

Model Aquatic Health Code

Draft Monitoring & Testing Module CODE Sections Modified after the First 60-day Review that Closed on 12/12/2012

Informational Copy: NOT Currently Open for Public Comment

This version of the MAHC Monitoring & Testing Module has been modified based on the first round of public comments received. It is being re-posted so users can view how it was modified but is not currently open to public comment. The complete draft MAHC, with all of the individual module review comments addressed will be posted again for a final review and comment before MAHC publication. This will enable reviewers to review modules in the context of other modules and sections that may not have been possible during the initial individual module review. The public comments and MAHC responses can be viewed on the web at <http://www.cdc.gov/healthywater/swimming/pools/mahc/structure-content/index.html>

The MAHC committees appreciate your patience with the review process and commitment to this endeavor as we all seek to produce the best aquatic health code possible.

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MAHC Monitoring & Testing Module Abstract

Ensuring water and air quality is important for maintaining a safe and healthy environment for pool and spa users and operators. The Monitoring and Testing Module identifies activities and procedures that pool and spa operators should follow to proactively evaluate the water and air quality in their facilities. The Monitoring and Testing Module contains requirements for new and existing aquatics facilities that include:

- 1) Ensuring that water quality testing devices comply with existing standards.
- 2) Requiring automatic controllers
- 3) Monitoring automated controllers and treatment systems to ensure proper functioning.
- 4) Use of dye testing to evaluate pool circulation.
- 5) Procedures for collecting water samples from in-line sample ports and from bulk pool water, including frequency and timing of sample collection.
- 6) Frequency of testing for specific water quality chemical parameters.

The Monitoring & Testing Code Module shows a Table of Contents giving the context of the Monitoring & Testing Design, Construction, Operation and Maintenance in the overall Model Aquatic Health Code's Strawman Outline (<http://www.cdc.gov/healthywater/pdf/swimming/pools/mahc/structure-content/mahc-strawman.pdf>).

MAHC "Strawman" Table of Contents (4.0 – 6.0 show proposed structure)

- 1.0 Preface
- 2.0 User Guide
- 3.0 Definitions
- 4.0 Design Standards and Construction
- 5.0 Operation and Maintenance
- 6.0 Policies and Management
- 7.0 Index
- 8.0 Annexes
- 9.0 Summary of Changes

4.0 Design Standards and Construction

- 4.1 Plan Submittal
- 4.2 Materials
- 4.3 Equipment Standards
- 4.4 Pool Operation and Facility Maintenance [N/A]
- 4.5 Pool Structure (Shell)

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- 4.6 Indoor/Outdoor Environment
- 4.7 Recirculation and Water Treatment**
- 4.8 Decks and Equipment
- 4.9 Filter/Equipment Room
- 4.10 Hygiene Facilities (Bathhouse)
- 4.11 Water Supply/Wastewater Disposal
- 4.12 Specific Venues – Special Requirements

- 4.7 Recirculation and Water Treatment
 - 4.7.1 Recirculation Systems and Equipment
 - 4.7.2 Filtration
 - 4.7.3 Disinfection
 - 4.7.3.1 Oxidants
 - 4.7.3.2 Stabilizers
 - 4.7.3.3 Supplemental/Other
 - 4.7.3.4 pH
 - 4.7.3.5 Levels
 - 4.7.3.6 Feed Equipment
 - 4.7.3.7 Testing for Water Quality and Circulation**
 - 4.7.3.8 Automated Controller**
 - 4.7.3.9 Microbiological Testing Equipment**
 - 4.7.3.10 Filtration and Water Treatment Equipment**

- 5.0 Operation and Maintenance**
- 5.1 Plan Submittal [N/A]
- 5.2 Materials [N/A]
- 5.3 Equipment Standards [N/A]
- 5.4 Pool Operation and Facility Maintenance
- 5.5 Pool Structure (Shell)
- 5.6 Indoor/Outdoor Environment
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- 5.7 Recirculation and Water Treatment**
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 - 5.7.2 Filtration
 - 5.7.3 Disinfection**
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 - 5.7.3.2 Stabilizers
 - 5.7.3.3 Supplemental/Other
 - 5.7.3.4 pH
 - 5.7.3.5 Levels

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5.7.3.6	Feed Equipment
5.7.3.7	Testing for Water Quality and Circulation
5.7.3.8	Automated Controllers
5.7.3.9	Microbiological Testing Equipment
5.7.3.10	Filtration and Water Treatment Equipment
5.7.4	Water Sample Collection for Routine Monitoring
5.7.5	Water Quality Chemical Testing Frequency
5.7.6	Water Clarity

Acronyms in this Module:

ANSI	American National Standards Institute
CYA	Cyanuric Acid
EPA	Environmental Protection Agency
FAC	Free available chlorine
MAHC	Model Aquatic Health Code
NRTL	Nationally Recognized Testing Laboratory
NSF	National Sanitation Foundation
OEM	Original Equipment Manufacturer
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
SI	Saturation Index
UVT	UV Transmissivity
WQTD	Water Quality Testing Device

Glossary Terms in this Module:

“Aquatic Facility” means a physical place that contains one or more aquatic venues and support infrastructure under a single management structure.

“Aquatic Venue” means an artificially constructed or modified natural structure where the general public is exposed to water intended for recreational or therapeutic purpose. Such structures do not necessarily contain standing water, so water exposure may occur via contact, ingestion, or aerosolization. Examples include swimming pools, wave pool, river, spas (including spa pools and hot tubs), therapeutic pools, spray pads/interactive water venues.

“Automated controller” means a system of at least one chemical probe, a controller, and auxiliary or integrated component that senses the level of one or more water parameters and provides a signal to other equipment to maintain the parameters within a user-established range.

“Chlorine” means an element that at room temperature and pressure is a heavy green gas with characteristic odor and is extremely toxic. It can be compressed in liquid form and stored in heavy steel tanks, but most pools now add other chlorine compounds (e.g.

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hypochlorite) that similar to the liquid form release hypochlorous acid when dissolved in water. Chlorinating agents are the most commonly used disinfectants for aquatic venues.

“Deck” means surface areas serving the pool, beyond perimeter deck, which is expected to be regularly trafficked and made wet by pool users.

“Disinfection” means a treatment that kills microorganisms (e.g., bacteria, viruses, and parasites); in water treatment, a chemical (commonly chlorine, chloramine, or ozone) or physical process (e.g., ultraviolet radiation) can be used.

“EPA Registered” means all pesticide products regulated and registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) by the U.S. Environmental Protection Agency (EPA; <http://www.epa.gov/agriculture/lfra.html>). EPA registered products will have a registration number on the label (usually it will state “EPA Reg No.” followed by a series of numbers). This registration number can be verified by using the EPA National Pesticide Information Retrieval System (<http://ppis.ceris.purdue.edu/#>)

“Free Available Chlorine” means the available disinfectant in the water. It is the portion of total chlorine that is not combined chlorine and is available as disinfectant. When chlorine is added to water, hypochlorous acid is produced in either the molecular state (HOCl) or the ionized state (hypochlorite ion (OCI-) plus hydrogen ion (H+)), and a by-product specific to the type of chlorine is produced. The pH of the water determines the amount of hypochlorous acid in each state. HOCl is a very effective bactericide and is the active available chlorine disinfectant in the water. OCI- is also a bactericide, but acts more slowly than HOCl. Thus chlorine is a much less effective bactericide at high pH. The sum of HOCl and OCI- is referred to as “free chlorine” in pool water. The hypochlorous acid that remains in pool water uncombined with ammonia is called “free chlorine residual.” A free chlorine residual must be maintained for adequate disinfection.

“Manual Disinfectant Feed System” means a disinfectant delivered by a flow through erosion feeder or metering pump without an automated controller.

“Monitoring” is the regular and purposeful observation and checking of systems or facilities and recording of data, including system alerts, excursions from acceptable ranges, and other facility issues. Monitoring includes human or electronic means.

“Nationally Recognized Testing Laboratory” means a testing facility recognized by ANSI as an organization that provides third party product safety testing and certification services to manufacturers.

“Oxidation-reduction potential” means a measure of the tendency for a solution to either gain or lose electrons; higher (more positive) reduction potential indicates a more oxidative solution.

“pH” means a symbol that expresses the negative log of the concentration of hydrogen ions. When water ionizes, it produces hydrogen ions (H+) and hydroxide ions (OH-). If

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there is an excess of hydrogen ions the water is acidic. If there is an excess of hydroxide ions the water is basic. pH ranges from 0 to 14. Pure water has a pH of 7.0. If pH is higher than 7.0, the water is said to be basic, or alkaline. If the water's pH is lower than 7.0, the water is acidic. As pH is raised, more ionization occurs and chlorine disinfectants decrease in effectiveness.

“Qualified Operator” means a person who meets the requirements specified in MAHC 6.1.1.

“Saturation Index” means a mathematical representation or scale representing the ability of water to deposit calcium carbonate, or dissolve metal, concrete or grout.

“Spa” means a structure that is intended to be used for bathing or other recreational uses and is not drained and refilled after each use. It may include, but is not limited to, hydrotherapy, air induction bubbles, and recirculation.

“Substantial Renovation” means the renovation of a major component or substantial structural part of an aquatic venue that either:

- 1) Materially increases the value of the property,
- 2) Substantially prolongs the useful life of the venue, or
- 3) Adapts the venue to a new or better use.”

“UV Transmissivity” means the percentage measurement of ultraviolet light able to pass through a solution.

“Water Quality Testing Device” means a product designed to measure the level of a parameter in water. A WQTD includes a device or method to provide a visual indication of a parameter level, and may include one or more reagents and accessory items.

Preface: *This document does not address all health and safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to each use.*

Model Aquatic Health Code
Monitoring & Testing Module Code
4.0 Design and Construction

Keyword	Section	Code	Grade
	4.0	Design Standards and Construction	
	4.1	Plan Submittal	
	4.2	Materials	
	4.3	Equipment Standards	
	4.4	Pool Operation and Facility Maintenance	
	4.5	Pool Structure	
	4.6	Indoor/Outdoor Environment	
		Placeholder for Ventilation Language regarding monitoring CO ₂ levels	
	4.7	Recirculation and Water Treatment	
	4.7.1	Recirculation Systems and Equipment	
	4.7.2	Filtration	
	4.7.3	Disinfection	
	4.7.3.1	Oxidants	
	4.7.3.2	Stabilizers	
	4.7.3.3	Supplemental/Other	
	4.7.3.4	pH	
	4.7.3.5	Levels	
	4.7.3.6	Feed Equipment	
<i>Water Quality Testing Devices</i>	4.7.3.7	Water Quality Testing Devices and Kits	
<i>Certification</i>	4.7.3.7.1	Conformity with NSF/ANSI Standard 50 shall be evidenced by the certification, listing, and testing by a third party Nationally Recognized Testing Laboratory (NRTL).	
<i>Water Clarity Device</i>		<i>Note: For info regarding water clarity devices, refer to MAHC Section 5.7.6.</i>	
<i>Automated Controllers</i>	4.7.3.8	Automated Controllers	
<i>Required</i>	4.7.3.8.1	Automated controllers shall be installed for monitoring all AQUATIC VENUES.	
<i>Installed</i>	4.7.3.8.1.1	Automated controllers shall be required within one year from time of adoption.	
<i>Comply</i>	4.7.3.8.1.2	Automated controllers shall comply with the most recent requirements of NSF/ANSI Standard 50.	

<i>Keyword</i>	<i>Section</i>	<i>Code</i>	<i>Grade</i>
<i>Certification</i>	4.7.3.8.1.2. 1	Conformity with NSF/ANSI Standard 50 shall be evidenced by the certification, listing, and/or testing by a third party NRTL.	
<i>Microbiological Testing Equipment</i>	4.7.3.9	<i>Microbiological Testing Equipment</i>	
<i>EPA-Approved</i>	4.7.3.9.1	Microbiological testing equipment and methods shall be EPA-Approved, EPA-Accepted, EPA-Equivalent, conforming to the latest edition of <i>Standard Methods for the Examination of Water and Wastewater</i> , or conforming to the most recent version of NSF/ANSI Standard 50.	
<i>Filtration and Water Treatment Equipment</i>	4.7.3.10	<i>Filtration and Water Treatment Equipment</i>	
<i>Comply</i>	4.7.3.10.1	Circulation and sanitation equipment shall comply with the most recent requirements of NSF/ANSI Standard 50.	
<i>Certification</i>	4.7.3.10.1.1	Conformity with NSF/ANSI Standard 50 shall be evidenced by the certification, listing, and testing by a third party NRTL.	
<i>Ozone Monitored</i>	4.7.3.10.2	Ozone Systems shall be capable of being monitored at a frequency consistent with MAHC Table 5.7.3.3.5.	
<i>Ozone Fault Detections</i>	4.7.3.10.2.1	Ozone system fault detections shall be tied into the operation of the ozone system.	
<i>Shut Down</i>	4.7.3.10.2.2	Any fault shall shut down the ozone generator and display the fault for the operator to observe.	
<i>Alarm</i>	4.7.3.10.2.3	Ozone systems shall be equipped with a low-ORP alarm.	
<i>Indoor</i>	4.7.3.10.2.4	For indoor installations, ozone systems shall be equipped with an ozone off-gas alarm (i.e., ambient gaseous ozone monitor).	
<i>Recommendations</i>	4.7.3.10.2.5	Manufacturer's recommendations shall be followed to place ozone monitors.	
<i>UV Systems</i>	4.7.3.10.3	To ensure proper functioning, UV systems shall be capable of being monitored at a frequency consistent with MAHC Table 5.7.3.3.6.	

Model Aquatic Health Code Monitoring & Testing Module 5.0 Operation and Maintenance

Keyword	Section	Code	Grade
	5.0	Operation and Maintenance	
	5.1	Plan Submittal	
	5.2	Materials	
	5.3	Equipment Standards	
	5.4	Pool Operation and Facility Maintenance	
	5.5	Pool Structure	
	5.6	Indoor/Outdoor Environment	
	5.7	Recirculation and Water Treatment	
	5.7.1	Recirculation Systems and Equipment	
	5.7.2	Filtration	
	5.7.3	Disinfection	
	5.7.3.1	Oxidants	
	5.7.3.2	Stabilizers	
	5.7.3.3	Supplemental/Other	
	5.7.3.4	pH	
	5.7.3.5	Levels	
	5.7.3.6	Feed Equipment	
<i>Water Testing Devices</i>	5.7.3.7	Testing for Water Circulation and Quality	
<i>Dye Testing</i>		<i>NOTE: Dye testing shall be conducted in accordance with parameters outlined in MAHC Recirculation and Filtration Module. Language still under development.</i>	
<i>Copper/ Silver Systems</i>	5.7.3.7.1	Copper/Silver systems shall be tested for copper at the appropriate frequency and methodology approved by system manufacturer.	
<i>Copper Concentrations</i>	5.7.3.7.2	Copper concentrations in the water shall not exceed EPA National Drinking Water Standards.	
<i>Available</i>	5.7.3.7.3	Water Quality Testing Devices (WQTDs) for the measurement of disinfectant residual, pH, alkalinity, CYA (<i>if used</i>), and temperature, at a minimum, shall be available on site.	
<i>Expiration Dates</i>	5.7.3.7.3.1	WQTDs utilizing reagents shall be checked for expiration at every use.	
<i>Store</i>	5.7.3.7.4	WQTDs shall be stored in accordance with manufacturer's instructions.	

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Keyword	Section	Code	Grade									
Temperature	5.7.3.7.5	Chemical testing reagents shall be maintained at proper manufacturer specified temperatures.										
Calibration	5.7.3.7.6	WQTDs that require calibration shall be calibrated in accordance with manufacturer's instructions.										
Automated Controllers	5.7.3.8	Automated Controllers										
Sampling	5.7.3.8.1	The sample line for all probes shall be upstream from all primary and supplemental sanitation devices.										
Monitor	5.7.3.8.2	Automated controllers shall be monitored at start of operating day to ensure proper functioning.										
In Person	5.7.3.8.2.2	Automated controllers shall be monitored in person by visual observation.										
Activities	5.7.3.8.3	Monitoring shall include activities recommended by manufacturers, including but not limited to alerts and leaks.										
Replacement Parts	5.7.3.8.4	Only manufacturer-approved OEM replacement parts shall be used.										
Calibration	5.7.3.8.5	Automated controllers shall be calibrated per manufacturer directions.										
Ozone System	5.7.3.8.6	Ozone Systems shall be monitored consistent with MAHC Table 5.7.3.8.6										
Table		Table 5.7.3.8.6: Ozone System Monitoring Frequency										
Ozone System Monitoring Frequency		<table border="1"> <thead> <tr> <th>Parameter</th> <th>Monitoring Frequency</th> <th>Recording Frequency</th> </tr> </thead> <tbody> <tr> <td>Power Draw</td> <td>Continuous</td> <td>Every 4 hours</td> </tr> <tr> <td>ORP</td> <td>Continuous</td> <td>Every 4 Hours</td> </tr> </tbody> </table>	Parameter	Monitoring Frequency	Recording Frequency	Power Draw	Continuous	Every 4 hours	ORP	Continuous	Every 4 Hours	
Parameter	Monitoring Frequency	Recording Frequency										
Power Draw	Continuous	Every 4 hours										
ORP	Continuous	Every 4 Hours										
UV Systems	5.7.3.8.7	UV systems shall be monitored at a frequency consistent with MAHC Table 5.7.3.8.7.										
Table		Table 5.7.3.8.7: UV System Monitoring and Calibration										

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Keyword	Section	Code	Grade
UV System Monitoring and Calibration Frequency			

Frequency

<i>Parameter</i>	<i>Monitoring Frequency</i>	<i>Recording Frequency</i>
Power Draw	Continuous	Every 4 hours
Flow rate	Continuous	Every 4 hours
Set-Point Intensity	Continuous	Every 4 hours
Water Temperature (MP Medium Pressure)	Continuous	Daily
UV Lamp On/Off Cycles	Continuous	Weekly (Total cycles/week)
Iron, Calcium hardness	Weekly (if fouling is prevalent)	Weekly
UVT (UV Transmittance) Analyzer Calibration	Weekly	Weekly
Calibration of Intensity	Annual	At time of calibration
Calibration of Flow Meter	Per manufacturer's requirements	At time of calibration

- Microbiological Testing Equipment **5.7.3.9** **Microbiological Testing Equipment**
- Filtration and Water Treatment Equipment **5.7.3.10** **Filtration and Water Treatment Equipment**
- Water Sample Collection **5.7.4** **Water Sample Collection for Routine Monitoring**
- In-Line Sample port **5.7.4.1** The QUALIFIED OPERATOR shall acquire a water sample for testing from the in-line sample port when available.

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Keyword	Section	Code	Grade
Same Volume	5.7.4.1.1	If an AQUATIC VENUE has more than one recirculation system, the same sample volume shall be collected from each in-line sample port and tested separately.	
No Port	5.7.4.1.2	If no in-line sample port is available, the QUALIFIED OPERATOR shall acquire water samples from the pool according to MAHC Section 5.7.4.3.	
Routine Samples	5.7.4.2	If routine samples are collected from in-line sample ports, the QUALIFIED OPERATOR shall also acquire water samples from the bulk water of the pool at least once per day.	
Midday Collection	5.7.4.2.1	Daily bulk water samples shall be collected in the middle of the pool operational day, according to the procedures in MAHC Section 5.7.4.3.	
Compared	5.7.4.2.2	Water quality data from these pool samples shall be compared to data obtained from in-line port samples to assess potential water quality variability in the pool.	
Bulk Water Sample	5.7.4.3	The QUALIFIED OPERATOR shall use the following procedure outlined in MAHC sections 5.7.4.3.1 to 5.7.4.3.5 for acquiring a water sample from bulk water of the pool.	
Below Surface	5.7.4.3.1	All samples shall be obtained from at least 18 inches (45.7 cm) below the surface of the water.	
Water Depth	5.7.4.3.2	The sample shall be obtained from a section of the pool that has a water depth of between 3 to 4 feet (91.4 cm to 1.22 m) when available.	
Between Inlets	5.7.4.3.3	The sample shall be obtained from a location between water inlets.	
Rotate	5.7.4.3.4	Sampling locations shall rotate around the shallow end of the pool.	
Deepest Area	5.7.4.3.5	The QUALIFIED OPERATOR shall include the deepest area of the AQUATIC VENUE in the water sampling rotation once per week.	
Testing Frequency	5.7.5	Water Quality Chemical Testing Frequency	
Chemical Levels	5.7.5.1	Free available chlorine (FAC), combined available chlorine (CAC), or total bromine (TB), and pH shall be tested at all AQUATIC VENUES prior to opening each day.	

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Keyword	Section	Code	Grade
Manual Disinfectant Feed System	5.7.5.2	FAC or TB and pH shall be tested prior to opening to the public and every two hours at all AQUATIC VENUES using a MANUAL DISINFECTANT FEED SYSTEM	
Automatic Disinfectant Feed System	5.7.5.3	FAC (or TB) and pH shall be tested prior to opening and every four hours at all AQUATIC VENUES using an automated disinfectant feed system	
In-Line ORP Readings	5.7.5.4	In-line ORP readings shall be recorded at the same time the FAC (or TB) and pH tests are performed.	
Total Alkalinity	5.7.5.5	Total Alkalinity (TA) shall be tested weekly at all AQUATIC VENUES.	
Calcium Hardness	5.7.5.6	Calcium hardness shall be tested monthly at all AQUATIC VENUES.	
Cyanuric Acid	5.7.5.7	Cyanuric acid shall be tested monthly at all AQUATIC VENUES utilizing cyanuric acid.	
Tested	5.7.5.7.1	Cyanuric acid shall be tested 24 hours after the addition of cyanuric acid to the AQUATIC VENUE.	
Stabilized Chlorine	5.7.5.7.2	If AQUATIC VENUES utilize stabilized chlorine as its primary disinfectant, the operator shall test cyanuric acid every two weeks.	
Total Dissolved Solids	5.7.5.8	Total dissolved solids (TDS) shall be tested quarterly at all AQUATIC VENUES.	
Water Temperature	5.7.5.9	For heated AQUATIC VENUES, water temperature shall be recorded at the same time the FAC (or TB) and pH tests are performed.	
Salt	5.7.5.10	If in-line electrolytic chlorinators are used, salt levels shall be tested at least weekly or per manufacturer's instructions.	
Water Clarity	5.7.6	Water Clarity	
Reference Point	5.7.6.1	All AQUATIC VENUES shall comply with MAHC Section 5.7.6.1.1 to serve as a reference point for assessing adequate water clarity.	
Marker Tile	5.7.6.2	The AQUATIC VENUE bottom shall be visible at all times.	

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Keyword	Section	Code	Grade
Observation	5.7.6.2.1	To make this observation, a 4 in x 4 in square (103 cm ²) marker tile or main suction outlet in a contrasting color to the pool surface shall be located at the deepest part of the pool.	
Over 10 ft	5.7.6.2.2	For pools >10 ft deep, an 8 in x 8 in square (413 cm ²) marker tile or main suction outlet in a contrasting color to the pool surface shall be located at the deepest part of the pool.	
Visible	5.7.6.3	This reference point shall be visible at all times at any point on the DECK up to 30 feet away in a direct line of sight from the disc or main drain.	
Spas	5.7.6.3.1	For spas, this test shall be performed when the water is in a non-turbulent state and bubbles have been allowed to dissipate.	

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