

## Model Aquatic Health CODE

### Draft Module

#### Ventilation CODE Section for the First 60-day Review Posted for Public Comment on 04/13/2011

#### Currently Open for Public Comment that Closes on 06/12/2011

#### MAHC Ventilation Module Abstract

Health issues related to indoor pool use and associated poor water and air quality are increasingly being documented. The Ventilation Module is a first step towards improving air quality at indoor aquatic facilities and reducing associated health effects. The Ventilation Module contains requirements for new or modified construction that include:

- 1) Increased make-up air required in addition to that required in the ASHRAE 62 standard for indoor pools.
- 2) Determination of the extra make-up air needed based on the indoor venue water use type (e.g., flat water, agitated water, or hot water) and venue or deck patron density (square feet/person).
- 3) Inclusion in calculations of additional make-up air from surge tanks or gutters that introduce fresh air.
- 4) Development and implementation of plans to reduce combined chlorine compounds in indoor aquatic facilities and inform facility patrons of their impact on building air quality.

#### MAHC Ventilation Module Review Guidance

The [Model Aquatic Health CODE \(MAHC\) Steering](http://www.cdc.gov/healthywater/swimming/pools/mahc/steering-committee/) (<http://www.cdc.gov/healthywater/swimming/pools/mahc/steering-committee/>) and [Technical](http://www.cdc.gov/healthywater/swimming/pools/mahc/technical-committee/) (<http://www.cdc.gov/healthywater/swimming/pools/mahc/technical-committee/>) [Committees](#) appreciate your willingness to review this draft MAHC module. Your unique perspectives and science-based suggestions will help ensure that the best available standards and practices for protecting aquatic public health are available for adoption by state and local environmental health programs.

#### Review Reminders:

- Please download and use the [MAHC Comment Form](http://www.cdc.gov/healthywater/swimming/pools/mahc/structure-content/) (<http://www.cdc.gov/healthywater/swimming/pools/mahc/structure-content/>) to submit your detailed, succinct comments and suggested edits. Return your review form by June 12, 2011, as an email attachment to [MAHC@cdc.gov](mailto:MAHC@cdc.gov).
- If part of a larger group or organization, please consolidate comments to speed the MAHC response time to public comments.

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- To provide context for this module review, please consult the [MAHC Strawman Outline](http://www.cdc.gov/healthywater/pdf/swimming/pools/mahc/structure-content/mahc-strawman.pdf) (<http://www.cdc.gov/healthywater/pdf/swimming/pools/mahc/structure-content/mahc-strawman.pdf>). Section headers of related content have been included in this draft module to assist reviewers to see where each section fits into the overall MAHC structure. Additional MAHC draft modules that contain this content will be or already have been posted for your review.
- 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 published MAHC will be regularly updated through a collaborative all-stakeholder process.

Please address any questions you may have about MAHC or the review process to [MAHC@cdc.gov](mailto:MAHC@cdc.gov). You may also request to be on the direct email list for alerts (“Get Email Updates” is in a box on the right hand side of the Healthy Swimming website at [www.cdc.gov/healthyswimming](http://www.cdc.gov/healthyswimming)) on the other draft MAHC modules as they are released for public comment.

Thank you again, and we look forward to your help in this endeavor.  
Sincerely,

Douglas C. Sackett, Director  
MAHC Steering Committee

The following Table of Contents shows the context of the Ventilation 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>).

***Reviewer Note on Module Section Numbering:***

Please use the specific section numbers to make your comments on this Draft Model Aquatic Health Code module. These numbers may eventually change during the editing of the compiled Draft that will be issued for a final round of comments.

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### Acronyms in this Module:

ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers
DBP	Disinfection by-product
EPA	Environmental Protection Agency
IBC	International Building Code
MAHC	Model Aquatic Health Code
MERV	Minimum efficiency reporting value
RLV	Relative limit value
STEL	Short-term exposure limit
THM	Trihalomethane
TLV	Threshold limit value
NEHA	National Environmental Health Association

### Glossary Terms in this Module:

*NOTE: All glossary terms are denoted in the text by SMALL CAPS. Also, definitions are still being compiled so this section may not be complete. Thank you for your patience.*

**“Aquatic Facility”** means a physical place that contains one or more aquatic venues and support infrastructure under a single management structure. From a ventilation standpoint this refers to an indoor aquatic facility including the area of the building’s aquatic venues, the surrounding bather and spectator area, mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the aquatic facility.

**“Aquatic Feature”** means an individual component within an aquatic venue. Examples include mushrooms, slides, buckets, spray guns/nozzles, and other play features.

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**“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), splash pads, slide landing pools, interactive fountains, and/or therapy pools. Facilities may contain more than one of these venues in any combination.

**“Code”** means a systematic statement of a body of law, especially one given statutory force.

**“Contaminant”** means a substance that soils, stains, corrupts, or infects another substance by contact or association.

**“Disinfection”** means the reduction of pathogens (disease causing organisms).

**“Pool”** means a subset of aquatic venue designed to have impounded/standing water for total or partial bather immersion.

**“Safety” (as it relates to construction items)** means a design standard intended to prevent inadvertent or hazardous operation or use (i.e., a passive engineering strategy).

**“Standard”** means something established by authority, custom, or general consent as a model or example.

**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  
Ventilation Module  
CODE Section

**4.0 Design Standards and Construction**

Key word	Section	CODE	Grade
	<b>4.0</b>	<b>Design Standards and Construction</b>	
	<b>4.6</b>	<b>Indoor/Outdoor Environment</b>	
	4.6.1	Lighting	
	4.6.2	Ventilation	
	<b>4.6.2.1</b>	<b>Building Ventilation</b>	
<i>Purpose</i>	4.6.2.1.1	AQUATIC FACILITY building ventilation systems shall be designed, constructed, and installed to protect the health of the building’s occupants.	B
<i>Indoor Facility Areas</i>	4.6.2.1.2	Ventilation design requirements shall apply to a new or modified INDOOR AQUATIC FACILITY including the area of the building’s AQUATIC VENUES, the surrounding BATHER and spectator/stadium seating area, mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY.	B
<i>Open Buildings Exempt</i>	4.6.2.1.3	<i>AQUATIC FACILITY ventilation design system requirements do not apply to aquatic facilities that meet the definition of an “Open Building” in the International Building Code.</i>	C
<i>Mechanical / Natural</i>	4.6.2.1.4	Ventilation shall be provided through mechanical systems or engineered openings for natural ventilation.	B
<i>Mechanical Code</i>	4.6.2.1.5	AQUATIC FACILITY design, construction, and installation shall comply with the International Code Council (ICC) International Mechanical Code,	B

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Key word	Section	CODE	Grade
		Chapter 4, and/or applicable local CODES.	
ASHRAE 62	4.6.2.1.6	AQUATIC FACILITY ventilation system design, construction, and installation shall comply with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard 62, Ventilation for Acceptable Indoor Air Quality, and/or applicable local CODES with additional requirements as stated in section 4.6.2.1.7.	B
Additional ASHRAE 62 Equivalents	4.6.2.1.7.	<p>AQUATIC FACILITY ventilation system design, construction, and installation shall supply the fresh air requirements outlined in Table 1, which includes the minimum air of ASHRAE 62.1 and/or applicable local CODES PLUS the additional amount of fresh air needed while the facility is occupied. These additional fresh air requirements depend on the types and areas of AQUATIC VENUES, deck, and spectator/stadium seating areas making up the AQUATIC FACILITY as outlined below:</p> <ol style="list-style-type: none"> <li data-bbox="646 993 1333 1094">1) Flat Water - AQUATIC VENUE in which the water line is static except for movement made by users.</li> <li data-bbox="646 1140 1333 1392">2) Agitated Water - AQUATIC VENUE with mechanical means (AQUATIC FEATURES) to discharge, spray, or move the water's surface above and/or below the static water line of the AQUATIC VENUE. Where there is no static water line, movement shall be considered above the deck plane.</li> <li data-bbox="646 1438 1333 1497">3) Hot Water - AQUATIC VENUE with a temperature over 90 degrees Fahrenheit.</li> <li data-bbox="646 1543 1333 1753">4) The Density factor in Table 1 may be increased, but not reduced, if the intended use is different (i.e., a wading POOL is a flat water venue and intended density will be 10 ft<sup>2</sup> per person vs. a swimming POOL with a density of 20 ft<sup>2</sup> per person).</li> <li data-bbox="646 1799 1333 1900">5) For indoor AQUATIC FACILITIES with more than one type of AQUATIC VENUE, each AQUATIC VENUE area shall be calculated individually,</li> </ol>	B

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Key word

Section

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added together with the total deck and/or spectator/stadium seating area requirements and then added to the minimum ASHRAE 62 air requirements.

**Table 1. Factors for Calculating Outside Air Requirements for Aquatic Facilities.**

Factors	Flat Water	Agitated Water	Hot Water	Deck	Stadium Seating
$R_a$	0.48	0.48	0.48	0.48	0.06
$R_o$	10	25	60	10	7.5
Density	20	15	10	50	6.6
$R_a$ = ASHRAE 62.1 Equivalent (cubic feet per minute / square foot) $R_o$ = Occupant-driven cfm / person Density = Peak density (ft <sup>2</sup> / person) for the area					

Using the ASHRAE 62.1 definitions for outside air as a baseline and utilizing the ASHRAE method to determine the minimum outside air requirements and then adding additional fresh air for each AQUATIC VENUE type, the number of cubic feet per minute (cfm) of fresh air for an AQUATIC FACILITY is:

- Wet Area x  $R_a$
- +
- Stadium seating Area x  $R_a$
- +
- Aquatic venue area x ( $R_o$ / Density factor for that type of area)
- +
- Deck area x ( $R_o$ /density factor for deck)
- +
- Stadium seating area x ( $R_o$ /density factor for seating)

$R_a$  = cfm/ft<sup>2</sup> required for the area WITHOUT OCCUPANTS

$R_o$  = cfm/OCCUPANT

OCCUPANT = area in ft<sup>2</sup> / density at peak occupancy (ft<sup>2</sup>/person)

For indoor aquatic facilities with more than one type of AQUATIC VENUE, the total outside air required is calculated by adding together the air required by ASHRAE 62 with the additional air required to

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		address the contaminants from all AQUATIC VENUES in the AQUATIC FACILITY.	
		Although AQUATIC FACILITY ventilation system planning will include consideration of mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY, these non-wet areas are not included in the section 4.6.2.1.7 calculation.	
<i>Design Factors and Performance Requirements</i>	4.6.2.1.8	AQUATIC FACILITY ventilation system design engineer shall provide documentation with the plans submitted for review that the following parameters in the ventilation system design have been addressed to meet the ventilation performance requirements of this CODE:	B
		<ol style="list-style-type: none"> <li>1) Building size and layout,</li> <li>2) AQUATIC FACILITY size,</li> <li>3) AQUATIC FACILITY type and installed aquatic play components,</li> <li>4) Expected BATHER load and other building occupants,</li> <li>5) Known chemical, biological, and physical CONTAMINANTS,</li> <li>6) Individual AQUATIC VENUES and water quality systems will be identified, including water recirculation, filtration, DISINFECTION, secondary treatment systems,</li> <li>7) Placement of ventilation system and other building outside air intake to reduce the chance of RE-ENTRAINMENT of exhaust air back into the facility,</li> <li>8) Collection of return air near all AQUATIC VENUE surfaces in order to remove the highest concentration of airborne DISINFECTION BY-PRODUCTS contaminated air, and</li> <li>9) External environment, and infiltration and exfiltration concerns that would influence air quality in the INDOOR AQUATIC FACILITY.</li> </ol>	
<i>Surge Tank / Gutter Ventilation</i>	4.6.2.1.9	Ventilation system design fresh air calculations may include surge tank and gutter systems that introduce fresh air into the INDOOR AQUATIC FACILITY.	B

<i>Key word</i>	<i>Section</i>	<i>CODE</i>	<i>Grade</i>
<i>Paddle Fans</i>	4.6.2.1.10	Ventilation system design may not consider paddle fans as part of the fresh air calculations for the INDOOR AQUATIC FACILITY.	B
<i>Retractable Roofs</i>	4.6.2.1.11	Ventilation system design may not consider retractable roofs as part of the fresh air calculations for the INDOOR AQUATIC FACILITY.	B
<i>Building Openings</i>	4.6.2.1.12	Ventilation system design shall consider the effects of the planned opening of an open roof, door, and windows, if they exist in the INDOOR AQUATIC FACILITY.	C
<i>Occupied Open All Seasons</i>	4.6.2.1.13	Ventilation system design shall consider roof, door, and window openings in the INDOOR AQUATIC FACILITY, only if they are planned to be open during all times the INDOOR AQUATIC FACILITY is occupied, regardless of season.	C
<i>Toilet, Shower, and Dressing Rooms</i>	4.6.2.1.14	Ventilation system design for toilet, shower, and dressing rooms shall conform to applicable local CODES.	A
<i>Chemical Storage Rooms</i>	4.6.2.1.15	Ventilation system design for chemical storage rooms shall conform to the International Mechanical Code, International Fire Code, and any applicable local codes.	A
<i>System Commissioning</i>	4.6.2.1.16	AQUATIC FACILITY ventilation system design engineer shall commission the ventilation system in a manner to verify that the installed system is operating in compliance with the design intent.	C
<i>Commissioning Statement</i>	4.6.2.1.17	AQUATIC FACILITY ventilation system design engineer shall provide a written statement of commissioning to facility owner.	C
<i>Ventilation System Procedures</i>	4.6.2.1.18	AQUATIC FACILITY ventilation system design engineer and/or ventilation system manufacturer shall provide facility owner with a ventilation system operating manual which includes: <ol style="list-style-type: none"> <li>1) Startup and shutdown procedures,</li> <li>2) Purging and other safety procedures,</li> <li>3) Cleaning procedures,</li> <li>4) General maintenance requirements with parts listings and frequency of maintenance</li> </ol>	B

Key word	Section	CODE	Grade
		(i.e., filter cleaning frequencies, motor bearing maintenance), 5) Troubleshooting processes, 6) Frequency of required calibration of equipment, 7) Descriptions of general operating schemes, and 8) Contact information for the manufacturer.	
Notices	4.6.2.1.19	AQUATIC FACILITY ventilation system design engineer and/or the ventilation system manufacturer shall provide facility owner with notifications of relevant ventilation system recalls, part changes, or SAFETY alerts.	C
	4.6.2.2	<b>Air Quality – Health</b>	
Turnover Rates	4.6.2.2.1	INDOOR AQUATIC FACILITY ventilation system design shall provide air turnover rates that comply with ASHRAE 62.1 and/or applicable local CODES plus additional fresh air requirements specified in 4.6.2.1.7.	B
Fail Safes	4.6.2.2.2	INDOOR AQUATIC FACILITY ventilation system design shall provide fail safes to ensure that number of cubic feet per minute (cfm) of fresh air for an AQUATIC FACILITY is not less than the minimum calculated by the formula in 4.6.2.1.7 for the facility during times the facility is occupied.	B
Access Control	4.6.2.2.3	INDOOR AQUATIC FACILITY ventilation system design shall provide a means to limit physical or electronic access to system control to the operator and anyone the operator deems to have access.	B
Biological Air Contaminants	4.6.2.2.4	(Reserved)	
Permanent Data Plate	4.6.2.2.5	INDOOR AQUATIC FACILITY ventilation system design, construction, and installation shall include a conspicuous permanent data plate or label on the exterior of the equipment, which provides ventilation system information that affects health and SAFETY, including the minimum number of cubic feet per minute of fresh air furnished by each sub-unit of the	C

<i>Key word</i>	<i>Section</i>	<i>CODE</i>	<i>Grade</i>
		INDOOR AQUATIC FACILITY's ventilation system.	
	<b>4.6.2.3</b>	<b>Humidity Control</b>	
<i>Relative Humidity</i>	4.6.2.3.1	INDOOR AQUATIC FACILITY ventilation system design shall be capable of maintaining the relative humidity average at less than 65% in a 24 hour period when the building is occupied.	B
<i>Air Temperature</i>	4.6.2.3.2	INDOOR AQUATIC FACILITY ventilation system design shall be capable of maintaining the facility air temperature at no more than 8° above or 2° below the average AQUATIC VENUE water temperature, without including AQUATIC VENUES that exceed 90° F (32°C) in this design calculation.	B
	<b>4.6.2.4</b>	<b>Mechanical Systems</b>	
<i>Consistent Air Flow</i>	4.6.2.4.1	INDOOR AQUATIC FACILITY ventilation system design shall provide consistent air flow through all parts of the building that preclude any stagnant areas.	C
<i>Drafts</i>	4.6.2.4.2	INDOOR AQUATIC FACILITY ventilation system design shall minimize air velocities at deck level to reduce direct drafts on BATHERS.	C
<i>Condensation / Mold Control</i>	4.6.2.4.3	INDOOR AQUATIC FACILITY ventilation system design shall provide air flow that washes walls and windows with air to reduce condensation and mold growth.	B
<i>Filters</i>	4.6.2.4.4	INDOOR AQUATIC FACILITY ventilation system design shall provide effective filtration of fresh and recirculated air that addresses the specific indoor and outdoor environmental considerations for the facility.	B
<i>Ventilation System Filters</i>	4.6.2.4.5	INDOOR AQUATIC FACILITY ventilation system design shall include filters with a Minimum Efficiency Reporting Value (MERV) rating of 8.	B
<i>Recommended Filters</i>	4.6.2.4.6	AQUATIC FACILITY ventilation system design engineer and/or the ventilation system manufacturer shall provide facility owner with recommendations for filter replacement type, frequency and pressure differential specifications.	B

<i>Key word</i>	<i>Section</i>	<i>CODE</i>	<i>Grade</i>
	<b>4.6.2.5</b>	<b>Natural Air</b>	
<i>Complete Ventilation Purge</i>	4.6.2.5.1	INDOOR AQUATIC FACILITY ventilation system design shall provide a complete building purge method that will allow for complete exhaust of the building's air volume and replacement with fresh air, with no air recirculation at full fan speed for an indefinite period.	C

## Model Aquatic Health Code:

### Ventilation Module

#### 5.0 Operation and Maintenance

Key word	Section	CODE	Grade
	<b>5.0</b>	<b>Operation and Maintenance</b>	
	<b>5.6</b>	<b>Indoor/Outdoor Environment</b>	
	5.6.1	Lighting	
	5.6.2	Ventilation	
	<b>5.6.2.1</b>	<b>Building Ventilation</b>	
<i>Purpose</i>	5.6.2.1.1	INDOOR AQUATIC FACILITY building ventilation systems shall be maintained and operated to protect the health of the building’s occupants.	B
<i>Original Characteristics</i>	5.6.2.1.2	INDOOR AQUATIC FACILITY building ventilation systems shall be maintained and operated to comply with all requirements of the original system design, construction and installation.	B
<i>Indoor Facility Areas</i>	5.6.2.1.3	The ventilation operation and maintenance requirements shall apply to an INDOOR AQUATIC FACILITY including the AQUATIC VENUES, the surrounding BATHER and spectator/stadium seating area, mechanical rooms, bath and locker rooms, and any associated rooms which have a direct opening to the AQUATIC FACILITY.	C
<i>Ventilation Maintenance</i>	5.6.2.1.4	INDOOR AQUATIC FACILITY operator shall develop and implement a ventilation system program of STANDARD operating, maintenance, testing, and inspection procedures with detailed instructions, necessary equipment and supplies, and oversight for those carrying out these duties, in accordance with the AQUATIC FACILITY ventilation system design engineer’s and/or the ventilation system manufacturer’s recommendations.	B
<i>Ventilation</i>	5.6.2.1.5	INDOOR AQUATIC FACILITY operator shall monitor, log	B

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<i>Key word</i>	<i>Section</i>	<i>CODE</i>	<i>Grade</i>
<i>Monitoring</i>		and maintain ventilation system set-points and other operational parameters as specified by the AQUATIC FACILITY ventilation system design engineer and/or the ventilation system manufacturer.	
<i>Ventilation Cleaning</i>	5.6.2.1.6	INDOOR AQUATIC FACILITY operator shall implement a ventilation system cleaning program to remove CONTAMINANTS within the equipment in accordance with the AQUATIC FACILITY ventilation system design engineer's and/or the ventilation system manufacturer's recommendations.	B
<i>Manuals / Commissioning Reports</i>	5.6.2.1.7	INDOOR AQUATIC FACILITY operator shall maintain the AQUATIC FACILITY ventilation system design engineer's original operating manuals and commissioning reports, updates and modification specifications for any modifications.	B
<i>Air Quality -- Health</i>	<b>5.6.2.2</b>	<b>Air Quality – Health</b>	
<i>Combined Chlorine Reduction</i>	5.6.2.2.1	INDOOR AQUATIC FACILITY operator shall develop and implement a plan to reduce combined chlorine compounds introduced into the building from operation of AQUATIC VENUES.	A
<i>Public Information and Health Messaging</i>	5.6.2.3.2	INDOOR AQUATIC FACILITY operator shall develop and implement a public information and health messaging program to inform facility patrons of their impact on building air quality.	C
	<b>5.6.2.3</b>	<b>Humidity Control [NA]</b>	
<i>Mechanical Systems</i>	<b>5.6.2.4</b>	<b>Mechanical Systems</b>	
<i>Air Filter Changing</i>	5.6.2.4.1	INDOOR AQUATIC FACILITY operator(s) shall replace or clean, as appropriate, ventilation system air filters in accordance with the AQUATIC FACILITY ventilation system design engineer's and/or the ventilation equipment manufacturer's recommendations, whichever is most frequent.	B
<i>Records</i>	5.6.2.4.2	Owner shall record and affix to the outside of the unit a log recording when filters were changed or cleaned.	C

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<i>Key word</i>	<i>Section</i>	<i>CODE</i>	<i>Grade</i>
<i>Natural Air</i>	<b>5.6.2.5</b>	<b>Natural Air</b>	
<i>Building Purge Plan</i>	5.6.2.5.1	Operator shall develop an action plan including procedures for purging the building if necessary.	B