Summary of Substantive Changes
between the 2019 and the 2020 editions of
NSF/ANSI 55 "Ultraviolet Microbiological Water Treatment Systems"

Presented to the IAPMO Standards Review Committee on August 9, 2021

General: The changes to this standard may have an impact on currently listed products. The substantive changes are:

- Expanded the scope to include drinking fountain outlets and added requirements for these outlets (see Section 6.6.1)
- Changed the mean UV absorption requirement for systems with UV sensor and alarm set point (see Section 7.2.2.5.1)
- Changed the microbiological performance requirements for class A, B, and systems with UV sensor and alarm set point (see Section 7.3)
- Changed requirements for growth mediums, challenge organisms, and analysis of influent and effluent samples in Normative annex N-1, and N-2 (see Sections N-1.7, N-1.8, N1-10, N-2.6, N-2.7, and N-2.9)

Section 6.6, Product water dispensing outlets: Expanded the scope to include drinking fountain outlets and added requirements for these outlets as follows:

Product water dispensing outlets other than drinking fountain outlets, if provided, shall be designed, constructed, and located so that the discharge orifice is directed downward. ~~and t~~The lower edge of the outlet shall be at an elevation not less than 51 mm (2 in) above the flood rim of the waste receptacle.

6.6.1 Drinking fountain outlets

6.6.1.1 *The drinking water outlet shall be protected by a guard designed to (1) prevent a user from directly contacting the outlet while drinking from the system, and (2) prevent foreign matter from dropping vertically into the outlet. The guard shall be of such width, height, and design that the user's mouth or lips cannot readily touch the outlet. Spaces between the outlet and guard shall be readily accessible for cleaning.*

6.6.1.2 *The outlet and guard shall be designed to discourage hose connections or other improper uses.*

6.6.1.3 *The drinking fountain outlet shall be set to direct water flow at an angle from the vertical to prevent water in a jet from returning to the outlet. The flow from the outlet shall not touch the guard.*

6.6.1.4 *The lower edge of the drinking water outlet shall be at least 25 mm (1 in) above the flood rim of the waste receptacle.*

Section 7, Elective performance claims – Test methods: Changed the mean UV absorption requirement for systems with UV sensor and alarm set point as follows:

7.2.2.5, Determination of test operating conditions

For UV devices not equipped with an alarm set point mechanism, Section 7.2.2.5.2 shall be used to determine the normal output.

7.2.2.5.1 Systems with UV sensor and alarm set point

Sufficient PHBA shall be added to reduce UV light transmission to the alarm set point ~~in~~ of the device. For Class A devices, no less than the quantity of PHBA required to give a mean UV absorption of ~~0.3/cm~~ 0.155 per cm (70% UVT) at 254 nm shall be used.

NOTE — Absorbtion = -log(%T/100) where %T is expressed as a percentage (70%). Refer to Standard Methods for the Examination of Water and Wastewater,[9] Method 5910 UV Absorbing Organic Constituents.

7.2.2.8.2 Acceptance

7.2.2.8.2.1 Class A systems

For Class A systems, the geometric mean of all MS-2 coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples for each unit under test shall demonstrate a log reduction greater than or equal to the reduction caused by a dose of 40 mJ/cm^2 [4.0 × 104 µW-sec/cm^2] as calibrated in Section 7.2.2.

7.2.2.8.2.2 Class B systems

For Class B systems or components, the geometric mean of all T1 coliphage cell counts on influent samples minus the geometric mean of counts on all effluent samples for each unit under test shall demonstrate a log reduction equivalent to or greater than the reduction caused by a dose of 16 mJ/cm^2 [1.6 × 104 µW-sec/cm^2] as calibrated in Section 7.2.2.

Section 7.3, Microbiological performance: Changed the microbiological performance requirements for class A, B, and systems with UV sensor and alarm set point as follows:

7.3 Microbiological performance

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7.3.1.1 Class A systems

A Class A system shall deliver a UV dose to achieve a ~~4.00~~ 3.50 log reduction of the challenge organism concentration in the influent at the alarm set point when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

7.3.1.2 Class B systems

A Class B system which is evaluated with the UV source irradiance at normal output shall deliver a UV dose to achieve a ~~2.14~~ 2.00 log reduction of the challenge organism concentration in the influent when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

A Class B system which is evaluated with the UV source irradiance at 70% of normal output, or at the alarm set point, shall deliver a UV dose to achieve a 1.50 log reduction of the challenge organism concentration in the influent when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

7.3.1.5.2 Systems with UV sensor and alarm set point

Sufficient UV absorbant shall be added to reduce UV light transmission to the alarm set point ~~in~~ of the device. For Class A devices, no less than the quantity of UV absorbant required to give a mean UV absorption of ~~0.30~~ 0.155 per cm (70% UVT) at 254 nm shall be used.

NOTE — Absorption = -log(%T/100) where %T is expressed as a percentage (70%). Refer to Standard Methods for the Examination of Water and Wastewater,[9] Method 5910 UV Absorbing Organic Constituents.

7.3.1.5.3.1 Adjustment of Class B criteria to simulate UV source end of life

To simulate the UV irradiance at end of life for systems which are operated at the normal output, the reduction criteria shall be a log reduction greater than or equal to ~~2.14~~ 2.00 when the system is evaluated under Section 7.3.1.7 or 7.3.1.8 using UV sources conditioned for 100 hours.

7.3.1.8 Batch treatment systems: Changed the batch treatment requirements for class A, and B as follows:

7.3.1.8.2 Acceptance

7.3.1.8.2.1 Class A systems

For Class A systems, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples for each unit under test shall demonstrate a log reduction greater than or equal to ~~4.00~~ 3.50.

7.3.1.8.2.2 Class B systems

For a Class B system which is evaluated with the UV source irradiance at normal output, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples for each unit under test shall demonstrate a log reduction greater than or equal to ~~2.14~~ 2.00.

For a Class B system which is evaluated with the UV source irradiance at 70% of normal output or at the alarm setpoint, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction greater than or equal to 1.50.

N-1.7, Growth medium: Changed requirements for growth mediums as follows:

N-1.7.1.3 Phage top agar ~~TSA 1%~~ TSB + 1%

Ingredient	*Amount*
tryptone	*7.5 g*
soytone	*2.5 g*
sodium chloride	*2.5 g*
agar	*5.0 g*
DI Water	*500 mL*
pH	*7.3 ± 0.2*

Add 1% of bacto-agar into the mixture of tryptic soy broth (TSB). ~~TSA~~ TSB + 1% shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± ~~1~~ 1.8 °F) at 15 psi for ~~20~~ 15 min. Agar shall be stored at 5 ± 3 °C (41 ± ~~1~~ 5.4 °F). On the day of testing, the ~~TSA~~ TSB + 1% shall be liquefied and placed in the 45 ± 1 °C (113 ± ~~1~~ 1.8 °F) water bath. The MS-2 coliphage top agar shall be maintained at 45 ± 1 °C (113 ± ~~1~~ 1.8 °F) to prevent agar solidification.

N-1.8, Culture of challenge organisms: Changed requirements for challenge organisms as follows:

N-1.8.1 MS-2 coliphage

N-1.8.1.1 Stock culture preparation of MS-2 coliphage

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c) Serial dilutions of MS-2 coliphage suspension ~~(10^{-1} to 10^{-12})~~ shall be made using sterile PBS or SBDW. ~~10^{-5} to 10^{-12} dilutions shall be plated~~ Dilute as needed in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of E. coli ATCC #15597 host shall be added ~~quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates.The plates shall be rocked to spread inoculum evenly~~ to the tube containing E. coli and vortex to mate the bacteriophage and E. coli. After vortexing, add about 5 mL of melted TSB + 1%. Immediately

pour onto the 1.5% TSA plates. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± ~~1~~ 1.8 °F) for 18 ± 2 h.

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e) After the 2 h incubation, the tubes shall be centrifuged at 9280 x g for 5 min, or 2320 x g for 20 min, at 20 ± 1 °C (68 ± ~~1~~ 1.8 °F). ~~The resulting supernatant shall be removed while avoiding the pellet. A sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter.~~ The supernatant shall be filtered. The resulting supernatant shall be transferred to a new container for filtration, while avoiding disturbing the pellet. First, a sterile 47 mm filtration assembly shall be aseptically constructed using a 0.45 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter. The supernatant shall be filtered. This step is needed to filter any agar or large debris from the supernatant. Lastly, a sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22-µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter.

N-1.8.1.2 Enumeration of MS-2 Coliphage plaques

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c) Serial dilutions of MS-2 coliphage suspension ~~(10^{-1} to 10^{-12})~~ shall be made using sterile PBS or SBDW. ~~10^{-5} to 10^{-12} dilutions shall be plated~~ Dilute as needed in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of E. coli ATCC #15597 host shall be added ~~quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates.The plates shall be rocked to spread inoculum evenly~~ to the tube containing E. coli and vortex to mate the bacteriophage and E. coli. After vortexing, add about 5 mL of melted TSB + 1%. Immediately pour onto the 1.5% TSA plates. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± ~~1~~ 1.8 °F) for 18 ± 2 h.

N-1.10 Analysis of influent and effluent samples: Changed requirements for analysis of influent and effluent samples as follows:

***N-1.10.1** Enumeration of MS-2 coliphage plaques*

a) *Serial dilutions of the influent and effluent samples ~~(10^{-1} to 10^{-12})~~ shall be made using sterile PBS or SBDW. ~~10^{-5} to 10^{-12} dilutions shall be plated~~ Dilute as needed in duplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of E. coli ATCC #15597 host shall be added ~~quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates.The plates shall be rocked to spread inoculum evenly~~ to the tube containing E. coli and vortex to mate the bacteriophage and E. coli. After vortexing, add about 5 mL of melted TSB + 1%. Immediately pour onto the 1.5% TSA plates. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± ~~1~~ 1.8 °F) for 18 ± 2 h.*

N-2.6 Growth medium: Changed requirements for growth mediums as follows:

N-2.6.1.3 Phage top agar ~~TSA 1%~~ TSB + 1%

Ingredient	*Amount*
tryptone	*7.5 g*
soytone	*2.5 g*
sodium chloride	*2.5 g*
agar	*5.0 g*
DI Water	*500 mL*
pH	*7.3 ± 0.2*

Add 1% of bacto-agar into the mixture of tryptic soy broth (TSB). ~~TSA~~ TSB + 1% shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± ~~1~~ 1.8 °F) at 15 psi for ~~20~~ 15 min. Agar shall be stored at 5 ± 3 °C (41 ± ~~1~~ 5.4 °F). On the day of testing, the ~~TSA~~ TSB + 1% shall be liquefied and placed in the 45 ± 1 °C (113 ± ~~1~~ 1.8 °F) water bath. The MS-2 coliphage top agar shall be maintained at 45 ± 1 °C (113 ± ~~1~~ 1.8 °F) to prevent agar solidification.

N-2.7 Culture of challenge organisms: Changed requirements for challenge organisms as follows:

N-2.7.1.1 Stock culture preparation of Qβ coliphage

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c) *Serial dilutions of Qβ coliphage suspension ~~(10^{-1} to 10^{-12})~~ shall be made using sterile PBS or SBDW. ~~10^{-5} to 10^{-12} dilutions shall be plated~~ Dilute as needed in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted Qβ coliphage shall be transferred. Then 0.1 mL of E. coli ATCC # 23631 host shall be added ~~quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates.The plates shall be rocked to spread inoculum evenly~~ to the tube containing E. coli and vortex to mate the bacteriophage and E. coli. After vortexing, add about 5 mL of melted TSB + 1%. Immediately pour onto the 1.5% TSA plates. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± ~~1~~ 1.8 °F) for 18 ± 2 h.*

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e) *After the 2-h incubation, the tubes shall be centrifuged at 9280 x g for 5 min, or 2320 x g for 20 min, at 20 ± 1 °C (68 ± ~~1~~ 1.8 °F). ~~The resulting supernatant shall be removed while avoiding the pellet. A sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter.~~ The supernatant shall be filtered. The resulting supernatant shall be transferred to a new container for filtration, while avoiding disturbing the pellet. First, a sterile 47 mm filtration assembly shall be aseptically constructed using a 0.45 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter. The supernatant shall be filtered. This step is needed to filter any agar or large debris from the supernatant. Lastly, a sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22-µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter.*

N-2.9 Analysis of influent and effluent samples: Changed requirements for analysis of influent and effluent samples as follows:

N-2.9.1 Enumeration of Qβ coliphage plaques

a) Pipette sample volumes and dilutions that will yield from 30 to 300 PFU per plate. Serial dilutions of the influent and effluent samples ~~(10^{-1} to 10^{-12})~~shall be made using sterile PBS or SBDW. ~~10^{-5} to 10^{-12} dilutions shall be plated~~ Dilute as needed in duplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted Qβ coliphage shall be transferred. Then 0.1 mL of E. coli ATCC # 23631 host shall be added ~~quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates.The plates shall be rocked to spread inoculum evenly~~ to the tube containing E. coli and vortex to mate the bacteriophage and E. coli. After vortexing, add about 5 mL of melted TSB + 1%. Immediately pour onto the 1.5% TSA plates. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 1.8 °F) for 18 ± 2 h.