RWF Task Group on Water Quality Testing Devices
Straw Ballot
July 11, 2022

This document is the property of NSF and is for NSF Committee purpose only. Unless given prior approval from NSF, it **shall not** be reproduced, circulated, or quoted, in whole or in part, outside of NSF.

Purpose

This straw ballot will incorporate language regarding WQTD sensors in NSF/ANSI/CAN 50.

Background

Section 20 – Water quality testing devices. The scope of this sections covers test strips and reagents with or without electronic comparators as well as probe-based technologies. However, the test methods are not supported in this section.

The issue proponent suggests the standard should incorporate applicable requirements from section 19 (automated controllers) into section 20.

- Data plate markings
- Display accuracy
- Chemical resistance

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. The group reviewed an r1 ballot of the language, which received comments. Language was further revised over the course of several meetings, with the r3 language presented here the culmination of the group's discussions.

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.

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

[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 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 Sensor-based Water Quality Testing Device (WQTD): a water quality testing device that measures water quality in situ but does not have any control capability.

-
-
-

19 Automated controllers

19.1 Scope

Automated controllers are used to monitor water conditions such as pH, ORP, free chlorine or other parameters specified by the manufacturer and to control equipment such as chemical feeders and pumps. Equipment covered by this section includes the controller and the chemical probes, and flow cells. Water contact components and materials of automated controllers shall be evaluated to the health effects criteria of Section 4. Mechanical chemical feeders are covered in Section 11, and flow-through chemical feeders are covered in Section 12.

19.2 Chemical resistant materials

Parts normally in contact with the chemically treated water shall be resistant to the solutions specified in Section N-10.1.2.

19.3 Monitor display

The automated controller shall be equipped with a display that indicates:

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

—operation status (if the parameter is above or below set point);

—whether the automated controller is working properly as specified in Section 19.6; and

—if an automated controller has a digital or analog display, then applicable parameter levels (pH, ORP, etc.) shall be displayed using the following units of measurement, as applicable:

ORP	millivolts (mV)
pH	pH units
temperature	°F or °C
turbidity	nephelometric turbidity units (NTU)
free available chlorine or bromine	ppm or mg/L
total chlorine or bromine	ppm or mg/L

19.4 Life test

Three automated controllers shall be evaluated per Section N-10.2.4. A minimum of one of three controllers shall complete 110,000 actuation cycles, and a minimum of 295,000 cycles shall be accumulated between the three controllers. None of the controllers shall fail at or below 80,000 cycles. Each cycle shall consist of operating the controller for 1 s on / 9 s off, at the manufacturer's maximum rated load. The life test is independent of other tests. The display tests shall be performed after the chemical resistance tests.

19.5 Performance

19.5.1 Operating conditions

The automated controller shall respond with output signals that accurately correspond with the varying input signal when tested per Annex N-10 at four increments between 0% and 100% of the operating ranges specified in Table 19.1. The automated controller may be tested at four increments between 0% and 100% of the manufacturer's full operating range if it is more restrictive than a range listed in Table 19.1. The automated controller shall meet the requirements of this section before and after the chemical resistance test.

Table 19.1
Operation range for automated controllers (as applicable)

Parameter	Suggested operation ranges	Measurement accuracy
ORP	650 to 850 mV	± 20 mV
pH	6.8 to 8.2	± 0.2
free available chlorine or bromine	0 to 10 ppm as Cl_2 0 to 20 ppm as Br_2	10%
total chlorine or bromine	0 to 10 ppm as Cl_2 0 to 20 ppm as Br_2	10%
Temperature	65°F to 110°F	± 1.5°F

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

For other parameters, testing shall be conducted at four increments between 0 and 100% of the full operating range.

If an automated controller does not have a digital or analog display, then an alternate means of verification shall be conducted. This alternate shall be outlined by the manufacturer and shall be able to demonstrate control of the pH and chlorine values of the water as specified in Table 19.1.

19.5.2 Set point

At any set point within a parameter range specified in Table 19.1, an automated controller shall provide an equipment actuation signal (actuate) in response to the signal from an applicable sensor. The actual parameter value at which the automated controller actuates shall be within the tolerance specified in Table 19.1 relative to the set point.

19.6 Failure sensing and signaling devices

The automated controller shall possess a default mechanism or process capable of detecting and delivering a distinct visible signal to notify the user when the controller is not maintaining a parameter within the acceptable range for swimming pool or spa / hot tub water as set by the user.

19.7 Operational protection

19.7.1 The automated controller shall have an automatic mechanism for preventing the operation of any chemical feeder actuated by the controller whenever water circulation at the chemical injection points is interrupted.

19.7.2 The controller shall automatically turn off the equipment actuated by the controller when:

—a parameter maintained by the automated controller remains outside the set point range for longer than the manufacturer's recommended time limit; and

—an equipment operation cycle (e.g., chemical feed cycle) exceeds the manufacturer's recommended time limit.

19.8 Operation and installation instructions

—the manufacturer shall supply installation and operation instructions with each automated controller. These instructions shall include the following:

—proper installation, operation, and maintenance instructions; installation instructions shall document how the controller should be wired in order to provide for electrical interlock for chemical feeders with a circulation pump;

—diagrams and a parts list to facilitate the identification and ordering of replacement parts;

—replacement probe or sensor model numbers;

—maximum external load rated in volts and amps;

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

—caution statement warning the user that the automatic controller should not be installed where it is accessible to the public; and

—applicable operating ranges (such as pH and ORP minimum and maximum) for the automated controller.

19.9 Data plate

Data plate shall be permanent, easy to read, and securely attached, cast, or stamped onto the automated controller at a location readily accessible after normal installation. Data plate shall contain at least the following:

- equipment name;
- manufacturer's name and contact information (address, phone number, website, or prime supplier);
- model number;
- electrical requirements; volts, amps, and Hertz;
- maximum external load rated in volts and amps;
- serial number and date of manufacture;
- caution statements (prominently displayed); and
- replacement sensor model numbers.

20 Water quality testing devices (WQTD)

20.1 General

WQTD are used to monitor and measure recreational water quality parameters to help maintain the optimal swimming environment. Products covered by this section include test strips used with or without an electronic comparator, chemical (liquid or powder) kits with or without electronic comparators, and analytical probes as well as other products or technologies.

20.1.1 WQTD units intended for permanent outdoor installation shall enclose the portions of WQTD sensing components, probes, and electrical connections not designed to be continuously submerged in water to limit exposure of those components to the environment. Compliance shall be checked by testing in accordance with Annex N-12.1.

20.1.2 WQTD units intended to permanently float in the body of water being monitored shall not allow water to access those portions of the WQTD sensing components, reagents, probes, and electrical connections that are not designed to be continuously submerged in water when then entire WQTD is submerged in water such that its lowest point is 1000 mm below the surface of the water for a period of 30 minutes.

20.2 Testing

Reagent, dry or wet, based WQTD units selected for testing shall be from at least 2 different batches or manufacturing runs. Each lot submitted for initial testing shall have a minimum of 50% shelf life remaining at the start of the testing. Products are conditioned, or calibrated, or both as appropriate, per the manufacturer’s instructions then exposed and tested per Annex N-11 requirements to various test solutions to evaluate their accuracy, repeatability, reproducibility, and shelf life, within specified use ranges.

4 monitors and probes for each parameter shall be submitted for testing a sensor based WQTD. Probe-based WQTD units selected for testing shall be determined by the requirements of the chemical resistance,

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

monitor display and operating conditions requirements of the Automatic Controller section of this standard. Products are conditioned, or calibrated, or both as appropriate, per the manufacturer's instructions then exposed and tested per Annex N-10 requirements to various test solutions to evaluate their accuracy, precision and chemical resistance, within specified use ranges

20.2.1 Temperature of room used for testing

Testing shall be conducted at laboratory ambient air temperature and humidity with the stock and test solutions noted in Annex N-11 or Annex N-10 for probe-based products.

20.2.2 Temperature of solution used for testing
The WQTD shall be tested at one or both solution temperatures of pool and spa as noted in Annex N-11, Section N-11.1.~~1~~.2, or Annex N-10 for probe-based products and based upon the manufacturer's recommendation.

20.2.3 Test parameters
For colorimeters / titrators / spectrophotometers and test strip WQTD units, f~~F~~or each parameter tested, it shall meet the applicable requirements in Annex N-11. The WQTD shall be used to analyze test solutions within each range shown in Annex N-11 (see table below) if the parameter falls within the WQTDs operating range for that parameter. Test solutions shall be divided equally to test the WQTD seven times at each concentration for each unit of the WQTD under test.

For probe-based WQTD units, for each parameter tested, the WQTD shall meet the accuracy acceptance criteria of Annex N-11.12, except for ORP, which shall be evaluated for precision/repeatability only, as described in 20.2.5. The procedure used to obtain the accuracy data for determination of compliance to Annex 11.12 for pH and temperature probe based WQTDs shall be the procedure specified in Annex N-10.2.3.

Table 20.1
WQTD acceptance tables

Parameter	Annex N-11 accuracy level	Test solution table
pH	N-11.12.1	Table N-11.1
chlorine (free and combined)	N-11.12.2	free: Table N-11.2 combined: Table N-11.3
bromine (free and total)	N-11.12.3	Table N-11.4
hardness	N-11.12.4	Table N-11.5
total alkalinity	N-11.12.5	Table N-11.6
cyanuric acid	N-11.12.6	Table N-11.7
TDS	N-11.12.7	Table N-11.8
salinity	N-11.12.8	Table N-11.9

20.2.4 Accuracy within operating range (Level 1, 2, or 3)
Testing shall be conducted based upon the manufacturers recommended/claimed use range and the operating ranges to evaluate conformance with L1, L2, or L3 requirements for each parameter. For colorimeters / titrators / spectrophotometers and test strip WQTD units, a~~A~~ll test points shall be used to determine accuracy and the seven test results shall be averaged to determine compliance with Annex N-11 (for that parameter).

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

For probe based WQTD units, all test points shall be used to determine accuracy, and the lowest accuracy obtained from any of the four probe samples shall be used to determine compliance with Annex N-11.12 (for that parameter).

20.2.5 Precision and reproducibility

At each parameter tested, the average standard deviation in the results for each unit of a WQTD shall meet the precision requirements of Section N-11.13 based on the level of the WQTD, as described below.

—test strips: test two lots of test strips with one set of solutions. Both lots shall meet the precision requirements, and the difference between the accuracy of the first and second lot of the test strips shall meet the reproducibility requirements;

—colorimeters / titrators / spectrophotometers: test one device with two reagent lots with one set of solutions, and test two devices with one reagent lot on a different day with a fresh midpoint solution. Both reagent lots shall meet the precision requirements, and the difference between the accuracy of the first and second lot of the reagents shall meet the reproducibility requirements. On the second day,the difference between the accuracy of the first and second devices shall meet the reproducibilityrequirements.

—Probe-based (non-ORP): steady state readings of four probes are used when testing according to N10.2.3, and the probe with the highest difference from the true value shall be used for evaluation to the WQTD accuracy requirements in Annex N-11.12.

—Probe-based (ORP): probe based WQTD that measure ORP shall be evaluated using steady state readings of four probes according to N-10.2.3.3.1. At each concentration, none of the readings from any one of the four probes shall deviate from the average of the four readings at that test point by more than the values in Annex N-11.12.

20.2.6 Reagent Shelf life

The shelf life for the reagents and components of a WQTD shall be at least as long as specified by the manufacturer when the reagents and components are tested in accordance with Section N-11.14. When tested with reagents and components stored for the manufacturer specified shelf life (± 2 weeks), the accuracy, and repeatability of the WQTD shall meet the requirements of Annex N-11. After initial testing of the WQTD, it shall be stored in accordance with the manufacturer's instructions and retested at the manufacturer's prescribed shelf life (± 2 weeks) for compliance to these requirements in Section 20 and Annex N-11.

For reagent based WQTD devices intended for permanent outdoor installation:

— As described above, the reagents shall be stored for the manufacturer specified shelf life (± 2 weeks), then tested for accuracy, and repeatability to the requirements of Annex N-11.

— - An additional test for accuracy and repeatability shall be performed on reagent that has been stored at 110±5°F or the manufacturer's recommended maximum storage temperature for the maximum amount of time that the reagent can be stored in situ in the WQTD per the manufacturer's instructions.

20.2.7 Probe chemical resistant materials

Parts normally in contact with the chemically treated water shall be resistant to the solutions specified in Section N-10.1.2; probe-based WQTDs shall demonstrate compliance via the Chemical Resistance test for

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

automated controllers listed in N-10.1 in place of shelf-life testing. After the completion of the Chemical Resistance test, the probe based WQTD shall be re-evaluated according to 20.2.3, 20.2.4, and 20.2.5.

20.3 Operation and use instructions

20.3.1 Reagent based

The manufacturer shall provide operation and use instructions with the WQTD. The instructions shall address:

- WQTD components;
- WQTD conditioning, if applicable;
- detailed use instructions, including:
- sample size;
- reagent(s) required and measurement of reagents;
- addition of reagent(s) and mixing;
- wait times, if applicable; and
- method of determining test result, including calculation and conversion factors, as applicable.
- maintenance of WQTD components, if applicable;
- proper storage of the WQTD and its components;
- trouble shooting suggestions, dilution use explanation;
- range limitations or variations of the WQTD for use or testing parameters;
- potential interference agents; ~~and~~
- suggested sequence of water quality tests (i.e., pH first, then chlorine); and
- For reagent based WQTD devices intended for permanent outdoor installation, the manufacturer shall specify the length of time the reagent can be used or stored once installed in the WQTD.

20.3.2 Probe based

The manufacturer shall supply installation and operation instructions with each probe-based WQTD. These instructions shall include the following:

- proper installation, operation, and maintenance instructions;

- operation instructions, including method of determining test result, including calculation and conversion factors, as applicable;

- maintenance of WQTD components, if applicable;

- proper storage of the WQTD and its components;

- range limitations or variations of the WQTD for use or testing parameters;

- potential interferences;

- diagrams and a parts list to facilitate the identification and ordering of replacement parts;

- replacement probe or sensor model numbers;

- applicable operating ranges (such as pH and ORP minimum and maximum) for the probe-based WQTD.

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

20.4 WQTD marking / identification

20.4.1 Reagent Based

The WQTD shall have identification or marking that is permanent, easy to read, and securely attached to the unit. The identification or marking shall contain:

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

— model number or part number of the unit;

~~— parts list to facilitate the identification and ordering of replacement parts (or referral to a manual or website for those units with size constraints);~~

— WQTD classification level (L1, L2, L3) for each parameter (or lowest level achieved); and

— disposal date of the WQTD and its components.

24.4.2. Probe Based

Data plate shall be permanent, easy to read, and securely attached, cast, or stamped onto the probe-based WQTD at a location readily accessible after normal installation. Data plate shall contain at least the following:

- — equipment name;
- — manufacturer's name and contact information (address, phone number, website, or prime supplier);
- — model number; and
- — WQTD classification level (L1, L2, L3) for each parameter (or lowest level achieved)
-
-
-

Normative Annex 10

(formerly Annex N)

Test methods for the evaluation of automated chemical controllers

N-10.1 Chemical resistance

N-10.1.1 Purpose

The purpose of this Annex is to determine if the automated controller components that are normally in contact with the chemically treated water will erode or sustain structural deformation. Following chemical exposure, the accuracy of the input and output sensor signals of the controller shall be determined as specified under Section 19.5.1 using the applicable methods in Section N-10.2.

N-10.1.2 Test solutions

Water temperature

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

Swimming pools	Hot tubs / spas
75 ± 10 °F (24 ± 6 °C)	102 ± 5 °F (39 ± 3 °C)

Chemical composition				
	Alkalinity	**pH**	**Sanitizer**	
1	80 ± 15 mg/L as $CaCO_3$	6.8 to 7.4	free chlorine:	8 to 12 mg/L as Cl_2
2	160 ±15 mg/L as $CaCO_3$	7.8 to 8.2	free chlorine:	8 to 12 mg/L as Cl_2
NOTE — The test temperature may be obtained by heating or cooling the test water solution or by heating or cooling the ambient temperature around the automated controller equipment.				

N-10.1.2.1 All controllers, except those labeled to be for swimming pools only, shall be tested at the hot tub / spa water temperature.

N-10.1.2.2 Four separate probes/sensors are required and run in parallel for this testing.

N-10.1.2.3 In order to maintain concentrations or stability of the testing chemical solutions, seal the solution container with a lid, and insert probes through the lid.

N-10.1.3 Method

a) Expose all normally wetted parts of the probe/sensor to each of the chemical solutions in Section N-10.1.2 for a period of 100 d ± 6 h at the ambient temperature specified in Section N-10.1.2.

b) Rinse the exposure solution from the probe/sensor components and operate the automated controller under normal conditions (e.g., pH 7.5, ORP 700 mV) for 24 h ± 1 h according to the manufacturer's instructions.

c) After the 24 h period, evaluate the controller as specified under Section 19.5.1.

N-10.1.4 Acceptance criteria

After chemical exposure, automated chemical controller components shall show no signs of erosion or structural deformation and shall operate in accordance with Section 19.5.1.

N-10.2 Performance

N-10.2.1 Purpose

The purpose of this Annex is to determine if the automated controller responds with output signals that accurately correspond with the applicable input signals under normal operating conditions.

N-10.2.2 Test water

	Swimming pools	Hot tubs / spas

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

water temperature	75 ± 10 °F (24 ± 6 °C)	102 ± 5 °F (39 ± 3 °C)

N-10.2.3 Methods

Prior to performing the described methods, the automated controller shall be installed and prepared for operation according to the manufacturer's instructions. The controller shall be tested to each method with four sensors. Controllers without replaceable sensors, like colorimetric analyzers, shall have each test repeated four times.

N-10.2.3.1 pH

N-10.2.3.1.1 Monitor display accuracy

a) Fill an appropriately sized container with the test water at the required temperature (Section N-10.2.2).

b) Calibrate a laboratory pH meter equipped with a pH electrode according to manufacturer's instructions using appropriate buffer solutions (pH 7 and pH 10).

c) Attach the sensor under test to the automated controller.

d) Place the laboratory pH electrode and the sensor (attached to the automated controller), or controller influent tube into the test water solution (stir on a stir plate).

e) Add 1 N sulfuric acid (to lower the pH) or 1 N sodium hydroxide (to raise the pH) as required to bring the test water solution pH to 7.0 as measured by the laboratory pH meter.

f) Record the readout of the automated controller (sensor and pH meter).

g) Add 1 N sodium hydroxide drop-wise until the laboratory pH meter reads a pH between 7.1 and 7.5. Allow the sensor and pH meter to equilibrate and record the readout of the laboratory pH meter. Record the readout of the automated controller (sensor).

h) Repeat the previous step, this time bringing the laboratory pH meter reading to a pH between 7.5 and 8.0. Again, record the readouts.

i) Repeat the previous step again, this time bringing the laboratory pH meter reading to a pH between 8.0 and 8.2. Record the readouts.

N-10.2.3.1.2 Controller output accuracy

a) Prepare a sample of test water listed under Section N-10.2.2 and adjust pH to 7.0 using 1 N sulfuric acid.

b) Attach the sensor under test to the automated controller per manufacturer's instructions.

c) Set the automated controller to a set point of 7.5.

d) Attach two indicators sized for the appropriate voltage into each output terminal of the automated controller.

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

e) Place the sensor under test, or controller influent tube, in the pH 7.0 solution with a total alkalinity range of 80 to 120 ppm.

f) Record the pH level indicated on the display of the automated controller. Record the operation status of the automated controller.

g) Slowly add 1 N sodium hydroxide solution until the controller actuates and record the pH on the display.

h) Slowly add 1 N sulfuric acid solution until the controller deactuates and record the pH on the display.

i) Repeat the test with each sensor for a total of four tests. Calculate the average pH displayed for the actuation and deactuation. Record the largest variance of a single reading from the average values.

N-10.2.3.2 Chlorine / bromine

N-10.2.3.2.1 Monitor display accuracy

a) Calibrate a spectrophotometer using standard solutions following *Standard Methods*[Error! Bookmark not defined.] 4500-Cl G, such that the instrument is capable of measuring available chlorine levels in the range of 0 to 10 ppm, or for bromine using HACH Method 8016 for available bromine levels in the range of 0 t 20 ppm.

b) Weigh 0.20 g of a solution having 5% free chlorine derived from either sodium hypochlorite or calcium hypochlorite. Quantitatively transfer to a 1 L volumetric flask and dilute to volume using deionized water. The resulting stock solution should contain approximately 10 ppm available chlorine. For preparing an aqueous bromine solution obtain a 0.1N Bromine Standard Solution. Perform serial dilutions (e.g., $^1/_{10}$; $^1/_{10}$; $^1/_4$; $^1/_2$) so that the resulting stock solution contains approximately 20 ppm available bromine.

c) Using the appropriate analytical method from part a), measure the available chlorine level for the stock sodium hypochlorite or calcium hypochlorite solution, or the bromine level for the stock bromine standard solution.

d) Volumetrically dilute the stock sodium hypochlorite or calcium hypochlorite solution by the appropriate proportions to give four solutions between 0 and 10 ppm available chlorine. For example, diluting the stock to $^1/_5$, $^1/_2$, and $^4/_5$ would provide the approximate concentrations of 2 ppm, 5 ppm, and 8 ppm; these dilutions along with the stock solution would give four solutions in the required concentration range. Using the spectrophotometer, measure the available chlorine level for each sodium hypochlorite solution. For bromine volumetrically dilute the stock bromine solution by the appropriate proportions to give four solutions between 0 and 20 ppm available bromine. For example, diluting the 20-ppm stock to $^1/_{10}$, $^1/_4$, and $^1/_2$, would provide the approximate concentrations of 2 ppm, 5 ppm, and 10 ppm; these dilutions along with the stock solution would give four solutions in the required concentration range. Using the analytical method referenced above, measure the available bromine level for each solution.

e) Place the sensor, or influent tube of the controller, in the midrange sample (nominal value 5 ppm for chlorine; 10 ppm for bromine). Calibrate the automated controller so that the display registers the same reading as the analytical method from step d. Place the sensor in each of the four solutions and record the readout of the sensor, by starting with the lowest concentration solution and working up to the highest concentration, rinsing the sensor between each reading.

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

N-10.2.3.2.2 Controller output accuracy

a) Using sodium hypochlorite or calcium hypochlorite and aqueous bromine stock solutions described in Section N-10.2.3.2.1 prepare test solutions with a free available chlorine concentration of 2 mg/L as Cl_2 (ppm), or 4 mg/L as Br_2 (ppm).

b) Attach the sensor under test to the automated controller per manufacturer's instructions.

c) When testing for chlorine, set the controller to a set point of 3.0 ppm free available chlorine or 6.0 ppm free bromine.

d) Attach two indicators sized for the appropriate voltage into each output terminal of the automated controller.

e) Place the sensor, or influent tube, under test in the 2-ppm sodium hypochlorite solution, or the 4 ppm bromine solution.

f) Record the chlorine, or bromine level indicated on the display (in ppm) of the automated controller. Record the operation status of the automated controller.

g) Slowly add 1 N sodium hypochlorite or calcium hypochlorite solution (or 0.1 N aqueous bromine) until the controller deactuates. Record the chlorine or bromine ppm on the controller display.

h) Slowly add 1 N sodium thiosulphate solution until the controller actuates. Record the chlorine or bromine ppm on the controller display.

N-10.2.3.3 ORP

N-10.2.3.3.1 Monitor display accuracy

When testing the ORP probe, the alkalinity should be in the range of 80 to 120 ppm and a pH of 7.5 ± 0.2 throughout all tests. The temperature should remain constant (room temperature) throughout the duration of all of the tests ± 3 °F.

a) Weigh 0.20 g of a solution having 5% free chlorine derived from either sodium hypochlorite or calcium hypochlorite. Quantitatively transfer to a 1 L volumetric flask and dilute to volume using deionized water. The resulting stock solution should contain approximately 10 ppm available chlorine.

b) Volumetrically dilute the stock sodium hypochlorite or calcium hypochlorite solution by the appropriate proportions to give the following four solutions: 1 ppm, 3 ppm, 5 ppm, and 7 ppm chlorine.

c) Place four ORP sensors in the solution in step b and connect them to the displays / automated controllers or place the influent tubes from four controllers in the solution, (actual samples under test,) so that there will be four independent sensor/display setups. Calibrate them per the manufacturer's instructions.

d) At each concentration record the readings of the four ORP sensors. Calculate the average of the readings at each concentration.

N-10.2.3.3.2 Controller output accuracy

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

a) Using sodium hypochlorite or calcium hypochlorite, prepare a test solution with a chlorine concentration of 2 mg/L as Cl_2 (ppm).

b) Attach the sensor under test to the automated controller per manufacturer's instructions.

c) Attach two indicators sized for the appropriate voltage into each output terminal of the automated controller.

d) Place the sensor under test, or the influent tube of the controller, in the 2-ppm sodium hypochlorite solution.

e) Set the automated controller set point to just activate controlled output, verify output. Reduce set point to just deactivate controller output, verify output. Record ORP reading at set point.

f) Slowly add 1-N sodium hypochlorite or calcium hypochlorite solution until the controller deactuates. Record the ORP display on the controller.

g) Slowly add 1-N sodium thiosulfate solution until the controller actuates. Record the ORP display on the controller.

N-10.2.3.4 Temperature

N-10.2.3.4.1 Monitor display accuracy

a)Fill an appropriately sized container with the test water.

b)Calibrate a laboratory temperature gauge.

c)Attach the sensor under test to the automated controller.

d)Place the laboratory temperature gauge and the sensor (attached to the automated controller), or controller influent tube into the test water solution (stir on a stir plate).

e)Slowly adjust the test water to 65°F (18.33°C), or the lowest temperature of the claimed range of the Controller, whichever is higher in temperature.

f) Record the readout of the automated controller and laboratory gauge.

g)Increase the water temperature in increments of 5°F to 110°F (43.33 °C) or to the highest temperature in the claimed range of the controller, whichever is lower.

h)Record the readout of the automated controller and laboratory gauge at every increment until completion of the range.

N-10.2.3.4.2 Controller Output Accuracy

a) Prepare a sample of test water and adjust the temperature to 80°F (26.7°C).

b) Attach the sensor under test to the automated controller per manufacturer's instructions.

c) Set the automatic controller to a setpoint of 75°F (23.9°C).

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

d) Attach an indicator sized for the appropriate voltage into the output terminal for temperature control e) Place the sensors under test, or controller influent tube, into the prepared test solution.

e) Record the temperature indicated on the display of the automated controller. Record the operation status of the automated controller.

f) Slowly lower the temperature of the test water until the controller actuates, and record the temperature on the display.

g) Slowly raise the temperature of the test water until the controller de-actuates, and record the temperature on the display.

h) Repeat the test with each sensor for a total of four tests. Calculate the average temperature displayed for the actuation and de-actuation. Record the largest variance of a single reading from the average values.

N-10.2.4 Life test

Using a signal generator feed each of the sensors that directly control an output. The signal should mimic that of the sensor circuit being tested alternating between a demand for feed for a period of 1 s on / 9 s off. A resistive load, rated at 100% of the manufacturer's rated load, shall be connected to each of the automated controller outputs. A counter shall measure the number of cycles performed (each cycle consists of a complete on-off sequence).

N-10.2.5 Acceptance criteria

N-10.2.5.1 Monitor display accuracy

N-10.2.5.1.1 pH

At each of the four pH points tested, the difference between the pH level indicated on the monitor display of the automated controller and the laboratory pH meter reading shall not exceed the tolerance level given in Table 19.1. The pH on the monitor display for each actuation and de-actuation shall not vary by more than ± 0.2 pH units from the average value of each set of actuation and de-actuation readings.

N-10.2.5.1.2 Chlorine / bromine

At each of the four available chlorine concentrations tested, the difference between the chlorine or bromine concentration indicated on the monitor display of the automated controller and the concentration measured by the appropriate analytical method used shall not exceed the tolerance level given in Table 19.1.

N-10.2.5.1.3 ORP

At each concentration none of the sensor / display combinations shall deviate by more than 10% of the average of the four readings at that set point.

N-10.2.5.1.4 Temperature

At each of the water temperatures tested, the difference between the temperature indicated on the monitor display of the automated controller and the temperature measured by the appropriate analytical method used shall not exceed the tolerance level given in Table 19.1.

NSF Confidential

Not for publication. This document is part of the NSF standard development process. This draft text is for circulation for review and/or approval by a NSF Standards Committee and has not been published or otherwise officially adopted. All rights reserved. This document may be reproduced for informational purposes only.

N-10.2.5.2 Controller output accuracy

For each of the applicable parameters tested under Section N-10.2.3, the automated controller shall respond with output signals that accurately correspond with the varying input signals within the appropriate tolerance levels given in Table 19.1.

N-10.2.5.3 Life test

At the end of the test the resistive load should still be actuated on and off by the automated controller. At least one of the automated controllers should complete 110,000 cycles, and a minimum of 295,000 cycles shall be accumulated between the three automated controllers.

•
•
•

Normative Annex 11

(formerly Annex O)

Water quality testing devices

N-11.12 Accuracy testing

•
•
•

N-11.12.9 Accuracy levels for temperature (range of operation 65° to 110°F)

L1	all temperatures	± 0.5 °F
L2	all temperatures	± 1.5 °F
L3	all temperatures	± 2.5 °F

N-11.12.10 Precision levels for ORP (range of operation ±1000mV)

L1	all solutions	± 1%
L2	all solutions	± 5%
L3	all solutions	± 10%

•
•
•

NSF Confidential