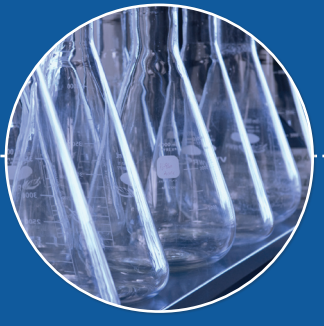
*NSF International Standard /*
*American National Standard*

# NSF/ANSI 55 - 2022

## Ultraviolet Microbiological Water Treatment Systems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NSF International Standard /
American National Standard
for Drinking Water Treatment Units –

# Ultraviolet Microbiological Water Treatment Systems

Standard Developer
**NSF International**

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September 25, 2022
**American National Standards Institute**

Prepared by
**The NSF Joint Committee on Drinking Water Treatment Units**

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**Abbreviations**

The following table is provided as a reference for unit abbreviations for common forms of measurement used within NSF documents.

| | | |
|---|---|---|
| time | second | s |
| | minute | min |
| | hour | h |
| | day | d |
| | week | wk |
| | month | mo |
| | year | yr |
| length | inch | in |
| | foot | ft |
| | yard | yd |
| | micrometer | µm |
| | nanometer | nm |
| | millimeter | mm |
| | centimeter | cm |
| | meter | m |
| | kilometer | km |
| liquid measure | milliliter | mL |
| | liter | L |
| | liters per day | LPD |
| | liters per minute | LPM |
| | gallon | gal |
| | gallons per minute | GPM |
| | gallons per day | GPD |
| weight | microgram | µg |
| | picogram | pg |
| | nanogram | ng |
| | milligram | mg |
| | centigram | cg |
| | gram | g |
| | kilogram | kg |
| | pound | lb |
| | ton | t |
| miscellaneous | atomic mass unit | amu |
| | colony forming units | CFU |
| | daltons | Da |
| | kilopascal | kPa |
| | logarithm | log |
| | millijoule | mJ |

| | | |
|---|---|---|
| | milliwatt | mW |
| | microwatt-seconds | µW-sec |
| | mass-to-charge ratio | m/z |
| | nephelometric turbidity units | NTU |
| | plaque forming units | PFU |
| | pounds per square inch gauge | psig |

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**Contents**

**Foreword**[2]

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 µW-sec/cm$^2$ while a > 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/cm$^2$ (40,000 µW-sec/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 U.S. EPA, April 1987.

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

[5] Harris, D. George, Adams, Dean, et al. "UV Inactivation of Selected Bacteria and Viruses With Photoreactivation of the Bacteria." *Water Resources*, Vol. 21 (1986), 687-692.

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/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, 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 (nonspore forming heterotrophic bacteria) commonly found in drinking water. Survival data (Chang, 1985)[4] show that a > 2 log reduction of nonspore forming heterotrophic bacteria may be accomplished by an UV 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 edition of the standard contains the following revisions:

**Issue 56**

This revision adds language to Sections 8.1.1 and 8.4.1 to allow installation, operation, and maintenance instruction manuals, as well as performance data sheets, to be provided online.

**Issue 61**

This revision updates the minimum 2-L sample requirement to a recommendation in Section 4.2.3.

**Issue 62**

This revision updates storage instructions for coliphages, including establishing separate storage directions for working stocks vs. propagation freezer stocks.

**Issue 63**

This revision updates normative references throughout the standard.

**Issue 64**

This revision adds NSF/ANSI/CAN 372 as a normative reference in Section 2, and its requirements for lead content in Section 4.1.2.

**Issue 65**

This revision updates normative references (Section 2), corrects a typo (Table 4.3) and section references (Table 7.2), updates the NIST mass spectral library version (Section 4.3.1.2), and changes normative language from “must” to “shall” (Section 7.2.1.2).

The Interpretations Annex contains responses to interpretation requests. The responses will be published in each version of the standard until such time that the interpretation response is no longer applicable.

[6] Clancy, J. L., et al. “Using UV to Inactivate *Cryposporidium*.” *Journal of American Water Works*, Vol 92, Issue 9 (2002), 97-104.

[7] Craik, S. A., et al. “Inactivation of *Giardia Muris* Cysts Using Medium-Pressure Ultraviolet Radiation in Filtered Drinking water.” *Water Resources*, Vol. 34, No. 18 (2000), 4325-4332.

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.

This standard and the accompanying text are intended for voluntary use by certifying organizations, regulatory agencies, and/or manufacturers as a basis of providing assurances that adequate health protection exists for covered products.

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, U.S.A.

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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. This standard covers systems which use UV radiation within the range of 240 nm to 300 nm inclusive. 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: *Drinking Water Treatment Units – Health Effects* or NSF/ANSI 58: *Reverse Osmosis Drinking Water Treatment Systems* 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 supports 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