MUNICIPAL WATER MATTERS

JUNE 2016 ISSUE

A PUBLICATION BY NSF INTERNATIONAL'S

GLOBAL WATER DIVISION

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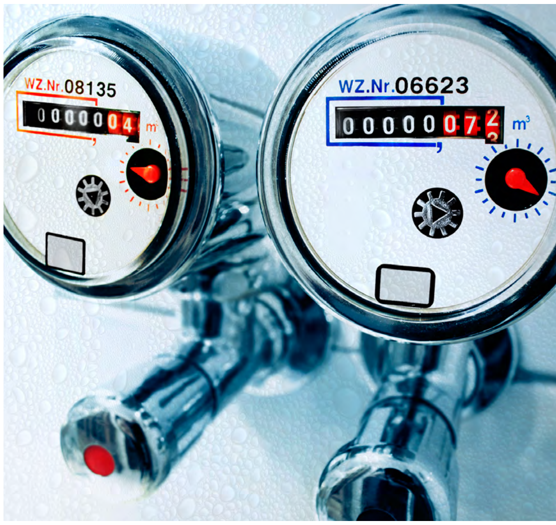


About NSF

NSF International is a global independent organization that writes standards, and tests and certifies products for the water, food, health sciences and consumer goods industries to minimize adverse health effects and protect the environment (nsf.org). Founded in 1944, NSF is committed to protecting human health and safety worldwide. Operating in more than 165 countries, NSF International is a Pan American Health Organization/ World Health Organization (WHO) Collaborating Center on Food Safety, Water Quality and Indoor Environment.

NSF's global water services include testing, certification and auditing for municipal water treatment components and chemicals, plastic piping systems, plumbing fixtures and fittings, point-of-use and point-of-entry water systems and filters.

Survey of the Association of State Drinking Water Administrators (ASDWA)

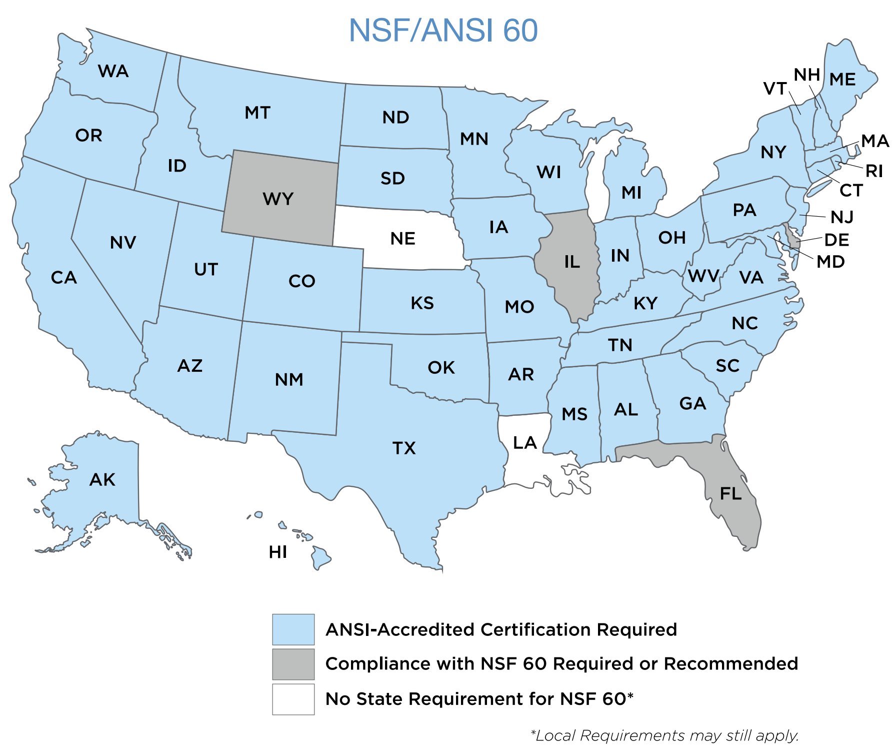
By Suzan Somo

NSF International, in cooperation with the Association of State Drinking Water Administrators (ASDWA), conducted a survey of U.S. state drinking water agencies about their recognition and use of the following NSF/ANSI standards:

- NSF/ANSI 60: Drinking Water Treatment Chemicals – Health Effects
- NSF/ANSI 61: Drinking Water System Components – Health Effects
- NSF/ANSI 223: Conformity Assessment Requirements for Certification Bodies that Certify Products Pursuant to NSF/ANSI 60: Drinking Water Treatment Chemicals – Health Effects
- NSF/ANSI 372: Drinking Water System Components – Lead Content

The survey identified which U.S. states currently have legislation, regulations or policies for each of these NSF/ANSI standards[1].

- NSF/ANSI Standard 60: 48 states have legislation, regulations or policies requiring drinking water chemicals to comply with or be certified to NSF/ANSI 60.



1 NSF International (2016), Survey of ASDWA Members on the use of NSF/ANSI Standards, www.nsf.org/newsroom_pdf/ASDWA_Survey.pdf

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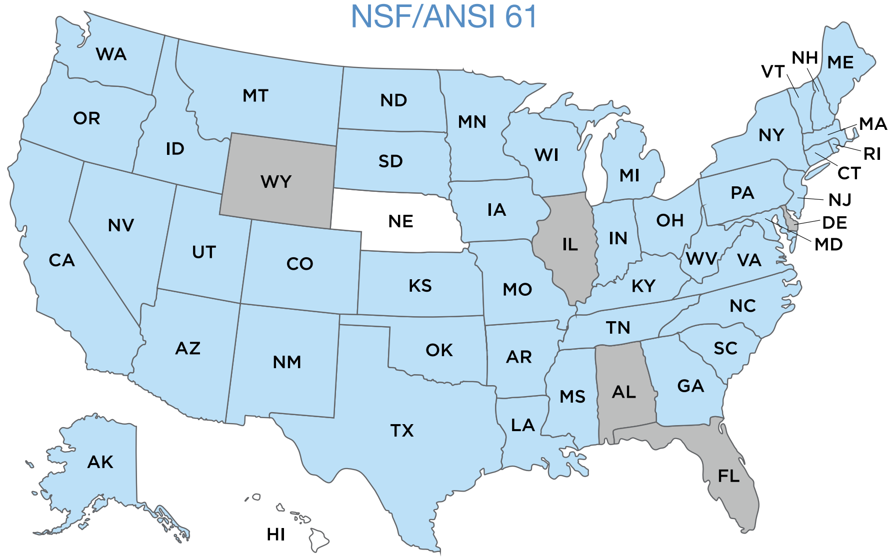
- NSF/ANSI 61: 48 states have legislation, regulations or policies requiring drinking water system components to comply with or be certified to NSF/ANSI 61.
- NSF/ANSI 223: This standard establishes requirements for minimum inspection frequencies and minimum product test frequencies for surveillance activities associated with the certification of treatment chemicals. There are requirements for increased surveillance activities for production facilities located in countries where there is significant international perception of corruption and also increased audit frequencies for facilities that are found to have significant variances from the requirements of NSF/ANSI 60. As of June 2016, this standard has not been adopted in any U.S. state.
- NSF/ANSI 372: Eight states have legislation, regulations or policies requiring drinking water system components to comply with or be certified to NSF/ANSI 372. This includes seven states that have regulations and one state that has a policy.

Certification or compliance to NSF standards is also required in many Canadian provinces and territories. For further information, please contact **americas@nsf.org.**

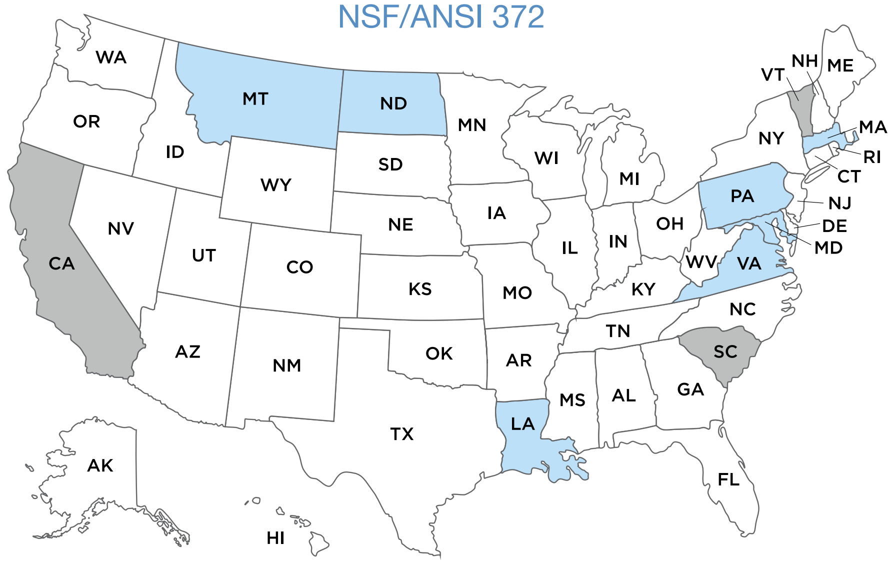
NSF/ANSI 61



ANSI-Accredited Certification Required
Compliance with NSF 61 Required or Recommended
No State Requirement for NSF 61*

Local Requirements may still apply.

NSF/ANSI 372



Requirements for NSF 372
Requirements for Compliance to 0.25% Lead Content
No State Requirements for NSF 372 or 0.25% Lead Content

Common NSF Marks for Products in Utilities

By Suzan Somo

The NSF Mark is your assurance that a product has been tested by one of the most respected independent certification organizations in existence today. It is valued by consumers, manufacturers, retailers and regulatory agencies worldwide at the local, state and federal levels. The NSF certification mark means that the product complies with all standard requirements.

Examples of NSF/ANSI 61 Marks and Dual Certification Marks

NSF Standard B/W Mark	NSF Standard Blue Mark (see color reqs. in PP-1)	NSF Standard Text Mark (for Products with Size/ Design Constraints)	Description and Use Requirements
NSF® Certified to NSF/ANSI 61	NSF® Certified to NSF/ANSI 61	NSF® - 61	Standard NSF Certification mark for NSF/ANSI 61 - Packages, containers, documentation, or individual drinking water system components certified by NSF as shall bear this NSF mark.
NSF® Certified to NSF/ANSI 61 Section 9	NSF® Certified to NSF/ANSI 61 Section 9	NSF® - 61/9	NSF Certification mark for NSF/ANSI 61, Section 9 - Packages, containers, documentation, or individual drinking water system components certified by NSF as may bear this mark. *Note: Products certified to NSF-61, Section 9 may use either the NSF-61/9 or NSF-61 mark, or both.*
NSF® Certified to NSF/ANSI 61-G	NSF® Certified to NSF/ANSI 61-G	NSF®-61-G	Products certified by NSF against the requirements of NSF/ANSI 61 and NSF/ANSI 372 may identify that compliance by utilizing this mark.
NSF® Certified to NSF/ANSI 61 & 372	NSF® Certified to NSF/ANSI 61 & 372	NSF®-61-372	Products certified by NSF against the requirements of NSF/ANSI 61 and NSF/ANSI 372 may identify that compliance by utilizing this mark.
NSF® Certified to NSF/ANSI 61-G & 372	NSF® Certified to NSF/ANSI 61-G & 372	NSF®-61-G-372	Products certified by NSF against the requirements of NSF/ANSI 61 and NSF/ANSI 372 may identify that compliance by utilizing this mark.

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Examples of NSF/ANSI 372 Marks

NSF® Certified to NSF/ANSI 372 | NSF® Certified to NSF/ANSI 372 | NSF® Certified to NSF/ANSI 372

Examples of NSF/ANSI 60 Marks

NSF® Certified to NSF/ANSI 60 | NSF® Certified to NSF/ANSI 60 | NSF® Certified to NSF/ANSI 60

Circle vs. Text Mark

NSF Circle Certification Mark	Description and Use Requirements
NSF® Certified to NSF/ANSI 61	This certification mark is for use on packaging or bills of lading. Must have NSF approval to use this mark.

NSF Text Mark (blue or black is acceptable)	Description and Use Requirements
NSF® - 61 NSF® - 61	The text version of the mark is for use with certified products with design or space constraints. Must have NSF approval to use this text mark.

Questions about the use of any NSF Mark can be directed to watermarketing@nsf.org.

FAQ Section

by Suzan Somo

NSF/ANSI 61, NSF/ANSI 372, Annex G and Lead Content – how do they relate?

While NSF/ANSI 61 establishes limits for the amount of lead that may migrate into drinking water from the water contact materials within a drinking water product, NSF/ANSI 372 establishes a limit on the amount of lead that may be contained within the water contact materials in a drinking water contact product. NSF/ANSI 372 may be used in conjunction with NSF/ANSI 61 for the purpose of minimizing lead from drinking water products.

Prior to being developed as NSF/ANSI 372, part of the content of this standard was established as NSF/ANSI 61, Annex G – Weighted average lead content evaluation procedure to a 0.25% lead requirement. The need for creating Annex G was the spread of individual state regulatory requirements limiting the amount of lead that may be contained in products contacting drinking water. While Annex G was an optional evaluation method within NSF/ANSI 61, it required that products also meet the chemical extraction requirements of NSF/ANSI 61 and it was limited in application to drinking water products that were included within the scope of NSF/ANSI 61. It was determined by the NSF Joint Committee on Drinking Water Additives – System Components, that a separate standard addressing lead content requirements (i.e. NSF/ANSI 372) would provide greater flexibility in the application of the lead content requirements to the marketplace and to organizations seeking to reference such requirements.

Today, although Annex G has been retired from NSF/ANSI 61, NSF continues to support the "-G" certification marks as long as they are of value. These marks help to provide a simple mechanism of denoting compliance with both the chemical extraction requirements of NSF/ANSI 61 and the "lead-free" requirements of U.S. state and federal laws.

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NSF/ANSI 61 vs. NSF/ANSI 14 and the PW Mark – how do they differ?

While NSF/ANSI 61 establishes minimum health effects requirements for the chemical contaminants and impurities that are directly imparted to drinking water from products, components and materials used in drinking water systems, this standard does not establish performance requirements for drinking water system products, components, or materials. *NSF/ANSI 14: Plastics Piping System Components and Related Materials* establishes minimum physical, performance and health effects requirements for plastics piping system components and related materials.

The physical, performance and health effects requirements of NSF/ANSI 14 apply to thermoplastic and thermoset plastic piping system components, including pipes, fittings, valves, joining materials, gaskets and appurtenances. NSF/ANSI 14 also applies to materials (resin or blended compounds) and ingredients used to manufacture plastic piping system components. All major plumbing codes require that plastic piping products comply with NSF/ANSI 14, including the Uniform Plumbing Code (UPC).

Products, components and materials meeting the applicable requirements of NSF/ANSI 14, applicable performance standards (ASTM, AWWA, ASME, CSA) for pressure-rated applications, long-term strength of plastic pipe requirements and NSF/ANSI 61 health effects requirements may use the following NSF PW (potable water) marks:

NSF/ANSI 61 and Stainless Steel

By Theresa Bellish

Stainless steel pipe, fittings and other products are suitable for use with drinking water and provide excellent corrosion resistance if the material is welded and processed correctly. However, if inappropriate or inadequate welding or passivation processes are used, the products can be subject to corrosion and leach harmful contaminants such as chromium VI into drinking water.

It is a misunderstanding that if a grade of stainless steel appears in Annex C of NSF/ANSI 61 that any product manufactured solely from that alloy can be represented as certified to NSF/ANSI 61, or that anyone without the NSF/ANSI 61 certification can "self perform" leach tests and deem the product NSF certified. Installers and consumers of stainless steel products wishing to use products certified to NSF/ANSI 61 must obtain them from companies that appear in the NSF International listings of NSF/ANSI 61 certified products at: **http://www.nsf.org/Certified/PwsComponents**.

Several grades of stainless steel are listed in NSF/ANSI 61, Annex C. These grades have standard material formulations or specifications (ASTM, SAE) and have been tested to the requirements of NSF/ANSI 61 at specific surface area-to-volume ratios and at certain temperatures (23°C and 30°C, but not at 60°C or 82°C). The stainless steel grades currently listed in Annex C are 304, 304L, 316, 316L, 2205, 2203, 2101, 2304 and 2202. NSF will consider additional material grades but will require additional testing to ensure compliance before adding to Annex C. Manufacturers utilizing these materials in their products under the conditions stated in Annex C may require less product testing to achieve certification. However, if the components are welded or subject to passivation or other processing, the final product will require testing for certification. Also, if the products are used with domestic or commercial hot water, they will also require testing at that temperature.

Stainless steel products that are certified by NSF to NSF/ANSI 61 allow potable water system producers and operators to be certain they are installing tested, quality products that comply with regulatory requirements and protect public health.

NSF/ANSI 61 is the only American National Standard addressing the human health effects of drinking water system components. As an approved standard of the American National Standards Institute, NSF/ANSI 61 is the legally recognized national standard in the United States for the human health effects of drinking water contact materials, components and devices. This standard forms the basis of the regulatory framework and public health protection for controlling the health effects of drinking water contact materials across the U.S. and Canada. It has also been used as a specification by water utilities around the world in countries including South Korea, Saudi Arabia and UAE. The majority of U.S. states and Canadian provinces currently require municipal drinking water system components to comply with the requirements of NSF/ANSI 61.

NSF/ANSI 61 is a health effects standard that evaluates the amount of contaminants that leach from the products into drinking water, rather than setting prescriptive limits on content. This differs from U.S. Food and Drug Administration (FDA) requirements that are based on prescriptive content requirements.

NSF/ANSI 61 requires analysis for any chemicals that leach from a material into drinking water and it requires a toxicological evaluation of chemical concentrations to ensure that they are below levels that may cause potential adverse human health effects. The toxicological evaluation criteria are based on lifetime exposure to the concentration of contaminants in drinking water.

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NSF International Certification of Products to NSF/ANSI 61

For stainless steel products, NSF offers certification for both the pipe and fitting manufacturers, as well as fabrication shops that weld NSF/ANSI 61 certified pipe and fittings into pipe spool assemblies. NSF listings for certified stainless steel pipe and fitting manufacturers, as well as fabrication shops that assemble pipe spools are updated daily and available at: **http://www.nsf.org/certified-products-systems**.

The NSF certification process requires a disclosure by the pipe and fitting manufacturer of all water contact materials in the product, and a disclosure of the production and passivation processes. NSF toxicologists perform a formulation review of each water contact material to determine any possible ingredients, contaminants or reaction by-products that may potentially leach from the material into drinking water. This formulation review then determines the battery of chemical analyses that will be performed on a particular material.

The testing of the finished product is performed by exposing the product to pH 5 and pH 10 waters and analyzing for regulated metals such as antimony, arsenic, barium, cadmium, chromium (including chromium VI), copper, lead, mercury, selenium, thallium and nickel. The product is also exposed to pH 8 water which is tested for organic chemical contaminants that could leach out into the water. Contaminants from stainless steel products may derive from the welding, machining or passivation process.

The certification process covers two separate applications: ambient/cold water use, which is tested at 23°C, and domestic or commercial hot water requirements, which are tested at 60°C or 82°C. It is important to note that if the pipe will be used with hot water, the official NSF certification listing needs to indicate that it is suitable for use with domestic or commercial hot water.

NSF then conducts an inspection of the production facility to verify the product formulation and production process and to ensure adequate quality control procedures are in place to prevent the use of unauthorized materials or procedures.

For pipe fabricators and pipe and fitting manufacturers, NSF requires annual unannounced audits to verify the sources and certification of the materials they are using. Samples are also collected for annual exposure testing to verify that no harmful levels of contaminants are leaching out of the product into drinking water.

For questions concerning certification of products to NSF/ANSI 61, please contact **americas@nsf.org**.

NSF/ANSI 419: A National Standard for Membrane Filtration

By Theresa Bellish

NSF/ANSI 419: Public Drinking Water Equipment Performance - Filtration, is an NSF/ANSI national standard for microfiltration (MF) and ultrafiltration (UF) membrane modules, as well as bag and cartridge filter systems. This standard establishes performance testing protocols that are consistent with the product-specific microbial challenge testing requirements for Cryptosporidium removal credits under the U.S. EPA Long-Term 2 Enhanced Surface Water Treatment Rule (LT2 Rule).

NSF International formerly hosted the U.S. EPA Environmental Technology Verification (ETV) Program Drinking Water Systems Center. Upon notification from U.S. EPA that the EPA ETV program would end in 2014, NSF elected to convert the existing ETV membrane protocol into an NSF/ANSI standard. The result was NSF/ANSI 419, which was published in January 2015.

NSF/ANSI 419 allows for a Cryptosporidium removal performance certification to accompany certification to NSF/ANSI 61, which covers health effects certification for wetted materials.

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With the NSF/ANSI 419 performance standard for membrane modules, states can be assured that test data generated following the standard's testing protocol is of high quality, and that a consensus test protocol was followed to generate the test data. States can also be assured that material and part changes are being monitored, and the manufacturing QC records are being periodically inspected. This NSF certification program requires annual auditing of the manufacturing facility. During this audit, the bill of materials on file is compared to the NSF wetted parts list to verify that no unauthorized material changes have been made. The audit also includes inspection of the manufacturing QC test records.

The NSF standards process is an ideal format for the relatively new and dynamic field of membrane water treatment for LT2 Rule credits, and beyond, as states also consider removal credits for other microorganisms, including viruses. Utility and state agencies can verify product compliance with NSF/ANSI 419 through NSF's certification listings instead of spending days reviewing validation reports.

The NSF/ANSI standards are living documents that can be continuously improved to ensure they are current and technically sound. The NSF standards process provides a platform to address in a timely manner stakeholder comments and concerns, recent scientific advances, emerging pathogens and lessons learned from recent testing activities.

NSF Training and Education Services

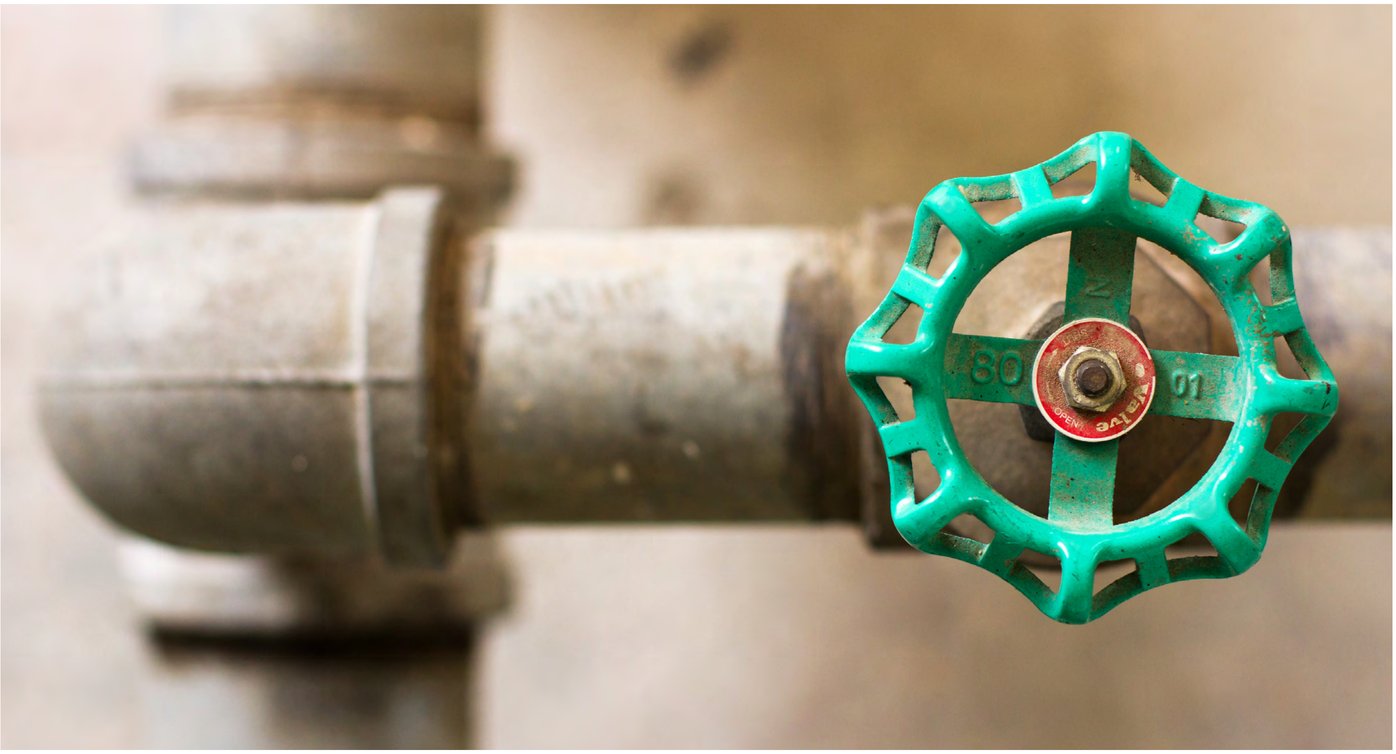
By Theresa Bellish

NSF International will provide free webinars for water utilities, state drinking water agencies and public health officials interested in updates on NSF/ANSI 60, NSF/ANSI 61 or other NSF standards. Content can be tailored to meet specific training goals including:

- Certification of UV membranes to LT2 requirements
- Concrete site mix evaluation program
- Pool chemical certification under NSF/ANSI 50
- Other issues of interest to specific agencies

This complimentary service is an important resource for many state and local health departments and water utilities that need information or training on NSF standards or product certifications. If you are interested in having NSF conduct a webinar or other training platform such as on-site classroom training, please contact:

Stan Hazan, Senior Director of Regulatory Affairs, at **hazan@nsf.org.**



Occurrence of UCMR Chemicals in Drinking Water Materials and Chemicals

By Peter Greiner and Dave Purkiss

Water systems are monitoring for a wide variety of contaminants that are being reviewed for possible future regulations as part of the Unregulated Contaminant Monitoring (UCM)[1] program. NSF International reviewed testing results for drinking water contact materials and treatment chemicals that had been evaluated to the requirements of NSF/ANSI 60 and 61 for the presence of these contaminants.

NSF/ANSI 60 and 61 cover both regulated and unregulated contaminants that treatment chemicals and water contact materials contribute to drinking water. Levels and frequencies of UCM contaminants such as chlorate, chromium VI, nitrosamines, perchlorate and a variety of other contaminants were detected in the evaluation of drinking water treatment chemicals and materials in water treatment and distribution products. In some cases, these levels exceeded the allowable thresholds of the NSF standards and therefore may contribute to compliance problems in the future if contaminants become regulated with established EPA drinking water standards.

1 USEPA (2015) Unregulated Contaminant Monitoring Rule, http://water.epa.gov/lawsregs/sdwa/ucmr

Background

The U.S. EPA has used the UCM program since 2003 to collect data for contaminants that may be present in drinking water, but are not regulated and do not have established EPA maximum contaminant levels (MCL). There have been three rounds of monitoring to date. Round one took place between 2001 and 2005 and involved monitoring for 24 chemicals and one microbial contaminant. Round two occurred between 2007 and 2011 and monitored 25 chemical

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contaminants. Round three is currently underway and requires monitoring for 28 chemicals and two microbial contaminants.

NSF/ANSI 60: Drinking Water Treatment Chemicals- Health Effects and *NSF/ANSI 61: Drinking Water System Components – Health Effects* were established in 1988 following a request for proposals from the U.S. EPA that was awarded to an NSF led consortium in 1984. Currently 48 U.S. states and most Canadian provinces and territories require compliance or third-party certification of water treatment chemicals and water contact materials to the NSF standards.

While there are various sources of contaminants that have been surveyed in the UCM program, it is important to control for additional levels that may be added by materials and chemicals that are used in water treatment or distribution products. Identifying these product sources years before regulations are implemented allows time for industry to possibly reformulate and remove or reduce the potential for these products to contribute these contaminants to water.

The American National Standard NSF/ANSI 60 establishes health-based criteria for drinking water treatment chemicals and any associated contaminants. It was developed to ensure treatment chemicals do not add unsafe levels of chemicals or contaminants to drinking water. It requires an evaluation to ensure contaminants associated with the chemical will not exceed established thresholds when the treatment chemical is dosed at the manufacturer's stated maximum use level.

Certification requires a review of the formulation to identify residual ingredients, reaction by-products or contaminants that may contaminate drinking water. An inspection of the manufacturing facility is required to verify the product formulation and raw materials used. The treatment chemical is tested, which typically involves dosing the chemical into reagent water at 10 times the maximum use levels so that trace amounts of contaminants can be detected. Contaminant concentrations are then mathematically adjusted to reflect the concentration expected when the treatment chemical is dosed at the manufacturer's specified maximum use level. These concentrations are then compared against health-based criteria. If contaminants are regulated by the U.S. EPA or Health Canada, the single product allowable concentration (SPAC) is typically one-tenth of the EPA MCL or the Canadian MAC. If contaminants are not regulated by the U.S. EPA or covered by Health Canada guidelines, a total allowable concentration (TAC) is established via risk assessment procedures in Annex A of the NSF standard, which is intended to provide an equivalent level of protection as an MCL or MAC. A SPAC for the unregulated contaminant under the standard would then be one-tenth that of the TAC.

The American National Standard NSF/ANSI 61 establishes health-based criteria for materials in drinking water treatment and distribution equipment. It covers products used in source water extraction, drinking water treatment and distribution systems, and plumbing products in buildings. The evaluation process is similar to NSF/ANSI 60, involving a review of each water contact material formulation to identify chemicals that may contaminate drinking water.

Products are exposed to various formulated waters for defined exposure periods and the exposure water is analyzed for any chemical contaminant that the material contributes to the water. Contaminant concentrations are then mathematically adjusted to reflect the concentration expected when the product is used in the field. These concentrations are then compared against health-based criteria of the TACs and SPACs in NSF/ANSI 61.

Review of the Test Results

A review of NSF/ANSI 60 and NSF/ANSI 61 test results for the presence of UCM contaminants was performed for all products submitted to NSF for testing between 2008 and 2013. The total number of analyses for the contaminant and the number that exceeded the TAC were recorded to indicate the potential for products that could cause compliance

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issues if regulatory standards were established at levels similar to the NSF/ANSI 60 and 61 criteria. Since NSF/ANSI 61 addresses materials, components and devices, in many cases the exact material source could not be identified because the device tested had multiple materials. These results are marked "Unknown" in the table below.

Contaminant	# of Analyses	# of Hits	#>TAC	TAC mg/L	Product Source
Chlorate	127	42	0	1	Sodium Hypochlorite
Cobalt	317	42	6	0.003	Brass, Stainless Steel, Unknown
Chromium VI	9800	25	6	0.020	Chrome, Stainless Steel, Cement, Concrete, Unknown
Molybdenum	329	55	3	0.040	Stainless Steel
Nitrosamines					
Nitrosodiethylamine	128	42	6	$6x10^{-6}$	NBR, SBR, EPDM
Nitrosodimethylamine	128	84	4	$7x10^{-6}$	NBR, SBR, EPDM
Nitrosodi-n-butylamine	128	65	2	$6x10^{-5}$	NBR, SBR, EPDM
Perchlorate	358	78	0	0.015	Sodium Hypochlorite
Perchlorate	13	4	1	0.015	PVC, CPVC
VOCs					
Chloromethane	11,500	1	1	0.030	Unknown
Bromomethane	11,500	24	0	0.010	Unknown
1,3 butadiene	11,500	64	0	0.100	Unknown
1,2,3 trichloropropane	11,500	1	0	0.040	Unknown

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The UCM program has covered 77 different chemical contaminants to date. Thirteen were found to be contributed by drinking water products evaluated by NSF International to NSF/ANSI 60 or 61 over the period of 2008-2013.

The occurrence of chlorate and perchlorate has been well documented in sodium hypochlorite as have the factors that influence the concentration increase with age[1]. Hypochlorite degrades into chlorate which further degrades into perchlorate. The concentration increases with time, increased temperature and concentration. pH, ionic strength and some metals also influence the degradation rate.

While the presence of perchlorate was found in a number of hypochlorite samples evaluated to NSF/ANSI 60, none exceeded the TAC. Chlorate was found in a large number of samples, with the highest concentrations found at repackaging facilities, reflecting the influence of age on concentration.

Chilling hypochlorite before shipping and diluting hypochlorite upon receipt are the primary methods for controlling the degradation into chlorate and perchlorate. AWWA B-300[2] contains recommendations for the handling and storage of hypochlorite and the AWWA website[3] contains a hypochlorite calculator that can be used to predict the concentration of these contaminants based on the storage conditions, age and concentration of the hypochlorite.

1 Standford, Benjamin. (2011) Perchlorate, bromated, and chlorate in hypochlorite solutions, AWWA Journal, Vol. 103, No. 6
2 AWWA (2011) AWWA-B300- Hypochlorites
3 AWWA (2015) Hypochlorite Assessment Model, www.awwa.org

A very small percentage of products evaluated to NSF/ANSI 61 has been found to contribute chromium VI to water. This includes a few chrome-plated products, cements and concrete as well as some stainless steel products. A few stainless steel products also contributed molybdenum and cobalt to water.

Elastomeric materials have been reported to contribute nitrosamines to drinking water[4]. The data review found several SBR, NBR and EPDM products yielded various types of nitrosamines which have very low health effects thresholds. The elastomer industry has now developed nitrosamine-free accelerators which may address this issue.

Only a very few products had detections for the volatile organic chemicals contained in the UCM program and could not be related to any specific material.

4 Morran, et al. (2011) Nitrosamines from Pipeline Materials in Drinking Water Distribution Systems, Journal AWWA, Vol.103, No.10

Hypochlorite Treatment Chemicals Specifications in NSF/ANSI Standard 60

By Blake Stark

The U.S. EPA enacted the Disinfectants/Disinfection Byproducts Rules to reduce drinking water exposure to disinfection byproducts. In many cases, disinfection of water is necessary to inactivate (or kill) microbial pathogens. However, disinfectant chemicals can react with naturally occurring materials in the water to form byproducts, some of which may increase health risks if consumed over many years in excess of the EPA's standard. This article focuses on test parameters in NSF/ANSI 60 for hypochlorite chemicals, which are used commonly for disinfection of drinking water, and how these parameters may be used as a screening tool for many contaminants which are regulated under the disinfection byproducts regulations.

Bromate

The EPA Disinfectants and Disinfection Byproducts Rule establishes an MCL of 10 ppb for bromate ion. As hypochlorite treatment chemicals, in addition to ozonation systems, are a known potential contributing source of bromate ion to drinking water, the single product allowable concentration (SPAC) for bromate in NSF/ANSI 60 was established at 3.3 ppb (one-third of the EPA MCL). Thus, an NSF/ANSI 60 compliant chemical is verified not to contribute more than 3.3 ppb bromate ion, when dosed into drinking water at its maximum use level.

In addition, as many water utilities manufacture sodium hypochlorite chemicals through on-site hypochlorite generators (in lieu of, or in addition to, purchased bleach), criteria were also established in NSF/ANSI 60 to address the bromate-forming potential of sodium chloride salt, which is used as the feedstock for on-site hypochlorite generators. Many natural salt formations contain a small level of bromide, which can form and release bromate ion during the electrochlorination process when hypochlorite effluent is generated. Under the NSF/ANSI 60 requirements for electrochlorination salt:

> Each certified manufacturer provides a declaration of the maximum bromide concentration of the product. Analytical verification is then made by the product certifier, on an annual basis, that the product's bromide concentration is less than or equal to the product specification.

> The product's bromide specification may not exceed 59/kg in sodium chloride salt for electrolytic hypochlorite generators at a maximum feed rate of 10 mg/L (as chlorine)$^{+}$.

> A higher concentration of bromide is permitted in NaCl salt used in generators that deliver lower maximum feed concentrations of chlorine, so that the total concentration of bromate does not exceed 3.3 ppb.

> +The 50 mg/kg limit is based on a base assumption that 3.3 ug/L (ppb) bromate will be produced from 3.5 pounds of NaCl containing 59 mg/kg bromide with 15 gallons of water to produce (via electrolysis) one pound of free available chlorine (FAC) equivalent disinfectant and dosed to affect a 10 mg/L FAC in the finished drinking water.

Perchlorate

Following the EPA draft health advisory of 15 ppb for perchlorate, and state regulatory limits for perchlorate established in California (6 ppb) and Massachusetts (2 ppb), NSF/ANSI 60 includes a general perchlorate SPAC/limit of 5 ppb (one-third of the EPA health advisory level) for all hypochlorite products. In addition, bleach manufacturers

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may also have products evaluated and certified to the California SPAC of 2 ppb (one-third of the CA state MCL) or a Massachusetts SPAC of 0.7 ppb (one-third of the MA state MCL), for special evaluations tailored to these state regulatory limits.

Chlorate

NSF/ANSI 60 includes pass/fail criteria for chlorate as a required test parameter. A Health Canada guideline of 1 ppm has been established for chlorate. Accordingly, a SPAC for chlorate of 300 ppb (one-third of the Health Canada Guideline) is in place as evaluation criteria for chlorate in bleach chemicals.

As the concentration of perchlorate and chlorate in sodium hypochlorite has been shown to increase over time (as bleach is stored), a corresponding update to the labeling requirements in NSF/ANSI 60 requires a born-on date (original bleach manufacturing date) and any subsequent bleach repackaging dates to be shown on the product label or other documentation provided with the product shipment. This enables water utility operators to take steps to prevent accumulation of significant levels of chlorate and perchlorate in stocks of hypochlorite.

The Southern Nevada Water Authority completed an American Water Works Association (AWWA)/Water Research Foundation (WRF) sponsored study in 2009, *Hypochlorite-An Assessment of Factors that Influence the Formation of Perchlorate and Other Contaminants*. Whereas NSF/ANSI 60 is a health effects standard for the chemical vendors/products, many recommendations from the Southern Nevada study relate to the storage, use and handling of sodium hypochlorite by water utilities. These recommendations were incorporated into the AWWA B300 Hypochlorites Standard and include the following instructions:

- Dilute hypochlorite solutions on delivery. Dilute a 15 percent solution by a factor of 2, which decreases perchlorate formation by a factor of 7.
- Reduce storage temperature. Each 5 degree reduction in temperature reduces the rate of decomposition by a factor of 2.
- Control pH between 11 and 13. Below pH 11, chlorate formation increases. Above pH 13, perchlorate formation increases. On-site generators typically are between pH 9-10 and the solutions should be used within one to two days.
- Control the concentration of metal ions. Purchase filtered sodium hypochlorite solutions and use low metal ion concentration feed water for on-site generators.
- Use fresh hypochlorite solutions when possible.
- Use a low bromide salt in on-site generators to reduce the formation of bromate.

For additional information, please contact Blake Stark at **stark@nsf.org**.

A New NSF Standard for Pool Chemicals

By Blake Stark

Swimming pool chlorination is a long-standing practice that helps improve the safety of pools and reduces the incidence of communicable diseases. Many newer techniques to disinfect and treat swimming pool water have recently come on the market, such as chemical disinfectants and other types of chemicals, some of which could be used as alternatives to chlorination. However, while pool and spa disinfectants have been regulated by U.S. EPA, no U.S. regulations addressed the potential health effects of other types of pool chemicals. Some states required pool chemicals to conform to the NSF International standard for drinking water treatment chemicals, NSF/ANSI 60, but that standard isn't ideal for assessing oral exposure to pool water and lacks the methodology to evaluate dermal and inhalation effects. The overall lack of an adequate method to assess the health effects of pool chemicals prompted public health officials to propose to the NSF/ANSI 50 committee the development of new criteria to assess pool and spa chemicals. A task group was formed in 2012 to develop the criteria and worked with public health professionals, recreational water facility operators, treatment chemical manufacturers, state agencies and officials with the U.S. EPA Office of Pesticides.

These resulting criteria for pool treatment chemicals were incorporated as testing and evaluation requirements in *NSF/ANSI 50: Equipment for Pools, Spas, Hot Tubs and Other Recreational Water Facilities* in fall, 2015. The criteria for pool chemicals in NSF/ANSI 50 focus primarily on health effects, which is especially important for chemicals not covered by the scope of the U.S. EPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requirements, such as disinfectants, algaecides and other biocides, which undergo a separate evaluation/registration through the U.S. EPA Office of Pesticides. Disinfectants, algaecides and other biocides that are registered by the agency are not subject to the additional risk assessment criteria of the new requirements in NSF/ANSI 50; however, such chemicals are still tested for contaminants.

Toxicology Review and Evaluation Procedures for Swimming Pool Treatment Chemicals

NSF/ANSI 50 contains these requirements for evaluating and reviewing swimming pool treatment chemicals:

- Detailed product formulation information shall be obtained that allows for the identification of all unique chemical components of the product, as well as the concentrations of each component. Additionally, the maximum recommended dose rate of the product shall be provided.
- Based on formulation information and label or use instructions, the concentration of each swimming pool treatment chemical (and/or contaminants) in the swimming pool water following dosing at the maximum recommended dose rate shall be calculated.
- As an initial toxicity screening evaluation, any chemical constituent (or contaminant) in the product formulation that has a concentration in the swimming pool water of ≤ 10µg/L at the maximum recommended dose does not require further toxicology evaluation. This threshold value shall not apply to any substance for which available toxicity data and sound scientific judgment indicate a significantly increased risk for an adverse health effect at a swimming pool water concentration at or below 10µg/L. All chemical constituents (or contaminants) that exceed the 10µg/L threshold at or below the maximum recommended dose require additional evaluation.
- For chemical constituents (or contaminants) with concentrations in the swimming pool water that exceed 10µg/L at or below the maximum recommended dose, an exposure assessment shall be performed utilizing equations and assumptions prescribed in the new standard.
- Following the determination of exposure levels (in mg/kg-day) for chemical constituents (or contaminants) with concentrations in the swimming pool water that exceed 10µg/L at or below the maximum recommended dose, the procedure defines several approaches that may be utilized to determine the acceptability of the calculated exposure.
- A determination shall be made as to whether a published (publicly available in printed or electronic format) and peer-reviewed, quantitative risk assessment for the chronic exposure to the substance is available. When a quantitative risk assessment is available, the assessment and its corresponding reference dose shall be reviewed for their appropriateness in evaluating the human health risk of the swimming pool treatment chemical constituent (or contaminant).
- As an alternative approach, the total allowable concentration (TAC) values as reported in NSF/ANSI 60 and NSF/ANSI 61 may be utilized if available for the specific chemical constituent (or contaminant) by converting the TAC value into a mg/kg-day rate by utilizing default body weight and drinking water consumption assumptions (70 kg and 2 L), respectively. The resulting mg/kg-day rate may be compared with the estimated exposure at the maximum recommended dose to determine acceptability.
- If a TAC value or other published risk assessment value is unavailable, a risk assessment for the specific chemical constituent (or contaminant) may be conducted in accordance with the procedures outlined. However, in lieu of determining a TAC value, the identified point of departure may be utilized to conduct a margin of exposure (MoE) analysis.
- If a TAC value or other published risk assessment value is unavailable and there are insufficient toxicity data from which to perform a risk assessment, the chemical exposure cannot be assessed and presence of the chemical in the formulation is precluded at a concentration in the swimming pool water of greater than 10ug/L.

New NSF/ANSI 223 Establishes Minimum Requirements for NSF/ANSI 60 Product Certifiers

By Blake Stark

In recent years, the NSF International Joint Committee on Drinking Water Treatment Chemicals and the NSF Council of Public Health Consultants (CPHC) adopted NSF/ANSI 223: Conformity Assessment Requirements for Certification Bodies that Certify Products Pursuant to NSF/ANSI 60: Drinking Water Treatment Chemicals-Health Effects. This standard establishes minimum requirements for certification organizations to be used in evaluating and certifying products to NSF/ANSI 60.

Background

The California Code of Regulations (CCR) was updated on March 9, 2008 to require annual recertification of drinking water treatment chemicals to NSF/ANSI 60. This change was prompted by concerns that, while some certification organizations provided annual retesting of treatment chemicals, other organizations allowed for up to five years in between product retests - a period considered too long by public health norms. In 2009, Section 3.8 (Conformity Assessment), which contained minimum product testing and facility inspection requirements, was incorporated into NSF/ANSI 60-2009a. However, it was decided that requirements for the conformity assessment process (e.g. facility inspections, periodic retest requirements) would better serve the public health and industry stakeholders if placed in a separate conformity assessment standard specific to certification agencies. To accomplish this, NSF convened a Conformity Assessment Task Group composed of water utility personnel, drinking water supply regulators, ANSI-accredited NSF/ANSI 60 product certifiers and several manufacturers/distributors of treatment chemicals to develop NSF/ANSI 223.

Purpose and Scope of NSF/ANSI 223

NSF/ANSI 223 covers the minimum requirements to be used by conformity assessment organizations when testing and certifying products to NSF/ANSI 60. These requirements are supplemental to those contained in ISO/IEC 17065 and do not replace the requirements in the ISO standard. NSF/ANSI 223 requirements include documentation reviews, product testing and facility inspections conducted during surveillance. Minimum facility inspection requirements are defined, as are the conditions under which announced inspections are allowed in lieu of unannounced inspections. In addition, an informative annex has been included to provide examples of conformity

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assessment activities drawn from the experiences of accredited NSF/ANSI 60 product certifiers. Two of the major requirements of NSF/ANSI 223 are with respect to product testing and facility audits:

Product Testing (NSF/ANSI 223, Section 4)

Each chemical product that is certified to NSF/ANSI 60 shall be sampled and tested at least once per calendar year. This includes the chemistry-specific parameters identified in NSF/ANSI 60 and any additional parameters (if applicable) that are assigned during the product's formulation review. Within each chemical family, the product with the highest concentration may be tested as the representative of a series of analogous lower concentration products. Also, for a facility that blends, dilutes, dissolves, repackages or transfers products (where each of the original/incoming source products is certified on its own), a minimum of one product sample per facility shall be tested annually.

Facility Audits (NSF/ANSI 223, Section 5)

NSF/ANSI 223 establishes minimum audit content/scope criteria which include validation of product formulations, review of records related to formulation control and product sampling. The standard also establishes minimum audit frequency criteria for NSF/ANSI 60 certified facilities. Each certified chemical production or distribution facility shall be audited a minimum of once per calendar year. Facilities that have had severe and/or repeated non-compliances related to NSF/ANSI 60 certification shall have a quarterly minimum audit frequency for a time period of no less than 36 months (reference Section 5.2.2 for details). In addition, NSF/ANSI 223 prescribes an increased audit frequency for some international facilities:

- Facilities located in countries that have a score of less than 50 on the TI CPI, or that lack a score on this index, shall have a minimum audit frequency of twice per calendar year (reference Section 5.2.3 for details). The facility may reduce this to an annual audit frequency if:
    - The facility has demonstrated and maintained 36 months of continuous freedom from Standard 60-related audit deficiencies; or
    - The facility is registered to one of the following quality or environmental management standards by a third-party registrar

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(that is accredited by an International Accreditation Forum signatory): ISO 9001, ISO 14000/14001, American Chemistry Council's Responsible Care Management System® or the National Association of Chemical Distributors' Code of Management Practice; or

- o The facility is part of a wholly-owned global business entity or joint venture where all parties are operating under a quality management plan as described above.

> Facilities that repackage/distribute material that is supplied by a facility located in a country with a TI CPI score under 50 shall have a minimum audit frequency of twice per calendar year (reference Section 5.2.4 for details). The certification body has the option to reduce the inspection frequency to once per calendar year if the supplying facility meets one of the following criteria:

- o The supplier to the facility receives audits from a certification body that is accredited by an International Accreditation Forum signatory.
- o The chemical repackager/distributor has an alternate method that is acceptable to the certification body, which provides a mechanism to verify that no changes have been made to the supplied product.

For more information, or for a copy of NSF/ANSI 223, contact Blake Stark at **stark@nsf.org**.

What is the Transparency International Corruption Perceptions Index?

Transparency International's (TI) Corruption Perceptions Index (CPI) is constructed to aid international businesses in understanding the conditions they will face in the different countries in which they do business. The index has been constructed annually since 1995 for TI by Professor Johann Graf Lambsdorff of the University of Passau. The process sources 16 independent surveys of countries, and a country must appear in at least three of these sources in order for a score to be calculated. A score of 50 or lower on the CPI indicates that corruption is a significant factor in doing business in that country. As production moves to a wider variety of source countries and raw material sourcing is further diversified due to cost considerations, a method is needed to differentiate locations where oversight can be relaxed, and where it must be maintained. This external source of such judgments is the method most commonly used worldwide.

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References

USEPA (2015) Unregulated Contaminant Monitoring Rule, **http://water.epa.gov/lawsregs/sdwa/ucmr**

NSF International (2014) NSF/ANSI 60: Drinking Water Treatment Chemicals – Health Effects

NSF International (2014) NSF/ANSI 61: Drinking Water System Components – Health Effects

NSF International (2014), Survey of ASDWA Members on the use of NSF/ANSI Standards, **www.nsf.org/newsroom_pdf/ASDWA_Survey.pdf**

Standford, Benjamin. (2011) Perchlorate, bromated, and chlorate in hypochlorite solutions, AWWA Journal, Vol. 103, No. 6

AWWA (2011) AWWA-B300- Hypochlorites

AWWA (2015) Hypochlorite Assessment Model, **www.awwa.org**

Morran, et al. (2011) Nitrosamines from Pipeline Materials in Drinking Water Distribution Systems, Journal AWWA, Vol.103, No.10

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LWD-1473-0616