Summary of Substantive Changes
between the 2017 and the 2019 editions of

NSF/ANSI/CAN 50 "Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs, and other Recreational Water Facilities"

Presented to the IAPMO Standards Review Committee on August 10, 2020

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

- Changed swimming pool skimmer housing and weir dimensional requirements to match the spa/hot tub skimmers, and allowed the use of additional water based flow rate skimmers based on testing in Annex N-5.2 (see Section 10.1.3, 10.2, and Annex N-5.2)
- Updated skimmer operation and installation instructions for hair and body entrapment warning to comply with ANSI/APSP-16 instead of ANSI/ASME A112.19.8, added instructions for minimum and maximum flow rates, marking requirements, and optional requirements for instructions to water level based flow rate skimmers (see Section 10.9, Annex N-5.2)
- Added a requirement for the UV treatment system to contain a secondary supplemental system which provides an effective mean to alert the user when a component is not operating (see Section 15.5)
- Added requirements for the UV treatment system operation and installation instructions to include whether the UV system contains a mechanical cleaning system or requires an external cleaning system installed (see Section 15.6)
- Removed ASTM F462 and ASTM D1894 as an acceptable testing reference for spa/hot tub slip resistance requirements (see Section 21.4.3.2.2)
- Added general and testing requirements for water conditioning devices utilized in recreational water facilities (see Section 25)
- Added general and testing requirements for interactive waterplay venue surfacing systems, including slip-resistance, cleanability, and impact attenuation of these surfaces (see Section 26)
- Revised the water exposure testing to make organics extraction use chlorinated water to be consistent with the latest NSF 61 update (see Section N-1.3.3)
- Corrected the skimmer head loss equations for normal operation and equalizer operation (see Section N-5.4.4)
- Corrected accuracy levels for water quality testing devices (see Section N-11.12.1, and N-11.12.6)
- Changed the shelf life testing of water quality devices to match the updated methods based on closed package studies (see Section N-11.14)
- Added requirements for standardized evaluation levels used to treat and balance recreational water (see Annex N-12)

Title: The term chemicals was included in the title as follows:
Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs, and other Recreational Water Facilities

Section 2, Normative references: Changed the section number from 1.5 to 2 and added the following referenced standards as follows:
~~1.5~~ 2 Normative references
ANSI/APSP/ICC-11, Standard for Water Quality in Public Pools and Spas
AS 4586 – 2013, Slip resistance classification of new pedestrian surface material
ASTM E1153 – 2014, Standard Test Method For Efficacy Of Sanitizers Recommended For Inanimate, Hard, Nonporous, Non-Food Contact Surfaces
ASTM G154, Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
DIN EN-1177, Impact attenuating playground surfacing – Methods of test for determination of impact Attenuation
ISO/TS 15883-5, Washer-disinfectors – Part 5: Test soils and methods for demonstrating cleaning efficacy Annex H1
Model Aquatic Health Code 2018

Section 3, Definitions: The definition for water conditioning device was added as follows:
***3.153** water conditioning device: A device intended to treat swimming pool water and improve water quality without the introduction of additional chemicals.*

Section 10, Recessed automatic surface skimmers: Reduced the housing opening at the entrance throat for swimming pool skimmers from a minimum 7.5 in to 4 in and for swimming pool flap-type weirs from 7.5 in to 3.75 in as follows:
~~9.1~~10.1 Housing
….
***~~9.1.3~~ 10.1.3** On swimming pool ~~skimmers, the housing opening at the entrance throat shall be at least 7.5 in (190 mm) wide. On~~ and spa/ hot tub skimmers, the housing opening at the entrance throat shall be at least 4 in (102 mm) wide. If a circular weir is used, there shall be a clearance of at least 2 in (51 mm) between the weir lip and the side of the skimmer housing.*

~~9.2~~ 10.2 Weir
***~~9.2.1~~ 10.2.1** A skimmer shall have a weir that operates freely with continuous action and adjusts automatically to variations in water level over a minimum range of 4 in (102 mm), or 3 in (76 mm) if an auto-fill pool water level control device is used when operated at the ~~maximum~~ minimum design flow rate (~~see Annex E,~~ Section ~~E.2~~ N-5.2).*
***~~9.2.2~~ 10.2.2** Flap-type weirs on swimming pool ~~skimmers shall have a minimum unobstructed width of 7.25 in (184 mm) over the full operating range. Flap-type weirs on~~ and spa / hot tub skimmers shall have a minimum unobstructed width of 3.75 in (95 mm) over the full operating range. Flap-type weirs shall be buoyant and designed to develop an even flow over their full width. The clearance between the weir and the housing side shall not exceed 0.125 in (3 mm) at any point. Hinge construction shall preclude leakage.*

The weir shall be firmly attached to the housing and shall be accessible for cleaning and replacement in the field.

Section 10.4, Equalizer line: Updated equalizer line flow requirements with compliance to ANSI/APSP-16 instead of ANSI/ASME A112.19.8 as follows:

***~~9.4~~ 10.4** Equalizer line*

***~~9.4.2~~ 10.4.2** Consult local codes to determine if skimmer installation requires an equalizer line. If an equalizer line is required for skimmer installation, any submerged suction equalizer outlet shall be covered by an appropriately certified and sized suction fitting (cover, sump, and fasteners) that is certified in accordance with ANSI/APSP-16. It is the responsibility of installers, service technicians and facility operators to comply with local codes and regulations. If it is acceptable to disable the equalizer line during installation / service, such work shall be conducted in accordance with the skimmer manufacturer's instructions.*

For skimmer designs that incorporate an equalizer line, one of the following shall occur:

– if the skimmer manufacturer does supply a suction fitting (along with the skimmer), the skimmer manufacturer shall specify the minimum flow rating that meets or exceeds the maximum flow rate of the skimmer equalizer. The skimmer manufacturer shall mandate installation of the skimmer with the provided suction fitting which shall be certified to ANSI/APSP-16 with a flow rating that meets or exceeds the maximum flow rate of the skimmer equalizer; or

– if the skimmer manufacturer doesn't supply a suction fitting (along with the skimmer), the skimmer manufacturer shall specify the minimum flow rating that meets or exceeds the maximum flow rate of the skimmer equalizer. The skimmer manufacturer shall mandate the installation of a suction fitting that is certified to ~~ANSI/ASME A112.19.8~~ANSI/APSP-16 with a flow rating that meets or exceeds the maximum flow rate of the skimmer equalizer.

Section 10.9, Operation and installation instructions: Updated skimmer operation and installation instructions for hair and body entrapment warning to comply with ANSI/APSP-16 instead of ANSI/ASME A112.19.8, added instructions for minimum and maximum flow rates, marking requirements, and optional requirements for instructions to water level based flow rate skimmers as follows:

~~9.9~~ 10.9 Operation and installation instructions

***~~9.9.2~~ 10.9.2** A skimmer equipped with an equalizer shall have, in its operation and installation instructions:*

– a warning that the skimmer is to be installed with an equalizer wall or drain fitting ~~conforming~~ certified to ~~ANSI/ASME A112.19.8~~ANSI/APSP-16 to prevent hair or body entrapment at the skimmer equalizer;

– the skimmer manufacturer shall specify the minimum flow rating of the suction fitting (which meets or exceeds the maximum flow rating of the skimmer suction line); and

– to address jurisdictions that do not allow skimmers to be installed with equalizer lines, the skimmer manufacturer shall provide instructions for disabling (i.e., installation of the skimmer without the equalizer line) the equalizer line.

***~~9.9.3~~10.9.3** A skimmer's flow ratings (GPM, LPM) shall be specified ~~based on the nominal pipe size intended to plumb the suction line (and/or equalizer line)~~ by the manufacturer and conform to Sections 10.3.3.1 through 10.9.3.3, when applicable. ~~The maximum velocity for any nominal pipe sizeshall not exceed 6 FPS (1.83 MPS)~~ When skimmers include water level based, maximum flow rating marks inside the housing, instructions shall indicate they are to be observed by users when the skimmer is off (i.e., no flow).*

10.9.3.1 *The minimum flow rating shall develop an even flow over the full width of the weir when tested at the skimmer's lowest operating water level (see Section N-5.2).*
10.9.3.2 *The maximum flow rating for each indicated operating water level shall not exceed the nominal pipe sizes specified by the manufacturer or entrain air in the suction line (see Section N-5.2). The maximum velocity for any nominal pipe size specified shall not exceed 6 FPS (1.83 MPS). Velocity calculations shall be based on the nominal inside diameter for ASTM D17859 schedule 40 PVC pipe.*
10.9.3.3 *The manufacturer may optionally specify water level based, maximum flow ratings within the operating range of the weir (e.g., the normal, mid-point operating level) that are higher than the maximum flow rating achieved when tested at the lowest operating water level of the weir (see Section N-5.2). When multiple water level based flow ratings are used, each shall be indicated on a data plate inside the skimmer housing that is permanent, easy to read, and securely attached, cast or stamped at the appropriate water elevation. The elevation of these markings shall be set and observed when the pump is off.*

~~9.10~~ 10.10 *Data plate*
A skimmer shall have a data plate that is permanent, easy to read, and securely attached, cast or stamped into the cover or skimmer housing at a location readily accessible after installation. The data plate shall contain the following information:
– manufacturer's name and contact information (address, phone number, website, or prime supplier);
– skimmer model number;
– minimum design flow rate in GPM (LPM);
– maximum design flow rate in GPM (LPM); and
– multiple water level based maximum design flow rates in GPM (LPM) that refer to or are located adjacent water level marks located inside the skimmer housing, if applicable.

Section 14, Ozone generation process equipment: Clarified the requirements for ion generators as follows:
~~13.19~~ 14.19 **Disinfection efficacy**
Process equipment designed for supplemental disinfection such as ~~copper and/or silver~~ ion generators, ozone and ultraviolet light equipment shall demonstrate a 3 log (99.9%) or greater inactivation of influent bacteria when tested according to Section N-8.1.
Process equipment designed for secondary disinfection such as ~~copper and/or silver~~ ion generators, ozone and ultraviolet light equipment shall demonstrate a 3 log (99.9%) or greater reduction of Cryptosporidium parvum when tested and evaluated according to Section 14.20.

Section 15.5, Performance Indication: Added a requirement for the UV treatment system to contain a secondary supplemental system which provides an effective mean to alert the user when a component is not operating as follows:
~~14.5~~ 15.5 Performance indication
A supplemental UV system shall be provided with an effective means to alert the user when a component of this equipment is not operating.
A secondary UV ~~Each~~ system shall incorporate on the control panel a constantly visible readout of the actual flow (in US GPM), the actual calculated dose (in m~~j~~J/cm^2) and the actual lamp intensity (in ~~w/cm^2~~ w/m^2). It is acceptable for the display to constantly cycle through the parameters. The cycle duration shall not take more than 15 s.

Section 15.6, Operation and installation instructions: Added requirements for the UV treatment system operation and installation instructions to include whether the UV system contains a mechanical cleaning system or requires an external cleaning system installed as follows:

~~14.6~~ 15.6 Operation and installation instructions

~~14.6.1~~ 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;

.....

15.6.2 *UV systems claiming inactivation of cysts, the installation and operational instructions or product manual shall contain the following:*

.....

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

Section 15.8, Disinfection efficacy: Clarified the intention and role of Annex N-8.1 in the disinfection efficacy as follows:

~~14.8~~15.8 Disinfection efficacy

*Ultraviolet light ~~P~~p*rocess equipment designed for supplemental disinfection *~~such as copper and/or silver ion generators, ozone and ultraviolet light equipment~~* shall demonstrate a 3 log (99.9%) or greater inactivation of influent bacteria when tested according to *~~Annex H,~~* Section *~~H1~~ N-8.1*.

~~Process equipment designed for secondary disinfection such as ozone and ultraviolet light equipment shall demonstrate a 3-log (99.9%) or greater inactivation of Cryptospordium parvum when tested and evaluated according to Section 14.18.~~

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.

Ultraviolet light process equipment designed for 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."

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."

Section 21, Spas and hot tubs: Removed ASTM F462 and ASTM D1894 as an acceptable testing reference for spa/hot tub slip resistance requirements as follows:

21.4.3.2.2 Steps and stepping surfaces within the activity spa intended primarily for ingress/egress footing shall be slip-resisting and shall achieve a wet pendulum slip resistance of P5 when tested in accordance with AS4586-2013~~, as defined by the requirements of the following:~~

~~— ASTM F462; or~~

~~— ASTM D1894~~

~~Testing shall be performed with the traditional soapy water solution and the tap water treated with 2.0 ppm of free available chlorine.~~

Section 25, Water condition devices: Added general and testing requirements for water conditioning devices utilized in recreational water facilities as follows:

25 Water conditioning devices

This section contains requirements for water conditioning devices. A water conditioning device is a physical device that, without the introduction of any chemicals, treats the water by reducing:

– combined chlorine;

– chlorine consumption;

– acid consumption;

– phosphate levels;

– water consumption during filter cleaning; or

– any combination of the above.

This includes but is not limited to magnetic devices and ultraviolet light generators. This section is not intended for filtration or chemical feeding equipment.

25.1 General design and construction

25.1.1 *Components and parts of water conditioning devices requiring cleaning and maintenance shall be accessible.*

25.1.2 *If circulation system components are not supplied with the installation kit the manufacturer shall provide a piping diagram, a parts list, and installation procedures.*

25.2 Head loss

If a water conditioning device is intended to be installed in the water circulation line, the manufacturer shall make available a head loss claim. The actual head loss shall not exceed the claimed head loss by more than 5%.

25.3 Hydrostatic pressure

Water conditioning equipment that operates under pressure shall have a minimum designed pressure rating of 50 psi. The water conditioning device and all provided installation components shall show no evidence of rupture, leakage, burst, or permanent deformation when subject to a hydrostatic pressure 1.5 times the manufacturer's maximum operation pressure.

25.4 Valve and component identification

All valves and components provided with the water conditioning device shall have a permanent, easily legible, and conspicuous label or tag identifying their operation.

25.5 Performance indication

Water conditioning devices shall be provided with a means to alert the user when the device or a component of the water conditioner that is essential to its performance is not operating. If the performance of the water conditioner is dependent on a specified water flow rate, the flow shall be provided on the data plate and use instructions.

25.6 Operational protection

Power to the water conditioning device shall be interrupted upon the loss of circulation flow if operation of the device without circulation flow could introduce a potential hazard to bathers or equipment.

25.7 Performance validation

Water conditioning equipment intended for the reduction of combined chlorine, chlorine consumption, acid consumption, phosphate levels or filter cleaning water consumption shall be tested in accordance with Section 25.

25.8 Operation and installation instructions

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 installation;
– operation and maintenance instructions;
– a statement of the manufacturer's warranty;
– applicable caution statements (prominently displayed);
– ventilation requirements (if applicable);
– applicable specific water conditioning performance claim(s):
– reduction of combined chlorine;
– reduction of chlorine consumption;
– reduction of acid consumption;
– reduction of phosphate levels; or
– reduction of filter cleaning water consumption.

25.9 Data plate

A 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 at least the following:

– equipment name / model number;

– manufacturer's name and contact information (address & phone number or website);

– electrical requirements - volts, amps and hertz (if applicable);

– serial number or date of manufacture, or both;

– flow rate (if applicable);

– caution statements (prominently displayed);

– a statement reading "This water conditioning device has been certified for the reduction of <insert the specific parameter or parameters for which the device has been tested and met the compliance criteria listed in Section 25>.";

– applicable specific parameter(s):

– combined chlorine;

– chlorine consumption;

– acid consumption;

– phosphate levels; or

– filter cleaning water consumption.

– the specific certification mark.

25.10 Ultraviolet light conditioners

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Ultraviolet light conditioners shall comply with the following requirements in addition to the applicable requirements written in the preceding sections.

***25.10.1** Ultraviolet light conditions shall be equipped with an automatic mechanism for shutting off the power whenever the cover is removed.*

***25.10.2** UV systems shall have a prominently displayed caution statement that UV light is harmful to eyes and exposed skin and to turn off electrical supply before opening the unit.*

***25.10.3** UV systems that have been certified as only a water conditioning device, and not as ultraviolet light process equipment, shall have a statement in the manual and on the data plate that the unit has not been certified for supplemental or secondary disinfection.*

***25.11** Test method for water conditioning device performance validation*

25.11.1 Purpose

The purpose of this test is to determine the effect of a water conditioning device on the chlorine consumption, acid consumption, combined chlorine level, phosphate level, or filter cleaning water usage.

25.11.2 Apparatus

– a test tank capable of holding a volume of 10,000 gallons;

– an environment free from direct air currents on the tank surface and with a temperature of 75 ± 10 °F;

– circulation piping constructed of 2" schedule 40 PVC;

– a sand filter having a diameter of 18 in, a sand bed depth between 10 and 11 in, equipped with multiport valve, filled with standard #20 sand and conditioned with initial backwash and rinse;

– a pump with suction within 1 ft of the tank bottom, and return 6 to 12 in below the water surface, capable of an increase in filter inlet pressure 2: 8 psi with less than a 10% drop in flow when compared to the flow rate obtained through a clean filter;

– a test tank mixing pump sufficient in capacity to maintain suspension of turbidity challenge media;

– a particulate dosing mechanism equipped to introduce to the test tank crushed silica #140, Sil-Co-Sil 106 or equivalent with an accuracy of ± 5 g;
– a dosing pump equipped to inject hydrochloric acid into the circulation system after the filter and heater for pH control;
– a dosing pump equipped to inject sodium hypochlorite into the circulation system after the filter and heater for chlorine control separated by a minimum of two feet from the hydrochloric acid injection point;
– a dosing pump equipped to introduce to the test tank the synthetic bather load with an accuracy of ± 5 ml.

25.11.3 Reagents and test kits

– crushed silica #140, Sil-Co-Sil 106 or equivalent;
– 0.1 to 0.2M Hydrochloric acid, HCl, reagent grade;
– sodium bicarbonate, NaHCQ3, > 99%;
– 3 to 4% sodium hypochlorite, NaOCI. If household bleach is used, documentation shall be provided that no other additives were present in the bleach (dyes, fragrances, etc.);
– calcium chloride (anhydrous or hydrated), CaCl2, > 99%;
– calibration chemicals as specified by the chemical controller manufacturer;
– phosphate method (US EPA Method 200.7),20 minimum accuracy± 0.1 mg/Las P; and
– hardness (Standard Methods7 2340) and alkalinity (Standard Methods7 23208; Hach/US EPA 8221)20 test kits.

Table 25.1
Synthetic bather load insult
stock solution preparation
(50 ml is equivalent to 1.95 bather hours)

Chemical Concentration	***Concentration (g/L)***
urea	*25.1*
albumin	*3.9*
creatinine	*1.7*
lactic acid	*1.33 mUL*
uric acid	*0.619 mUL*
glucoronic acid	*0.470 mUL*
sodium chloride	*8.873*
sodium sulfate	*14.2*
ammonium chloride	*2.8*
sodium bicarbonate	*2.7*
potassium hydrogen phosphate	*4.6*
potassium sulfate	*4.1*
suntan lotion	*4.0 mUL*

25.11.4 Instrumentation

– inline flow meters, minimum accuracy of ± 3%. One shall be dedicated for recirculation flow and one shall be dedicated for backwash flow;
– inline turbidimeter, minimum accuracy of accurate to 2% of reading, plus ± 0.02 NTU, installed before the filter;
– filter inlet pressure sensor, minimum accuracy of 0.25 psi;

– scale accurate to± 0.05 lb;
– stopwatch accurate to ± 1 % over the test duration;
– inline electric heater, 12 kilowatt, with removable element for ease of cleaning and weighing, Coates Heater Company Inc, series CE, or equivalent;
– a data acquisition system capable of measuring and logging filter inlet pressure, flow rate and turbidity at a period not to exceed 2 min; and
– water chemistry controller, certified to NSF/ANSI/CAN 50:
– calibrated using the manufacturer's recommended calibration procedure;
– accuracy of the pH and chlorine sensors shall be verified twice daily against a method accurate to ± 0.05 mg/L for chlorine and ± 0.1 for pH;
– the sampling port must be located upstream of the chlorine and pH adjustment feed locations; and
– capable of measuring and logging the following at a period not to exceed 2 min:
– pH;
– free available chlorine;
– total chlorine; and
– temperature (minimum accuracy of± 2 °F).

25.11.5 Initial water characteristics

temperature	*82 ± 5 °F*
pH	*7.50 ± 0.10*
free chlorine	*1.75 ± 0.25 mg/L*
turbidity	*≤2.0 NTU*
alkalinity	*100 ± 1 0mg/L as CaCQ3*
hardness	*250 ± 10 mg/L as CaCQ3*
total phosphates	*1 0.3 ± 0.2 mg/L as P*

[1] Setting the initial level of phosphates may be omitted if no phosphate reduction claim is being made.

25.11.6 Method

a) Fill the test tank with water conditioned to the parameters specified in Section 25.3. Makeup water shall be added to the tank if more than 5% of the volume is lost during testing. Makeup water added to the tank during testing shall also meet the specifications of Section 25.3.
b) Measure the following at the initiation of testing and once daily thereafter:
– mass and pH of the hydrochloric (muriatic) acid stock solution. This data shall be used to calculate consumption of HCl;
– mass and free chlorine concentration of the sodium hypochlorite stock solution. This data shall be used to calculate consumption of chlorine;
– total hardness and total alkalinity of the test tank water. Hardness and alkalinity are not adjusted if they fall below the initial value specified in Section 25.11 .3; and
– total phosphates of the test tank water. It is permissible to omit the measurement of phosphates from the daily measurements if no phosphate reduction claim is being made by the unit under test.
c) Start the circulation and mixing pumps. The flow rate of the circulation system shall be 27 .8 ± 1 GPM, so that a 6-hr turnover time is achieved.
d) Start the automatic controller and data acquisition system with measurement and data logging at a period not to exceed two minutes.

– pH adjustments shall be made using an on/off control strategy that initiates the addition of acid upon the measured pH rising to 7.60 and turning off upon the measured pH falling to 7.40.
– Free chlorine adjustments shall be made using an on/off control strategy that initiates the addition of the sodium hypochlorite stock solution upon the measured free chlorine falling to 1.5 mg/L and turning off upon the measured free chlorine rising to 2.0 mg/L.
e) Every 6 hr (i.e., once per turnover) introduce 204 ± 5 ml of synthetic bather load into the test tank.
f) Particulate challenge dosing:
– for water conditioning devices claiming a reduction of chlorine consumption, combined chlorine levels, acid consumption, phosphates, or turbidity: at the start of the test and every 24 hr afterwards (i.e., once per four turnovers) introduce 475 ± 5 grams crushed silica #140. Introduction of the crushed silica shall only occur if the tank turbidity is s 3 NTU, if the tank turbidity is greater than 3 NTU, four additional turnovers shall pass before particulate challenge is added.
Upon completion of this test procedure through step j, at which time the water conditioning device is installed, the particulate challenge dosing schedule for the remainder of the test shall match that used during the period prior to the installation of the water conditioning device, regardless of tank turbidity levels. This is done to provide the same quantity of particulate challenge during the test periods before and after installation of the water conditioning device.
– for water conditioning devices claiming a reduction of filter cleaning water usage: every 6 hr (i.e., once per turnover) introduce 950 ± 10 grams crushed silica #140.
– for water conditioning devices making multiple reduction claims: It is permissible to test water conditioning devices claiming a reduction in filter cleaning water usage as well as a reduction of chlorine consumption, combined chlorine levels, acid consumption, phosphates, or turbidity using either particulate challenge dosing scheme listed in step f, however the test duration criteria listed in steps i and m must still be achieved.
g) If during any portion of the testing the sand filter inlet pressure increases by 8 psi above its clean inlet pressure, all process equipment (flow, heating, chemistry control, and challenge dosing) shall be stopped and the filter shall be cleaned according to the following procedure:
1) Record date and time such that the amount of filtration time from the previous cleaning can be determined.
2) Perform a cleaning cycle on the filter:
a. Place the filter in backwash mode.
b. Introduce flow to the filter and record and maintain the flow at the designed backwash flow rate.
c. Monitor the waste line turbidity in intervals not to exceed 30 sec, and stop flow upon the turbidity reaching 8 ± 2 NTU.
d. Record the amount of time required for the effluent turbidity to reach 8 ± 2 NTU.
e. Place the filter in rinse mode, restart the system flow, and record and maintain the flow at the designed rinse flow rate.
f. After 30 sec, stop the system flow.
g. Place the filter in filter mode, and restart normal operation.
h. Calculate the total amount of water used during cleaning:
Filter cleaning water usage =
[backwash time(min) x backwash flow rate (gpm)] + [rinse time (min) x rinse flow rate (gpm)]
3) Filtration system cleaning shall not result in a system down time of more than 16 hr.
h) Baseline data gathering:
– for water conditioning devices claiming a reduction of chlorine consumption, combined chlorine levels, acid consumption, or phosphates: continue testing over 7 d for the purpose of baseline data gathering.

– for water conditioning devices claiming a reduction in filter cleaning water usage: continue testing until one backwash has been performed on the sand filter or 7 d, whichever is longer, for the purpose of baseline data gathering.

i) After the completion of baseline data gathering, stop circulation, rebalance the test water to the levels specified in Section 25.3, and replace the media in the sand filter with new sand to the same bed depth as that used during the baseline ± 0.25 in.

j) Install the water conditioning device under test according to the equipment installation manual, and repeat steps a through i with the water conditioning device operating according to the manufacturer's instructions.

k) For water conditioning devices claiming a reduction of chlorine consumption, combined chlorine levels, acid consumption, phosphates, or turbidity, continue testing over 7 d.

l) For water conditioning devices claiming a reduction in filter cleaning water usage, continue testing until one backwash has been performed on the sand filter or 7 d, whichever is longer.

25.11.7 Acceptance criteria

For devices claiming a reduction in chlorine consumption, the mass of chlorine used during the test period shall be a minimum of 25% less than the mass of chlorine used during the baseline period.

For devices claiming a reduction in combined chlorine, the average combined chlorine in the test water measured during the test period shall be a minimum of 25% or 0.20 mg/L, whichever is greater, less than the average combined chlorine in the test water measured during the baseline period.

For devices claiming a reduction in acid consumption, the mass of HCl used during the test period shall be a minimum of 25% less than the mass of HCl used during the baseline period.

For devices claiming a reduction in filter cleaning water usage, the volume of water used to clean the system sand filter during the test period shall be a minimum of 25% less than the volume of water used to clean the system sand filter during the baseline period. To account for baseline and test periods of differing duration, the comparison of the volume of cleaning water used during both periods shall be prorated. The prorated water usage shall be calculated for both the baseline and test periods according to the following:

$$\text{prorated baseline water usage} = \frac{\text{filter cleaning water usage (baseline)}}{\text{baseline time (hours)}} \times 24$$

$$\text{prorated test period water usage} = \frac{\text{filter cleaning water usage (test period)}}{\text{test period time (hours)}} \times 24$$

For devices claiming a reduction in phosphates, the average total phosphate concentration in the test water measured during the test period shall be a minimum of 25% or 0.3 mg/L, whichever is greater, less than the average total phosphate concentration in the test water measured during the baseline period.

Section 26, Interactive waterplay venue surfacing systems: Added general and testing requirements for interactive waterplay venue surfacing systems, including slip-resistance, cleanability, and impact attenuation of these surfaces as follows:

26 Interactive waterplay venue surfacing systems

26.1 Scope

The purpose of this section is to specify the evaluation and testing criteria of surfacing systems. These evaluation and testing requirements will enable the appropriate assessment of a safety surfacing system for interactive waterplay venues. These evaluation and testing requirements pertain only to the surface on grade I ground level.

26.2 General product requirements

Safety surfacing systems shall comply with all the requirements of this section.

26.2.1 Product manual

The manufacturer shall provide a product manual for the surfacing system. The product manual shall include:

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

trade designation of safety surfacing system;

installation instructions; and

cleaning / maintenance instructions.

26.2.2 Warranty statement

The manufacturer shall provide a written warranty statement for the safety surfacing system .

26.3 Material safety

All materials in a surfacing system shall meet the applicable material requirements of Section 4.

26.4 UV Stability

The safety surfacing system shall be tested for UV Stability in accordance with the method specified below.

26.4.1 Test samples

Nine test samples each measuring 6 ± 1 in square shall be used. A rigid substrate may be used to mount nonrigid safety surfacing test samples for the exposure.

If in application, depth markings or other safety information is displayed by the surfacing system via the use of contrasting material colors of the safety system itself, one or more of the test samples shall be comprised of two colors. The two colors shall be the color intended for conveying the safety information and one being the most similar base color of the safety surfacing system.

26.4.2 Test method

Surface flooring systems shall be tested for 750 hr of fluorescent UV light in accordance to ASTM G154,9 Table X2.1 Cycle 1 (8 hr of UVA-340 at 0.89 W/m2/nm at 60 •c black panel temperature, then 4 hr of Condensation at 50 •c black panel temperature).

26.4.3 Acceptance criteria

If in application, depth markings or other safety information is displayed by the surfacing system via the use of contrasting material colors of the safety system itself, color changes, when viewed from between 5 and 6 ft with an illuminance at the surfacing system between 10 and 15 horizontal foot-candles, that prevent the differentiation of these contrasting colors shall be cause for rejection.

The safety surfacing system shall be permitted to show signs of wear or erosion, provided the wear or erosion of the safety surfacing system does not preclude further testing of the specimens to the slip resistance and impact attenuation sections of this standard.

Five of the nine test samples shall be subjected to the slip resistance test requirements of Section 26.7, and four of the nine test samples shall be subjected to the impact attenuation requirements of Section 26.8.

26.5 Resistance to pool water

The resistance to pool water of the safety surfacing system shall be tested in accordance with the method specified below.

26.5.1 Apparatus

The temperature of the test samples and pool water shall be maintained in an environment of 102 ± 5 °F.

26.5.2 Sample requirements

Ten samples, 6 ± 1 in square, shall be provided per test. One sample shall be reserved as a control and the nine others exposed to pool water in accordance with this procedure.

If in application, depth markings or other safety information is displayed by the surfacing system via the use of contrasting material colors of the safety system itself, the test samples shall be comprised of two colors.

The two colors shall be the color intended for conveying the safety information and one being the most similar base color of the safety surfacing system.

26.5.3 Test method

Prepare the exposure water in accordance to APSP 11, 5 and expose the sample to pool water continuously for 100 d including the three shock periods. Each of the three shocks shall last for a duration of 24 hr each.

The chlorine content during the shock period is elevated to 20 mg/L. The shocks shall take place on Day 21, Day 49 and Day 77.

26.5.4 Acceptance criteria

If in application, depth markings or other safety information is displayed by the surfacing system via the use of contrasting material colors of the safety system itself, color changes, when viewed from between 5 and 6 ft with an illuminance at the surfacing system of between 10 and 15 horizontal foot-candles, that prevent the differentiation of these contrasting colors shall be cause for rejection.

The safety surfacing system shall be permitted to show signs of wear or erosion, provided that the wear or erosion of the safety surfacing system does not preclude further testing of the specimens to the slip resistance and impact attenuation sections of this standard.

Five of the nine test samples shall be subjected to the slip resistance test requirements of Section 26. 7 and four of the nine test samples shall be subjected to the impact attenuation requirements of Section 26.8.

26.6 Cleanability

A safety surfacing system, if cleaned in accordance with the MAHC 6.5.4.4 1 and 6.5.4.5, shall harbor fewer viable bacteria when compared to an untreated control surface. The cleanability of the safety surfacing system shall be tested in accordance with the method specified below.

26.6.1 Challenge microorganisms

Enterococcus faecium ATCC 6569; and

Pseudomonas aeruginosa ATCC 27313

26.6.2 Sample requirements

2.0 inches by 0.5 in plaques (carriers) of the safety surfacing system shall be provided for testing. If in application the safety surfacing system has any seams, the test carriers shall have seams. Test samples must be able to withstand sterilization conditions (autoclaving, dry heat, chemical sanitization, UV sterilization) without compromising its surface.

26.6.3 Test method

26.6.3.1 Test soil preparation

Prepare a soil with a composition of the following prior to the addition of bacterial suspension (prepared in deionized water):

– mucin: 11.5 g/l;

– corn starch: 38.5 g/l; and

– peptone: 6.9 g/L.

Dissolve 1.5 ± 0.015 g mucin and 0.9 ± 0.009 g peptone into 120 ml deionized water by boiling. Suspend 5 ± 0.05 g corn starch in 10 ml deionized water, add to the 120 ml hot mucin-peptone solution, and mix until combined. Sterilize the mixture in an autoclave at 121 •c for 15 min. This sterile soil shall have a shelf life not to exceed one month when stored at 7 to 15 •c.

26.6.3.2 Inoculum preparation

Prepare each organism separately. Pass 0.1 ml of culture from a freezer vial into 10 ml tryptic soy broth (TSB). Transfer 1 ml of TSB culture onto 2 to 3 tryptic soy agar (TSA) slants. Incubate at 35.0 ± 1.0 •c for 18 to 24 hr. Harvest slants with a total of 3 ml of sterile buffered dilution water (SBDW).

26.6.3.3 Spike preparation and carrier inoculation

Spike 900 µl of soil with 100 µl of a single culture and vortex for 15 s. Inoculate each carrier in three different areas, including the seam on carriers, with a 10 µl spike preparation per area. Dry for :5 60 min in a biological safety cabinet.

26.6.3.4 Inoculum enumeration

Serially dilute the inoculum suspension in test soil and pour-plate in duplicate with TSA. Incubate plates for 24 ± 2 hr at 35 ± 1 ·c.

26.6.3.5 Carrier count

Carrier	*n*
inoculated and bleach-treated	*5*
inoculated and water-treated	*3*
uninoculated untreated	*1 (to confirm sterility of carriers)*

26.6.3.6 Carrier treatment

Place each inoculated and dried carrier in a sterile 1.2 l jar and submerge in 200 ml of 10% (v/v) household bleach solution for 20 ± 0.5 min. Prepare the bleach solution with filter-sterilized dechlorinated water and use on the same day. Treat control carriers with filter-sterilized dechlorinated water for 20 ± 0.5 min. After the required contact time, add 800 ml letheen broth containing 2.5 g/l of sodium thiosulfate to each test jar (4 ml 50% sodium thiosulfate in 796 ml letheen broth). Place each jar in a sonicating water bath at 35 kHz for 120 ± 5 s to elute.

26.6.3.7 Dilution and plating scheme

Serially dilute the carrier eluents, process by pour plating in duplicate and incubate for 24 ± 2 h at 35 ± 1 c.

26.6.3.8 Calculations

Calculate the eluent density (CFU/ml) for each eluent sample. Calculate the carrier density (CFU/carrier) for each carrier. Calculate the geometric mean value (CFU/carrier) for control and treated test carriers and calculate the percent reduction according to ASTM E1153-14:9

$$\text{reduction} = \frac{(a - b)}{a} \times 100\%$$

where:

a = geometric mean of the control carrier densities

b = geometric mean of the treated test carrier densities

26.6.4 Acceptance criteria

The percent reduction of the treated test carrier density shall be 99.9% or greater when compared to the control carrier density.

26.7 Imperviousness

Safety surfacing systems shall be as impervious to penetration by water as typical broom finished concrete used in interactive water play venues. The imperviousness of safety surfacing systems shall be tested in accordance with the method specified below.

26.7.1 Apparatus

Clamps may be used in lieu of through-bolts.

26.7.2 Sample requirements

Three round samples with a 6-in diameter shall be provided per testing. Samples shall be of the same design, construction and color.

26.7.3 Imperviousness procedure

26.7.3.1 Method

The imperviousness test shall be conducted as follows:

a) Condition the specimens for 24 h in an oven at 50 ± 3 •c (122 ± 5 °F), cool them in a desiccator to ambient laboratory temperature and measure the mass of the specimens to the nearest 0.001 g.

b) Install each specimen into an apparatus as shown in Figure 1.

c) Fill the test pipe with 6 in of water, conditioned to the following characteristics.

– pH: 7.2 to 7.6;

– alkalinity: 60 to 100 mg/L as $CaCO_3$;

– total hardness: 200 to 400 mg/L as $CaCO_3$; and

– total chlorine: 2.0 to 4.0 mg/L.

d) Leave the specimens in the test apparatus for 24 hr at 73 ± 3 °F.

e) Remove the specimens from the apparatus one at a time and wipe off the surface water with a dry cloth.

f) Immediately measure the mass of the specimens to the nearest 0.001 g.

26.7.3.2 Calculations performance requirement

Wf-Wo

absorption % = Wo x 100

where:

Wf = final weight of test pieces after immersion in water

Wo = original weight of dried pieces

Calculate the percentage increase in mass to the nearest 0.1 %.

26.7.4 Acceptance criteria

The average change in mass of the samples shall not exceed 2.5%.

26.8 Slip resistance

Virgin samples, samples exposed to UV light in accordance with Section 26.4 of this standard, and samples exposed to pool water in accordance with Section 26.5 of this standard, all shall achieve a minimum P4 rating (i.e., a British Pendulum Number, 8PM, or slip resistance value, SRV, of 40 or greater) when tested in accordance with AS 4586-20138 (Appendix A - Wet Pendulum Method).

26.9 Impact attenuation

26.9.1 Method

The head injury criterion (HIC) value of the safety surfacing system shall be tested in accordance with EN-1177.

26.9.2 Test samples

Impact attenuation shall be performed on virgin samples, samples exposed to UV light in accordance with Section 26.4 of this standard, and samples exposed to pool water in accordance with Section 26.5 of this standard.

A modified test sample size is permitted to accommodate size limitations of samples conditioned per Sections 26.3 and 26.4 of this standard.

Four samples, measuring 6 ± 1 in, conditioned per Section 26.3 shall be assembled into a grid and subjected to the impact attenuation testing as specified in EN 1177, which shall include a drop test at the center of a tile, at a joint between two adjoining tiles, and at the junction where the greatest number of tiles meet.

Four samples, measuring 6 ± 1 in, conditioned per Section 26.4 shall be assembled into a grid and subjected to the impact attenuation testing as specified in EN 1177, which shall include a drop test at the center of a tile, at a joint between two adjoining tiles, and at the junction where the greatest number of tiles meet.

26.9.3 Acceptance criteria

The HIC value used to calculate the critical fall height shall be 750. The measured critical fall height rating shall be 0.20 m minimum.

Annex N-5.2, Weir opening: Allowed the use of additional water based flow rate skimmers based on testing in Annex N-5.2 as follows:

~~E.2.1~~ N-5.2.1 Purpose

The purpose of this test is to verify that a weir will automatically adjust to changes in the water level when operating at the ~~minimum~~, maximum, and when used, water level based design flow rates.

N-5.2.4 Weir opening and flow rating confirmation test method

***N-5.2.4.1** Weir operation and minimum flow rating test method*

a) Install the skimmer to the test tank in accordance with the manufacturer's instructions.
b) Connect a flow meter to the skimmer's outlet port.
c) Fill the tank to the skimmer's normal operating level and set the flow at the ~~maximum~~ minimum design flow rate.

d) *Slowly raise the water level in the tank until it reaches the maximum level at which the weir shall operate. Record this level.*

e) *Slowly lower the water level in the tank while observing the water flow over the weir. When the velocity of water traveling over the weir is no longer sufficient to sustain ~~a normal operating level (i.e.,lowest overflow level of the weir) in the skimmer throat (and no entrained air observed in suction line), close the drain valve and record the water level in the tank~~ an even flow over the full width of the weir or entrained air is observed in the suction line, close the drain valve and record the water level in the tank.*

…….

N-5.2.4.2 Weir operation and maximum flow rating test method

a) Refill the tank to the skimmer's normal operating level and set the flow at the maximum design flow rate.

b) Slowly lower the water level in the tank while observing the suction line for entrained air. When entrained air observed in suction line, close the drain valve and record the water level in the tank.

N-5.2.4.2.1 Acceptance criteria

The difference between the maximum water level recorded in accordance with E.2.4.1.d and the minimum water level recorded in accordance with E.2.4.2.b shall be at least 4 in (102 mm), or 3 in (76 mm) if an auto-fill pool water level control device is used.

N-5.2.4.3 Optional water level based, maximum flow ratings test method

a) Refill the tank to the skimmer's highest water level based operating mark and set the flow to that mark's specified flow rate.

b) Observe the suction line for entrained air over a period of 30 s.

c) For any other water level based operating marks, set the flow to rate to each mark's maximum operating flow rate and then slowly lower the water level in the tank to that mark.

d) Observe the suction line for entrained air over a period of 30 s.

N-5.2.4.3.1 Acceptance criteria

No entrained air shall be observed in the suction line.

~~E.2.5 Acceptance criteria~~

~~The difference between the maximum water level and the minimum water level at which the skimmer functions shall be at least 4 in (102 mm), or 3 in (76 mm) if an auto-fill pool water level control device is used.~~

Normative Annex N-1 (formerly Annex A), Materials review and qualification methods: Language for exposure water in the Table listed under Section N-1.3.3 (formerly Section A 3.3) was revised to make organics extraction testing use chlorinated water to be consistent with the latest NSF 61 update.

Normative Annex N-5 (formerly Annex E), Test methods for the evaluation of recessed automatic skimmers: Corrected the skimmer head loss equations for normal operation and equalizer operation as follows:

~~Skimmer Head Loss, Normal Operation (ft) = $Z_1 - \frac{P_1}{2.307} - \frac{Q^2}{8002611 \times D_1^4}$~~

Skimmer Head Loss, Normal Operation (ft) = $Z_1 - 2.307 \times P_1 - \frac{Q^2}{385.9 \times D_1^4}$

Normative Annex N-11 (formerly Annex O), Water quality testing devices: Changed the shelf life testing of water quality devices to match the updated methods based on closed package studies as follows:

~~***O.14 Shelf life testing***~~

~~*To verify shelf life, open or use product as required for the above testing. Upon completion of use of product close/seal/turn off, and store in accordance with manufacturer's instructions or store at 50% relative humidity at 73 ± 8 °F (23 ± 4 °C) for the duration of the shelf life. Within a range of ± 2 wk of the expiration date/shelf life claim, open/turn on etc. and conduct testing with the product for the appropriate product types or parameters. If product does not comply, the manufacturer shall revise shelf life claims, storage conditions, etc. as appropriate.*~~

N-11.14 For shelf-life claims based on closed package studies

Approximately one month before the shelf life time has elapsed, follow the manufacturer's instructions to conduct testing with the WTD or test kit for the appropriate product types or parameters. If the WTD or test kit includes reagents (e.g., liquid, powders, dry-phase chemistry) use reagents from an unopened package of the same lot used during the initial testing phase. If the product does not meet the shelf life claims, the manufacturer shall revise shelf life claims or other pertinent storage and handling information as appropriate. For shelf life claims based on open package studies use the same package(s) used in the original testing phase.

Annex N-11 Tables: Corrected accuracy levels for water quality testing devices in the following Tables:

~~***0.12.1***~~ ***N-11.12.1*** *Accuracy levels for pH (range of operation 5 to 10)*

~~***0.12.6***~~ ***N-11.12.6*** *Accuracy levels for cyanuric acid (range of operation 0 to 240 mg/L)*

Normative Annex N-12 (formerly Annex R), Toxicology review and evaluation procedures for swimming pool treatment chemicals: Added requirements for standardized evaluation levels used to treat and balance recreational water as follows:

N-12.3.2 Approved standard evaluation levels

Table N-12.1 lists chemicals used in the treatment of recreational water. The standardized evaluation level has been previously approved under Annex N-12 for use in recreational water and listed chemicals may be used at the stated dose, or less, without further Annex N-12 evaluation. However, this does not exempt the recreational water treatment products from contaminant testing or the evaluation of any measured contaminants to the requirements of Annex N-12.

Table N-12.1, Approved standardized evaluation levels: This table was added to Normative Annex 12.

Informative Annex 1 (formerly Annex J), Equipment – Recommendations for installation and operation: Removed chlorinator sizing recommendation to make the sizing performance based as follows:

~~***J.5.1.1.1 Sizing a pool chlorinator system***~~

~~*Chlorine chemical generators and feeders for pool chlorinator systems should be capable of supplying no less than 3 lb (1.4 kg) of chlorine per day, per 10,000 gal (37.8 kL).*~~

~~***J.5.1.1.2 Sizing a spa chlorinator system***~~

~~*Chlorine chemical generators and feeders for spa chlorinator systems should be capable of supplying no less than 3 lb (1.4 kg) of chlorine per day, per 1,000 gal (3.8 kL).*~~