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NSF/ANSI 55 - 2017

Ultraviolet Microbiological Water Treatment Systems





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Foreword[2]

The purpose of this Standard is 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).[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 µW-sec/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 µw-sec/cm^2. In NSF/ANSI 55 2000, a minimum UV dosage of 38,000 µW-sec/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/cm2 (40,000 µw-sec/cm^2) at the alarm set point.

Prior to the late 1990s, it was thought that 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)[6] and *Giardia* (Craik, 2000)[7] show that a minimum 3- to 4-log reduction in both *Cryptosporidium* and *Giardia* may be

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[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] "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

[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. 687–692, 1986

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

[7] "Inactivation of *Giardia Muris* Cysts Using Medium-Pressure Ultraviolet Radiation in Filtered Drinking water," Craik,

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accomplished by a UV dosage of 10 mJ/cm^2.

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)4 show that a greater than 2-log reduction of non-spore forming heterotrophic bacteria may be accomplished by an ultraviolet dosage of 16,000 µW-sec/cm^2. 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/cm^2 to allow for measurable testing.

This version of the Standard contains the following revisions:

Issue 43
Normative references were updated.

Issue 44
Evaluation criteria columns from tables 4.1, 4.2, and 4.3 were removed and now reference the evaluation criteria in Annex D, Table D.1 in NSF/ANSI 61.

It is the intent of the Joint Committee to eliminate the use of *S. cerevisiae* as a challenge organism for Class B devices from the Standard after September 2017, a period of five years from the adoption of using T1 Coliphage 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, P.O. Box 130140, Ann Arbor, Michigan 48113-0140, USA.

S. A., et al. *Water Resources*, Vol. 34, No. 18, pp 4325-4332, 2000

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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 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 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/inactivation in conformance to 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.