Model Aquatic Health Code

Recirculation Systems and Filtration Module CODE Sections Modified after the First 60-day Review that Closed on 08/31/2013

Informational Copy: NOT Currently Open for Public Comment

This version of the MAHC Recirculation and Filtration 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/structurecontent/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 Recirculation Systems and Filtration Module Abstract

Health issues related to waterborne diseases as well as exposure to chemicals associated with pool water are increasingly being documented. The Recirculation Systems and Filtration Module is a first step towards improving water quality at aquatic facilities and reducing associated health effects. The Recirculation Systems and Filtration Module contains design and construction requirements that are, unless otherwise specified, applicable only for new or modified construction. New and improved elements include:

1) More aggressive turnover times and more uniform standards for recirculation system design and operation.
2) Filter design and operation standards that will promote more effective and efficient filtration.
3) Requiring water replenishment to dilute out the dissolved contaminants that cannot be removed by pool filters.
4) Development of a long-term plan to use pool filters for pathogen removal in addition to water clarity in a multiple barrier system that would complement all disinfection processes.
5) Use of improved flow meters

The Recirculation Systems and Filtration Code Module shows a Table of Contents giving the context of the Recirculation Systems and Filtration 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"

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Acronyms and Initialisms in this Module:

AHJ	authority having jurisdiction
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
GPM	gallons per minute
MAHC	Model Aquatic Health Code
MSBL	maximum sustainable bather load
NPSH	net positive suction head
NRTL	Nationally Recognized Testing Laboratory
NSF	National Sanitation Foundation
TDS	total dissolved solids

UV	Ultraviolet
VFD	variable frequency drive

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, and spray pads/interactive water venues.

"Authority Having Jurisdiction" (AHJ) means an agency, organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

"Backflow" means a hydraulic condition caused by a difference in water pressure that causes non-potable water or other liquid to enter the potable water system by either backpressure or back-siphonage.

"Bather" means a person at an aquatic venue who has contact with water either through spray or partial or total immersion. The term Bather as defined, also includes staff members, and refers to those users who can be exposed to contaminated water as well as potentially contaminate the water.

"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. 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.

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

"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.

"Hydraulically apportioned" means both the relative difference between the water flow over the gutter or through the skimmers compared with the water flow through the main drain; and the even distribution of treated water returned to different areas of the pool through the inlets.

"Increased Risk Aquatic Venue" means an aquatic venue which due to its intrinsic characteristics and intended users has a greater likelihood of affecting the health and safety of the patrons of that venue by being at increased risk for contamination (e.g., by diaper-aged children/children aged <5 years old) or being used by people that may be more susceptible to infection (e.g., therapy patients with open wounds). Examples of increased-risk aquatic venues include spray pads, wading pools and other aquatic venues designed for diaper-aged children as well as therapy pools.

"Inlets" mean wall or floor fittings where treated water is returned to the pool.

"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.

"Perimeter Gutter System" means the alternative to skimmers as a method to remove water from the pool's surface for treatment. The gutter provides a level structure along the pool perimeter versus the intermittent skimmers.

"pH" is the negative log of the concentration of hydrogen ions. When water ionizes, it produces hydrogen ions (H+) and hydroxide ions (OH-). If 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.

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

"Sanitize" means reducing the level of microbes to that considered safe by public health standards. This may be achieved through a variety of chemical or physical means including chemical treatment, cleaning or drying.

"Secondary disinfection systems" means those disinfection processes (e.g., UV, ozone) which are required in certain circumstances to meet the minimum standards of this code and are in addition to the requirements of Section 5.0 of this code.

"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.

"Spray Pad" means no standing water, features included that spray bathers with recirculating water.

"Supplemental disinfection systems" means those disinfection processes or systems which are optional and not required on an aquatic venue for health and safety reasons. They may be used to enhance overall system performance.

"Surge Tank Net Capacity" means the total tank capacity minus the volume of the tank that is filled when the pool is unoccupied.

“Recirculation System” means the combination of the main drain, gutter or skimmer, inlets, piping, pumps, controls, surge tank or balance tank to provide pool water recirculation to and from the pool and the treatment systems.

“Skimmer System” means periodic locations along the top of the pool wall for removal of water from the pool’s surface for treatment.

“Water Replenishment System” means a way to remove water from the pool as needed and replace with make-up water to maintain water quality.

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
Recirculation Systems and Filtration 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**	
	4.7	**Recirculation and Water Treatment**	
Recirculation Systems	**4.7.1**	**Recirculation Systems and Equipment**	
General	***4.7.1.1***	***General***	
Equipped and Operated	4.7.1.1.1	All AQUATIC FACILITIES shall be equipped and operated with a recirculation and filtration system capable of meeting the provisions outlined in MAHC Section 4.7.	
Component Installation	4.7.1.1.2	The installation of the recirculation and the filtration system components shall be performed in accordance with the designer's and manufacturers' instructions.	
Recirculation System	4.7.1.1.3	A water RECIRCULATION SYSTEM consisting of one or more pumps, pipes, return INLETS, suction outlets, tanks, filters, and other necessary equipment shall be provided.	
Combined Aquatic Venue Treatment	***4.7.1.2***	***Combined Aquatic Venue Treatment***	
Maintain and Measure	4.7.1.2.1	When treatment systems of aquatic venues are combined, the design shall include all appurtenances to maintain and measure the required water characteristics including but not limited to flow rate, pH, and disinfectant concentration in each venue/feature.	
Secondary Disinfection	4.7.1.2.2	If SECONDARY DISINFECTION is required for an INCREASED RISK AQUATIC VENUE/FEATURE as per MAHC Section 4.7.3.3.1.2, then SECONDARY DISINFECTION shall be required for all treatment systems that are combined with the INCREASED RISK AQUATIC VENUE/FEATURE. *Note: Please see language inserted below, taken from MAHC Disinfection and Water Quality Draft Guidance, MAHC Code Section 4.7.3.3.1.2:*	

Keyword	Section	Code	Grade
		The new construction or substantial renovation of the following INCREASED RISK AQUATIC VENUES shall be required to use a SECONDARY DISINFECTION SYSTEM after adoption of this CODE: 1) AQUATIC VENUES designed primarily for diaper-aged children (children <5 years old), such as a. wading AQUATIC VENUES, b. water activity AQUATIC VENUES, c. interactive water features with no standing water, and 2) Therapy pools.	
Isolate	4.7.1.2.3	Each aquatic venue of a combined venue treatment system shall be capable of being isolated for maintenance purposes.	
Inlets	***4.7.1.3***	***Inlets***	
General	*4.7.1.3.1*	*General*	
Hydraulically Balanced	4.7.1.3.1.1	The RECIRCULATION SYSTEM shall be designed with sufficient flexibility to achieve a HYDRAULIC apportionment that will ensure the following: 1) Effective distribution of treated water, and 2) Maintenance of a uniform disinfectant residual and pH throughout the AQUATIC VENUE.	
Alternative Design Justification	4.7.1.3.1.1.1	Alternative designs shall be allowed based on adequate engineering justification.	
Inlets	4.7.1.3.1..2	Effective distribution of treated water shall be accomplished by either a continuous PERIMETER OVERFLOW system with integral INLETS or by means of directionally adjustable INLETS adequate in design, number, and location.	
Adequate mixing	4.7.1.3.1.3	POOLS shall use wall and/or floor INLETS to provide adequate mixing.	
Greater than 50 feet wide	4.7.1.3.1.3.1.	For pools greater than 50 feet wide (15.24_m), floor inlets shall be required.	
Other Inlet Types	4.7.1.3.1.4	All other types of INLET systems not covered in this section shall be subject to approval by the AHJ with proper engineering justification.	

Keyword	Section	Code	Grade
Hydraulically Sized	4.7.1.3.1.5	INLETS shall be hydraulically sized to provide the design flow rates for each POOL area of multi-zone pools based on the required design turnover rate for each zone.	
Floor Inlets	*4.7.1.3.2*	*Floor Inlets*	
Uniformly Spaced	4.7.1.3.2.1	Floor INLETS shall be **1)** spaced to effectively distribute the treated water throughout the pool, and **2)** flush with the bottom of the POOL.	
Distance	4.7.1.3.2.1.1	Distance between floor INLETS shall be no greater than 20 feet (6.1 m).	
Row	4.7.1.3.2.1.2	A row of floor INLETS shall be located within 15 feet (4.6 m) of each side wall.	
Spaced	4.7.1.3.2.2	Floor INLETS, used in combination with wall INLETS, shall be spaced no greater than 25 feet (7.6 m) from nearest side walls.	
Wall Inlets	*4.7.1.3.3*	*Wall Inlets*	
Effective Mixing	4.7.1.3.3.1	Wall INLET velocity shall mix the water effectively.	
Adjustable	4.7.1.3.3.2	INLETS shall be directionally adjustable to provide effective distribution of water.	
Inlet Spacing	4.7.1.3.3.3	Wall INLETS shall be spaced no greater than 20 feet (6.1 m) apart.	
Corner	4.7.1.3.3.3.1	INLETS shall be placed within 5 feet (1.5 m) of each corner of the POOL.	
Skimmers	4.7.1.3.3.3.2	Inlets shall be placed at least 5 feet (1.52_m) from a skimmer.	
Isolated	4.7.1.3.3.3.3	INLETS shall be placed in each recessed or isolated area of the POOL.	
Directional Flow	4.7.1.3.3.4	Wall INLETS that are part of a manufactured gutter system do not need to be designed to provide directional flow.	
Dye Testing	4.7.1.3.3.5	Dye testing may be required by the AHJ to evaluate the mixing characteristics of the RECIRCULATION SYSTEM.	
Failed Test	4.7.1.3.3.5.1	If dye test reveals inadequate mixing in the POOL after 20 minutes,	

Keyword	Section	Code	Grade
		the RECIRCULATION SYSTEM shall be adjusted or modified to assure adequate mixing.	
Overflow Systems	***4.7.1.4***	***Perimeter Overflow Systems/Gutters***	
General	*4.7.1.4.1*	*General*	
Skimming	4.7.1.4.1.1	All POOLs shall be designed to provide SKIMMING for the entire POOL surface area with engineering rationale provided by the design professional.	
Around Entire Pool	4.7.1.4.1.1.1	For pools that require a perimeter overflow system, the POS shall extend around the entire pool perimeter.	
Zero-depth Entry	4.7.1.4.1.2	Zero-depth entry POOLS shall have a continuous overflow trench that terminates as close to the side walls as practical including any zero depth portion of the pool perimeter.	
Ends	4.7.1.4.1.2.1	Where a POS cannot be continuous the ends of each section shall terminate as close as practical to each other.	
Size and Shape	*4.7.1.4.2*	*Gutter Size and Shape*	
Continuous Water Removal	4.7.1.4.2.1	The gutter system shall be designed to allow continuous removal of water from the POOL'S upper surface at a rate of at least 125 percent of the approved total recirculation flow rate chosen by the designer.	
Inspection	4.7.1.4.2.2	Gutters shall permit ready inspection, cleaning, and repair.	
Outlets	*4.7.1.4.3*	*Gutter Outlets*	
Design Capacity	4.7.1.4.3.1	Drop boxes, converters, return piping, or flumes used to convey water from the gutter shall be designed to **1)** prevent flooding and backflow of skimmed water into the pool, and **2)** handle at least 125 percent of the approved total recirculation flow.	
Surge Capacity	*4.7.1.4.4*	*Surge Tank Capacity*	
Net Surge Capacity	4.7.1.4.4.1	All POS shall be designed with an effective net surge capacity of not less than 1 gallon for each square foot (41 L/m^2) of POOL surface area.	

Keyword	Section	Code	Grade
Surge Components	4.7.1.4.4.1.1	Surge shall be provided within a surge tank, or the gutter or filter above the normal flow line, or elsewhere in the system.	
Tank Capacity	4.7.1.4.4.2	The tank capacity specified shall be the net capacity.	
Tank Levels	4.7.1.4.4.3	The design professional shall define the minimum, maximum, and normal pool operating water levels in the surge tank.	
Marked	4.7.1.4.4.3.1	The surge tank's minimum, maximum, and normal POOL operating water levels shall be marked on the tank so as to be readily visible for inspection.	
Overflow Pipes	4.7.1.4.4.4	Surge tanks, shall have overflow pipes to convey excess water to waste via an air gap or other approved BACKFLOW prevention device.	
Tolerances	*4.7.1.4.5*	*Tolerances*	
Venue Perimeter	4.7.1.4.5.1	Gutters shall be level within a tolerance of plus or minus 1/16 inch (mm) around the perimeter of the AQUATIC VENUE.	
Makeup Water	*4.7.1.4.6*	*Makeup Water System*	
Automatic	4.7.1.4.6.1	Automatic makeup water supply equipment shall be provided to maintain continuous skimming of POOLS with POS.	
Air Gap	4.7.1.4.6.2	Makeup water shall be supplied through an air gap or other approved BACKFLOW prevention device.	
Skimmers	***4.7.1.5***	***Skimmers and Alternative Gutter Technologies Using In-pool Surge Capacity***	
General	*4.7.1.5.1*	*General*	
Manufactured	4.7.1.5.1.1	The use of manufactured direct suction skimmers shall be in accordance with the manufacturer's recommendations.	
Provided	4.7.1.5.1.2	Where skimmers are used, at least one surface skimmer shall be provided for each 500 square feet (46 m^2) of surface area or fraction thereof.	
Conditions	4.7.1.5.1.2.1	Additional skimmers may be required to achieve effective skimming under site-specific conditions (*e.g., heavy winds and/or CONTAMINANT loading*) and/or to comply with all applicable building codes.	
Hybrid Systems	4.7.1.5.1.3	Hybrid systems that incorporate surger weirs in the overflow	

Keyword	Section	Code	Grade
		gutters to provide for in-POOL surge shall meet all of the requirements specified for each system *(with the exception of the surge or balance tank since the surge capacity requirement will be alternately met by the in-POOL surge capacity*).	
Surge Weirs	4.7.1.5.1.3.1	The number of surge weirs shall be based on the individual surge weir capacity and the operational apportionment of the design recirculation flow rate.	
Locations	4.7.1.5.1.3.1.1	The location of the required number of surge weirs shall be uniformly spaced in the gutter sections.	
Design Capacity	4.7.1.5.1.4	The SKIMMER SYSTEM, when used, shall be designed to handle up to 100% of the total recirculation flow rate chosen by the designer.	
Pool Width Limitations	4.7.1.5.1.6	POOLS using skimmers shall not exceed 30 feet (9.1 m) in width.	
Location	*4.7.1.5.2*	*Skimmer Location*	
Effective	4.7.1.5.2.1	Skimmers shall be so located as to provide effective skimming of the entire water surface.	
Steps and Recessed areas	4.7.1.5.2.2	Skimmers shall be located so as not to be affected by restricted flow in areas such as near steps and within small recesses	
Wind Direction	4.7.1.5.2.3	Wind direction shall be considered in number and placement of skimmers	
Flow Rate	*4.7.1.5.3*	*Skimmer Flow Rate*	
NSF 50	4.7.1.5.3.1	The flow rate for the skimmers shall comply with manufacturer data plates or NSF/ANSI50 including Annex K.	
Control	*4.7.1.5.4*	*Control*	
Weir	4.7.1.5.4.1	Each skimmer shall have a weir that adjusts automatically to variations in water level over a minimum range of 4 inches (10 cm).	
Trimmer Valve	4.7.1.5.4.2	Each skimmer shall be equipped with a trimmer valve capable of distributing the total flow between individual skimmers.	
Tolerances	*4.7.1.5.5*	*Tolerances*	
Skimmer Base	4.7.1.5.5.1	The base of each skimmer shall be level with all other skimmers in the pool within a tolerance of plus or minus ¼ inch (6 mm).	

Keyword	Section	Code	Grade
Testing	*4.7.1.5.6*	*Testing*	
Flotation Tests	4.7.1.5.6.1	Flotation tests should be performed annually to ensure effective skimming and proper adjustment of flow distribution between skimmers.	
Submerged Suction	***4.7.1.6***	***Submerged Suction Outlet***	
General	*4.7.1.6.1*	*General*	
Conform	4.7.1.6.1.1	Submerged suction outlets, including sumps and covers, shall conform to the requirements of ANSI/APSP-16 2011.	
Number and Spacing	*4.7.1.6.2*	*Number and Spacing*	
Hydraulically Balanced	4.7.1.6.2.1	A minimum of two HYDRAULICALLY BALANCED filtration system outlets are required in the bottom.	
Located on the Bottom	4.7.1.6.2.1.1	One of the outlets may be located on the bottom of a side/end wall at the deepest level.	
Connected	4.7.1.6.2.1.2	The outlets shall be connected to a single main suction pipe by branch lines.	
Valved	4.7.1.6.2.1.3	The branch lines shall not be valved so as to be capable of operating independently.	
Spaced	4.7.1.6.2.2	Outlets shall be equally spaced from the POOL side walls.	
Located	4.7.1.6.2.3	Outlets shall be located no less than 3 feet (m) apart, measuring between the centerlines of the suction outlet covers.	
Tank Connection	*4.7.1.6.3*	*Tank Connection*	
Gravity Drains	4.7.1.6.3.1	Where gravity outlets are used, the main drain outlet shall be connected to a surge tank, collection tank, or balance tank/pipe.	
Flow Control	*4.7.1.6.4*	*Flow Distribution and Control*	
Design Capacity	4.7.1.6.4.1	The main drain system shall be designed at a minimum to handle recirculation flow of 100% of total design recirculation flow rate. The branch pipe from each main drain outlet shall be designed to carry 100% of the recirculation flow rate.	
Three or More Drains	4.7.1.6.4.1	Where 3 or more main drain outlets are connected by branch	

Keyword	Section	Code	Grade
		piping in accordance with section 4.7.1.6.2.1.1 through 4.7.1.6.2.1.3, , the design flow through each drain outlet may be as follows; Q max for each drain= Q(total recirculation rate)/(number of drains less one) Qmax=Qtotal/(N-1)	
Proportioning Valve	4.7.1.6.4.2	The single main drain suction pipe to the pump shall be equipped with a proportioning valve(s) to adjust the flow distribution between the main drain piping and the surface overflow system piping.	
Flow Velocities	*4.7.1.6.5*	*Flow Velocities*	
Standards	4.7.1.6.5.1	Flow velocities shall meet ANSI/APSP-16 2011 based on 100% design flow through each main drain cover.	
Piping	***4.7.1.7***	***Piping***	
Design	*4.7.1.7.1*	*Design*	
Materials	4.7.1.7.1.1	Piping system components in contact with swimming POOL water shall be of non-toxic material, resistant to corrosion, able to withstand operating pressures, chemicals, and temperatures.	
Standards	4.7.1.7.1.2	Piping and piping system component materials shall meet NSF/ANSI Standard 61 and NSF/ANSI Standard 14 as applicable.	
Certified	4.7.1.7.1.2.1	Piping and piping system component materials shall be certified by an ANSI-accredited certification organization.	
Velocity	*4.7.1.7.2*	*Velocity in Pipes*	
Discharge Piping	4.7.1.7.2.1	RECIRCULATION SYSTEM piping shall be designed so that water velocities do not exceed 8 feet (2.4 m) per second on the discharge side of the recirculation pump unless alternative values have proper engineering justification.	
Suction Piping	4.7.1.7.2.2	Suction piping shall be sized so that the water velocity does not exceed 6 ft/s.	
Additional Considerations	4.7.1.7.2.3	Gravity piping shall be sized with consideration of available system head or as demonstrated by detailed hydraulic calculations at the design recirculation flow rate.	
Drainage and Installation	*4.7.1.7.3*	*Drainage and Installation*	

Keyword	Section	Code	Grade
Temperature Variations	4.7.1.7.3.1	Provisions shall be made for expansion and contraction of pipes due to temperature variations.	
Drainage	4.7.1.7.3.2	Provisions shall be made for complete drainage of all POOL piping for winterization.	
Supported	4.7.1.7.3.3	All piping shall be supported continuously or at sufficiently close intervals to prevent sagging and settlement.	
Component Identification	*4.7.1.7.4*	*Piping and Component Identification*	
Clearly Marked	4.7.1.7.4.1	All exposed piping shall be clearly marked to indicate function.	
Flow Direction and Source	4.7.1.7.4.2	All piping shall be clearly marked to indicate type or source of water and direction of flow with clear labeling and/or color coding.	
Valves	4.7.1.7.4.3	All valves shall be clearly marked to indicate function with clear labeling and/or color coding.	
Schematic Displayed	4.7.1.7.4.4	A complete easily readable schematic of the entire POOL RECIRCULATION SYSTEM shall be openly displayed in the mechanical room or available to maintenance and inspection personnel.	
Testing	*4.7.1.7.5*	*Testing*	
Static Water Pressure Test	4.7.1.7.5.1	Suction and supply POOL piping shall be subjected to a static water pressure test for the duration specified by the design engineer and/or AHJ.	
Greater	4.7.1.7.5.2	New and renovated suction and supply POOL piping shall be able to maintain the greater of the two following amounts of pressure: 1) 25% greater than the maximum design operating pressure of the system, or 2) 25 psi (172 KPa).	
Strainers and Pumps	***4.7.1.8***	***Strainers and Pumps***	
Strainers	*4.7.1.8.1*	*Strainers*	
Strainer / Screen	4.7.1.8.1.1	All filter recirculation pumps, except those for vacuum filter installations shall have a strainer/screen device on the suction side to protect the filtration and pumping equipment.	
Materials	4.7.1.8.1.2	All material used in the construction of strainers and screens shall be:	

Keyword	Section	Code	Grade
		1) Nontoxic, impervious, and enduring, 2) Able to withstand design stresses, and 3) Designed to minimize friction losses	
Pumps	*4.7.1.8.2*	*Pumping Equipment*	
Variable Frequency Drives	4.7.1.8.2.1	Variable frequency drives (VFDs) may be installed to control all recirculation and feature pumps.	
Total Dynamic Head	4.7.1.8.2.2	The recirculation pump(s) shall have adequate capacity to meet the recirculation flow design requirements in accordance with the maximum total dynamic head required by the entire RECIRCULATION SYSTEM under the most extreme operating conditions (*e.g., clogged filters in need of backwashing*).	
Required Flow Rate	4.7.1.8.2.3	The pump shall be designed to maintain design recirculation flows under all conditions.	
Vacuum Limit Switches	4.7.1.8.2.4	Where vacuum filters are used, a vacuum limit switch shall be provided on the pump suction line.	
Maximum	4.7.1.8.2.5	The vacuum limit switch shall be set for a maximum vacuum of 18 inches (46 cm) of mercury.	
Pump Priming	4.7.1.8.2.6	All recirculation pumps shall be self-priming or flooded-suction.	
NPSH Requirement	4.7.1.8.2.7	All recirculation pumps shall meet the minimum NPSH requirement.	
Operating Gauges	*4.7.1.8.3*	*Operating Gauges*	
Vacuum Gauge	4.7.1.8.3.1	A compound vacuum-pressure gauge shall be installed on the pump suction line as close to the pump as possible.	
Suction Lift	4.7.1.8.3.2	A vacuum gauge shall be used for pumps with suction lift.	
Installed	4.7.1.8.3.3	A pressure gauge shall be installed on the pump discharge line adjacent to the pump.	
Easily Read	4.7.1.8.3.4	Gauges shall be installed so they can be easily read.	
Valves	4.7.1.8.3.5	All gauges shall be equipped with valves to allow for servicing under operating conditions.	
Flow Measure and Control	***4.7.1.9***	***Flow Measurement and Control***	

Keyword	Section	Code	Grade
Flow Meters	4.7.1.9.1	A flow meter accurate to within +/- 5% of the actual design flow shall be provided for each filtration system.	
Certified	4.7.1.9.1.1	Flow meters shall be certified in accordance with NSF/ANSI Standard 50.	
Valves	4.7.1.9.2	All pumps shall be installed with a manual adjustable discharge valve to provide a backup means of flow control as well as for system isolation.	
Flow Rates / Turnover Times	***4.7.1.10***	***Flow Rates/Turnover Times***	
Maximum Allowable	4.7.1.10.1	All AQUATIC VENUES shall comply with the following maximum allowable turnover times show in MAHC Table 4.7.1.10: "Maximum Allowable Turnover Times."	
Calculated	4.7.1.10.2	The turnover time shall be calculated based on the total volume of water divided by the flow rate through the filtration process.	
Unfiltered Water	4.7.1.10.2.1	Unfiltered water shall not factor into turnover time.	
Table 4.7.1.10		***Table 4.7.1.10: Maximum Allowable Turnover Times***	

Keyword Section Code Grade

Type of Pools	Turnover Maximum
Activity Pools	2 hours or less
Diving Pools	8 hours or less
Interactive Play*	0.5 hours or less
Lazy River	2 hours or less
Plunge Pools	1 hour or less
Runout Slide	1 hour or less
Wading Pools*	1 hour or less
Wave Pools	2 hours or less
All Other Pools	6 hours or less
*Shall have secondary disinfection systems	

Spa, Therapy*, & Exercise Pools		
Temperatures	Load (gals/person)	Turnover Maximum
≤ 72-93 °F	> 2500	4 hours or less
≤ 72-93 °F	> 450	2 hours or less
≤ 72-93 °F	≤ 450	1 hour or less
≥ 93-104 °F	All	0.5 hours or less
*Shall have secondary disinfection systems		

Turnover Variance 4.7.1.10.3 The AHJ may grant a turnover time variance for AQUATIC VENUES with extreme volume or operating conditions based on proper engineering justification.

Turnover Times 4.7.1.10.4 Turnover times shall be calculated based solely on the flow rate through the filtration system.

Required 4.7.1.10.4.1 The required turnover time shall be the lesser of the following

Keyword	Section	Code	Grade
		options: 1) the specified time in MAHC Table 4.7.1.10, or 2) the time required for individual components (*e.g., 3 skimmers with flow rates set by the manufacturer and an additional 20% for the main drains could exceed the minimum value in the table*).	
Total Volume	4.7.1.10.4.2	The total volume of the POOL system shall include the POOL and any surge/balance tank.	
Supply Water	4.7.1.10.4.3	Supply water to attractions (*e.g., slides, lazy rivers, and tube rides*) may be reused prior to filtration provided the DISINFECTANT and pH levels of the supply water are maintained at required levels.	
Secondary Disinfection	4.7.1.10.5	SECONDARY DISINFECTION SYSTEMS (*e.g. UV or Ozone*) for SPRAY PADS shall be installed on the total recirculation flow.	
Reuse Ratio	4.7.1.10.5.1	The ratio of INTERACTIVE WATER PLAY FEATURE water to filtered water shall be no greater than 3:1 in order to maintain the efficiency of the FILTRATION SYSTEM.	
Flow Turndown System	4.7.1.10.6	For AQUATIC FACILITIES that intend to reduce the recirculation flow rate below the minimum required design values when the POOL is unoccupied, the flow turndown system shall be designed as follows in MAHC Section 4.7.1.10.6.1 to 4.7.1.10.6.7.	
Online Turbidimeter	4.7.1.10.6.1	A flow turndown system shall have an online turbidimeter capable of pulling water from the RECIRCULATION SYSTEM ahead of the filter.	
Linked	4.7.1.10.6.2	A flow turndown system shall have a VFD(s) linked to an online turbidimeter and the main RECIRCULATION SYSTEM flow meter(s).	
VFDs	4.7.1.10.6.3	A flow turndown system shall have a VFD(s) programmed to modify the system flowrate when the turbidity is less than the maximum allowable value.	
Flowrate	4.7.1.10.6.4	The system flowrate shall not be reduced more than 25% lower than the minimum design requirements and only reduced when the POOL is unoccupied.	
Turbidity	4.7.1.10.6.5	The system flowrate shall be based on maintaining a turbidity of less than 0.5 NTU in the POOL.	
Disinfectant Levels	4.7.1.10.6.6	The turndown system shall be required to maintain required DISINFECTANT and pH levels at all times.	

Keyword	Section	Code	Grade
Increase	4.7.1.10.6.7	When the turndown system is also used to intelligently increase the recirculation flow rate above the minimum requirement (*e.g., in times of peak use to maintain water quality goals more effectively*), the following requirements shall be met at all times: 1) Velocity requirements inside of pipes (*per MAHC Section 4.7.1.7.2*), and 2) Maximum filtration system flows.	
Filtration	**4.7.2**	**Filtration**	
All Filters	***4.7.2.1***	***All Filters***	
Required	*4.7.2.1.1*	Filtration shall be required for all AQUATIC VENUES that recirculate water.	
Granular Media Filters	***4.7.2.2***	***Granular Media Filters***	
General	*4.7.2.2.1*	*General*	
Valves and Piping	4.7.2.2.1.1	The granular media filter system shall have valves and piping to allow isolation, venting, complete drainage (*for maintenance or inspections*), and backwashing of individual filters.	
Influent Pressure Gauge	4.7.2.2.1.2	Filtration accessories shall include the following items: 1) Influent pressure gauge, 2) Effluent pressure gauge or other means to view backwash water clarity, 3) Backwash sight glass , and 4) Manual air relief system.	
Listed	4.7.2.2.1.3	All filters shall be certified to NSF/ANSI 50 by an ANSI-accredited certification organization.	
Location and Spacing	*4.7.2.2.2*	*Filter Location and Spacing*	
Installed	4.7.2.2.2.1	Filters shall be installed with adequate clearance and facilities for ready and safe inspection, maintenance, disassembly, and repair.	
Media Removal	4.7.2.2.2.2	A means and access for easy removal of filter media shall be required.	
Rates	*4.7.2.2.3*	*Filtration and Backwashing Rates*	

Keyword	Section	Code	Grade
Operate	4.7.2.2.3.1	High-rate granular media filters shall be designed to operate at no more than 15 gpm/ft^2 (29.3 m/h) when a minimum bed depth of 15 inches is provided per manufacturer..	
Less than 15 Inch Bed Depth	4.7.2.1.3.1.1	When a bed depth is less than 15 inches, filters shall be designed to operate at no more than 12 gpm//ft2.	
Backwash	4.7.2.2.3.2	The granular media filter system shall be designed to backwash each filter at a rate of at least 15 gallons per minute per square foot (36.7 m/h) of filter bed surface area, unless explicitly prohibited by the filter manufacturer and/or approved at an alternate rate as specified in the NSF/ANSI 50 listing.	
Depth Requirements	*4.7.2.2.4*	*Filter Media Depth Requirements*	
Minimum	4.7.2.2.4.1	The minimum depth of filter media cannot be less than the depth specified by the manufacturer.	
Pressure	*4.7.2.2.5*	*Differential Pressure Measurement*	
Gauges	4.7.2.2.5.1	Influent and effluent pressure gauges shall have the capability to measure up to a 20 psi (138 KPa) increase in the differential pressure across the filter bed in increments of 1 psi (6.9 KPa) or less.	
Injection Equipment	*4.7.2.2.6*	*Coagulant Injection Equipment*	
Installed	4.7.2.2.6.1	If coagulant feed systems are used, they shall be installed with the injection point located before the filters and for pressure filters, on the suction side of the recirculation pump(s) with electrical interlocks in accordance with MAHC Section 4.7.3.2.1.4.	
Precoat Filters	***4.7.2.3***	***Precoat Filters***	
General	*4.7.2.3.1*	*General*	
Listed	4.7.2.3.1.1	All precoat, filters *(i.e., pressure and vacuum*) shall be certified to NSF/ANSI 50 by an ANSI- accredited certification organization.	
Appropriate Media	4.7.2.3.1.2	Filters should be used with the appropriate filter media as recommended by the filter manufacturer for maximum clarity and cycle length for AQUATIC VENUE use.	
Certified and Sized	4.7.2.3.1.2.1	Filter media shall be certified to NSF/ANSI Standard 50 by an ANSI- accredited certification organization and within the size specifications provided by the filter manufacturer and NSF/ANSI 50.	

Keyword	Section	Code	Grade
Alternate Types	4.7.2.3.1.2.2	Alternate types of filter media shall be permitted in accordance with the filter manufacturer's recommendation for aquatic venue use.	
NSF Standard	4.7.2.3.1.2.3	Alternate types of filter media shall be in accordance with NSF Standard 50.	
Filtration Rates	*4.7.2.3.2*	*Filtration Rates*	
Vacuum Precoat	4.7.2.3.2.1	The design filtration rate for vacuum precoat filters shall not be greater than either: 1) 2.0 gallons per minute per square foot (4.9 m/h), or 2) 2.5 gpm/sf (6.1m/h) when used with a continuous precoat media feed (commonly referred to as “body-feed”).	
Pressure Precoat	4.7.2.3.2.2	The design filtration rate for pressure precoat filters shall not be greater than 2.0 gallons per minute per square foot (4.9 m/h) of effective filter surface area.	
Calculate	4.7.2.3.2.3	The filtration surface area shall be calculated as the measured surface area of the septum plus 1/8 inch layer of precoat media.	
Introduction System	*4.7.2.3.3*	*Precoat Media Introduction System*	
Precoat process	4.7.2.3.3.1	The precoat process shall follow the manufacturer’s recommendations and requirements of NSF/ANSI Standard 50.	
Continuous Feed	*4.7.2.3.4*	*Continuous Filter Media Feed Equipment*	
Manufacturer Specification	4.7.2.3.4.1	If equipment is provided for the continuous feeding of filter media to the filter influent, the equipment shall be used in accordance with the manufacturer’s specifications.	
Filter Media Discharge	4.7.2.3.4.2	All discharged filter media shall be handled in accordance with local and state laws, rules, and regulations.	
Cartridge Filters	***4.7.2.4***	***Cartridge Filters***	
Listed	4.7.2.4.1	Cartridge filters shall be installed in accordance with the filter manufacturer's recommendations and certified to NSF/ANSI 50 by an ANSI-accredited certification organization..	
Filtration Rates	4.7.2.4.2	The design filtration rate for surface-type cartridge filter shall not exceed 0.30 gallons per minute per square foot (0.20 L/s/m^2).	

Keyword	Section	Code	Grade
Elements	4.7.2.4.3	Filter cartridges shall be supplied and sized in accordance with the filter manufacturer's recommendation for POOL use.	
Spare Cartridge	4.7.2.4.4	One complete set of spare cartridges shall be maintained on site in a clean and dry condition.	
Disinfection and pH	**4.7.3**	**Disinfection and pH Control**	
Chemical Addition	***4.7.3.1***	***Chemical Addition Methods***	
Disinfection and pH	4.7.3.1.1	DISINFECTION and pH control chemicals shall be automatically introduced through the RECIRCULATION SYSTEM.	
Controller used	4.7.3.1.1.1	A chemical controller, as specified in 4.7.3.2.10,, shall be provided and used for monitoring and control of disinfectant and pH feed equipment.	
Feeder	4.7.3.1.1.2	DISINFECTION and pH control chemicals shall be added using a feeder that meets the requirements outlined in MAHC Section 4.7.3.2.5.	
Feed Equipment	***4.7.3.2***	***Feed Equipment***	
General	*4.7.3.2.1*	*General*	
Feeders & Devices	4.7.3.2.1.1	The POOL shall be equipped with chemical feed equipment such as flowthrough chemical feeders, electrolytic chemical generators,mechanical chemical feeders, chemical feed pumps, and automated controllers that is tested and certified by an ANSI-accredited certification organization in conformance with NSF/ANSI 50.	
Maintained	4.7.3.2.1.2	All chemical feed equipment shall be maintained in good working condition.	
Controls and No or Low Flow Deactivation	4.7.3.2.1.3	All chemical feeders shall be provided with an automatic means to be disabled through an electrical interlock with at least two of the following: 1) Recirculation Pump Power, 2) Flow Meter/Flow switch in the return line, 3) Chemical Control Power and Paddle Wheel or Flow Cell on the chemical controller.	
Installation	4.7.3.2.1.4	The chemical feeders shall be installed according to the manufacturer's instructions.	

Keyword	Section	Code	Grade
Protective Cover	4.7.3.2.1.4.1	A physical barrier shall be installed between chemical feed pumps supplying acid or liquid hypochlorite solution, and other pool components to shield staff and equipment from chemical sprays from leaking connections.	
Sizing	*4.7.3.2.2*	*Sizing of Disinfection Equipment*	
Sizing	4.7.3.2.2.1	Feeders shall be capable of supplying disinfectant and pH control chemicals to the POOL to maintain the minimum required DISINFECTION levels at all times in accordance with the MAHC.	
Chlorine Dosing	4.7.3.2.2.2	All CHLORINE dosing and generating equipment including erosion feeders, in-line electrolytic and brine/batch generators, shall be designed with a capacity to provide the following: 1) Outdoor POOLS (unstabilized): 4.0 lbs of FAC/day/10,000 gals. of POOL water. 2) Indoor POOLS: 2.5 lbsof FAC/ day/10,000 gals. of POOL water.	
Rates	4.7.3.2.2.3	The rates above are suggested minimums and in all cases the engineer shall validate the feed and production equipment specified.	
Introduction of Chemicals	*4.7.3.2.3*	*Introduction of Chemicals*	
Separation	4.7.3.2.3.1	The injection point of DISINFECTION chemicals shall be located before any pH control chemical injection point with sufficient physical separation of the injection points to reduce the likelihood of mixing of these chemicals in the piping during periods of interruption of recirculation system flow.	
Backflow	4.7.3.2.3.2	Means of injection shall not allow BACKFLOW into the chemical system from the POOL system.	
Coagulants	4.7.3.2.3.3	Coagulants shall be metered and injected through a pump system prior to the filters per the manufacturer's recommended rate	
Compressed Chlorine Gas	*4.7.3.2.4*	*Compressed Chlorine Gas*	
Prohibited	4.7.3.2.4.1	Use of compressed CHLORINE gas shall be prohibited for new construction and after substantial alteration/modification to existing facilities.	
Types of Feeders	*4.7.3.2.5*	*Types of Feeders*	

Keyword	Section	Code	Grade
Liquid Solution Feeders	4.7.3.2.5.1	Liquid solution feeders shall include positive displacement pumps such as peristaltic pumps, diaphragm pumps, and piston pumps.	
Feed Rates	4.7.3.2.5.1.1	Feed rates shall be locally adjusted on the pumps and also on/off controlled using chemical controllers.	
Erosion	4.7.3.2.5.2	Erosion feeders may be pressure, pressure differential, or spray erosion types.	
Dry Chemical Feeders	4.7.3.2.5.2.1	Dry chemicals shall be granules or tablets.	
Located	4.7.3.2.5.2.2	Feeders shall have isolation valves on each side of the feeder to be closed before opening the unit.	
Source Water	5.7.3.2.5.2.3	Erosion feeders shall use AQUATIC VENUE water post-filtration as the source water unless approved by feeder manufacturer.	
Gas Feed Systems	4.7.3.2.5.3	Carbon dioxide and ozone are the only gas feed systems permitted in AQUATIC FACILITIES.	
Ventilation	4.7.3.2.5.4	Proper ventilation shall be required for all gas systems.	
Alarms	4.7.3.2.5.5	Where CO_2 cylinders are located indoors, a monitor and alarm shall be provided to alert occupants/operator of high CO_2 and/or low O_2 levels.	
UV Systems	4.7.3.2.5.6	Where used, Ultraviolet light (UV) systems shall be installed in the RECIRCULATION SYSTEM after the filters	
Bypass	4.7.3.2.5.6.1	A bypass pipe that is valved on both ends shall be installed to allow maintenance on the UV unit while the POOL is in operation.	
Interlock	4.7.3.2.5.6.2	UV system operation shall be interlocked with the recirculation pump. so that power to the UV system is interrupted when there is no water flow to the UV unit..	
Strainer	4.7.3.2.5.6.3	An inline strainer shall be installed after the UV unit to capture broken lamp glass or sleeves.	
Electrolytic Generators	*4.7.3.2.6*	*Salt Electrolytic Chlorine Generators, Brine Electrolytic Chlorine or Bromine Generators*	
Salt Electrolytic Chlorine Generators	4.7.3.2.6.1	In-line generator(s) or brine (batch) generator(s) shall be permitted on AQUATIC VENUES.	
In-line method	4.7.3.2.6.2	In-line generators shall use pool-grade salt dosed through an	

Keyword	Section	Code	Grade
		electrolytic chamber into the POOL to introduce CHLORINE into the POOL vessel	
Batch method	4.7.3.2.6.3	Brine (Batch) generators shall produce CHLORINE through an electrolytic cell.	
Chlorine Production	4.7.3.2.6.3.1	Chlorine shall be produced from brines composed of pool-grade salt.	
TDS Readout	4.7.3.2.6.4	Electrolytic generators shall have a TDS or salt(NaCl)readout and a low salt indicator.	
Feed Rate	4.7.3.2.6.5	The feed rate shall be adjustable from zero (0) to full range.	
Capacity	4.7.3.2.6.6	The generator(s) shall be capable of providing a CHLORINE dosage equivalent to 100% of the total daily facility requirement.	
UL Certified	4.7.3.2.6.7	The generator unit shall be UL listed and third party certified in accordance with UL 1081(for electrical/fire/shock safety).	
Interlock	4.7.3.2.6.8	The generator(s) shall be interlocked per MAHC Section 4.7.3.2.1.4.	
Installed	4.7.3.2.6.9	The generator units shall be installed according to the manufacturer's instructions.	
Saline Content	4.7.3.2.6.9.1	The saline content of the POOL water shall be maintained in the required range specified by the manufacturer.	
Feeders	*4.7.3.2.7*	*Feeders for pH Adjustment*	
Provided	4.7.3.2.7.1	Feeders for pH adjustment shall be provided on all POOLs.	
Approved Substances	4.7.3.2.7.2	Approved substances for pH adjustment shall be muriatic (hydrochloric) acid, sodium bisulfate, carbon dioxide, sulfuric acid, sodium bicarbonate, and soda ash.	
Prohibited	4.7.3.2.7.2.1	Sodium hydroxide use shall be prohibited.	
Positive Displacement	4.7.3.2.7.3	pH adjustment feeders shall be positive displacement type.	
Adjustable	4.7.3.2.7.4	pH adjustment feeders shall be adjustable from zero to full range.	
Marked	4.7.3.2.7.5	Reservoirs shall be clearly marked and labeled with contents.	
Controllers	*4.7.3.2.8*	*Controllers*	

Keyword	Section	Code	Grade
NSF Listed	4.7.3.2.8.1	All chemical controllers for pH and disinfectant MONITORING/control shall be certified to NSF/ANSI 50 by an ANSI-accredited certification organization..	
Operation Manuals	4.7.3.2.8.2	Operation manuals or other instructions that give clear directions for cleaning and calibrating controller probes and sensors shall be provided in the same room as the controller.	
Interlocked	4.7.3.2.8.3	The controllers shall be interlocked per MAHC Section 4.7.3.2.1.4	
Automated	4.7.3.2.10.4	Automated chemical feed control systems shall be used to turn on or off a chemical feeder.	
Set Point	4.7.3.2.10.5	A set point shall be used to target the disinfectant level and the pH level.	
Replenishment and Disposal	**4.7.4**	**Water Replenishment System**	
Pool Wastewater	4.7.4.1	Waste streams generated by POOLS shall be properly discharged in accordance withMAHC section 4.11.6.	
Discharge and Measure	4.7.4.2	A means of intentionally discharging and measuring the volume of both discharged POOL water and filter backwash wastewater (or alternate means of achieving the same result) shall be installed.	
Alternate System	4.7.4.2.1	An alternate system capable of removing an equivalent amount of small organic compounds and salts shall also be acceptable.	
Product Water	4.7.4.2.1.1	If applicable, the return water from the alternate system shall maintain salt and total organic carbon concentrations that are less than or equal to tap water.	
Discharge	4.7.4.2.3	This system shall be designed to discharge (or treat and reuse) pool water at a rate of up to 4 gallons (15 L) per BATHER per day per AQUATIC VENUE.	
Spas	**4.7.5**	**Spas**	
General	***4.7.5.1***	***General***	
Requirements	4.7.5.1.1	Spas shall conform to the design, operation, and maintenance requirement of POOLS except as required below.	
Flow Rates/ Turnover Times	4.7.5.2	***Flow Rates/Turnover Times***	
Maximum Allowable	4.7.5.2.1	All SPA VENUES as defined in the MAHC shall be designed to have	

Keyword	Section	Code	Grade
		a maximum allowable turnover time of 0.5 hour or less: 1)	
Turnover Time Variance	4.7.5.2.2	The AHJ may grant a turnover time variance for AQUATIC VENUES with extreme volume or operating conditions based on proper engineering justification.	
Turnover Times	4.7.5.2.3	Turnover times shall be calculated based solely on the flow rate through the filtration system.	
Filtration Inlets	***4.7.5.3***	***Filtration System Inlets***	
Minimum	4.7.5.3.1	Spas shall have a minimum of two adjustable filter system INLETS spaced at least 3 feet (0.91 m) apart and designed to distribute flow evenly.	
Jet Inlets	***4.7.5.4***	***Jet System Inlets***	
Air flow	4.7.5.4.1	Air flow shall be permitted through the jet system and/or when injected post-filtration.	
Skimmer	4.7.5.4.2	Submerged suction skimmers shall be allowed provided that the manufacturer's recommendations for use are followed.	

Model Aquatic Health Code
Recirculation Systems and Filtration Module Code
5.0 Operation and Maintenance

Keyword	Section	Code	Grade
	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**	
Systems & Equipment	**5.7.1**	**Recirculation Systems and Equipment**	
General	***5.7.1.1***	***General***	
Continuous Operation	5.7.1.1.1	All components of the filtration and RECIRCULATION SYSTEMS shall be kept in continuous operation (twenty-four (24) hours per day).	
Flow	5.7.1.1.2	Flow through the various components of a RECIRCULATION SYSTEM shall be balanced according to the provisions outlined in MAHC Section 5.7.1 to maximize the clarity and safety of a POOL.	
Gutter/ Skimmer Pools	5.7.1.1.3	For gutter or skimmer POOLs with main drains, the required recirculation flow shall be as follows during normal operation: 1) at least 80% of the flow through the perimeter overflow system and 2) no greater than 20% through the main drain.	
Combined Venue Treatment	***5.7.1.2***	***Combined Venue Treatment***	
Each Pool	5.7.1.2.1	Each individual POOL in a combined treatment system shall meet the required turnover times and achieve all water quality criteria (*including, but not limited to, pH, disinfectant concentration, and clarity/turbidity*).	
Inlets	***5.7.1.3***	***Inlets***	
Surface Skimming	***5.7.1.4***	***Surface Skimming Devices***	
Perimeter Overflow	5.7.1.4.1	The perimeter overflow systems shall be kept clean and free of	

Keyword	Section	Code	Grade
		debris that may restrict flow.	
Automatic Fill	5.7.1.4.2	The automatic fill system shall maintain the water level at an elevation such that the gutters must overflow continuously around the perimeter of the POOL.	
Automatic Fill	5.7.1.4.3	The automatic fill system shall maintain skimmer water levels near the middle of the skimmer openings.	
Flow	5.7.1.4.4	The flow through each skimmer shall be adjusted as often as necessary to maintain skimming action that will remove all floating matter from the surface of the water.	
Strainer Baskets	5.7.1.4.5	The strainer baskets for skimmers shall be cleaned as necessary to maintain proper skimming..	
Weirs	5.7.1.4.6	Weirs must remain in place and in working condition at all times.	
Broken or Missing Weirs	5.7.1.4.6.1	Broken or missing skimmer weirs shall be replaced immediately.	
Flotation Test	5.7.1.4.7	A flotation test may be required by the AHJ to evaluate the effectiveness of surface skimming.	
Submerged Drains	***5.7.1.5***	***Submerged Drains/Suction Outlet Covers or Gratings***	
Replaced	5.7.1.5.1	Loose, broken, or missing suction outlet covers and sumps shall be secured or replaced immediately and installed in accordance with the manufacturer's requirements.	
Closed	5.7.1.5.1.1	POOLS shall be closed until the required repairs can be completed.	
Documentation	5.7.1.5.4	The manufacturer’s documentation on all outlet covers and sumps shall be made part of the permanent records of the facility.	
Piping	***5.7.1.6***	***Piping***	
Strainers & Pumps	***5.7.1.7***	***Strainers and Pumps***	
Strainers	5.7.1.7.1	Strainers shall be in place and cleaned as required to maintain pump performance.	
Close/Open Procedures	5.7.1.7.3	Facilities shall follow procedures for closing and re-opening whenever required as outlined in MAHC Section 5.4.1.	

Keyword	Section	Code	Grade
Flow Meters	***5.7.1.8***	***Flow Meters***	
Maintained	5.7.1.8.1	Flow meters shall be maintained in proper working order.	
Flow Rates / Turnovers	***5.7.1.9***	***Flow Rates/Turnovers***	
Operated	5.7.1.9.1	All aquatic venues shall be operated at the designed flow rate to provide the required turnover rate 24-hours per day except as allowed in MAHC Section 4.7.1.10.	
Filtration	**5.7.2**	**Filtration**	
Granular Media Filters	***5.7.2.1***	***Granular Media Filters***	
Filtration Rates	5.7.2.1.1	High-rate granular media filters shall be operated at no more than 15 gpm/ft^2 (29.3 m/h). when a minimum bed depth of 15 inches is provided per manufacturer. When a bed depth is less than 15 inches, filters shall operate at no more than 12 gpm//ft2.	
Backwashing Rates	5.7.2.1.2	The granular media filter system shall be backwashed at a rate of at least 15 gallons per minute per square foot (36.7 m/h) of filter bed surface area, unless explicitly prohibited by the filter manufacturer.	
Clear Water	5.7.2.1.3	Backwashing should be continued until the water leaving the filter is clear.	
Backwashing Frequency	5.7.2.1.4	All filters shall be backwashed at least every 2 weeks.	
Backwashing	5.7.2.1.4.1	Backwashing of each filter shall be performed) at a differential pressure increase over the initial clean filter pressure (*or as recommended by the filter manufacturer*) unless the system can no longer achieve the design flow rate.	
Backwash Scheduling	5.7.2.1.4.2	Backwashes shall be scheduled to take place when the pool is closed for use or unless operators follow the procedure specified in MAHC Section 5.7.2.1.4.2.1.	
Backwashing While Open to Bathers	5.7.2.1.4.2.1	If the filter is backwashed while the AQUATIC FACILITY is open to BATHERS, then one of the following two procedures shall be performed after the normal backwashing procedure is completed and prior to the filter being placed back in normal operation: 1) The filter flow shall be redirected to drain for a period of time sufficient to displace the volume of water inside of the filter or 1 minute per foot of bed depth above the laterals at the required filtration rate, whichever is greater, or	

Keyword	Section	Code	Grade
		2) The backwash flow rate shall be reduced to a rate of no greater than 5 gpm/ft^2 (12.2 m/h) for a period of time sufficient to displace the volume of water inside of the filter.	
Filter Media Inspections	5.7.2.1.5	Sand or other granular media shall be inspected for proper depth and cleanliness at least one time per year.	
Representative Filters	5.7.2.1.5.2	The qualified operator shall inspect sand or other granular media filters for proper depth and cleanliness at least once per year, replacing the media when necessary to restore depth or cleanliness.	
Vacuum Sand Filters	5.7.2.1.6	Vacuum sand filters shall be backwashed prior to a vacuum increase of 10 inches (254 mm) of mercury above the initial reading or as recommended by the manufacturer.	
Air Release Valve	5.7.2.1.6.1	The manual air release valve of the filter shall be opened as necessary to remove any air that collects inside of the filter as well as following each backwash.	
Filtration Enhancing Products	5.7.2.1.7	Products used to enhance filter performance shall be used according to manufacturers' recommendations.	
Precoat Filters	***5.7.2.2***	***Precoat Filters***	
Appropriate	5.7.2.2.1	The appropriate media type and quantity as recommended by the filter manufacturer shall be used.	
Approved	5.7.2.2.1.1	The media shall be NSF/ANSI 50 approved for use in the filter.	
Precoating	5.7.2.2.2	Precoating of the filters shall be required in closed loop (precoat) mode to minimize the potential for media or debris to be returned to the POOL unless filters are NSF/ANSI 50 certified to return water to the pool during the precoat process.	
Operation	5.7.2.2.3	Filter operation shall be per manufacturer and NSF/ANSI 50 requirements.	
Uninterrupted Flow	5.7.2.2.3.1	Flow through the filter shall not be interrupted when switching from precoat mode to filtration mode, which could result based on the order of opening and closing valves unless the filters are NSF/ANSI 50 certified to return water to the pool during the precoat process.	

Keyword	Section	Code	Grade
Flow Interruption	*5.7.2.2.3.1.1*	When a flow interruption occurs on precoat filters not designed to bump, the media must be backwashed out of the filter ansd a new precoat established according to the manufacturer's recommendations.	
Maximum Precoat Media Load	5.7.2.2.3.2	Systems designed to flow to waste while precoating shall use the maximum recommended precoat media load permitted by the filter manufacturer to account for media lost to the waste stream during precoating.	
Cleaning	5.7.2.2.4	The filter shall be cleaned/backwashed per manufacturer's instructions.	
Continuous Feed Equipment	5.7.2.2.5	Continuous filter media feed equipment tank agitators shall run continuously.	
Batch Application	5.7.2.2.5.1	Filter media feed may also be performed via batch application.	
Bumping	5.7.2.2.6	Bumping a precoat filter shall be performed in accordance with the manufacturer's recommendations.	
Filter Media	5.7.2.2.7	Precoat filter media shall meet the filter manufacturer's recommendation for POOL use and shall be certified to NSF/ANSI 50 by an ANSI-accredited certification organization..	
Diatomaceous Earth	5.7.2.2.7.1	Diatomaceous earth (DE), when used, shall be added to precoat filters in the amount of 1 to 2 pounds (0.45 to 0.91 kg) per 10 square feet of filtration surface area unless more is recommended by the filter manufacturer and the filter is NSF/ANSI 50 approved for a higher precoat media dosage rate..	
Perlite	5.7.2.2.7.2	Perlite, when used, shall be added to precoat filters in a minimum amount of 0.5 to 1 pounds (0.23 to 0.45 kg) per 10 ft^2 (0.93 m2) of filtration surface area unless more is recommended by the filter manufacturer and the filter is NSF/ANSI 50 approved for a higher precoat media dosage rate.. .	
Cartridge Filters	***5.7.2.3***	***Cartridge Filters***	

Keyword	Section	Code	Grade
NSF Standards	5.7.2.3.1	Cartridge filters shall be operated in accordance with the filter manufacturer's recommendation and shall be certified to NSF/ANSI 50 by an ANSI-accredited certification organization..	
Filtration Rates	5.7.2.3.2	The maximum operating filtration rate for any surface-type cartridge filter shall not: 1) Exceed the lesser of either the manufacturer's recommended filtration rate or 0.375 gallons per minute per square foot (0.26 L/s/m^2) or 2) drop below the design flow rate required to achieve the turnover rate for the venue.	
Filter Elements	5.7.2.3.3	Active filter cartridges shall be exchanged with clean filter cartridges and fouled cartridges cleaned in accordance with the filter manufacturer's recommendations whenever the filtration rate drops below 0.30 gallons per minute per square foot (0.20 L/s/m^2).	
Cleaning Procedure	5.7.2.3.3.1	When the filter element manufacturer has no established cleaning procedure, the cleaning procedures found in MAHC Section 5.7.2.3.3.2 and 5.7.2.3.3.3 shall be used.	
Filter Housing Cleaning	5.7.2.3.3.2	The following procedures shall be implemented to clean the filter housing: 1) Drain filter housing to waste. 2) Remove the filter cartridges from the housing. 3) Clean the inside of the filter with a brush and mild detergent to remove biofilms and algae 4) Rinse thoroughly. 5) Mist the housing walls with chlorine bleach.	
Cartridge Cleaning	5.7.2.3.3.3	The procedures outlined in this section shall be implemented to clean the filter cartridges when there is no cleaning procedure established by the filter manufacturer.	
Rinse Thoroughly	5.7.2.3.3.3.1	The cartridge shall be rinsed to remove as much dirt and debris as possible by washing inside and out with a garden hose and spray nozzle.	
Pressure Washer	5.7.2.3.3.3.2	A pressure washer shall not be used to backwash cartridge filters.	
Degrease	5.7.2.3.3.3.3	Cartridge filters shall be degreased each time they are cleaned per the procedures outlined in this section.	

Keyword	Section	Code	Grade
Soak	5.7.2.3.3.3.3.1	Soak the cartridge overnight in one of the following solutions: 1) A cartridge filter cleaner/degreaser per instructions on product label, or 2) A solution of water with 1 Cup of tri-sodium phosphate (TSP) per 5 gallons of water, or 3) 1 Cup of automatic dishwashing detergent per 5 gallons of water.	
Acid	5.7.2.3.3.3.3.2	Muriatic acid or products with acid in them shall never be used prior to degreasing.	
Rinse	5.7.2.3.3.3.3.3	The degreased cartridges shall be removed from the degreaser solution and thoroughly rinsed.	
Sanitize	5.7.2.3.3.3.4	To remove or prevent biofilms, algae, and bacteria growing on the cartridge, 1 quart of household bleach shall be added per 5 gallons of clean water and soak one hour before rinsing.	
Rinse	5.7.2.3.3.3.5	The clean cartridge shall be removed from the sanitization soak water and rinsed thoroughly with a hose.	
Dry	5.7.2.3.3.3.6	After the filter is cleaned,degreased, and sanitized , it shall be allowed to dry completely before being reintroduced to the pool.	
Spare Cartridge	5.7.2.3.4	One full set of spare cartridges shall be maintained on site in a clean and dry condition.	
Water Clarity & Visibility	5.7.2.3.5	At all times, the visibility from any location on the DECK to the bottom of the deepest part of the POOL shall be sufficient to distinguish between adjacent 3-inch squares of different colors or the main drain grates.	
Disinfection	**5.7.3**	**Disinfection**	
Chemical Addition	***5.7.3.1***	***Chemical Addition Methods***	
Automatically	5.7.3.1	***Disinfection and pH control chemicals shall be automatically introduced through the recirculation system.***	
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Keyword	Section	Code	Grade
Manual Addition	5.7.3.1.2.	Superchlorination or shock chemicals and other POOL chemicals may be added manually to the POOL.	
Absence of Bathers	5.7.3.1.2.1	Chemicals added manually directly into the AQUATIC VENUE shall only be introduced in the absence of BATHERS.	
Safety Requirements	5.7.3.1.3	Whenever required by the manufacturer, chemicals shall be diluted (or mixed with water) prior to application and as per the manufacturer's directions.	
Added	5.7.3.1.3.1	Chemicals shall be added to water when diluting as opposed to adding water to a concentrated chemical.	
Mixed	5.7.3.1.3.2	Each chemical shall be mixed in separate, labeled container.	
Never Together	5.7.3.1.3.2.1	Two or more chemicals shall never be mixed in the same dilution water.	
Stored	5.7.3.1.3.3	All chemical containers shall be stored in a safe manner so as to prevent cross-mixing of chemicals, exposure to water, and as per relevant building codes.	
Equipment maintenance	5.7.3.1.4	POOL DISINFECTION and pH adjustment feed equipment shall be maintained in good working condition at all times.	
Chemical level maintenance	5.7.3.1.4.1	POOL disinfectant and pH levels shall be maintained within the recommended ranges whenever the POOL is occupied.	
Feed Equipment	***5.7.3.2***	***Feed Equipment***	
General	*5.7.3.2.1*	*General*	
Sizing	*5.7.3.2.2*	*Sizing of Disinfection Equipment*	
Engineering	*5.7.3.2.3*	*Feeder Engineering*	
Introduction	*5.7.3.2.4*	*Introduction of Chemicals*	
Controls	*5.7.3.2.5*	*Feeder Controls*	
Compressed Chlorine Gas	*5.7.3.2.6*	*Compressed Chlorine Gas*	
Safety Requirements	5.7.3.2.6.1	Facilities using compressed chlorine gas shall provide the	

Keyword	Section	Code	Grade
		following:	
Separate Enclosure	5.7.3.2.6.1.1	The chlorinators and any cylinders containing chlorine gas used therewith shall be housed in an enclosure separated from other equipment rooms, including the swimming pool, corridors, dressing rooms and other space with a door so installed as to prevent gas leakage and equipped with an inspection window.	
Secured	5.7.3.2.6.1.1.2	Chlorine cylinders shall be secured from falling.	
Cylinders in Use	5.7.3.2.6.1.1.2.1	Cylinders in use shall be secured on a suitable platform scale.	
Vent to Exterior	5.7.3.2.6.1.1.3	A separate vent opening to the exterior shall be provided.	
Fan	5.7.3.2.6.1.1.4	An electric motor-driven fan shall take suction from near the floor level of the enclosure and discharge at a suitable point to the exterior above the ground level.	
Fan Switch	5.7.3.2.6.1.1.4.1	The fan switch shall be able to be operated from outside of the enclosure.	
Trained Operator	5.7.3.2.6.1.1.5	Any person who operates such chlorinating equipment shall be trained in its use.	
Stop Use	4.7.3.2.6.2	Facilities shall stop the use of CHLORINE gas if specific safety equipment and training requirements, along with local code considerations, cannot be met.	
Types	*5.7.3.2.7*	*Types of Feeders*	
Liquid Solution Feeders	5.7.3.2.7.1	For liquid solution feeders, spare feeder tubes (or tubing) shall be maintained onsite for peristaltic pumps.	
Checked Daily	5.7.3.2.7.1.1	Tubing and connections shall be checked on a daily basis for leaks.	
Routed	5.7.3.2.7.1.2	All chemical tubing shall be routed in PVC piping to support the tubing and to prevent leaks in areas where operating staff walk.	
Size	5.7.3.2.7.1.2.1	The double containment pvc pipe shall be of sufficient size to allow for easy replacement of tubing.	
Turns	5.7.3.2.7.1.2.2	Any necessary turns in the piping shall be designed so as to prevent kinking of the tubing.	
Chemical Feeders	5.7.3.2.7.2	Chemical feeders shall be installed such that they are not over	

Keyword	Section	Code	Grade
		chemical storage containers, other feeders, or electrical equipment.	
Dry Chemical Feeders	5.7.3.2.7.3	Chemicals shall be kept dry to avoid clumping and potential feeder plugging for mechanical gate or rotating screw feeders.	
Cleaned and Lubric ated	5.7.3.2.7.3.1	The feeder mechanism shall be cleaned and lubricated to maintain a reliable feed system.	
Venturi Inlet	5.7.3.2.7.4	Adequate pressure shall be maintained at the venturi INLET to create the vacuum needed to draw the chemical into the RECIRCULATION SYSTEM.	
Erosion Feeders	5.7.3.2.7.5	Erosion feeders shall only have chemicals added that are approved by the manufacturer.	
Opened	5.7.3.2.7.5.1	A feeder shall only be opened after the internal pressure is relieved by a bleed valve.	
Maintained	5.7.3.2.7.5.3	Erosion feeders shall be maintained according the manufacturer's instructions.	
Gas Feed Systems	5.7.3.2.7.6	The Chlorine Institute requirements for safe storage and use of CHLORINE gas shall be followed.	
Carbon Dioxide	5.7.3.2.7.7	Carbon dioxide feed shall be permitted to reduce PH.	
Controlled	5.7.3.2.7.7.1	Carbon dioxide feed shall be controlled using a gas regulator.	
Alarm/Monitor	5.7.3.2.7.7.2	CO2/O2 monitor and alarm shall be maintained in working condition.	
Forced Ventilation	5.7.3.2.7.7.3	Carbon dioxide is heavier than air, so forced ventilation shall be maintained in the storage room.	
Electrolytic Generators	*5.7.3.2.8*	*Salt Electrolytic Chlorine Generators, Brine Electrolytic Chlorine or Bromine Generators*	
Pool Grade Salt	5.7.3.2.8.1	Only pool grade salt shall be used.	
Maintained	5.7.3.2.8.2	Salt levels shall be maintained per the equipment manufacturer.	
Cleaning	5.7.3.2.8.3	Cleaning of electrolytic plates shall be performed as	

Keyword	Section	Code	Grade
		recommended by the manufacturer.	
Corrosion Protection	5.7.3.2.8.4	Corrosion protection systems shall be maintained in the POOL basin.	
Water Replenishment	**5.7.4**	**Water Replenishment**	
Volume	5.7.4.1	Removal of water from the POOL and replacement with make-up water shall be performed as needed to maintain water quality.	
Discharged	5.7.4.2	A volume of water totaling at least to 4 gallons (15 L) per BATHER per day per facility shall be either 1) Discharged from the system, or 2) Treated with an alternate system meeting the requirements of MAHC Section 4.7.4.2.1 and reused.	
Backwash Water	5.7.4.2.1	The required volume of water to be discharged may include backwash water.	
Multi-System Facilities	4.7.4.3	In multi-recirculation system facilities, WATER REPLENISHMENT shall be proportional to the number of BATHERS in each system.	
Spas	**5.7.5**	**Spas**	
Required Operation Time	5.7.5.1	SPA filtration systems shall be operated 24 hours per day except for periods of draining, filling, and maintenance.	
Drainage	5.7.5.2	SPAS shall be drained, cleaned, and water replaced when needed to maintain water quality, but at least once every week.	
Water Replacement	5.7.5.2.1	Water shall be replaced at the required interval as outlined in MAHC Section 5.7.5..2 or as calculated as follows, whichever interval is shorter:	
Calculated	5.7.5.2.1.1	The water replacement interval (in days) shall be calculated by dividing the SPA volume (in gallons) by 3 and then dividing by the average number of users per day.	
Scrubbed	5.7.5.2.2	SPA surfaces, including interior of skimmers, shall be scrubbed or wiped down, and all water drained prior to refilling at an interval not to exceed the water replacement interval.	