NSF/ANSI 55 Requirements for Ultraviolet Systems

By Rick Andrew

Ultraviolet (UV) technology using a low-pressure mercury source has become increasingly popular for POU/POE drinking water treatment. With enough energy, UV radiation at the 254-nm wavelength has the ability to disrupt DNA in pathogenic microorganisms so they cannot reproduce, which prevents them from causing disease in people drinking the water.

As the technology becomes more and more popular, more people are becoming aware of *NSF/ANSI 55* for UV systems. I have spoken with many manufacturers and others regarding specifics of the Standard (and features that products must have in order to meet it) and have found that they often have questions. This column will help to address some of the more frequently asked questions and help explain the requirements of this standard.

Class A versus Class B

NSF/ANSI 55 separates UV systems into two distinct classes. Class A devices are designed to inactivate and/or remove microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts and *Giardia* cysts from contaminated water. Class A UV systems are not intended for the treatment of water that has an obvious contamination or intentional source, such as raw sewage, nor are they intended to convert wastewater to drinking water. They are intended to be installed on visually clear water (not colored, cloudy or turbid).

Class B systems, on the other hand, are designed for supplemental bactericidal treatment of disinfected public drinking water, or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. Class B systems are designed to reduce normally occurring, nonpathogenic nuisance microorganisms only. These systems are not intended for the disinfection of microbiologically unsafe water, and may not make individual or general cyst claims. Microbiological health effects claims may not be made on Class B systems.

UV dosage

UV dosage is the measurement of the energy delivered by UV systems, typically measured in mJ/cm^2. The more dosage a system provides, the more energy it can deliver to any microorganisms present in the water being treated. At a certain threshold, this energy becomes sufficient to inactivate most of the microorganisms present.

NSF/ANSI Standard 55 requires that Class A UV systems must deliver a high enough UV dose at 254 nm (40 mJ/cm^2) to inactivate the pathogenic microorganisms that could be responsible for causing disease through contamination of our drinking water. Class B systems are required to deliver a lesser dose of 16 mJ/cm^2 that is sufficient to inactivate nonpathogenic organisms.

This dosage is verified through the bioassay test procedure detailed in the Standard. The test must be conducted at the highest achievable flow rate through the system, with UVT reduced to 70 percent, or to the alarm set point, whichever is lower.

Alarm or fail safe

NSF/ANSI 55 requires that Class A systems have alarm and/or fail-safe design elements incorporated into them. Specifically, Class A systems must include a UV sensor. A visible sensor is not sufficient to meet the Standard—it must be a UV sensor. The UV sensor must be connected to an alarm, which provides a visual and/or audible indication that the system is not performing, and/or terminates the discharge of treated water. The Standard includes a test to ensure that the UV sensor and alarm perform properly in low-dosage conditions. Although Class B systems are not required to have a UV sensor, if they are so equipped, the sensor must meet the test requirements.

Flow control

Because UV dosage is inversely proportional to flow rate through the system, *NSF/ANSI 55* requires that UV systems must include automatic, fixed flow-rate controls to prevent excessive flow over the manufacturer's recommended operating pressure

Figure 1. Structural integrity requirements for POU/POE UV systems

Complete systems	Hydrostatic pressure test[1]	Burst pressure test[1]	Cyclic pressure test[1]
Complete systems with pressure vessels having a diameter < 203 mm (8 in.)	2.4 x maximum working pressure or 1,654 kPa (240 psig)	none	none
Complete systems with pressure vessels having a diameter of ≥ 203 mm (8 in.)	1.5 maximum working pressure or 1,040 kPa (150 psig)	none	none
Complete systems designed for open discharge[2]	1.2 x maxiumum working pressure or 867 kPa (120 psig)	none	10,000 cycles at 0 to 345 kPa (0 to 50 psig)
Complete portable systems pressurized by user[3]	1.5 maximum working pressure	none	none

range. The Standard requires that the flow rate of the system be evaluated over the manufacturer's operating pressure range and up to at least 100 psi (690 kPa), and that the bioassay testing for UV dosage must be conducted at the highest flow rate achieved by the system.

Material safety

NSF/ANSI 55 requires that the system undergo extraction testing to ensure that no contaminants are leaching from drinking water contact materials at levels of toxicological concern. Prior to extraction testing, complete formulation information on all materials in contact with drinking water must be reviewed to determine appropriate analytical treatment of the extraction water. The concept is that by completely understanding the chemical composition of all drinking water contact materials, the potential for their migration can be evaluated by appropriate laboratory analysis.

Structural integrity

POU/POE UV systems must be structurally sound so they can withstand the rigors of long-term use in residential plumbing systems and not leak. With this in mind, *NSF/ANSI 55* requires that they be tested for structural integrity. Although specific test requirements vary by product configuration, most UV systems are required to withstand an elevated pressure of 240 psi (1,654 kPa) for 15 minutes without leaking. For more detailed information, see Figure 1.

Product literature

The functionality and operating requirements of POU/POE UV systems must be clearly communicated to consumers. With this thought in mind, *NSF/ANSI 55* requires that specific information must be included in four basic pieces of product literature:

1) Installation, operation and maintenance instructions—a manual describing complete system requirements and features
2) Data plate—a permanent label on the system
3) Replacement element packaging—including information to help match up replacement elements with proper systems
4) Performance data sheet—a document summarizing performance of the system

Figure 2. Basic requirements of *NSF/ANSI 55* for POU/POE UV systems

Requirement	Class A System	Class B System
UV dosage	40 mJ/cm^2 at highest achievable flow rate with flow control in place, with UVT reduced to alarm set point or 70%, whichever is lower	16 mJ/cm^2 at highest achievable flow rate with flow control in place, with UVT reduced to 70%
UV sensor	Required	Not required
Alarm (visual, audible, termination of treated water)	Required	Not required
Flow control	Required	Required
Material safety	Formulation review for all drinking water contact	Formulation review for all drinking water contact
	materials; extraction test	materials; extraction test
Structural integrity	Testing required based on product configuration	Testing required based on product configuration
Product literature	Installation, operation, and maintenance instructions, performance data sheet, data plate, and replacement element packaging required to include specific information	Installation, operation, and maintenance instructions, performance data sheet, data plate, and replacement element packaging required to include specific information

Questions answered

As the popularity of UV drinking water treatment increases, there are more and more people interested in the requirements of *NSF/ANSI 55*. Although the Standard has significant detail that makes for a difficult read, especially regarding the complex bioassay dosage testing methods, many of the fundamentals of the Standard are straightforward enough for most lay people to understand quite well. Based on the types of questions that I have received from manufacturers and others, it is my hope that this column will help address many of the issues and uncertainties raised by those investigating the requirements. For reference, see Figure 2 as a summary of the basic requirements.

About the author

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