RWF Task Group on UV
Straw Ballot
January 21, 2022

Purpose

This straw ballot will revise language regarding validation of UV dose displays in NSF/ANSI/CAN 50.

Background

At the 2019 Joint Committee on Recreational Water Facilities annual meeting, an issue paper presented noted that there was no verification of the recently added dose display requirement. After some discussion, a motion was approved by the JC to charge the RWF TG on UV with development of validation methodology for the displays.

The RWF Task group on UV met 8 times since then, discussing, drafting and revising language. The attached ballot is presented for consideration to the group.

This straw ballot will last two weeks.

The grey highlighted portions of the language are proposed additions to the language of the standard.
The ~~strikeout~~ portions of the language are proposed deletions to the language of the standard.

An affirmative (yes) vote on this straw ballot means you agree with the revised language as submitted.

A negative (no) vote on this straw ballot means you disagree with the revised language as submitted. A negative vote must include an explanation of why you disagree with the revised draft.

[Note – the recommended changes to the standard which include the current text of the relevant section(s) indicate deletions by use of ~~strikeout~~ and additions by grey highlighting. Rationale Statements are in *italics* and only used to add clarity; these statements will NOT be in the finished publication.]

NSF/ANSI/CAN Standard

Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs, and other Recreational Water Facilities

Evaluation criteria for materials, components, products, equipment, and systems for use at recreational water facilities

-
-
-

3 Definitions

-
-
-

3.XX residential disinfection use: Units that demonstrate a 3 log (99.9%) or greater reduction of *Pseudomonas aeruginosa* and *Enterococcus faecium* when tested according to Section 15.8.1.

-
-
-

3.114 secondary disinfection: Units that demonstrate a 3 log (99.9%) or greater reduction or inactivation of *Cryptosporidium parvum* in a single pass when tested in accordance to Section ~~14.18.2~~ 15.8.3.

-
-
-

3.134 supplemental disinfection: Units that demonstrate a 3 log (99.9%) or greater reduction of *Pseudomonas aeruginosa* and *Enterococcus faecium* when tested according to Section ~~N-8.1~~15.8.2 .

-
-
-

15 Ultraviolet (UV) light process equipment

15.1 General

UV light process equipment covered by this section is intended for the secondary and supplemental treatment of public and residential swimming pools and spas / hot tubs. Since these products are not intended to produce residual levels of disinfectant within the body of the swimming pool or spa, these products are intended for use with appropriate residual levels of EPA registered disinfecting chemicals.

Specific residual levels of EPA registered disinfecting chemicals may be required by the regulatory agency having authority. The residual chemical shall be easily and accurately ~~measureable~~ measurable by a field test kit.

15.2 Cleanability

Parts of process equipment requiring cleaning and maintenance shall be accessible.

15.3 Design pressure (pressure vessels)

Units and components of process equipment that are subjected to pressure shall meet a working pressure of 50 psi (33 kPa) or be equipped with a pressure-reducing valve set at the manufacturer's working pressure.

15.4 Flow metering device

If the performance of a unit is dependent on a specified flow rate, a means to monitor and control the flow shall be provided.

15.5 Performance indication

15.5.1 A residential supplemental UV system shall be provided with an effective means to alert the user when a component of this equipment is not operating.

15.5.2 A supplemental UV system shall indicate that a sufficient UV dose is being produced for supplemental disinfection whenever the unit is at an intensity reading greater than or equal to the highest intensity reading observed during disinfection efficacy testing required by 15.8.2. Whenever the unit is at an intensity reading less than the highest intensity reading observed during disinfection efficacy testing required by 15.8.2, the unit shall display a warning that there is insufficient dose for supplemental disinfection.

15.5.3 A secondary UV system shall incorporate on the control panel a constantly visible readout of the actual flow (in US GPM), the actual calculated dose (in mJ/cm^2) and the actual lamp intensity (in w/m^2). It is acceptable for the display to constantly cycle through the parameters. The cycle duration shall not take more than15 s.

Table 15.1 – UV display validation

Use	Test Method	Performance indication
Residential supplemental	15.8.1	effective means to alert the user when a component is not operating (see 15.5.1)
supplemental	15.8.2	indication that sufficient dose is being produced (see 15.5.2)
secondary	15.8.3	constantly visible readout of flow, dose, intensity (see 15.5.3)

15.6 Operation and installation instructions

15.6.1 Drawings and a parts list for easy identification and ordering of replacement parts shall be furnished with each unit and shall include:

—model number of the unit;

—instructions for proper size selection and installation;

—whether the system has a mechanical cleaning system or requires an external chemical cleaning system installed per Section 15.13.1;

—operation and maintenance instructions;

—a statement of the manufacturer's warranty;

—applicable caution statements (prominently displayed);

—ventilation requirements (if applicable);

—cross connection protection (if the unit is physically connected to a potable water supply);

—maximum daily operation time (if not designed for continuous operation); and

—a warning, if the potential exists for release of high dosages of substances that may endanger bathers.

15.6.2 UV systems ~~claiming inactivation of cysts~~ certified for secondary disinfection, the installation and operational instructions or product manual shall contain the following:

—reactor configuration type (U, S, etc.);

—number of lamps per reactor;

—lamp designation or model number;

—sensor designation or model number;

—UVT of water (minimum value or a range of UVTs under which validation was performed);

—organism used in testing;

—correlation between test organism and *C. parvum*;

—effective log inactivation of organism at maximum flow rate or validated flow rates;

—effective UV dose delivered at specified ~~wavelength~~ intensity and flow rate; and

—whether the system has a mechanical cleaning system or requires an external chemical cleaning system installed per Section 15.13.1

15.7 Data plate

Data plate shall be permanent; easy to read; and securely attached, cast, or stamped onto the unit at a location readily accessible after normal installation. Data plate(s) shall contain the following:

—equipment name and function(s);

—manufacturer's name and contact information (address, phone number, website, or prime supplier);

—model number designation;

—electrical requirements for operational volts, amps, and ~~H~~hertz of the unit;

—serial number or year of construction;

—maximum rated operating pressure in kPa (psi);

—prominently displayed caution statement:

"*UV light is harmful to eyes and exposed skin; turn off electrical supply before opening unit.*"

—caution statement that the unit should be used with registered or approved disinfection chemicals to impart required residual concentrations;

—model and number of UV lamp(s);

— maximum daily operation time (if not designed for continuous operation);

—maximum design flow rate in GPM (LPM); and

—a statement identifying if the unit is suitable for residential disinfection, supplemental disinfection or for secondary disinfection, in a minimum 16 pt font:

"*This unit has been certified to NSF/ANSI/CAN 50 for {disinfection level}".*

Rationale: 16 pt font per ANSI Z535.4 Product Safety Signs And Labels Table B1 guidance for recommended letter height at 2 feet viewing distance in favorable to unfavorable reading conditions.

15.8 Disinfection efficacy

Per Section 15.12, residential and supplemental disinfection efficacy testing shall be performed after the system and lamp have accumulated 3000 hours of operation.

15.8.1 Ultraviolet light process equipment designed for residential supplemental disinfection shall demonstrate a 3 log (99.9%) or greater inactivation of influent bacteria when operating at full power and tested according to Section N-8.1 with water having a UVT_{254} of 94%. Adjustments to UVT shall be made with SuperHume.

15.8.2 Ultraviolet light process equipment designed for non-residential supplemental disinfection shall demonstrate a 3 log (99.9%) or greater inactivation of influent bacteria when:

—operating at full power and tested according to Section N-8.1 with water having a UVT_{254} of 94%. Adjustments to UVT shall be made with SuperHume; and

—operating at a reduced power such that intensity observed by the UV intensity sensor matches that observed during the testing in part (a) above and tested according to Section N-8.1 with water having a UVT_{254} of ≥96%.

Methods to reduce lamp power for testing may include variable output electronic ballasts, thyristors, pulse-width modulation control modules, doped quartz sleeves, stainless steel mesh between lamp and quartz, shunt resistors, lamps further aged beyond 3000 hours, or any other method such that the intensity of light presented to the reactor volume is sufficiently reduced to lower the intensity measured by an un-modified UV intensity sensor to the desired reading.

15.8.3 Ultraviolet light process equipment designed for secondary disinfection shall demonstrate a 3 log (99.9%) or greater inactivation of *C. parvum* when tested and evaluated according to Section 15.18 and is exempt from Section N-8.1 testing if during secondary validation the lamp intensity (per Section 15.5) is equal to or greater than the lamp intensity after the unit has completed life testing. Section N-8.1 shall be required if the dose is less.

15.8.4 Ultraviolet light process equipment designed for residential supplemental disinfection shall carry the following information in the installation and use instructions and be noted in the official certification listings:

> *"This unit has demonstrated an ability to provide three log inactivation of <name organisms>. This unit has not demonstrated an ability to provide three log kill or inactivation of <name organisms if applicable>. This product is designed for supplementary disinfection and is intended for use with appropriate residual levels of EPA registered disinfecting chemicals. Specific residual levels of EPA registered disinfecting chemicals may be required by the regulatory agency having authority."*

NOTE – The second sentence above is pending removal via a currently open ballot, 50i183r1.

15.8.5 Ultraviolet light process equipment designed for secondary disinfection shall carry the following information in the installation and use instructions and be noted in the official certification listings:

> *"This unit has been tested to confirm a minimum inactivation equivalent of 3 log (99.9%) C. parvum in accordance with NSF/ANSI/CAN 50 and the US EPA UV DGM. This product has met the requirements of NSF/ANSI/CAN 50, Section N-8.1: Disinfection Efficacy, for the ≥ minimum of a 3 log (99.9%) reduction of Enterococcus faecium [ATCC #6569] and Pseudomonas aeruginosa [ATCC #27313]. This product is intended for secondary disinfection and is intended for use with appropriate residual levels of EPA registered disinfecting chemicals. Specific residual levels of EPA registered disinfecting chemicals may be required by the regulatory agency having authority."*

15.9 Valve and component identification

All valves and performance indication devices shall have a permanent, easily legible, and conspicuous label or tag identifying their operation.

15.10 Operating temperatures

The unit and all its components shall be designed to withstand a maximum operating temperature of 102 ± 5 °F (39 ± 3 °C).

15.11 Operational protection

Units shall be equipped with an automatic mechanism for shutting off the power to the UV light source whenever the cover is removed.

15.12 Life test

When tested in accordance with the life test described in Annex N-9, a minimum of 8,000 operating hours shall be accumulated among the three units; no less than 3,000 operating hours shall be accumulated on one of the three units. At the conclusion of the testing, the units with 3,000 operating hours shall be evaluated to the operational protection, pressure, and disinfection efficacy requirements of this Section.

Life testing shall be conducted within the operating temperatures of its intended end use; swimming pool 75 ± 10 °F (24 ± 6 °C) or spas and hot tubs, 65 to 104 °F (18 to 40 °C).

Life testing is not required on UV units being tested for *Cryptosporidium* inactivation (Section 15.18) because the NSF ETV UV Protocol and US EPA UV DGM[Error! Bookmark not defined.] requires a 100-h burn in for the lamp prior to testing.

15.13 Cleaning

15.13.1 For systems utilizing quartz sleeves to separate the water passing through the chamber from the UV source, the system shall be designed to permit cleaning of the lamp jackets and the sensor window or lens without mechanical disassembly. All piping for in-place cleaning purposes shall be entirely independent of the water piping system in and out of the unit, and a drain shall be provided. The chamber shall be designed so that at least one end can be dismantled for general and physical cleaning.

15.13.2 For systems utilizing polytetra-fluoroethylene (PTFE) surface materials to separate the water passing through the UV chamber from the UV lamps, the unit shall be designed to be readily accessible to the interior and exterior of the PTFE. The unit shall be designed to permit use of either physical or chemical cleaning methods.

15.14 Ultraviolet (UV) lamps

UV lamps shall be readily accessible for replacement, and instructions for replacement shall be provided.

15.15 Chemical resistant materials

Internal surfaces exposed to direct ultraviolet light shall be resistant to use application conditions.

15.16 Head loss

The manufacturer shall make available a head loss claim for systems installed into the main line. The actual head loss shall not exceed the claimed head loss by more than 10% or by 0.5 psi, whichever is higher.

15.17 Hydrostatic pressure requirements

UV light process equipment that normally operates under pressure shall show no evidence of rupture, leakage, burst, or permanent deformation when subjected to a hydrostatic pressure 1.5 times the manufacturer's maximum operating pressure (see Section ~~N-6.4~~ N-6.1).

Rationale: corrected reference section

15.18 UV *Cryptosporidium* inactivation and dose determination

Manufacturers of UV systems with a claim to inactivate cysts (such as *Cryptosporidium*, *Giardia*, etc.) shall demonstrate a minimum 3 log (99.9%) or greater inactivation of *C. parvum* in a single pass.

NOTE — Operators of spray parks, spray pads, or interactive water features with no standing water should consider greater inactivation performance of 4 log (99.99%). The local public health authority may select different levels of log inactivation or power delivery for different applications such as competition lap pools, spas, wave pools, wading pools, etc.

15.18.1 Sample selection

When validating a range of aquatic or recreational water use UV systems for inactivation of cysts such as *C. parvum*, each of the following variables shall be used to determine which UV reactor / systems and components shall be tested within the range of product. Select at least two worst-case models from the range of products based upon all of the following variables.

—test the unit representative of the worst-case reactor hydraulics and UV dose delivery as determined by computational fluid dynamics modeling, including intensity and flow modeling;

—test the unit with the lowest power to highest flow rate;

—test one unit of each configuration (if family range contains U and S reactors, test each);

—test one unit of each UV lamp type (if alternate lamp types or suppliers, test each);

—in the case where the UV system utilizes low pressure (LP) lamps, it is sufficient to provide a data sheet of the lamp that includes the expected lamp life. In addition, the following characteristics of the lamp must be the same:

—lamp length, the length of the lamp from base face to base face, ± 0.5 in;
—the arc length, the lit length, ± 0.5 in;
—the diameter, ± 10%;
—the quartz material, fused silica, synthetic quartz, deep UV blocking;
—electrode current, ± 0.2 A;
—lamp wattage, ± 5 W;
—output, 185/254 nm or 254 nm;
—mercury source, elemental, spot amalgam, pocket amalgam; and
—connections, single ended, double ended.

—test one unit of each UV sensor type (if alternate UV sensor types or suppliers, test each).

NOTE — The above variables require that multiple UV systems are tested in order to validate a range of products.

15.18.2 Testing

Products shall be tested to confirm single pass inactivation equivalent to 3 log (99.9%) or greater of *C. parvum* in accordance with NSF/EPA ETV – *Generic Protocol for Development of Test / Quality Assurance Plans for Ultraviolet (UV) Reactors*.**Error! Bookmark not defined.** Only full stream testing shall be acceptable, there shall be no partial or side stream treatment testing.

The manufacturer of a reactor validated for performance under one of the following protocols shall submit details of the testing for evaluation and validation:

—US EPA UV DGM;**Error! Bookmark not defined.**

— US EPA Innovative Approaches for Validation of Ultraviolet Disinfection Reactors for Drinking Water Systems[20];
—DVGW, W-294 Parts 1-3;**Error! Bookmark not defined.** or
—ÖNORM, 5873 1 and 2.**Error! Bookmark not defined.**

Validation of a range of reactors with pre-existing test data shall include testing of at least one (1) unit at one (1) set point to evaluate for potential changes in design, suppliers and corroborate previous data.