



*NSF International Standard /
American National Standard*

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Ultraviolet Microbiological
Water Treatment Systems



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American National Standard
for Drinking Water Treatment Units –

**Ultraviolet Microbiological
Water Treatment Systems**

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Foreword²

The purpose of this Standard is to establish minimum requirements for the reduction of microorganisms using ultraviolet (UV) radiation. 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 (POE) and point-of-use (POU) UV 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 POE and POU UV disinfection systems.

A virus reduction of 4 logs 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).³

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)⁴ show that between a 3 and 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)⁵ show 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 was 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. Therefore, 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 US EPA, April 1987.

⁴ "UV Inactivation of Pathogenic and Indicator Microorganisms," Chang, J.C., Johnson, J. Doald, et al. *Journal of Applied Environmental Microbiology*, Vol. 49, pp. 1361 to 1365, 1985.

⁵ "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 to 692, 1986.

Prior to the late 1990s, it was thought that UV 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)⁶ and *Giardia* (Craik, 2000)⁷ show that a 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, UV 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)⁴ show that a greater than 2 log reduction of non-spore forming heterotrophic bacteria may be accomplished by an UV 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.

This edition of the Standard contains the following revisions:

Issue 45

This revision addresses inconsistent language across the scopes of the DWTU Standards and adds clarifying language on systems that include components or functions covered under other NSF Standards.

Issue 46

This revision adds clarification to the product literature requirements under 8.3 for replacement components.

Issue 47

This revision removes *S. cerevisiae* as a challenge organism for Class B devices.

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. This Standard is maintained on a Continuous Maintenance schedule and can be opened for comment at any time. Comments should be sent to Chair, Joint Committee on Drinking Water Treatment Units at standards@nsf.org, or c/o NSF International, Standards Department, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA.

⁶ "Using UV to Inactivate *Cryptosporidium*," Clancy, J. L., et al. *Journal of American Water Works*, Vol 92, Issue 9, pp. 97 to 104, 2000.

⁷ "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 to 4332, 2000.

NSF/ANSI Standard for Drinking Water Treatment Units –

Ultraviolet Microbiological Water Treatment Units

1 General

1.1 Purpose

The purpose of this Standard is to establish minimum requirements for the reduction of microorganisms using ultraviolet (UV) radiation. 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 UV microbiological water treatment systems and components for point-of-use (POU) and point-of-entry (POE) applications. Systems are intended to be used under the following specific conditions.

1.2.1 Class A systems

Class A POE and POU systems covered by this Standard are designed to be used for treating microbiologically unsafe water, but do not reduce chemical or inert particulate contaminants. Systems covered in this Standard are designed to inactivate microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts, from 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). Systems with manufacturer claims that include components or functions covered under other NSF or NSF/ANSI Standards or Criteria shall conform to the applicable requirements therein.

Class A systems not installed downstream of a device tested for cyst reduction / inactivation in conformance to 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 in conformance to NSF/ANSI 53 or 58 may make a general cyst claim when used on untreated surface waters, or ground water, or both, under the direct influence of surface water.

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

1.2.2 Class B systems or components

Class B POE and POU systems covered by this Standard are designed to be used for supplemental bactericidal treatment for the inactivation of microorganisms that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality. Systems covered under this Standard are intended to inactivate 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.