TO: Joint Committee on Recreational Water Facilities

FROM: Mr. Tom Vyles, Chairperson

DATE: October 21, 2022

SUBJECT: Proposed revision to NSF/ANSI/CAN 50 *Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities (50i173r4)*

Draft 4 of NSF/ANSI/CAN 50 issue 173 is being forwarded to the Joint Committee for balloting. Please review the changes proposed to this Standard and **submit your ballot by November 11, 2022** via the NSF Online Workspace (http://standards.nsf.org).

Please review all ballot materials. When adding comments, please include the section number applicable your comment and add all comments under one comment number whenever possible. If additional space is needed, you may upload a word or .PDF version of your comments online via the browser function.

Purpose

This ballot will revise the WQTD accuracy tables in Annex N-11 of NSF/ANSI/CAN 50.

Background

Percent of Value and Absolute Value Accuracy Levels

The Normative Annex 11 “Water quality testing devices” has test accuracy levels in section N-11.12 as percent of value for alkalinity, cyanuric acid, TDS and salinity while for pH, chlorine and bromine an absolute error range is specified. This is inconsistent and does not align with the source of errors for most of these tests. The result is that some perfectly acceptable test kits are not able to achieve L1 or L2 even though they are generally accurate within normal ranges.

Measuring devices and visual tests actually have both percent of value errors and absolute value errors. Most test measuring equipment specifies accuracy as the greater of percent of value and an absolute value where the latter applies to the low value readings. Percent of value errors are typically introduced by variation in accuracy of the concentration of test reagents and, for all but pH, in the accuracy of the reagent and sample volume. Absolute errors are typically from bias error, electronic noise, quantization of reagent for drop counting tests, and visual color saturation or contrast discrimination for comparator and turbidimetric tests.

While having an absolute error level for pH is reasonable given its limited range, using only absolute error for chlorine and bromine does not make sense. As shown in the table below, the percent of value error in the last column varies significantly and is inconsistent with the distribution of actual errors in such testing and are not stitched well at all (e.g. L1 accuracy level at 2.8 ppm is ± 0.2 and ± 0.7).

N-11.12.2 Accuracy levels for chlorine; free and combined (range of operation 0 to 10 mg/L)

L1	between 0 and 2.8	± 0.2 ppm	7.1% to ∞%
	between 2.8 and 7	± 0.7 ppm	10% to 25%
	between 7 and 10	± 1.5 ppm	15% to 21%

789 N. Dixboro Road, Ann Arbor, Michigan 48105-9723 USA
T +1 734 769 8010 | F +1 734 769 0109 | www.nsf.org

L2	between 0 and 1	± 0.3 ppm	30% to ∞%
	between 1 and 2.8	± 0.5 ppm	18% to 50%
	between 2.8 and 5.5	± 1.0 ppm	18% to 36%
	between 5.5 and 10	± 2.5 ppm	25% to 45%
L3	between 0 and 1	± 0.4 ppm	40% to ∞%
	between 1 and 2.8	± 0.8 ppm	29% to 80%
	between 2.8 and 5.5	± 1.5 ppm	27% to 54%
	between 5.5 and 10	± 3.5 ppm	35% to 64%
	strip or comparator	within 1 increment of the expected value	

If the accuracy level were specified as the higher of a percent of value and an absolute value, then there would be smaller stitching jumps and the errors would align better with actual test kit errors.

Similarly, some of the current test criteria in section N-11.12 are biased against visual tests including the cyanuric acid (CYA) visual turbidimetric test. Current visual turbidimetric "disappearing dot" CYA test kits use a (somewhat) logarithmic scale usually from 30 to 100 so some kits/tubes from 20 to 100 are also available. The test criteria specifying only percent of value prevents the low end of the test from passing reliably. This is shown in the following table where the last column shows the accuracy level going to 0 in the lowest range. A turbidimetric test with a range starting from 30 ppm would be tested at 40 ppm but may not even be able to achieve L2 because of the ± 20% that would require 8 ppm accuracy when the test instructions may round to the next 10 ppm line. A 5 ppm error could snap down to 30 ppm or up to 50 ppm exceeding the 8 ppm accuracy requirement. For a test with a range starting at 20 ppm and tested at 30 ppm, it would require 6 ppm accuracy where that same 5 ppm error could snap down to 20 ppm or up to 40 ppm and exceed the 6 ppm accuracy requirement.

N-11.12.6 Accuracy levels for cyanuric acid (range of operation 0 to 240 mg/L)

L1	between 0 and 35	± 15%	0 to 5.3 ppm
	between 36 and 80	± 12%	4.3 to 9.6 ppm
	between 81 and 120	± 10%	8.1 to 12 ppm
	between 121 and 240	± 15%	18 to 36 ppm
L2	all solutions	± 20%	0 to 48 ppm
L3	all solutions	± 50%	0 to 140 ppm
	strip or comparator	within 1 increment of the expected value	

If the accuracy level were specified as the higher of a percent of value and an absolute value, then visual turbidimetric test kits could pass L2 leaving L1 for electronic spectrophotometric or photometric test devices. Test strips would continue to be L3.

Dilution as Primary Method for Cyanuric Acid Tests
Dilution for cyanuric acid turbidimetric tests should be allowed as a primary method, not just as a 2nd test.

Conclusion
Changes to address these issues will allow for lower-cost portable test kits to be used by health departments and operators under constrained budgets with no significant loss in regulatory compliance and will allow for higher CYA levels to be measured and compliant with this standard.

This issue paper was presented at the 2020 RWF Joint Committee meeting, and a motion to send the paper to the RWF TG on Water Quality Testing Devices was approved. That group discussed the language over multiple teleconferences, and straw balloted the language twice, further revising based on comments received. The group's recent 6-17-22 teleconference saw further revisions based on discussion and was presented in an r3 ballot. That ballot drew a comment suggesting the L2 and L3 levels also adopt a similar tiered approach. The Task Group reviewed this proposal during its 6/30/22 teleconference, and agreed to ballot those changes.

If you have any questions about the technical content of the ballot, you may contact me in care of:

Mr. Tom Vyles, Chairperson
Joint Committee on Recreational Water Facilities
c/o Joint Committee Secretariat
Jason Snider
NSF
Tel: (734) 418-6660
E-mail: jsnider@nsf.org

[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

•
•
•

Normative Annex 11
(formerly Annex O)

Water quality testing devices

•
•
•

N-11.12 Accuracy testing

N-11.12.1 Accuracy levels for pH (range of operation 5 to 10)

L1	between 6.7 and 7.6	± 0.2 pH
	between 7.7 and 8.5	± 0.2 pH
L2	between 6.7 and 7.6	± 0.4 pH
	between 7.7 and 8.5	± 0.4 pH
L3	between 6.7 and 7.6	± 0.5 pH
	between 7.7 and 8.5	± 0.5 pH
	strip or comparator	within 1 increment of the expected value

N-11.12.2 Accuracy levels for chlorine; free and combined (range of operation 0 to 10 mg/L)

L1	between ~~0 and 2.8~~ 0 and 2.5	± ~~0.2 ppm~~ 12% or ± 0.3 ppm, whichever is greater
	between ~~2.8 and 7~~ 2.5 and 6	~~± 0.7 ppm~~ 15%
	between ~~7 and 10~~ 6 and 10	± ~~1.5 ppm~~ 20%
L2	between ~~0 and 1~~ 0 and 2.5	± ~~0.3 ppm~~ 20% or ± 0.5 ppm, whichever is greater
	between ~~1 and 2.8~~ 2.5 and 6	± ~~0.5 ppm~~ 25%
	~~between 2.8 and 5.5~~	~~± 1.0 ppm~~
	between ~~5.5 and 10~~ 6 and 10	± ~~2.5 ppm~~ 30%
L3	between ~~0 and 1~~ 0 and 2.5	± ~~0.4 ppm~~ 25% or ± 0.6 ppm, whichever is greater
	between ~~1 and 2.8~~ 2.5 and 6	± ~~0.8 ppm~~ 30%
	~~between 2.8 and 5.5~~	~~± 1.5 ppm~~
	between ~~5.5 and 10~~ 6 and 10	± ~~3.5 ppm~~ 35%
	strip or comparator	within 1 increment of the expected value

N-11.12.3 Accuracy levels for bromine; total (range of operation 0 to ~~20~~ 22 mg/L)

L1	between ~~0 and 6~~ 0 and 5.5	± ~~0.4 ppm~~ 12% or ± 0.7 ppm, whichever is greater
	between ~~6 and 14~~ 5.5 and 13	± ~~1.4 ppm~~ 15 %
	between ~~14 and 20~~ 13 and 22	± ~~3.0 ppm~~ 20%
L2	between ~~0 and 6~~ 0 and 5.5	± 1~~.0 ppm~~ 20% or ± 1.1 ppm, whichever is greater
	between ~~6 and 12~~ 5.5 and 13	~~± 2.0 ppm~~ 25%
	between ~~12 and 20~~ 13 and 22	± 3~~.0 ppm~~ 35%
L3	between ~~0 and 12~~ 0 and 5.5	± ~~2.0 ppm~~ 25% or ± 1.4 ppm, whichever is greater
	between ~~12 and 20~~ 5.5 and 13	± ~~4.0 ppm~~ 30%
	between 13 and 22	± 35%
	strip or comparator	within 1 increment of the expected value

N-11.12.4 Accuracy levels for hardness (range of operation 0 to 1,100 mg/L as $CaCO_3$)

L1	all solutions	± ~~5%~~ 15% or ± 15 ppm, whichever is greater
L2	all solutions	± ~~10%~~ 25% or ± 25 ppm, whichever is greater
L3	all solutions	± 50% or ± 50 ppm, whichever is greater
	strip or comparator	within 1 increment of the expected value

N-11.12.5 Accuracy levels for alkalinity (range of operation 30 to 220 mg/L as $CaCO_3$)

L1	all solutions	± ~~10%~~ 15% or ± 15 ppm, whichever is greater

L2	all solutions	± ~~20%~~ 25% or ± 25 ppm, whichever is greater
L3	all solutions	± 50% or ± 50 ppm, whichever is greater
	strip or comparator	within 1 increment of the expected value

N-11.12.6 Accuracy levels for cyanuric acid (range of operation 0 to 240 mg/L)

L1	between 0 and ~~35~~ 240	± 15% or ± 5 ppm, whichever is greater
	~~between 36 and 80~~	~~± 12%~~
	~~between 81 and 120~~	~~± 10%~~
	~~between 121 and 240~~	~~± 15%~~
L2	all solutions	± 20% or ± 10 ppm, whichever is greater
L3	all solutions	± 50% or ± 25 ppm, whichever is greater
	strip or comparator	within 1 increment of the expected value

N-11.12.7 Accuracy levels for TDS (range of operation 0 to 4,400 mg/L)

L1	all solutions	± ~~5%~~ 10% or ± 100 ppm, whichever is greater
L2	all solutions	± ~~10%~~ 25% or ± 250 ppm, whichever is greater
L3	all solutions	± 50% or ± 500 ppm, whichever is greater
	strip or comparator	within 1 increment of the expected value

N-11.12.8 Accuracy levels for salinity (range of operation 0 to 7150 mg/L)

L1	all solutions	± ~~5%~~ 10% or ± 100 ppm, whichever is greater
L2	all solutions	± ~~10%~~ 25% or ± 250 ppm, whichever is greater
L3	all solutions	± 50% or ± 500 ppm, whichever is greater
	strip or comparator	Within 1 increment of the expected value

-
-
-

Table N-11.7
Cyanuric acid

Deionized water (mL)	Calcium hardness (mg/L as $CaCO_3$)	Magnesium hardness (mg/L as $CaCO_3$)	Free available chlorine (mg/L)	Temperature (°C)	pH	Total alkalinity (mg/L as $CaCO_3$)	Cyanuric acid (mg/L)
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	27 ± 1	7.4 ± 0.1	100 ± 10	15 ± 5
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	27 ± 1	7.4 ± 0.1	100 ± 10	30 ± 5
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	27 ± 1	7.4 ± 0.1	100 ± 10	50 ± 10
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	27 ± 1	7.4 ± 0.1	100 ± 10	100 ± 20
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	27 ± 1	7.4 ± 0.1	100 ± 10	200 ± 40
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	39 ± 1	7.4 ± 0.1	100 ± 10	15 ± 5
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	39 ± 1	7.4 ± 0.1	100 ± 10	30 ± 5
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	39 ± 1	7.4 ± 0.1	100 ± 10	50 ± 10
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	39 ± 1	7.4 ± 0.1	100 ± 10	100 ± 20
1,000	220 ± 30	80 ± 10	2.0 ± 0.2	39 ± 1	7.4 ± 0.1	100 ± 10	200 ± 40

NOTE – When testing CYA level results in greater than 80 ppm, perform a 2nd test with 1:1 dilution with DI or tap water, read result and multiply by 2 to verify level. Test kits may also use 1:1 dilution with DI or tap water to extend their direct reading range.