

NSF/ANSI 55 – 2004

Ultraviolet microbiological water treatment systems

**NSF International Standard/
American National Standard**

NSF/ANSI 55 – 2004



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for Drinking Water Treatment Units –

Ultraviolet microbiological water treatment systems

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Foreword²

It is the purpose of this Standard to establish minimum requirements for the reduction of microorganisms using ultraviolet radiation (UV). UV water treatment systems covered by this Standard are intended for water that may be either microbiologically safe or microbiologically unsafe. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners, as well as the minimum service-related obligations that the manufacturer shall extend to system owners. Systems covered by this Standard are in keeping with the *Report of Task Force on Guide Standard and Protocol for Testing Microbiological Water Purifiers*, April, 1987.³

It is recognized that the federal, state and local objectives are to provide safe water supplies without user treatment. However, many users are faced with the presence of contaminants of both aesthetic and health concern in their water supplies and need guidance as to the availability of tested and certified point-of-entry and point-of-use ultraviolet water treatment systems. This Standard will help to meet this need but cannot be expected to address claims beyond those covered in this Standard.

Since it was not economically feasible to mount a routine testing program using all of the target microorganisms, e.g., bacteria, viruses, and protozoan cysts, an equivalent "disinfection" set of tests and requirements was developed for point-of-use and point-of-entry ultraviolet disinfection systems.

A virus reduction of 4 log against a poliovirus and rotavirus challenge and a bacteriological reduction of 6 logs against a challenge of a coliform bacteria (*Klebsiella terrigena*) has been recommended by Schaub and an expert task force (1987).⁴

The technical and health protection problems (laboratory staff) and the inherent cost of establishing and maintaining a live virus test program preclude its routine application in a multipurpose standards testing laboratory. Consequently, an alternate means of assuring virus efficacy was developed.

Survival data for poliovirus and rotavirus (Chang, 1985)⁵ show between a 3- to 4-log reduction in both poliovirus and rotavirus may be accomplished by a UV dosage of 30,000 $\mu\text{W}\text{-sec}/\text{cm}^2$ while a greater than 6-log reduction of *Escherichia coli* may be projected. Additional data (Harris, 1986)⁶ shows a 5-log reduction of poliovirus at 40,000 $\mu\text{W}\text{-sec}/\text{cm}^2$. In NSF/ANSI 55 2000, a minimum UV dosage of 38,000 $\mu\text{W}\text{-sec}/\text{cm}^2$ at the failsafe setpoint was set as an equivalent 4-log virus reduction requirement. To be consistent with International Standards, the minimum UV dose in NSF/ANSI 55 2002 has been changed to 40 mJ/cm^2 (40,000 $\mu\text{W}\text{-sec}/\text{cm}^2$) at the alarm set point.

² The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

³ *Guide Standard and Protocol for Testing Microbiological Water Purifiers*, Report of Task Force, submitted by Steven A. Schaub to the USEPA, April 1987

⁴ *Ibid.* p. 7

⁵ "UV Inactivation of Pathogenic and Indicator Microorganisms," Chang, J.C., Johnson, J. Doald, et al. *Journal of Applied Environmental Microbiology*, Vol. 49, pp. 1361–1365, 1985

⁶ "UV Inactivation of Selected Bacteria and Viruses With Photoreactivation of the Bacteria," Harris, D. George, Adams, Dean, et al., *Water Resources*, Vol. 21, pp. 687–692, 1986

Prior to the late 1990's it was thought ultraviolet light had limited cysticidal ability, which required information for the user as to the need for a prefilter complying with NSF/ANSI 53: *Drinking water treatment units – Health effects* for cyst reduction. Survival data for *Cryptosporidium* (Clancy, 2000)⁷ and *Giardia* (Craik, 2000)⁸ show minimum 3- to 4-log reduction in both *Cryptosporidium* and *Giardia* may be accomplished by a UV dosage of 10 mJ/cm².

Where drinking water is considered to be free of disease causing pathogenic organisms and has a turbidity level within acceptable drinking water standards, ultraviolet treatment may be useful for the supplemental treatment of this drinking water. It would be suitable for the reduction of normally occurring microbiological flora (non-spore forming heterotrophic bacteria) commonly found in drinking water. Survival data (Chang, 1985)⁹ show a greater than 2-log reduction of non-spore forming heterotrophic bacteria may be accomplished by an ultraviolet dosage of 16,000 µW-sec/cm². The yeast organism *Saccharomyces cerevisiae* was chosen as the test challenge to allow for a reasonable influent concentration and an easily measured reduction in the effluent. Most vegetative bacteria including coliform species are too susceptible to UV radiation at the dose range of 16,000 µW-sec/cm² to allow for measurable testing.

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

This version of the Standard contains the following revisions:

- Section 4.2.3.5 has been revised to clarify how without media testing is to be conducted in complex scenarios involving media that is chemically bound to non-media materials.
- The test method in 7.2.2.7 and 7.2.2.8 has been revised to generate reliable and repeatable data within the intent of the standard. The method provides an evaluation of a UV system at two conditions of operation, immediately after a long stagnation period and during stable operation. The method has been shortened by two days given that the data generated on days 8 & 9 were equivalent to the data generated on days 2 through 4. Therefore, this change does not compromise the integrity of the data.

This Standard and the accompanying testing program will provide assurance to the user and the regulatory officials that point-of-entry and point-of-use ultraviolet water treatment systems will perform, with proper operation and maintenance, in accordance with the claims made under the Standard. However, final acceptance of systems for any application covered under governmental regulation will be subject to the approval of the appropriate federal, state, and/or local regulatory agency having jurisdiction.

This Standard was developed by the NSF Joint Committee on Drinking Water Treatment Units using the consensus process described by the American National Standards Institute.

Suggestions for improvement of this Standard are welcome. Comments should be sent to Chair, Joint Committee on Drinking Water Treatment Units, c/o NSF International, Standards Department, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA.

⁷ "Using UV to Inactivate *Cryposporidium*," Clancy, J. L., et al. *Journal of American Water Works*, Vol 92, Issue 9, pp. 97-104, 2000

⁸ "Inactivation of *Giardia Muris* Cysts Using Medium-Pressure Ultraviolet Radiation in Filtered Drinking water," Craik, S. A., et al. *Water Resources*, Vol. 34, No. 18, pp 4325-4332, 2000

⁹ *Ibid.* p. 1362

NSF/ANSI Standard for Drinking Water Treatment Units –

Ultraviolet microbiological water treatment units

1 General

1.1 Purpose

It is the purpose of this Standard to establish minimum requirements for the reduction of microorganisms using ultraviolet radiation (UV). UV water treatment systems covered by this Standard are intended for water that may be either microbiologically safe or microbiologically unsafe. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners as well as the minimum service-related obligations that the manufacturer shall extend to system owners.

1.2 Scope

This Standard covers ultraviolet microbiological water treatment systems and components for point-of-use and point-of-entry applications. Systems are intended to be used under the following specific conditions.

1.2.1 Class A systems

Class A point-of-entry and point-of-use systems covered by this Standard are designed to inactivate and/or remove microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts, from contaminated water. Systems covered by this Standard are not intended for the treatment of water that has an obvious contamination or intentional source, such as raw sewage, nor are systems intended to convert wastewater to drinking water. The systems are intended to be installed on visually clear water (not colored, cloudy, or turbid).

Class A systems not installed downstream of a device tested for cyst reduction/inactivation in conformance with the appropriate NSF/ANSI Standard may claim *Cryptosporidium* oocysts and *Giardia* cysts only. Class A systems installed downstream of a device tested for cyst reduction/inactivation in conformance with the appropriate NSF/ANSI standard may make a general cyst claim when used on untreated surface waters and/or ground water under the direct influence of surface water.

NOTE – Current data support that *Cryptosporidium* oocysts and *Giardia* cysts are inactivated by ultraviolet treatment.

1.2.2 Class B systems or components

Class B point-of-entry and point-of-use systems covered by this Standard 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. The system is designed to reduce normally occurring nonpathogenic nuisance microorganisms only. The Class B system is not intended for the disinfection of microbiologically unsafe water and may not make individual or general cyst claims. Class B systems shall not make microbiological health effects claims.