Steps for PFAS in NSF 61

Standing Task Group under the Joint Committee to address:

- Whether additional PFAS ***compounds*** should be added to PFAS test battery specified under the standard.
    - Based on toxicology data and evidence of use in drinking water system components
        - Short chain (C2-C3) compounds
- Whether additional ***materials*** should be tested for potential PFAS leaching.
    - Based on evidence of PFAS use as intentional additive or process aid in manufacturing process

PFAS Compound Summary- Drinking Water System Components



Questions?

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