Model Aquatic Health Code

Draft Facility Design and Construction Module ANNEX Section Modified After the First 60-day Review that Closed on 10/14/2012

Informational Copy: NOT Currently Open for Public Comment

This version of the MAHC Facility Design and Construction 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 Facility Design and Construction Module Abstract

The sound design and construction of swimming pools, spas, and aquatic venues are paramount to ensuring health and safety of patrons who use these facilities. The Facility Design & Construction Module contains requirements for new pool construction that includes:

1) Design/construction aspects of the pool shell that include general shape, design, and slope requirements to prevent injury;

2) Design/construction aspects of the aquatic venue that include decks, lighting, electrical, wastewater, and fencing;

3) Design/construction aspects of specialty bodies of water and features that include spas, wave pools, slide pools, wading pools, and infinity edges; and

4) Design/construction parameters for pool equipment and under what conditions its use is acceptable including starting blocks, moveable floors, bulkheads, and diving boards.

The Facility Design and Construction CODE Module provides a Table of Contents giving the context of the Facility Design and Construction 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/ma strawman.pdf).

Note on the MAHC Annex

Rationale

The annex is provided to:

(a) Give explanations, data, and references to support why specific recommendations are made;
(b) Discuss the rationale for making the code content decisions;
(c) Provide a discussion of the scientific basis for selecting certain criteria, as well as discuss why other scientific data may not have been selected, e.g. due to data inconsistencies;
(d) State areas where additional research may be needed;
(e) Discuss and explain terminology used; and
(f) Provide additional material that may not have been appropriately placed in the main body of the model code language. This could include summaries of scientific studies, charts, graphs, or other illustrative materials.

Content

The annexes accompanying the code sections are intended to provide support and assistance to those charged with applying and using Model Aquatic Health Code provisions. No reference is made in the text of a code provision to the annexes which support its requirements. This is necessary in order to keep future laws or other requirements based on the Model Aquatic Health Code straightforward. However, the annexes are provided specifically to assist users in understanding and applying the provisions uniformly and effectively. They are not intended to be exhaustive reviews of the scientific or other literature but should contain enough information and references to guide the reader to more extensive information and review.

It is, therefore, important for reviewers and users to preview the subject and essence of each of the annexes before using the document. Some of the annexes (e.g., References, Public Health Rationale) are structured to present the information in a column format similar to the code section to which they apply. Other annexes or appendices provide information and materials intended to be helpful to the user such as model forms that can be used, recreational water illness outbreak response guidelines, and guidelines for facility inspection.

Appendices

Additional information that falls outside the flow of the annex may be included in the Model Aquatic Health Code Annex

Acronyms and Initialisms in this Module:

See the Facility Design and Construction Module, Code Section

Glossary Terms in this Module:

See the Facility Design and Construction Module, Code Section

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
Facility Design and Construction Module Annex
4.0 Design and Construction

Keyword	Section	Annex
Design and Construction	**4.0**	**Design Standards and Construction**
Plan Submittal	**4.1**	**Plan Submittal**
Materials	**4.2**	**Materials**
Pools	**4.2.1**	**Pools**
Darker Colors	4.2.1.2.1	Darker colors or designs such as rock formations may be allowed by the AHJ.
Design Parameters	4.2.1.2.3	There are multiple forms of acceptable finishes available including but not limited to: paint, marcite plaster finish, quartz plaster finish, aggregate plaster finish, vinyl or PVC liner / paneling systems, stainless steel, tile, etc. Each system shall have advantages and disadvantages associated with cost, durability, clean-ability, etc. These advantages and disadvantages are also subject to installation design issues (e.g. indoors/outdoors, above/below water level, environmental effects, freezing or temperature exposures, etc.).
Smooth Finish	4.2.1.4	Skimmer pools require a 6” (150 mm) to 12” (300 mm) high finish due to the varying height of water associated with in pool surge capacity of skimmer pool systems. Gutter or perimeter overflow systems require a minimum finish height of 2” (50 mm). If dark colors are utilized for the pool finish, the pool finish should not exceed a maximum height of 12” (300 mm) for contrasting purposes. Typical finishes include: tile, stainless steel, vinyl, fiberglass, etc.
Slip Resistant	4.2.1.5	Water 3 feet (0.9 m) and less is considered shallow water and the majority of patrons are capable of walking on the pool bottom at these depths, so a slip-resistant surface is required. At depths greater than 3 feet (0.9 m), most patrons are sufficiently buoyant making the coefficient of friction for the pool floor surface less important. Slip resistant surfaces shall meet or exceed the minimum coefficient of friction (typically 0.8 for ramped surfaces and 0.6 for other wet surfaces) as set forth by the following groups:

Keyword	Section	Annex
		• Americans with Disabilities Act (ADA) • Occupational Safety and Health Administration (OSHA)
Natatorium	**4.2.2**	**Natatorium**
Interior Finish	***4.2.2.1***	***Interior Finish***
Condensation Prevention	***4.2.2.2***	***Condensation Prevention***
		Special care should be used in the construction of air-pressure-supported buildings to prevent the movement of moisture into building surfaces, conduits, etc.
Cold Weather	4.2.2.2.1	Paints suitable for use as vapor retarders usually have high solids, and must be carefully applied to achieve a rating of 0.4 perm for one coat. It is important to get very good coverage without gaps or thin spots. The paint supplier or manufacturer should be consulted for ratings and best practices.
Paint or Coating	4.2.2.2.2	One U.S. perm equals 1.0 grain of moisture per square foot per hour per inch-of-mercury differential pressure. One U.S. perm equals 57 SI perm.
Mechanical Systems	***4.2.2.3***	***Mechanical Systems***
Natatorium Air Pressure	4.2.2.3.3	Air-pressure-supported natatoriums may require pressurization of adjoining or connected spaces.
Natatorium Doors	***4.2.2.4***	***Natatorium Doors***
Door Freezing		Where exterior doors of a natatorium may be exposed to temperatures below the freezing temperature of water, the frames should be constructed to minimize the risk of the door freezing closed. Exception 1: Other doors should be acceptable, subject to approval by the AHJ, where heating systems are so arranged as to maintain such doors at least 5°F (2.8°C) above the freezing temperature of water. The issue here is one of emergency exit. There is a large amount of water vapor available to freeze into the gap between doors, etc.

Keyword	Section	Annex
Natatorium Windows	***4.2.2.5***	***Natatorium Windows***

Windows are usually maintained above natatorium-air dew point to prevent condensation and mold growth by heated supply air flowing over them. Heavy window frames on the interior side interfere with the proper flow of this heated air by the Coanda effect (a corollary of Bernoulli's principle). There are many ways to mechanically address window condensation issues. Air supply can be dumped on glazing from both above and below. Fin tube heaters have also been effectively employed along sills in many instances.

- See ASHRAE Handbook of Fundamentals[1]

Natatorium Electrical — ***4.2.2.6*** — ***Natatorium Electrical Systems***

Equipment Standards — **4.3** — **Equipment Standards**

General — **4.3.1** — **General**

Accredited Testing Facility — 4.3.1.1

Acceptable standards for common recirculation system components are listed below:

- Inlets – NSF/ANSI
- Overflow System/Gutters – NSF/ANSI
- Skimmers – NSF/ANSI
- Valves – NSF/ANSI
- Piping and Face Piping – NSF/ANSI
- Fittings – NSF/ANSI
- Strainers – NSF/ANSI
- Gauges – NSF/ANSI
- Flow Meters – NSF/ANSI
- Solar Pool Heaters – NSF/ANSI
- Rapid Sand Filters – NSF/ANSI
- High-Rate Sand Filters – NSF/ANSI
- Pre-Coat Filters – NSF/ANSI
- Filter Media – NSF/ANSI
- Cartridge Filters – NSF/ANSI
- Bottom Drains/Main Drain System – ASME
- Pumps – NSF/ANSI, UL, California Assembly Bill,

[1] ASHRAE. 2013 ASHRAE Handbook—Fundamentals. Accessed 12/11/13 from https://www.ashrae.org/resources--publications/handbook/description-of-the-2013-ashrae-handbook--fundamentals

Keyword | Section | Annex

NEC
- Heaters, HVAC, and Dehumidifiers – UL
- Combustion/Furnaces – ANSI, CSA 2.6-2006 Ga, UL
- Boilers – ASME, ANSI, CSA
- Gas-fired Pool Heaters – ANSI, CSA
- Flues – UL
- Mechanical Chemical Feeding Equipment – NSF/ANSI, UL, CSA
- Ozone – NSF/ANSI, UL, CSA, NEC
- Ultraviolet Light – NSF/ANSI, UL, CSA, NEC
- In-line and Brine Batch Electrolytic Chlorinator or Bromine Generator – NSF/ANSI, UL, CSA, NEC, Canadian PMRA
- Copper/Silver and Copper Ion Generators – NSF/ANSI, UL, CSA, NEC, Canadian PMRA
- Chemical Storage – National Fire Code
- Automated Controllers – NSF/ANSI, UL, CSA, NEC
- Water Quality Testing Device – NSF/ANSI
- Electrical – NEC
- Lights – UL
- Diving Boards and Platforms – NSF/ANSI
- Starting Blocks – ANSI/NSPI, FINA, NFSHSA, NCAA
- Lifeguard Chairs – NASI/NSPI
- Ladders – ANSI/NSPI
- Handrail – ANSI/NSPI
- Stairs – ANSI/NSPI
- Handicapped Lifts – Americans with Disabilities Act
- Safety Covers – ANSI/NSPI, ASTM, UL

Recirculation Systems

4.3.2 Recirculation Systems and Equipment

Inlets

At the release date of this current version of the Model Aquatic Health Code, inlet products are currently listed by NSF to an engineering specification. Language is ready for ballot into NSF/ ANSI Standard 50.

Overflow System / Gutters

At the release date of this current version of the Model Aquatic Health Code, overflow system gutters products are currently listed by NSF to an engineering specification. Language is ready for ballot into NSF/ ANSI Standard 50.

Skimmers

At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the

Keyword	Section	Annex
		current version of the applicable standard for skimmers.
Main Drain System		At the release date of this version of the Model Aquatic Health Code, American National Standards Institute /Association of Pool and Spa Professionals (ANSI/APSP) Standard 16 – 2011, titled "American National Standard for Suction Fittings for Use in Swimming Pools, Wading Pools, Spas and Hot Tubs" is the current version of the applicable standard for main drain systems.
Multiport Valves		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for multiport valves.
Face piping		At the release date of this current version of the Model Aquatic Health Code, face piping products are currently listed by NSF to an engineering specification. Currently at the Task Group Level for development of language for inclusion into NSF/ ANSI Standard 50.
Diaphragm Valves		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 14 – 2008e is the current version of the applicable standard for diaphragm valves. Product is currently at the Task Group Level for development of language for inclusion into NSF/ ANSI.
Check Valves		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 14 – 2008e is the current version of the applicable standard for check valves. Product is currently at the Task Group Level for development of language for inclusion into NSF/ ANSI Standard 50 as well.
Fittings		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 14 – 2008e is the current version of the applicable standard for fittings. Product is currently at the Task Group Level for development of language for inclusion into NSF/ ANSI Standard 50 as well.
Pipe		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 14 – 2008e is the current version of the applicable standard for pipe. Product is currently at the Task Group Level for

Keyword	Section	Annex
		development of language for inclusion into NSF/ ANSI Standard 50 as well.
Pumps		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 1081 (non-metallic pumps up to 5 Hp), California Assembly Bill 1953 and United States National Electrical Code NFPA- 70 (2008) are the current version of the applicable standards for pumps.
Strainers		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for strainers.
Gauges		At the release date of this current version of the Model Aquatic Health Code, gauges are currently listed by NSF to an engineering specification. Currently at the Task Group Level for development of language for inclusion into NSF/ ANSI Standard 50.
Flow Meters		At the release date of this current version of the Model Aquatic Health Code, flow meters are currently listed by NSF to an engineering specification. Currently at the Task Group Level for development of language for inclusion into NSF/ ANSI Standard 50.
Heaters	***4.3.2, cont.***	***Heaters***
HVAC and Dehumidifiers		At the release date of this current version of the Model Aquatic Health Code, UL 1995 is the current version of the applicable standard for HVAC and dehumidifiers.
Solar Pool Heaters		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for solar pool heaters.
Furnaces		At the release date of this current version of the Model Aquatic Health Code, ANSI Z83.8-2006 Gas Heaters and Gas-Fired Duct Furnaces, CSA 2.6 -2006 Gas Heaters and Gas-Fired Duct Furnaces and UL 757 Oil-Fired Furnaces are the current version of the applicable standards for furnaces.
Boilers		At the release date of this current version of the Model Aquatic Health Code, ASME Boiler Code, ANSI Z21.13 –

Keyword	Section	Annex
		CSA 4.9 Gas Fired Hot Water Boilers are the current version of the applicable standards for boilers.
Gas-Fired Pool Heaters		At the release date of this current version of the Model Aquatic Health Code, ANSI Z21.10.3 CSA 4.3 and ANSI Z21.56/ CSA 4.7 is the current version of the applicable standards for gas-fired pool heaters. Currently under review for inclusion into NSF/ ANSI Standard 50.
Flues		At the release date of this current version of the Model Aquatic Health Code, UL 1777 is the current version of the applicable standard for flues.
Filtration	***4.3.2, cont.***	***Filtration***
Rapid Sand Filters		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for rapid sand filters.
High-Rate Sand Filters		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for high-rate sand filters
Precoat Filters		Filters previously known as diatomaceous earth filters changed to precoat filters based on significant use of alternate filter media such as perlite. At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for precoat filters.
Filter Media		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for filter media.
Cartridge Filters		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for cartridge filters.
Other Filter Types		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for other filter types.

Keyword	Section	Annex
Disinfection Equipment	***4.3.2, cont.***	***Disinfection Equipment***
Mechanical Chemical Feeding Equipment		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 – 2010 and UL 1081, CSA C22 are the current versions of the applicable standards for mechanical chemical feeding equipment.
Ozone		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 1081, CSA C22 and United States National Electrical Code NFPA- 70 (2008) are the current versions of the applicable standards for ozone generators.
Ultraviolet Light		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 – 2010, NSF/ ANSI Standard 50 – 2010 Annex H, NSF/ ANSI Standard 50 – 2010 Annex H Section 13.11 optional testing for Cryptosporidium validation, CSA C22 and United States National Electrical Code NFPA- 70 (2008) are the current versions of the applicable standards for ultraviolet light systems. Other Potential guidance can be found in the USEPA UV Design Guidance: http://www.epa.gov/safewater/disinfection/lt2/pdfs/guide_lt2_uvguidance.pdf.
In-line Electrolytic Chlorinator		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 1081, CSA C22, United States National Electrical Code NFPA- 70 (2008) and Canadian PMRA are the current versions of the applicable standards for in-line electrolytic chlorinators.
Brine Batch Electrolytic Chlorine or Bromine Generator		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 1081, CSA C22, United States National Electrical Code NFPA- 70 (2008) and Canadian PMRA are the current versions of the applicable standards for brine batch electrolytic chlorine or bromine generators.
Copper/Silver and Copper Ion Generator		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 1081, CSA C22, United States National Electrical Code NFPA- 70 (2008) and Canadian PMRA are the current

Keyword	Section	Annex
		versions of the applicable standards for copper/ silver and copper ion generators.
Chemical Storage		At the release date of this current version of the Model Aquatic Health Code, United States National Fire Code NFPA- 1 (2009) is the current version of the applicable standard for chemical storage.
Automated Controllers		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 - 2010, UL 61010-1, CSA C22.2, and United States National Electrical Code NFPA- 70 (2008) are the current versions of the applicable standards for automated controllers.
Water Quality Testing Device		At the release date of this current version of the Model Aquatic Health Code, NSF/ ANSI Standard 50 2010 is the current version of the applicable standard for water quality testing devices.
Electrical	***4.3.2, cont.***	***Electrical***
National Electrical Code		At the release date of this current version of the Model Aquatic Health Code, United States National Electrical Code NFPA- 70 (2008) is the current version of the applicable standard for general electrical.
Lights		At the release date of this current version of the Model Aquatic Health Code, UL 1241 – Junction Boxes for Swimming Pool Luminaires, UL 676- Underwater Luminaires and Submersible Junction Boxes, UL8750- Light Emitting Diode (LED) Equipment for Use in Lighting Products, and UL379- Transformers for Fountain, Swimming Pool, and Spa Luminaires are the current versions of the applicable standards for lights.
Deck Equipment	***4.3.2, cont.***	***Deck Equipment***
Diving Boards and Platforms		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003 is the current version of the applicable standard for diving boards and platforms.
Starting Blocks		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003, FINA, NFSHSA, and NCAA are the current version of the applicable standards for starting blocks.

Keyword	Section	Annex
Life Guard Chairs		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003 is the current version of the applicable standard for life guard chairs.
Ladders		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003 is the current version of the applicable standard for ladders.
Handrail		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003 is the current version of the applicable standard for handrail.
Stairs		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003 is the current version of the applicable standard for stairs.
Handicapped Lifts		At the release date of this current version of the Model Aquatic Health Code, the AMERICANS WITH DISABILITIES ACT is the applicable standard for handicapped lifts and is regulated by the Department of Justice.
Safety Covers		At the release date of this current version of the Model Aquatic Health Code, ANSI/ NSPI- 1 2003, ASTM 1346, and UL2452 are the current version of the applicable standards for safety covers.
	4.4	**Pool Operation and Facility Maintenance [N/A]**
Pool Structure	**4.5**	**Pool Structure**
Shape	**4.5.1**	**Shape**
Bottom Slope	**4.5.2**	**Bottom Slope**
Parameters and Variance	4.5.2.1	Special uses include therapy pools, scuba diving pools, special training pools and other uses that require depth variances without compromising public safety and health.
Under 5 feet	4.5.2.2	A maximum slope of 1:12 is used in water under 3 feet (91.4cm) for consistency with ADA since these ramps can be used for access. Variances may be considered by the AHJ.

Keyword	Section	Annex
Drain	4.5.2.4	Pools should be designed to allow for the water to drain to a low point in order to prevent standing water from creating a contamination issue.
Structural Stability	**4.5.3**	**Structural Stability**
		Expansion and/or construction joints should be utilized when determined prudent by a licensed structural engineer. Any joints should utilize waterproofing strategies such as water stops as they are subject to compromising a pool's integrity regarding water tightness. The condition of all joints should be inspected regularly to ensure their condition.
Access / Egress	**4.5.4**	**Pool Access/Egress**
Accessibility	4.5.4.1	As required by the Department of Justice, all pool designs shall be compliant with the Americans with Disabilities Act (ADA). The pool design shall not create safety hazards with regards to maintaining necessary clearances, not infringing upon the recirculation of pool water, or creating areas for potential entrapment.
Stairs	**4.5.5**	**Stairs**
Deep Water	4.5.5.3	It is common, especially in high-end diving wells with 10-meter towers, for there to be "swim-out" stairs underneath the dive tower. This provision is allowing for those types of deep water stairs without requiring the stairs to continue down to the bottom of the pool (which may be 17 feet deep and impractical in the diving well example).
Handrails	**4.5.6**	**Handrails**
ADA Accessibility	4.5.6.5	The outside diameter that the handrail configuration and dimensions need to conform to the pool access requirements outlined in ADA are not associated with ADA requirements, but these parameters are intended to address the necessary structural requirements which is not addressed in ADA. In the end, ADA standards will always take precedence over anything MAHC says. Another source for guidance is the Architectural Barrier's Guide – refer to Swimming Pools, Wading Pools, and Spas section number 242 and 1009.

Keyword	Section	Annex
Grab Rails	**4.5.7**	**Grab Rails**
Recessed Steps	**4.5.8**	**Recessed Steps**
Ladders	**4.5.9**	**Ladders**
General	***4.5.9.1***	***General Guidelines for Ladders***
Hand rails	***4.5.9.2***	***Ladder Hand Rails***
ADA Accessibility		Similar response to the handrail and grab rail comments in MAHC Annex section 4.5.6.5. The MAHC Committee is not intending to only pick certain aspects of ADA to enforce; they agree that all components of the current ADA requirements will stand irrespective to the MAHC language. However, ADA does not address structural requirements.
Pool Wall	4.5.9.2.4	This is a design criterion for pools in some of the western states. The initial intent was to design against entrapment between the railing and the pool wall -- both for fingers and also the hands/wrists/arms of smaller children. CPSC recommends 4 inches based on child anthropometry tables.
Concentrated Load	4.5.9.2.7	The structural requirements in the ladder, handrail, railing section are taken from commercial manufacturers and their recommended data.
Ladder Treads	***4.5.9.3***	***Ladder Treads***
Zero Depth Entries	**4.5.10**	**Zero Depth (Sloped) Entries**
Disabled Access	**4.5.11**	**Disabled Access**
Conform to Guidelines	4.5.11.1	Please refer to the governing justice department. (www.access-board.gov).
Color and Finish	**4.5.12**	**Color and Finish**
White or Light Pastel	4.5.12.1	Pool floors and walls should be white or light pastel in color such that the following items can be identified from the pool deck: • Person or body submerged in the water • Algae growth • Debris or dirt within the pool

Keyword	Section	Annex
		• Cracks in surface finish of the pool The term "light pastel color" should be consistent with Munsell color value 6.5 or higher. School, facility or team logos incorporated on the pool finishes are acceptable but will require review by the AHJ to ensure the design of such logos do not impede the color and finish functionality listed above. Ultimately, water clarity is the primary criteria with which to be concerned. If a pool has crystal clear water conditions and a bather is lying on the floor of a pool with a blue finish versus one with a white finish, it's logical to think that the bather would be more identifiable against the darker finish. However, there's also the argument for recognizing dirt and debris at the bottom of the pool.
Munsell Color Value	4.5.12.1.1	The State of Wisconsin uses the Munsell color chart and requires values of 6.5 or greater. The Munsell color system looks at color purity, hue, and lightness to assign a value. This system is used in other industries and information on this system is easily available. A contractor could provide a mock-up during the submittal process to the DOH or engineer for review and approval. Plaster and other quartz aggregate manufacturers have reflectance testing that is available for finish samples. The American Plasterer's Council defers to ASTM standard E 1477 – 98a title "Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating Sphere Reflectometers" to determine LRV values. It's a fairly simple test method where "Test specimens are measured for (total) luminous reflectance factor by standard color-measurement techniques using a spectrophotometer, tristimulus (filter) colorimeter, or other reflectometer having a hemispherical optical measuring system, such as an integrating sphere. The specular component is included to provide the total reflectance factor condition. The instrument standard is referenced to the perfect reflecting diffuser. Luminous reflectance factor is calculated as CIE tristimulus value Y for the CIE 1964 (10°) standard observer and CIE standard illuminant D 65 (daylight) or F 2 (cool white fluorescent).

Keyword	Section	Annex
Pool Walls	**4.5.13**	**Pool Walls**
Hand Holds	**4.5.14**	**Hand Holds**
Infinity Edges	**4.5.15**	**Infinity Edges**
Perimeter Restrictions	4.5.15.1	Often with infinity edge pools, the space immediately on the other side of the infinity edge is an inaccessible area because the deck needs to end in order to achieve the “infinity” effect—typically this is achieved by an elevation difference—the deck continues to extend around the pool perimeter, but below the edge. The MAHC technical committee goal was to allow these types of design features while ensuring that these areas of the pool are still readily accessible for emergency response.
Handholds	4.5.15.3	Infinity edges can be accomplished with an obtuse angle or knife edge, or even a C701 handhold. It is typically submerged a fraction of an inch.
Maximum Height	4.5.15.6	Building codes typically require a railing for heights greater than 30” for safety purposes.
Underwater Benches	**4.5.16**	**Underwater Benches**
		Underwater benches are intended to allow bathers to sit in locations along the pool wall. These chair/bench-like structures either protrude into the pool from the pool wall or are recessed into the pool wall. To accommodate the size of most people, the seat itself is often 16” (400 mm) to 18” (450 mm) wide and is located 12” (300 mm) to 24” (0.6 m) below the water line.
Slip Resistant	4.5.16.1	Slip resistant surfaces shall meet or exceed the minimum coefficient of friction as set forth by the following groups: • Americans with Disabilities Act (ADA) • Occupational Safety and Health Administration (OSHA)
Underwater Ledges	**4.5.17**	**Underwater Ledges**
Slip Resistant	4.5.17.1	An underwater toe ledge for resting (“tired swimmer’s ledge”) may be appropriate in any pool with water depths greater than 5 feet (1.5 m). They may be provided at the deep end of a competition pool or other pool with swim

Keyword	Section	Annex
		lanes. A ledge for resting may also be provided along the sidewalls of the same pools to allow resting for swimmers using the pool for recreational swimming. A ledge for resting should not allow a person to use the ledge to cross from a shallow area into a deeper area of a pool. A distance of at least 10 feet (3.0 m) is recommended between the drop-off into the deep area and the start of the ledge.
Structural Support	4.5.17.4	Underwater ledges for structural support for an upper wall (structural ledge) are often located at a water depth of about 3 feet (0.9 m) depending on the wall manufacturer. The upper wall is a product manufactured of stainless steel, fiberglass, acrylic, or other materials. The support ledge and wall below the ledge is concrete, gunite, or other materials that the wall manufacturer specifies. Although pools using this wall structure are generally smaller pools, these pools can be any depth.
Underwater Shelves	**4.5.18**	**Underwater Shelves**
		Underwater shelves can be areas such as an expanded top tread of a stairway or a separate area many feet wide and long. The main purpose is often for small children, lounging in very shallow water or in chairs, or contoured as couches.
Depth Markings	**4.5.19**	**Depth Markings**
Location	***4.5.19.1***	***Location***
Pool wall Markings	4.5.19.1.2	Vertical depth markings should be provided just below the handhold for pools with deck level gutters. They could also be considered on the wall of the natatorium if within a reasonable distance from the pool. For deck level gutter pools, vertical depth markings are more visible just below the water level when compared to locating them on a building wall or fence which may be 10 feet (3 m) to 50 feet (15.2 m) away and obstructed by deck equipment, pool appurtenances, etc.
Construction/ Size	***4.5.19.2***	***Construction / Size***
Tolerance	***4.5.19.3***	***Tolerance***
No Diving Markers	***4.5.19.4***	***No Diving Markers***

Keyword	Section	Annex
Depths	4.5.19.4.1	The intent of this section is to prohibit recreational and/or unsupervised users from performing deck level diving into water 5 ft. or shallower. It is not intended to apply to competitive divers competing under the auspices of an aquatics governing body (e.g., Federation Internationale de Natation (FINA), U.S.A. Swimming, National Collegiate Athletic Association (NCAA), National Federation of State High Schools Associations (NFSHSA), YMCA) or under the supervision of a coach or instructor. The vast majority of current standards allow for diving off the side of the pool in water 5 feet (1.5 m) deep. Water depths of at least 5 feet (1.5 m) are generally considered as safe for diving from the edge of a pool where the coping/deck is the typical 6 inches (150 mm) above the water surface.
Spinal Cord Injury Data		The American Red Cross recommends 9 feet (2.74 m) of water depth based on analyses of spinal cord injuries[2]. The organization has clarified this recommendation to state “Be sure water is at least nine-feet deep unless performed with proper supervision and in water depths that conform with the rules of the concerned regulating body, such as USA Swimming, the National Collegiate Athletic Association (NCAA), the Amateur Athletic Union (AAU), the National Federation of State High School Associations (NFHS), YMCA of the USA and the international swimming federation (FINA).”
		Although there are some national data on spinal cord injuries (SCIs) in general, data on diving-specific SCIs are limited, particularly for SCIs involving public pool-related competition diving.
		<u>General data on spinal cord injuries:</u> For SCIs in general, approximately 40 SCIs/million population occur each year in the US (about 12,400 injuries for 2010) with approximately 4.5% related to diving injuries[3]. SCIs are a catastrophic public health problem leading to disability and decreased life expectancy1 with a large economic and

[2] Cusimano MD, et al. Spinal cord injuries due to diving: a framework and call for prevention. J Trauma. 2008;65(5):1180-5.
[3] DeVivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. Spinal Cord. 2012 May;50(5):365-72.

social burden for those that suffer the injury[4,5].

Deck level diving and swimming pool-related SCIs: Most SCIs are related to diving into open water (lakes, ocean)[6] or use of private/residential pools. Analysis of the National Spinal Cord Injury Statistical Center database shows that 341 enrollees from 1973-1986 had an SCI as a result of diving into swimming pools[7]. Almost all of the injuries (87%) resulted from diving into private residential pools and 57% of injuries were a result of diving into water less than 4 feet with almost four out of five dives (76.8%) being deck level dives. Almost half (49%) of injuries involved alcohol use and 46% occurred during parties. In a summary of 194 neck injuries from deck level dives into in-ground pools (33% private residential)[8], 86.6% where in water less than or equal to 4 ft; 99.0% were in water less than or equal to 5 feet (1.5 m). Only 1 injury occurred in water between 6 and 7 feet. Another global review study showed that 89% of diving-associated neck injuries occurred in water less than 5 feet[3]. These data support keeping non-competition deck level diving to water depths greater than 5 feet.

An example of a “No Diving” Marker:

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[4] Blanksby BA, et al. Aetiology and occurrence of diving injuries. A review of diving safety. Sports Med. 1997;23(4):228-46.
[5] Borius PY, Gouader I, Bousquet P, Draper L, Roux FE. Cervical spine injuries resulting from diving accidents in swimming pools: outcome of 34 patients. Eur Spine J. 2010 Apr;19(4):552-7.
[6] Barss P, et al. Risk factors and prevention for spinal cord injury from diving in swimming pools and natural sites in Quebec, Canada: a 44-year study. Accid Anal Prev. 2008;40(2):787-97.
[7] DeVivo MJ, Sekar P. Prevention of spinal cord injuries that occur in swimming pools. Spinal Cord. 1997;35(8):509-15.
[8] Gabrielsen MA, Spivey M. Diving injuries: The etiology of 486 case studies with recommendations for needed action. 1990. Nova University Press, Ft. Lauderdale, FL.

Keyword	Section	Annex
"No Diving" Marker		
Slope Break	***4.5.19.5***	***Depth Marking at Break in Floor Slope***
Over 5 Feet	4.5.19.5.1	A contrasting band is required at the slope transition between shallow water and deep water as an additional means of caution (along with the safety rope and warning signage) to bathers.
Indoor / Outdoor Environment	**4.6**	**Indoor/Outdoor Environment**
Lighting	**4.6.1**	**Lighting**
General	***4.6.11***	***General Requirements***
Windows / Natural Light	***4.6.1.2***	***Windows/Natural Light***
Natural Lighting Methods	4.6.1.2.1	This would most likely be achieved through the use of photo sensors that would be triggered by a pre-established minimum light level. Manual controls would almost certainly be set based on time of day. As the amount of daylight fluctuates throughout the year, these would need to be adjusted.

Keyword	Section	Annex
Light Levels	***4.6.1.3***	***Light Levels***
Minimum Levels	4.6.1.3.1	The minimum light levels are as recommended in the Illuminating Engineering Society of North America (IESNA) RP-6-88, "Recommended Practice for Sports and Recreational Area Lighting" for the recreational class of use. Higher light levels are recommended for various competitive classes of use. There is a difference between indoor and outdoor settings because outdoor settings usually have a higher contrast with darkness that does not occur indoors.
Underwater Lighting	***4.6.1.4***	***Underwater Lighting***
Minimum Requirement	4.6.1.4.1	A common practice has been to express underwater lighting requirements in watts per square foot of pool surface. Light output efficacy (lumens per watt) can vary greatly depending on the light source. Incandescent lighting, the most historically prevalent underwater light source, also has the lowest or worst efficacy. Some of the most common incandescent lamps are listed below, along with their initial lumen output and calculated efficacy:

Lamp	Initial Lumens	Efficacy (Lumens/Watt)
200 Watt PAR 46	2270	11.35
200 Watt PAR 56	2270	11.35
300 Watt PAR 56	3840	12.80
500 Watt PAR 64	6500	13.00

For the purposes of these requirements, the underwater lighting requirements have been converted from incandescent watt equivalents to initial lamp lumens using a conversion factor of 12.0 lumens per watt. The converted watts per square foot of pool surface requirements are 0.5 watts [outdoor], 1.5watts [indoor], 1.5 watts [outdoor-diving], 2.5 watts [indoor-diving].

It is recommended that future studies be conducted to determine minimum lighting requirements based on water depth, hours of operation, and overhead lighting design. The main goal is to be able to see the bottom of the pool, in particular a person on the bottom, at all times when the pool is open to the public.

Keyword	Section	Annex
No Underwater Lighting	***4.6.1.5***	***Night Swimming with No Underwater Lights***
Minimum Requirements	4.6.1.5.1	Providing higher lighting levels (15 footcandles) than the minimum requirements (10 footcandles) of MAHC Section 4.6.1.3.1 eliminates the requirement for underwater lighting in outdoor pools.
Emergency Lighting	***4.6.1.6***	***Emergency Lighting***
Emergency Egress Lighting	4.6.1.6.1	This section isn't intended to provide less stringent requirements, just a baseline standard of design for locales that may not address this requirement. According to several MAHC committee members, 0.5 FC is a fairly standard industry design standard.
Glare	***4.6.1.7***	***Glare***
Windows	4.6.1.7.1	Windows and any other features providing natural light into the pool space and overhead pool lighting should be arranged to avoid glare on the pool surface that would prevent identification of objects on the pool bottom. Careful consideration should be given to the placement of windows and skylights about the pool. Natural light from directly overhead is less likely to create glare than light through windows at the sides and ends of the pool. Control of glare from artificial light is more likely if the angle of incidence of the main light beam is less than 50 degrees from straight down. Diffuse or indirect light sources may also help to minimize glare. The MAHC technical committees had a very difficult time coming to a consensus on code regulations that could be defended and enforced from a regulatory standpoint regarding glare. How does a plan reviewer determine that glare based on design documents are excessive (perhaps only in certain months of the year)? The TC felt that design recommendations would be best to address this issue in the annex as things currently stand.
Electrical Systems and Components	**4.6.2**	**Electrical Systems and Components**
		Nothing in this code should be construed as providing relief from any applicable requirements of the NEC or other

Keyword	Section	Annex
		applicable code, except where modified by this MAHC.
General	***4.6.2.1***	***General Guidelines***
Wiring		Wiring located near or associated with equipment for bodies of water should be installed in compliance with the NEC or with other applicable code, except where this MAHC is more restrictive. • See NEC Art. 100 “Location, Wet”. • See NEC Art. 110.11 “Deteriorating Agents”.
Sealed Conduit		Electrical conduit that enters or passes through a natatorium should be sealed at the point of entry into the natatorium against the movement of liquids and vapors through the conduit. Exceptions may include: 1) A conduit which only passes through a natatorium, and which has no fittings or joints exposed to natatorium air, should be acceptable without a seal. 2) Rigid or intermediate conduit which passes through a natatorium, and which is assembled with threaded couplings only should be acceptable without a seal where at least three threads are engaged at every joint. 3) Conduit which passes through a natatorium, and which is assembled with rain-tight compression fittings only should be acceptable without a seal. 4) Otherwise-approved non-metallic conduit assembled by glued joints or other solvent-welding method shall be acceptable without a seal where approved by the AHJ. Note: An explosion-proof seal is not required, unless by the AHJ. • See NEMA 250, National Electrical Manufacturers Association. • See CSA C22.2, Canadian Standards Association. • See UL 50, Underwriters Laboratories. • See UL 508, Underwriters Laboratories. • See NEC Art. 110.11, “Deteriorating Agents”. Where such devices must be installed in a natatorium or in spaces containing natatorium air, enclosures rated NEMA 4X are preferred.

Keyword	Section	Annex

Electric Panels

Electrical panel boards, distribution centers, motor-control centers, fuse panels, circuit-breaker panels, and similar equipment should not be installed in natatoriums or in any space that normally contains natatorium air. Exceptions may include:

1) Equipment which is listed and labeled for the conditions should be acceptable where approved by the AHJ.
2) Where safety switches or equipment-disconnect switches must be installed in a natatorium or in spaces containing natatorium air, e.g. per NEC, they should be rated for the conditions.

- See NEMA 250, National Electrical Manufacturers Association.
- See CSA C22.2, Canadian Standards Association.
- See UL 50, Underwriters Laboratories.
- See UL 508, Underwriters Laboratories.
- See NEC Art. 110.11, “Deteriorating Agents”
- Whips consisting of liquid-tight flexible metal conduit are preferable to BX cable or type AC conduit.

Exposed Wiring

Where natatorium lights, attachments, fasteners, and any associated wiring whips are exposed to natatorium air, they should be rated for the conditions.

- See NEC Art. 250-110(2).
- See International Association of Electrical Inspectors, Soares Book on Grounding, 8th Ed., 2001, p157.
- See Croft, Terrel and Summers, Wilford, American Electricians’ Handbook, Ed.12, Sec. 9-340(b).
- See ANSI/IEEE 241, Sec 5.17.6.

Metal Raceways

Metal raceways should be equipped with a grounding conductor sized according to NEC Article 250 to maintain device ground potential in the event of degradation of the raceway.

- See NEMA 250, National Electrical Manufacturers Association.
- See CSA C22.2, Canadian Standards Association.
- See UL 50, UL 508, Underwriters Laboratories.

Keyword	Section	Annex
		• See NEC Art. 110.11, "Deteriorating Agents". Any electrical switch installed in a natatorium shall be rated for the atmosphere. Exception may include a switch which is otherwise protected, as in a gasketed weather-tight box with a weather-tight actuator cover shall be acceptable.
Natatoriums	4.6.2.1.2	• See NEC Art. 300.7. • See Durston, Lee. Design, Construction, and Testing of the Commercial Air Barrier. Accessed at http://www.irinfo.org/articles/5_1_2009_durston.pdf • US Army Corps of Engineers . 2012. Air Leakage Test Protocol for Building Envelopes. Accessed at: • http://www.neec.net/sites/default/files/neec_codes/Air-Tightness-Air-Leakage_Final.pdf , and • http://www.wbdg.org/pdfs/usace_airleakagetestprotocol.pdf
Interior Chemical Storage Raceways	***4.6.2.2***	***Electrical Equipment in Interior Chemical Storage Space*** All raceways and raceway devices and boxes in a chemical-storage space should be non-metallic or otherwise rated for the atmosphere. • See NFPA 70HB08, Art. 100, "Labeled", Explanatory Note. • See NEC Art. 110.11, "Deteriorating Agents". • See NEC Art. 378.10, "Non-Metallic Raceways". • See Croft, Terrel and Summers, Wilford, American Electricians' Handbook, Ed. 12, Sec. 9-340(b). • See MSDS calcium hypochlorite, Sec. 10 Stability and Reactivity Data. • See MSDS sodium hypochlorite, Sec. 10 Stability and Reactivity Data. • See MSDS hydrochloric acid, Sec. 10 Stability and Reactivity Data. • See MSDS muriatic acid, Sec. 10 Stability and Reactivity Data.
Sealed		Raceways should be sealed at the point of entry to the chemical-storage space to prevent the egress of liquids, fumes, vapors, and gases from the chemical-storage space via the conduit. Note: Explosion-proof seals are not required, unless by the AHJ. • See NEC Art. 300.7.

Keyword	Section	Annex
		• See Durston, Lee, *Design, Construction, and Testing of the Commercial Air Barrier*.
Metal Raceways		Metal raceways should be equipped with a grounding conductor sized according to NEC Article 250 to maintain device ground potential in the event of degradation of the raceway. • See NEC Art. 250-110(2) International Association of Electrical Inspectors, *Soares Book on Grounding*, 8th Ed., 2001, p157. • See Croft, Terrel and Summers, Wilford, *American Electricians' Handbook, Ed. 12*, Sec. 9-340(b). • See ANSI/IEEE 241, Sec 5.17.6.
Electronics		All electrical equipment, devices and fixtures should be listed and labeled for the expected atmosphere of the space. • See NFPA 70HB08, Art. 100, "Labeled", Explanatory Note. • See NFPA 70HB08, Art. 100, "Listed", FPN.
Light Switches		Any light switches installed inside interior chemical-storage spaces should be approved for use in wet and corrosive atmospheres, or shall be otherwise protected, as by a weather-proof actuator cover with a gasket. • See NEC Art. 110.11, "Deteriorating Agents".
Permanent Electrical Devices		All permanently connected electrical devices should be grounded per the NEC or other applicable code, using a separate grounding conductor which does not depend on the conductive integrity of any metal conduit exposed to chemical-storage space air. • See NEC Art. 250-110(2) International Association of Electrical Inspectors, *Soares Book on Grounding*, 8th Ed., 2001, p157. • See Croft, Terrel and Summers, Wilford, *American Electricians' Handbook, Ed. 12*, Sec. 9-340(b). • See ANSI/IEEE 241, Sec 5.17.6.
Wet and Corrosive	4.6.2.2.1	• See NEC Art.100 "Location, Wet". • See NEC Art. 110.11, "Deteriorating Agents" • See MSDS calcium hypochlorite, Sec. 10 Stability

Keyword	Section	Annex
		and Reactivity Data • See MSDS sodium hypochlorite, Sec. 10 Stability and Reactivity Data • See MSDS hydrochloric acid, Sec. 10 Stability and Reactivity Data • See MSDS muriatic acid, Sec. 10 Stability and Reactivity Data
Electrical Conduit	4.6.2.2.2	• See NEC Art. 300.7. • See NEC Art. 110.11, "Deteriorating Agents" • See MSDS calcium hypochlorite, Sec. 10 Stability and Reactivity Data • See MSDS sodium hypochlorite, Sec. 10 Stability and Reactivity Data • See MSDS hydrochloric acid, Sec. 10 Stability and Reactivity Data • See MSDS muriatic acid, Sec. 10 Stability and Reactivity Data
Electrical Devices	4.6.2.2.3	Electrical panelboards, circuit breakers, disconnects, motors, motor overloads, and similar devices or equipment are included. • See NEC Art. 110.11, "Deteriorating Agents" • See Zalosh, Robert, Dust Explosion Fundamentals, NFPA.
Protected Against Breakage	4.6.2.2.4	• See MSDS calcium hypochlorite, Sec. 7 Handling and Storage, "Keep away from heat. Keep away from sources of ignition." • See MSDS calcium hypochlorite, Sec. 10 Stability and Reactivity Data
Heating	**4.6.3**	**Pool Water Heating**
Evaporation Control		Other codes do not address the need for constant control of natatorium air temp in order to control evaporation. They also do not address the need for heat on specific surfaces. Natatorium heating equipment should be selected and installed to preserve compliance with the NEC, the National Fuel Gas Code (if applicable), the International Mechanical Code, or other applicable codes, the terms of equipment listing and labeling, and with the equipment manufacturer's installation instructions. A method of space heating capable of continuously

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		maintaining the temperature of the air in a natatorium at or above the design temperature relative to the pool-water temperature shall be provided. ASHRAE 99.6% climate data is the most reliable for natatorium load calculations. • See *ASHRAE Handbook of Fundamentals*[1]
Uncontrolled Condensation		Uncontrolled condensation in a building can lead to the growth of molds, with subsequent health effects. Uncontrolled condensation in a building can lead to property damage from rust, rot, ice pressure, and other. Condensation can be controlled by: • controlling the evaporation rate of the water, • controlling the temperature and relative humidity of the room air, and • maintaining all exposed building surfaces above room-air dew point.
Evaporation Rate		The pool evaporation rate is affected by: • the size of the pool, • the agitation of the water, • the heat of vaporization of the water at that temperature and pressure, • the temperature difference between the pool-water and the room air and the associated difference in vapor pressures, and • the speed of the air over the pool's surface. • See Places of Assembly, *ASHRAE Handbook of Application*[1] **Example for Note:** A design pool-water temperature is 82°F (27.8°C) with a design air temperature of 84°F (28.9°C). It is decided to raise the pool-water temperature to 83°F (28.3°C); the air temperature should be raised to 85°F (29.4°C) to maintain the same evaporation rate. Any surface which is exposed to room air and which cools below the dew point of the room air will become wet with condensation. Such surface may not be visible, e.g. inside a wall.
Space		Space heating shall be available year-round.

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Heating		Space heating shall not be disabled seasonally. Exceptions may include: 1) Space heating need not be provided during such times as the pool(s) may be drained completely, all water features and other evaporative loads are disabled and drained, and the room relative humidity does not rise above the design range. 2) Space heating may not be required if ventilation with outdoor-air is sufficient to prevent room temperature from falling below the design range, and room relative humidity from rising above the design range.
Seasonal Disabling		Where pools are filled or partially filled, the evaporation rate will increase as room air temperature decreases. Seasonal disabling of space heating could allow a drop of room temperature, with a subsequent increase in evaporation rate and possible uncontrolled condensation. Surfaces where the temperature may decrease below the design dew point of the space under normal operation shall be identified as part of the design process. At least one inspection should be done during the first heating season to identify any other such surfaces. The addition of heat to surfaces identified may be necessary to maintain their temperature above the design dew point for the space. Where forced air is used to heat identified surfaces, the heating method specified shall be so installed as to heat the room's air supply. The temperature, flow rate, and delivery of the supply air for each identified surface shall be such as to heat that surface above the design dew point of the space, under the worst-case design conditions. Such surfaces may have low values of thermal resistance. Such surfaces may include, but are not limited to windows and their frames, doors and their frames, any metal structural members that penetrate the vapor retarder, and any under-insulated sections of walls or roofs. • See Thermal and Water Vapor Transmission Data, *ASHRAE Handbook of Fundamentals*[1]
Combustion Heaters		Where combustion space heaters or combustion heaters required are located inside a building, the space in which the heater(s) or an assembly including the heater(s) is

Keyword	Section	Annex
		located shall be considered to be an equipment room for the purposes of section 4.9.1. The requirements of section 4.9.1 shall apply. Exceptions may be made for: 1) Space heaters listed and labeled for installation in the atmosphere shall be acceptable without isolation from chemical fumes and vapors. Note: Not all space heaters listed for heating natatorium air are listed for installation in a natatorium. Combustion space heaters should not be installed in a natatorium, unless the heater is rated for the atmosphere.
High Temperature	4.6.3.1	This temperature limit shall not be construed to be the limit of the bulk water temperature. Bulk-water temperature limits are much lower, e.g. UL 1563. The limit of section 4.6.3.1.1 is for heating devices which heat a stream of water that is to be returned to the pool, spa, etc. Such devices must heat the water stream above the bulk-water temperature limit, but either (a) should not heat the water stream above the limit of 4.6.3.1.1, or (b) mixing or other methods should be employed to prevent patron exposure to temperatures above the limit of 4.6.3.1.1.[9] Examples of "applicable codes" include but are not limited to the National Electric Code, the National Fuel Gas Code (if applicable), NFPA 70, and the International Mechanical Code 304.1.
Equipment Room Requirements	4.6.3.4	Combustion heaters should not be installed in a natatorium, or exposed to other chemical fumes, unless the heater is rated for the atmosphere.
Drinking Fountains	**4.6.4**	**Drinking Fountains**
Provided	4.6.4.1	A drinking fountain is required at a pool simply to encourage swimmers not to drink the pool water and to keep swimmers hydrated. At an outdoor pool, the drinking fountain can be located inside an adjacent building to allow year-round use when the pool is closed for the winter. The

[9] Moritz AR and Henriques FC. Studies of thermal injury: The relative importance of time and surface temperature in the causation of cutaneous burns. Am J Pathol. 1947 Sep;23(5):695-720.

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		drinking fountain would not need to be winterized. When a drinking fountain is not located in the pool enclosure, it should not be located more than 25 feet (7.62 m) from the pool enclosure entrance. The agency having jurisdiction may approve a bottled water supply in place of a drinking fountain. The water from a bottled water supply shall be as readily accessible to bathers as would the water from a drinking fountain.
	4.6.5	**Garbage Receptacles**
	4.6.6	**Food and Drink Concessions**
Spectator Areas	**4.6.7**	**Spectator Areas**
Barrier	4.6.7.2.2	The MAHC committee tried to distinguish the word “barrier” from “enclosure.” Those definitions are in the glossary. As currently defined, a “barrier“ is simply intended to be an obstacle intended to deter direct access from one point to another. For example, a simple post and rope solution would meet our intent.
Balcony	4.6.7.3	The intent is to prevent people from using a balcony as a diving platform. If a balcony is close to overhanging a pool, some people may try and use it to jump or dive into a pool. The more substantial and preventative the barrier at the balcony is, the less likely is that a person will use it.
Bleachers	4.6.7.4	Many building code jurisdictions may not be aware of the new ICC 300 bleacher standard. Once jurisdictions adopt the 2007 International Building Code and supplements, the bleacher code will become better known.
	4.7	**Recirculation and Water Treatment**
Decks and Equipment	**4.8.**	**Decks and Equipment**
Decks	**4.8.1**	**Decks**
General Standards	***4.8.1.1***	***General Standards for All Decks***
Concrete Decking	4.8.1.1.5	• See American Concrete Institute Standards Reference 302.1 R-80, Guide for Concrete Floor and Slab Construction.
Perimeter	***4.8.1.2***	***Standards for Perimeter Decks***

Keyword	Section	Annex
Decks		
Impervious	4.8.1.2.1	The term "perimeter deck" refers to the area around and immediately adjacent to the pool. This area is the wettest area of the deck and extends out from the edge of the pool a minimum of 4 feet (1.21 m) or out to deck drains, whichever is farther. Finish materials for the perimeter deck must be suitable for the pool environment, non-toxic, and substantially impervious. See 4.8.1.4 and comments.
Drains	***4.8.1.3***	***Drains***
Slope	4.8.1.3.1	Table 4.8.1.2 was arrived at by distilling the preponderance of existing state codes and established standards. Fundamentally, these sources all seek to eliminate standing water from the deck, typically recognizing that smoother surfaces convey water more efficiently than rougher ones. Relating slopes to texture, rather than specific materials, provides the ability for any otherwise suitable deck material or finish to be considered by the adopting jurisdiction. There is an inherent conflict in sloping of decks. Steeper slopes provide more construction tolerance and surety in conveying water, particularly in active soil conditions. Shallow slopes are required to meet accessibility guidelines – particularly for cross-slopes. It is the intent of this section to encourage positive and proper drainage without running afoul of accessibility guidelines.
Cross Connection Control	4.8.1.3.3	Consult local AHJ regarding specific chemical handling and use to properly dispose, including discharge to the watershed or sanitary sewers where appropriate.
Materials/ Slip Resistance	***4.8.1.4***	***Materials / Slip Resistance***
Slip Resistance	4.8.1.4.2	While much research has been done and several standard tests created for defining "slip resistance", no industry standards exist specifically related to aquatic environments. Most studies have been performed in the interest of safety in employment, providing guidance with respect to work surfaces and footwear. The most commonly accepted test for slip resistance, using a device called the James Machine (ASTM D2047), is not suitable for testing

Keyword	Section	Annex
		wet surfaces, and is not portable for testing in the field.[10]
Carpet	4.8.1.4.3	Carpet and artificial turf have been found to be inappropriate finish materials for the wettest area immediately around the pool, i.e. perimeter deck. Although the materials that carpet is manufactured from are durable and do not support mold growth, when they are installed over a relatively impermeable surface, water flows very slowly through the carpet. Soil and contaminants entering into the carpet are not easily removed. Since the carpet stays wet longer, and soil and contaminants remain in the carpet mold and algae growth is observed. Therefore carpeting is not an acceptable finish material in the wet perimeter deck. Finish materials for the perimeter deck should not block deck drains or impair water flowing to deck drains. Carpeting can be installed beyond the deck drains, i.e. dry deck.
Wood	4.8.1.4.4	Properly treated or composite wood materials may be a suitable material for POOL DECKS provided all other decking requirements are maintained. Fasteners must be regularly inspected to ensure structural integrity and that all heads are flush or recessed into the deck surface.
Dry Deck	4.8.1.4.5	Regional materials, local practices and particular facility design intentions vary widely with respect to dry deck. This paragraph intends to provide the opportunity for regulatory oversight of dry deck, without limiting these variables best understood by local authority.
Landscaping	4.8.1.4.6	It is acknowledged that landscaping near pools is not an uncommon practice in enhancing a pool environment. Landscape materials themselves and the design of special pool types vary so widely as to require special consideration with respect to landscaping. This paragraph intends to provide the opportunity to allow landscaping, but only through the lens of the local authority. The landscaping materials are not intended to be placed in

[10] Ceramic Tile Institute. Endorsement of improved test methods and slip prevention standards for new flooring. Accessed 07/30/2013 from http://www.ctioa.org/reports/cof16.html.

Keyword	Section	Annex
		the wet perimeter deck area. It is assumed here that the pool deck will be designed and sloped to prevent drainage from landscaping materials from reaching the pool. For an outdoor pool, it is not possible to prevent wind from moving dirt, bugs, plant material, etc. from landscape material around and perhaps into the pool. The landscape designer must consider the type and location of landscape materials placed inside or outside of an outdoor swimming pool enclosure.
Size/ Width	***4.8.1.5***	***Size / Width***
Perimeter Deck	*4.8.1.5.1*	*Perimeter Deck*
WIdth	4.8.1.5.1.1	The 4 foot unobstructed deck area is intended to ensure a minimum clear area for emergency access and care around the pool. Examples of obstructions include but are not limited to INFINITY EDGES, ADA transfer walls, and curbs.
Perimeter Decking	4.8.1.5.1.2	Most pools require continuous decks in order to safely accommodate circulation of all users of the facility.
Unguarded Pools	4.8.1.5.1.3	Unguarded pools require special consideration must be provided for deck access. • Option 1 assures the entire perimeter is available for assistance. • Option 2 allows for incorporation of leisure amenities and pool features such as “infinity edges” and landscaping, while maintaining assurance that the entire pool can be reached with standard safety equipment. Individual requests for variance could accommodate different designs.
Fixed Equipment	*4.8.1.5.2*	*Fixed Equipment*
Circulation Path	*4.8.1.5.3*	*Circulation Path*
Wing Walls or Peninsulas	***4.8.1.6***	***Wing Walls or Peninsulas***
No Perimeter Deck	4.8.1.6.1	A wing wall or peninsula is intended to provide separation of different areas in a pool. The separated areas may have

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		differing uses, flow rates, currents, or water depths.
Perimeter Overflow System	4.8.1.6.2	The MAHC Committee defines wing walls as interior elements of the pool and interior to the perimeter overflow system, so did not feel it was appropriate to say that wing walls longer than some specified length should require perimeter overflow. It would be a function of the width of the wing wall as to whether or not it can be properly constructed. If the pool has a gutter system, it would probably need 4 feet of width to get a normal trough on either side. Skimmers could be achieved for narrower walls because they could be staggered.
Deck Drainage	4.8.1.6.5	The MAHC technical committee did not feel that deck drains would be required on wing walls since they are considered part of the pool and not subject to regular foot traffic. As for deck level pools, the wing walls would be at or below water level making drains impractical.
Islands	***4.8.1.7***	***Islands***
Minimum Clearance	4.8.1.7.7	A 7 foot (2.13 m) minimum clearance overhead is required since it is consistent with requirements of building code minimum ceiling clearances.
Heated Decks	***4.8.1.8***	***Heated Decks***
Freeze Protection	4.8.1.8.1	Heated decks are occasionally used in cold climates to provide pedestrian paths to and around outdoor heated pools or spas. This section provides that when heated decks or snow-melt systems are provided, a minimum slope must be uniformly provided. Clear delineation is required because icy areas and/or pathway edges near otherwise dry deck poses an unsafe condition.
Hose Bibbs	***4.8.1.9***	***Hose Bibbs***
Diving Boards and Platforms	**4.8.2**	**Diving Boards and Platforms**
Diving Envelope	***4.8.2.1***	***Diving Envelope***
Conforms	4.8.2.1.1	This code is designed to encourage pools to be built to the standards of the agency that will certify the diving at the facility. The code dimensions are purposely a compilation of the most conservative standards of diving envelope dimensions and are in no way intended to supersede the

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		certifying agencies dimensions, but instead are intended to be used only when there is no certifying agency for the facility. Since NCAA, USA Diving, and FINA do not have standards for boards less than 1-meter in height, the State of Michigan table (R325.21.33, Table 1) was revised to the most conservative standard found for 0.5-meter and 0.75-meter boards. These minimum dimensional requirements were then dictated to be more conservative in certain instances based largely on interpolations. Concerning use of diving boards higher than 1-meter, these boards are not recommended for non-competitive use. However, if the boards are constructed to this code or NCAA standards, then non-competitive use can be allowed under careful adult supervision or lifeguards. However, non-conformance with these standards is unsafe for recreational diving purposes.
Steps and Guardrails	***4.8.2.2***	***Steps and Guardrails***
Starting Platforms	**4.8.3**	**Starting Platforms**
Conform to Standard Codes	4.8.3.1	The intent is to require a minimum 4 ft. (1,22 m) water depth under the starting platform and the oversight of an aquatics governing body (e.g. FINA, USA Swimming, NCAA, NFSHSA, YMCA, etc.) or a coach or instructor.. FINA, USA Swimming, NFHS, and the NCAA allow 4 feet (1.22 m) at starting platforms. Although there are some national data on spinal cord injuries (SCIs) in general, data on diving-specific SCIs are limited, particularly for SCIs involving public pool-related competition diving.
Spinal Cord Injury Data		**General data on spinal cord injuries**: For SCIs in general, approximately 40 SCIs/million population occur each year in the US (about 12,400 injuries for 2010) with approximately 4.5% related to diving injuries[11]. SCIs are a catastrophic public health problem leading to disability and decreased life expectancy[12] with a large economic and

[11] DeVivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. Spinal Cord. 2012 May;50(5):365-72.

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social burden for those that suffer the injury[12,13].

Non-deck level diving, competition diving, and SCIs:
Data related to SCIs occurring as a result of competition diving off starting platforms are limited. Since starting platforms are several feet above the pool, the entering velocity of swimmers is greater than for deck level diving making it more difficult to alter trajectory once executed[14]. One large study investigated 74 SCIs in non-competitive divers occurring with use of springboards and/or jumpboards; 45% of the pools were public[15]. Of these injuries, 12.2% occurred in water <4 ft; 66.2% occurred in water <5 ft,; 94.6% occurred in water <6ft. All SCIs occurred in water of <7 ft. The MAHC requires that starting blocks be removed, if possible, or blocked off to prevent recreational divers from using them when not in use by competitive swimmers.

Data demonstrates that competitive swimmers can be trained to perform shallow water dives from starting blocks to reduce the risk of SCIs[16,17,18]. As a result, competitive aquatics governing bodies (e.g., Federation Internationale de Natation (FINA), U.S.A. Swimming, National Collegiate Athletic Association (NCAA), National Federation of State High Schools Associations (NFSHSA), YMCA) allow starting blocks to be placed over water as shallow as 4 ft. in depth as long as competition is conducted under the auspices of the governing body or by a coach or instructor. A progressive training regimen can be used so that diver training is conducted in deeper water until the diver has mastered the technique before the certified personnel

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12 Blanksby BA, et al. Aetiology and occurrence of diving injuries. A review of diving safety. Sports Med. 1997;23(4):228-46.
13 Borius PY, et al. Cervical spine injuries resulting from diving accidents in swimming pools: outcome of 34 patients. Eur Spine J. 2010 Apr;19(4):552-7
14 Albrand OW, Walter J. Underwater deceleration curves in relation to injuries from diving. Surg Neurol. 1975;4(5):461-4.
15 Gabrielsen MA, Spivey M. Diving injuries: The etiology of 486 case studies with recommendations for needed action. 1990. Nova University Press, Ft. Lauderdale, FL.
16 Blitvich JD, et al. Dive depth and water depth in competitive swim starts. J Swimming Res. 2000;14:33-39.
17 Cornett AC, et al. Start depth modification by adolescent competitive swimmers. Int J Aquatic Res Educ. 2012;6:68-79.
18 White JC, et al. Competitive swimmers modify racing start depth upon request. Int J Aquatic Res Educ. 2011;5:187-198.

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approve their starting block entries into shallower depths[19]. However, further data are needed on the adequacy of an intervention, like training, that relies on correctly performing a technique to prevent injury; aquatics governing bodies state they have not documented injuries since this progressive training regimen has been adopted. However, it is noted that high speed video of competing athletes during competition dives from starting platforms illustrates that about 3% of athletes diving into 4 feet of water[20] (the pool had the minimum depth recommended for athletes using starting blocks) touched the bottom, nearly half approach within 0.5 meters of the bottom, and over half exceeded head speed thresholds deemed possible to cause severe head trauma; there was some anecdotal information suggesting some divers touched intentionally. Conversely, filming of athletes diving into 7.5 ft of water (the pool studies exceeded Olympic competition depths of 6.5 feet below starting platforms) showed that very few swimmers approach to within even 1 meter of the pool bottom[21]. These data suggest that injury risk from using starting platforms is likely to be higher for older, presumably heavier, or inexperienced divers, particularly when diving into shallower depths.

Future Research

Future Directions and Research:

The MAHC recommends expanded analysis of national and other SCI data sets that might further inform this discussion. Future analysis of national databases should be undertaken, if possible, to assess the occurrence of SCIs in competitive swimmers and platform heights and water depths at which the injury occurred. Historical analysis and peer-reviewed publication of data or reports collected by aquatics governing groups on SCIs and other diving injuries would also be important to understand pool-specific diving injuries occurring in competitive swimmers and the efficacy of current progressive training or other interventions.

4.8.4 Lifeguard-Related

[19] Cornett AC, et al. Teaching competitive racing starts: Practices and opinions of professional swim coaches. Int J Aquatic Res Educ. 2012;6:156-170.
[20] Cornett AC, et al. Racing start safety: Head depth and head speed during competitive starts into a water depth of 1.22m. Int J Aquatic Res Ed. 2010;4:365-378.
[21] Cornett AC, et al. Racing start safety Head depth and head speed during competitive starts into a water depth of 2.29m. Int J Aquatic Res Ed. 2011;5:14-31.

Keyword	Section	Annex
Barriers and Enclosures	**4.8.5**	**Barriers and Enclosures**
General	***4.8.5.1***	***General Requirements***
Construction Requirements	***4.8.5.2***	***Construction Requirements***
Local Code	4.8.5.2.1	Many pool codes refer to a 4 inch (100 mm) sphere in the body of the code. From a Building Code perspective, this is not consistently enforced and they don't regulate that small of an opening. Building Code allows standard 2-1/4 inches mesh fencing and is not necessarily specific for swimming pools. Building Code typically dictates minimum height and proximity to property lines - unless it's a fall issue. With pools, we are mainly concerned with discouraging unauthorized entry / break-ins.
Building Emergency Exit	4.8.5.2.4	It is the intent of this section to prevent emergency egress routes from exposing building occupants to unguarded pool areas. It is not the intent of this section to permanently segregate multiple pools on the same site. Temporary or seasonal enclosures (properly maintained and employed) may be used to segregate paths of egress from a building or adjacent pool to safety. For example, where a seasonal outdoor pool is operated in conjunction with a year-round indoor pool, a seasonal exit pathway separation enclosure may be used to maintain exiting in the off-season. During the outdoor swim season (the pool is in operation), it is acceptable to egress via the pool deck to exit gates.
Height	4.8.5.2.7	The MAHC Committee discussed this issue at length. The prevailing "best practice" in the industry is for 4 foot (1.22 m) high fencing around unguarded pools. However, the Steering Committee decided to make the barrier height the same for all pools (6ft or 1.83 meters) since 4ft fences are scalable even with smaller mesh. Generally, even unguarded pools have some hours of use and these pools also need to discourage use outside of operational hours by youth and others. Their collective logic was that if a pool is designed for unsupervised use at all times then there is no real advantage to a fence higher than 6 foot (i.e., 8 foot or taller).
Other Barriers	4.8.5.2.7.3	The 42” (1.1 m) barrier height is consistent with standard building code requirements for a guardrail, which serves substantially similar purposes. This height provides for

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		consistency across codes for like appurtenances.
Gates / Doors	**4.8.5.3**	**Gates and Doors**
Absence of Local Building Codes	4.8.5.3.6	This section is intended to address large facilities where there may either be multiple pools, multiple grade elevations, or both. Exit gates must be provided to permit adequate emergency egress. For example, a facility with 10 pools split between different grade elevations should have the required number of exits spaced reasonably around the perimeter and not all at one grade elevation.
Indoor Pools	**4.8.5.4**	**Indoor Pools**
Indoor and Outdoor Pools	4.8.5.4.3	If a seasonal pool is on the same property as a pool operated outside of that same season, patrons need to be prevented from accessing the closed pool(s) for safety.
Wall Separating	4.8.5.4.4	6 feet 8 inches (2.03 m) minimum clearance overhead is required since it is consistent with requirements of building code minimum doorway clearances. Materials that do not pose a possibility of physical injury may be suspended from the structure to help contain the indoor natatorium environment.
Multiple Pools	**4.8.5.5**	**Multiple Pools**
Wading Pools	4.8.5.5.2	Rationale of 24” (0.6 m) deep rule is that if adjacent water is not substantively deeper than the wading pool, there is no need to segregate the two. If it is the only pool within the facility, then normal fencing and perimeter enclosure requirements would apply. If wading pools are a part of a larger facility with other types of pools, then the requirements proposed in 4.12.9.2 would apply.
Pool Cleaning Systems	**4.8.6**	**Pool Cleaning Systems**
		The MAHC Committee encourages draining spas for cleaning. A vacuum likely wouldn’t be required for very small pools, such as spas less than 75 square feet. A simple wall brush with pole can adequately and efficiently clean the floor.
No Hazard	4.8.6.1	Pumps shall not exceed 3 horsepower because the suction hydraulic of a larger pump through the small vacuum tubing would force the pump to operate at unacceptable

Keyword	Section	Annex
		hydraulic conditions. Strong suction forces provide a greater risk for bodily harm in the event of a vacuum system mishap. Pool vacuum systems must use suitably-sized pumps, proper diameter vacuum hoses, and reasonable hose lengths to provide optimum hydraulics for vacuuming operations. Conventional suction requirements call for a maximum 15 feet (4.57 m) of water at a flow of 4 GPM per lineal inch of suction cleaner head for the total suction head loss.
GFCI Connection	4.8.6.7	Not allowing extension cords prevents the possibility that the high voltage power supply unit has enough cord to potentially be dragged into the pool causing a potential safety risk.
Power Cord	4.8.6.8	The power cord length needs to be shorter than the distance between the receptacle and the edge of the pool in order to prevent the power supply from accidentally entering the pool water while connected.
Filter / Equipment Room	**4.9**	**Filter / Equipment Room**
Equipment Room	**4.9.1**	**Equipment Room**
General Requirements	***4.9.1.1***	***General Requirements***
Opening	4.9.1.1.3	Building code speaks to minimum door widths from an egress standpoint which is typically narrower. The height is consistent with building code requirements.
Construction	***4.9.1.2***	***Construction*** • See NEC Art. 110-26 Minimum clearances. • See International Mechanical Code Sec. 304.1. • See NFPA 54 National Fuel Gas Code Sec. 8.1.2.
Electrical	***4.9.1.3***	***Electrical***
Ventilation	***4.9.1.4***	***Ventilation***
Code Conformance	4.9.1.4.1	• See International Mechanical Code Sec. 502.
Markings	***4.9.1.5***	***Markings***

Keyword	Section	Annex
Piping Identified	4.9.1.5.1	Pipes may be color coded according to use with either labels or a reference chart; directional arrows with permanent labeling on the pipes; or by other means deemed suitable by the AHJ.
Combustion Equipment	***4.9.1.6***	***Equipment Rooms Containing Combustion Equipment***
Installed		No code language exists for this section since the MAHC defers to other codes but the rationale for some of it is still included in the Annex No items should be installed, nor shall storage be planned for any items, within the minimum clearances of a combustion device, as defined by the manufacturer, or within the minimum clearances as defined the National Fuel Gas Code or other applicable code, whichever are greater. • See International Mechanical Code Sec. 304.1. • See NFPA 54 National Fuel Gas Code Sec. 8.1.2.
Increased Ventilation		Rooms containing combustion equipment may be subject to requirements for increased ventilation and combustion-air intake, as specified by the National Fuel Gas Code or other pertinent codes. The equipment room should be so constructed as to allow for the planned equipment, or should be modified as necessary. Where an equipment room contains combustion equipment which uses equipment-room air for combustion, no other equipment should be so installed as to reduce the room air pressure beyond the acceptable air-intake pressure range for the combustion equipment. • See International Mechanical Code Sec. 701.
Noxious Gasses		All practical flames produce carbon monoxide or nitrous oxides. There is very little chance of being rid of both of them at the same time. Neither is good for human health. The key is to dilute combustion products and send them up the flue. This does not always work where equipment- room air pressure is lower than outdoor air pressure. Some combustion devices work by natural draft (buoyancy of hot gases) and cannot tolerate any pressure difference. Other combustion devices have higher pressure differences which they can overcome.

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		Where an equipment room contains combustion equipment which uses equipment room air for combustion, air-handling equipment should not use the room as a plenum. Exceptions may include where the combustion equipment is listed and labeled for the expected use, such installation shall be acceptable where approved by the AHJ. • See International Mechanical Code Sec. 701.
Plenum Room		A plenum room uses the equipment room as the intake duct for HVAC equipment. Thus, it will have a low air pressure while the HVAC equipment is operating. For a natatorium, the incoming air would contain halogen compounds, e.g. chloramines, and thus should never be used as combustion air. Where an equipment room contains combustion equipment which uses a draft hood, air-handling equipment should not use the room as a plenum. Exceptions may include where the combustion equipment is listed and labeled for the expected use, such installation shall be acceptable where approved by the AHJ. • See International Mechanical Code Sec. 701.
Lowered Room Pressure		In this situation, there is a tendency for the lowered room pressure to pull combustion products back down the flue into the room, and thus spread them everywhere. Rooms containing combustion equipment are also subject to requirements for separation from chemical-storage spaces.
Separation	***4.9.1.7***	***Separation from Chemical Storage Spaces***
		Largely, building standards do not speak to aquatic venues. For example, the dangers that chemical fumes pose to combustion equipment.
Equipment	*4.9.1.7.1*	*Equipment*
Contaminated Air	4.9.1.7.1.1	Combustion equipment, air-handling equipment, and electrical equipment should not be exposed to air contaminated with corrosive chemical fumes or vapors. • See ANSI/ACCA Manual SPS 2010 Sec 1-6. • See NFPA National Fuel Gas Code (2002) Sec.

Keyword	Section	Annex
		8.1.6 • See "Proper Venting of Gas Fueled Appliances", Chimney Safety Institute of America, Plainfield, IN, 2010 • See "Instruction Sheet IV, Identifying and Correcting Burner Problems", Propane Council, Washington, DC, 2010
Equipment Restrictions	4.9.1.7.1.2	Spaces containing combustion equipment, air handling equipment, and/or electrical equipment and spaces sharing air distribution with spaces containing such equipment shall not at the same time be used as chemical-storage spaces. Exceptions may include equipment listed and labeled for use in that atmosphere shall be acceptable, where approved by the AHJ. • See: International Mechanical Code Sec. 304.1 • See: ANSI/ACCA Manual SPS 2010 Sec 1-6.
Isolated	4.9.1.7.1.3	Spaces containing combustion equipment, air-handling equipment, and/or electrical equipment and spaces sharing air distribution with spaces containing such equipment shall be isolated from chemical-storage-space air. • See International Mechanical Code Sec. 304.1 • See ANSI/ACCA Manual SPS 2010 Sec 1-6.
Doors and Openings	*4.9.1.7.2*	*Doors and Openings*
Between	4.9.1.7.2.1	A door or doors should not be installed in a wall between such equipment rooms and an interior chemical-storage space. • See International Mechanical Code Sec. 304.1 • See ANSI/ACCA Manual SPS 2010 Sec 1-6.
No Openings	4.9.1.7.2.2	Chemical storage space door(s) must not be left open. This is important to controlling air pressure ratios, keeping corrosive gases out of combustion devices, and keeping children away from hazards. There should be no ducts, grilles, pass-throughs, or other openings connecting such equipment rooms to chemical-storage spaces.

Keyword	Section	Annex
		• See International Mechanical Code Sec. 304.1 • See ANSI/ACCA Manual SPS 2010 Sec 1-6.
Natatorium Air	4.9.1.7.2.3	Spaces containing combustion equipment, air-handling equipment, and/or electrical equipment and spaces sharing air distribution with spaces containing such equipment should be isolated from natatorium air. Exceptions may include equipment listed for the atmosphere, which may be acceptable. • See International Mechanical Code Sec. 304.1 • See ANSI/ACCA Manual SPS 2010 Sec 1-6. • See NFPA National Fuel Gas Code (2002) Sec. 8.1.6 • See “Proper Venting of Gas Fueled Appliances”, Chimney Safety Institute of America, Plainfield, IN, 2010 • See “Instruction Sheet IV, Identifying and Correcting Burner Problems”, Propane Council, Washington, DC, 2010. Combustion equipment cannot be allowed to breathe halogen compounds, because acids will form in the flue and destroy it, allowing carbon monoxide and other combustion products to enter the occupied space.
No Openings	4.9.1.7.2.4	There should be no ducts, grilles, pass-throughs, or other openings connecting such spaces to a natatorium. Exceptions may include HVAC equipment which is rated for natatorium atmosphere and which serves only that natatorium shall be acceptable. *Note: Ducts which connect the natatorium to the duct connections of air handlers should not be construed as connecting the air-handler space to the natatorium.* • See International Mechanical Code Sec. 304.1 • See ANSI/ACCA Manual SPS 2010 Sec 1-6.
Openings / Gaps	4.9.1.7.2.5	Where building construction leaves any openings or gaps between floors and walls, or between walls and other walls, or between walls and ceilings, such gaps should be permanently sealed against air leakage.

Keyword	Section	Annex
		• See ANSI/ACCA Manual SPS 2010 Sec 12-3.
Natatorium Access	4.9.1.7.3	Natatorium Access
Floor Slope	4.9.1.7.3.1	Where a door or doors must be installed in a wall between an equipment room and a natatorium, the floor of the equipment room should slope back into the equipment room in such a way as to prevent any equipment-room spills from running under the door into the natatorium. Exceptions may include: 1) This may be met by a floor all of which is at least four inches below the level of the nearest part of the natatorium floor. 2) This may be met by a continuous dike not less than four inches high located entirely within the equipment room, which will prevent spills from reaching the natatorium floor. *Note: Equipment-room floor drains may be required and all designs shall be compliant with ADA as they may be applicable.*
Cleaning Supplies		Even if pool chemicals and cleaning supplies are not in the equipment room, there is a very good chance that other fluids may be, e.g. ethylene-glycol heating fluids, petroleum refrigeration oils, polyol-ester refrigeration oils, alkyl-benzene refrigeration oils, other lubricants, caustic or acidic coil cleaners, etc.
Automatic Closer	4.9.1.7.3.2	Such door or doors should be equipped with an automatic closer. The door, frame, and automatic closer shall be installed and maintained so as to ensure that the door closes completely and reliably without human assistance.
Automatic Lock	4.9.1.7.3.3	Such door or doors should be equipped with an automatic lock. Such lock shall require a key or combination to open from the natatorium side. Such lock should be so designed and installed as to be opened by one hand from the inside of the room under all circumstances, without the use of a key or tool.
Restrict Access	4.9.1.7.3.3.1	Such doors should be equipped with permanent signage warning against unauthorized entry.

Keyword	Section	Annex
Other Guidance	***4.9.1.8***	***Other Equipment Room Guidance***
Access Space	4.9.1.8.1	Where ventilation, air filtration, or space dehumidification, heating, or cooling for a natatorium is by mechanical equipment located in an equipment room, adequate access space should be provided to allow for inspection and service. • See NEC Art. 110-26 Minimum clearances. • See International Mechanical Code Sec. 304.1. • See NFPA 54 National Fuel Gas Code Sec. 8.1.2
Size Requirements	4.9.1.8.1.1	The access spaces should be the greater of: 1) Those required by OSHA, NEC, National Fuel Gas Code, or other official requirements; or 2) The equipment manufacturer's recommendations.
Adequate Space	4.9.1.8.2	Where ventilation, air filtration, or space heating or cooling for a natatorium is beside mechanical equipment located in an equipment room, adequate space for required straight lengths of duct shall be provided as the greater of those described in AMCA 201, SMACNA Duct Manual, ACCA Manual SPS Sec. 13, or the equipment manufacturer's recommendations. • See ANSI/ACCA Manual SPS 2010 Sec 1-6. • Air Movement and Control Association; • Sheet Metal and Air Conditioning Contractors' National Association; • Air Conditioning Contractors of America
Minimize Hazards	4.9.1.8.3	• See ANSI/ACCA Manual SPS 2010 Sec 1-6. • See 29 CFR Part X 1926.1053(b)(9) (OSHA).
Refrigeration Equipment	4.9.1.8.4	Most refrigerants are heavier than air. When released from containment, most will evaporate rapidly, expanding greatly in the process. If a large enough amount is released, it could displace air to above head-height. For this reason mechanical codes usually require refrigerant-release to the outdoors when the amount of refrigerant exceeds some fraction of the occupied volume.
Chemical Storage Spaces	**4.9.2**	**Chemical Storage Spaces**

Keyword	Section	Annex
		Pool-chemical associated injuries have been routinely documented.[22,23] For 2007-2008, 32 pool chemical--associated health events that occurred in a public or residential setting were reported to CDC by Maryland and Michigan. These events resulted in 48 cases of illness or injury; 26 (81.3%) events could be attributed at least partially to chemical handling errors (e.g., mixing incompatible chemicals). ATSDR's Hazardous Substance Emergency Events Surveillance System received 92 reports of hazardous substance events that occurred at aquatic facilities. More than half of these events (55 [59.8%]) involved injured persons; the most frequently reported primary contributing factor was human error. Estimates based on CPSC's National Electronic Injury Surveillance System (NEISS) data indicate that 4,574 (95% confidence interval [CI]: 2,703--6,446) emergency department (ED) visits attributable to pool chemical--associated injuries occurred in 2008; the most frequent diagnosis was poisoning (1,784 ED visits [95% CI: 585--2,984[24]]). CDC has developed recommendations to reduce the risk of chemical-associated injuries at AQUATIC FACILITIES.[25]
Outdoor/ Indoor Storage	***4.9.2.1***	***Outdoor / Indoor Storage***
Stored Outdoors	4.9.2.1.1	Pool chemicals, acids, fertilizers, salt, de-icing chemicals, oxidizing cleaning materials, other corrosive or oxidizing chemicals, and pesticides should be stored outdoors or in a well-ventilated structure not intended for occupation.
Minimize Vapors	4.9.2.1.2	Where such materials must be stored in a building intended for occupation, the transfer of chemical fumes and vapors from the chemical-storage space to other parts of the building should be minimized.
Dedicated Space	4.9.2.1.3	At least one space dedicated to chemical storage should be provided. This space need not be an interior space.

[22] CDC. Acute illness and injury from swimming pool disinfectants and other chemicals --- United States, 2002—2008. MMWR Morb Mortal Wkly Rep. 2011;60(39):1343-1347.
[23] CDC. Pool chemical—associated health events in public and residential settings---United States, 1983-2007. MMWR Morb Mortal Wkly Rpt. 2009;58(18):489-493.
[24] Hlavsa MC, et al. Surveillance for waterborne disease outbreaks and other health events associated with recreational water use — United States, 2007–2008. MMWR Surveill Summ 2011;60:1-37.
[25] CDC. Recommendations for Preventing Pool Chemical-Associated Injuries accessed at http://www.cdc.gov/healthywater/swimming/pools/preventing-pool-chemical-injuries.html

Keyword	Section	Annex
Safe Spaces	4.9.2.1.4	The number of required chemical-storage spaces should be as necessary to allow safe storage of the chemicals present.
Additional Space	4.9.2.1.5	Where the listing, labeling, or MSDS of chemicals indicates incompatibility of storage with other chemicals present, other chemical storage space(s) should be provided.

- See ANSI/ACCA Manual SPS 2010 Sec. 1-6.
- See ANSI/ACCA Manual SPS 2010 Sec. 12-3.
- See NFPA 704 "Hazard Identification System" for chemical rankings.
- See EPA Oswer 90 008.1 Chemical Emergency Preparedness and Prevention Advisory SWIMMING POOL CHEMICALS: Chlorine.
- Calcium hypochlorite, sodium hypochlorite, muriatic acid, BCDMH, etc., have NFPA 704 health rankings of 3. IMC Sec. 502.8.4 and 502.9.2 apply.
- See Narnes, David, "Swimming Pool Chemical Safety", *http://www.ehow.com/way_5406877_swimming-pool-chemical-safety.html*
- See CDC. Recommendations for Preventing Pool Chemical-Associated Injuries accessed at http://www.cdc.gov/healthywater/swimming/pools/preventing-pool-chemical-injuries.html

Eyewash	4.9.2.1.6	It is the intent to allow re-fillable eyewash bottles and not require plumbed emergency eyewashes and showers unless required by the AHJ.
Outside	4.9.2.1.6.1	The intent is to allow some flexibility since installation in the chemical room may be prone to failure due to corrosion. External eye wash stations should be close and easily found such as in a location outside the door that all staff must walk past. The MAHC will continue to look for data supporting a maximum distance from the door.

Construction

4.9.2.2 Construction

As applicable, the standards of NFPA 400, the IFPC, and the IBC shall prevail. This standard is not intended to provide relief from these other regulations, but to provide best practice where these regulations are not adopted or enforced. The more stringent standard shall prevail as applicable.

Keyword	Section	Annex
Foreseeable Hazards	4.9.2.2.1	The construction of the chemical storage space should take into account the foreseeable hazards.
Protected	4.9.2.2.2	The construction of the chemical-storage space should, to the extent practical, protect the stored materials against tampering, wild fires, unexpected exposure to water, etc.
Floor	4.9.2.2.3	The floor or deck of the chemical-storage space should be protected against substantial chemical damage by the application of a coating or sealant capable of resisting attack by the chemicals to be stored.
Minimize Fumes	4.9.2.2.4	The construction and operation of a chemical storage space should minimize the transfer of chemical fumes into any interior space of a building intended for occupation.
Surfaces	4.9.2.2.5	Any walls, floors, doors, ceilings, and other building surfaces of an interior chemical-storage space should join each other tightly.
No Openings	4.9.2.2.6	Other than a possible door, there should be no permanent or semi-permanent opening between a chemical-storage space and any other interior space of a building intended for occupation.

- See International Mechanical Code Sec. 502.
- See ANSI/ACCA Manual SPS 2010 Sec. 1-6.
- See ANSI/ACCA Manual SPS 2010 Sec. 12-3.
- See NFPA 704 Hazard Identification System.
- See Sodium Hypochlorite MSDS, Health Hazard Data.
- See Calcium Hypochlorite MSDS, Health Hazard Data.
- See Hydrochloric Acid MSDS, Health Hazard Data.
- See Muriatic Acid MSDS, Health Hazard Data.

Exterior Storage

4.9.2.3 Exterior Chemical Storage Spaces

As applicable, the standards of NFPA 400, the IFPC, and the IBC shall prevail. This standard is not intended to provide relief from these other regulations, but to provide best practice where these regulations are not adopted or enforced. The more stringent standard shall prevail as applicable.

Keyword	Section	Annex
Outdoor Equipment	4.9.2.3.1	Equipment listed for outdoor use may be located in an outdoor equipment area.
Fencing	4.9.2.3.2	Such part of an outdoor equipment area as does not about a wall of a building shall be completely enclosed by fencing that is at least 6 feet (1.8 m) high on all other pools.
Gate	4.9.2.3.3	Fencing shall be equipped with a self-closing and self-latching gate having a permanent locking device.

Doors

4.9.2.4 Chemical Storage Space Doors

As applicable, the standards of NFPA 400, the IFPC, and the IBC shall prevail. This standard is not intended to provide relief from these other regulations, but to provide best practice where these regulations are not adopted or enforced. The more stringent standard shall prevail as applicable.

Signage 4.9.2.4.1

All doors opening into chemical-storage spaces should be equipped with permanent signage:

1) Warning against unauthorized entry.
2) Specifying the expected hazards, and
3) Specifying the location of the associated MSDS forms.

- See NFPA 704 “Hazard Identification System”.

Emergency Egress 4.9.2.4.2

Where a single door is the only means of egress from a chemical-storage space, the door should be equipped with an emergency-egress device.

This usually takes the form of a kick-out panel in the door. When trapped, a person can sit down and kick out the panel, creating an opening usually about six inches narrower than the door and about 28 inches (0.71 m) high. Since these are used in most enclosures where a person can be trapped, e.g. walk-in freezers, the volume is high enough for additional expense to be minimal. Trapping could happen in several ways, but the most common is binding of the door to the jamb. Corrosion products can build up inside a metal door between the jamb and the wall, forcing the jamb away from the wall and toward the door. At some point the door will either fail to open or fail to close.

Keyword	Section	Annex
Interior Door	4.9.2.4.3	Where a chemical-storage space door must open to an interior space, spill containment should be provided to prevent spilled chemicals from leaving the chemical-storage space. • See Sodium Hypochlorite MSDS, Health Hazard Data, Spill Data. • See Calcium Hypochlorite MSDS, Health Hazard Data, Spill Data. • See Hydrochloric Acid MSDS, Health Hazard Data, Spill Data. • See Muriatic Acid MSDS, Health Hazard Data, Spill Data.
Equipment Space	4.9.2.4.4	Where a chemical-storage space door must open to an interior space, the door should not open to a space containing combustion equipment, air-handling equipment, or electrical equipment. Such door should be acceptable where all equipment thus exposed is listed for the corrosive atmosphere. • See ANSI/ACCA Manual SPS 2010 Sec. 1-6. • See ANSI/ACCA Manual SPS 2010 Sec. 12-3. • See NEC Art. 110.11 "Deteriorating Agents". • See NEMA 250. • See CSA C22.2. • See UL 50. • See UL 508. • See NFPA National Fuel Gas Code (2002) Sec. 8.1.6 • See "Proper Venting of Gas Fueled Appliances", Chimney Safety Institute of America, Plainfield, IN, 2010 • See "Instruction Sheet IV, Identifying and Correcting Burner Problems", Propane Council, Washington, DC, 2010
Corrosive	4.9.2.4.4.1	Combustion equipment cannot be allowed to breathe halogen compounds, because acids will form in and destroy the flue. Air-handlers have strong negative air pressures inside them. This will draw in any contaminants around the cabinet and distribute throughout the ducted system.
Corrosion-	4.9.2.4.5.1	Doors should be constructed of corrosion-resistant

Keyword	Section	Annex
Resistant		materials. Such doors should be equipped with a corrosion-resistant, automatic lock to prevent unauthorized entry. Such lock should require a key or combination to open from the outside. Such lock should be so designed and installed as to be capable of being opened by one hand from the inside of the chemical-storage space without the use of a key or tool. Such doors should be supported on corrosion-resistant hinges, tracks, or other supports. Such doors should be equipped with suitable gaskets or seals on the top and all sides to minimize air leakage between the door and the door frame. Such doors should be equipped with a floor or threshold seal to minimize air leakage between the door and the floor or threshold. Such doors should be equipped with an automatic door closer that will completely close the door without human assistance. The door closer should be able to close the door completely against the specified difference in air pressure. Such doors should be equipped with a limit switch and an alarm that will sound if the door remains open for more than thirty (30) minutes. This alarm should have a minimum output level of 85 dbA at 10 feet (3.05 m). Where an open door will result in loss of air-pressure difference, this level can be met by the audible alarm.
Automatic Locks	4.9.2.4.5.2	Most locks for employee-only doors in public buildings would qualify, since such locks must lock automatically from the outside, but cannot require a key or tool for exit. Examples of suitable lock types would include, but not be limited to, the locks on hotel-room doors, the lock on the door of a personnel-file storage room, the lock on a janitor's closet, etc. • See ANSI/ACCA Manual SPS 2010 Sec. 1-6. • See ANSI/ACCA Manual SPS 2010 Sec. 4-4. • See ANSI/ACCA Manual SP 2010 Sec. 12-3.
Interior Storage	***4.9.2.5***	***Interior Chemical Storage Spaces*** As applicable, the standards of NFPA 400, the IFPC, and the IBC shall prevail. This standard is not intended to provide relief from these other regulations, but to provide best practice where these regulations are not adopted or enforced. The more stringent standard shall prevail as applicable.
No Air Movement	4.9.2.5.1	There should be no transfer grille, pass-through grille,

Keyword	Section	Annex
		louver, or other device or opening that will allow air movement from the chemical-storage into any other interior space of a building intended for occupation or into another chemical-storage space. • See ANSI/ACCA Manual SPS 2010 Sec. 4-4.
Electrical Conduit System	4.9.2.5.2	An interior chemical-storage space that shares any building surface (wall, floor, ceiling, door, etc.) with any other interior space or that shares an electrical-conduit system with any other space should be equipped with a ventilation system that maintains the air pressure in the chemical-storage space below that of any other interior space by 0.05 to 0.15 inches (1.3 to 3.8 mm) of water pressure, or by such greater pressure difference as should be necessary to ensure that all air movement through building surfaces or conduits should be toward the chemical-storage space. **Note 1**: This can usually be accomplished by maintaining the air pressure in the chemical-storage space at least 0.05 I.W.C. to 0.15 I.W.C. below that of any adjoining space and below that of any space connected to the chemical-storage space by an electrical conduit system. Larger pressure differences may be needed in special cases. **Note 2**: Where (1) all conduits passing through the chemical-storage space use only threaded joints within the chemical-storage space, and (2) all conduits terminating in the chemical-storage space (a) are effectively sealed, and (b) use only threaded joints within the chemical storage space, the specified air-pressure difference need not include the air pressures of interior spaces which do not share a building surface with the chemical-storage space.
Pressure Difference	4.9.2.5.2.2	This pressure difference should be maintained by a continuously operated exhaust system used for no other purpose than to remove air from that one chemical-storage space.
Separate Exhaust System	4.9.2.5.2.3	Where more than one chemical-storage space is present, a separate exhaust system should be provided for each chemical-storage space.

Keyword	Section	Annex
Airflow Rate	4.9.2.5.2.3.1	The exhaust airflow rate should be the greater of: 1) the OSHA requirements for working in such enclosed spaces, 2) the amount needed to maintain the concentration of vapors or fumes below the PEL for the expected exposure time (defined by 29 CFR 1910.1000 (OSHA)) for each stored chemical, or 3) the amount specified by International Mechanical Code Sec. 502, or 4) the amount needed to maintain the specified pressure difference.
Alarm	4.9.2.5.2.4	Function of this exhaust system should be monitored continuously by an audible differential-pressure alarm system which should sound if the specified differential air pressure is not maintained for a period of thirty minutes.
Minimum Output	4.9.2.5.2.4.1	This alarm should have a minimum output level of 85 dbA at 10 feet (3.05 m).
Manual Reset	4.9.2.5.2.4.2	The specified alarm should require manual reset to silence it.

- See ANSI/ACCA Manual SPS 2010 Sec. 1-6.
- See ANSI/ACCA Manual SPS 2010 Sec. 4-4.
- Differential pressure was extrapolated from *ASHRAE Applications Handbook*, Sec. 4.6 “Natatoriums – Ventilation Requirements”.
- See International Mechanical Code, Sec 502.1.
- See ANSI/ACCA Manual SPS 2010 Sec. 1-6.
- See ANSI/ACCA Manual SPS 2010 Sec. 4-4.
- See ANSI/ACCA Manual SPS 2010 Sec. 12-3.
- See Sodium Hypochlorite MSDS, Health Hazard Data.
- See Calcium Hypochlorite MSDS, Health Hazard Data.
- See Hydrochloric Acid MSDS, Health Hazard Data.
- See Muriatic Acid MSDS, Health Hazard Data.
- See ANSI/ACCA Manual SPS 2010 Sec. 1-6.
- See ANSI/ACCA Manual SPS 2010 Sec. 4-4.

Air Ducts

4.9.2.6 Air Ducts Interior Chemical Storage Spaces

Keyword	Section	Annex
No Air Movement	4.9.2.6.1	No duct shall allow air movement from the chemical-storage space into any other interior space of a building

Keyword	Section	Annex
		intended for occupation or into any other chemical storage space. • See International Mechanical Code, Sec 502.1. • See ANSI/ACCA Manual SPS 2010 Sec. 1-6. • See ANSI/ACCA Manual SPS 2010 Sec. 4-4. Ducts shouldn't be shared between spaces. Should the blower stop or fail there would be cross-contamination.
Pipes and Tubes	***4.9.2.7***	***Pipes and Tubes in Interior Chemical Storage Spaces***
Combustion Equipment	***4.9.2.8***	***Combustion Equipment in Interior Chemical Storage Spaces***
Installed	4.9.2.8.1	• See NFPA National Fuel Gas Code (2002) Sec. 8.1.6 • See "Proper Venting of Gas Fueled Appliances", Chimney Safety Institute of America, Plainfield, IN, 2010 • See "Instruction Sheet IV, Identifying and Correcting Burner Problems", Propane Council, Washington, DC, 2010.
Electrical Equipment	***4.9.2.9***	***Electrical Equipment in Chemical Storage Spaces***
Ozone Rooms	***4.9.2.10***	***Ozone Rooms***
Gaseous Chlorination	***4.9.2.11***	***Gaseous Chlorination Space*** Many current jurisdictions closely regulate the use of gas chlorine from a disaster preparation and response standpoint. This can make chlorine gas use prohibitive from a regulatory standpoint to the point that its use is difficult to justify.
Windows	***4.9.2.12***	***Windows in Chemical Storage Spaces***
Not Required	4.9.2.12.1	These windows are sometimes built into the door, although not always. (There are fire-rated doors with windows.) Such windows may serve several purposes.
Requirements	4.9.2.12.2	Such windows are usually installed for free lighting, although there can be drawbacks. Some chemicals may react on exposure to sunlight.

Keyword	Section	Annex
Sealing and Blocking	***4.9.2.13***	***Sealing and Blocking Materials***
Hygiene Facilities	**4.10**	**Hygiene Facilities**
Water Supply / Disposal	**4.11**	**Water Supply / Wastewater Disposal**
Water Supply	**4.11.1**	**Water Supply**
Other Sources	4.11.1.1.1	These water systems include community water systems, non-transient non-community water systems, or transient non-community water systems with some noted exceptions. There are several lake and spring sources around the country that have been used for decades to supply water to swimming pools. As long as the source water quality does not significantly change and can be treated by the pool equipment to protect the health and safety of pool users, it can be allowed.
Condensate / Reclaimed Water	4.11.1.1.2	The steps necessary to make reclaimed water meet source water standards are beyond the scope of the MAHC. These steps are set by the state and federal agencies that set requirements for drinking water. This would be up to the AHJ and local conditions. The MAHC Technical Committee felt that, especially considering recent affinities towards sustainability, reclaiming condensate would be acceptable as long as this water met the same standards as incoming domestic water (even if this required UV or other disinfectants, filters, etc.). A provision for deferring to the AHJ ruling based on locale was important to us as well. For instance, this may be more of a politically important issue in Arizona or Nevada than in other areas of the country.
Refill Pool	4.11.1.2.1	This requirement is for when facilities choose to be open when backwashing (e.g., they can backflush one filter while still maintaining filtration through another system). A facility may choose to regulate when their backwash cycles occur (such as at closing). Many fully automated backwash systems for HRS filters are programmed to backwash at night when the facility is closed and there are no other demands on the source water coming into the facility. Alternatively, operators may choose for an all deep 50 meter pool to just backwash one filter at a time and

Keyword	Section	Annex
		allow make-up water to reestablish rim flow before doing the next one, as opposed to doing all six or eight tanks sequentially.
Fill Spouts	**4.11.2**	**Fill Spouts**
Hazard	4.11.2.1	For example, a fill spout located under a diving board or next to a ladder or handrail is less likely to be a trip hazard or be a hazard to swimmers coming up from below.
Cross-Connection Control	**4.11.3**	**Cross-Connection Control**
Protected	4.11.3.1	1) An air gap can be provided through a fill spout at the side of a pool, through water supply piping over the edge of an open balance tank or surge tank, or over a fill stand pipe that is connected to the side of a pool. Splash guards are simply a means to keep fill water from splashing onto adjacent floors and walls. Water cannot be siphoned into the potable water supply through a properly designed splash guard. A proper design often consists of a concentric pipe that is a larger diameter than the fill pipe and that is open to the atmosphere at the top and bottom. 2) Because of the potential for back pressure or back siphonage, any potable water piping connected directly to any swimming pool piping must have an RPZ. Some permitting agencies or codes may allow pressure vacuum breakers or atmospheric vacuum breakers on water supplies not connected to the pool piping but supplying potable water to the pool through a submerged inlet in the pool. The pressure vacuum breaker would be located upstream of the shut-off valve. The atmospheric vacuum breaker would be located downstream of the shut-off valve. The AHJ may allow an elimination of an air gap to control splashing or flow of pool wastewater outside the receiving sump onto the equipment room floor. This can be

Keyword	Section	Annex
		accomplished by extending the pool wastewater pipe below the rim of the sump. This can be approved if the wastewater disposal pipe from the pool does not have a sealed connection to the sewer piping. This constitutes an air break. An air break can be justified for the worst case scenario of a sewer backup at the pool wastewater sump. During a sewer backup, sewage cannot back pressure into pool piping through an air break. Further, if the sewage is above the pool waste pipe outlet when the pool is operating, the normal pressure of the pool piping leaks pool water towards the sewer, preventing the pool piping from siphoning wastewater. If the pool is not operating, then there is no pressure or suction in the pool piping that could create a condition for siphoning sewage. If the permitting agency does not allow an air break, they may allow an air gap with a splash guard.
Deck Drains	**4.11.4**	**Deck Drains and Rinse Showers**
Sanitary Wastes	**4.11.5**	**Sanitary Wastes**
Pool Wastewater	**4.11.6**	**Pool Wastewater**
Ground Surface	4.11.6.2	Filters work to reduce the level of pathogens in the pool water by retaining the pathogen in the filter. As a result, pool backwash water has been demonstrated to contain detectable pathogen levels (e.g., *Cryptosporidium* and *Giardia*).[26,27] Therefore, filter backwash water should be considered waste water requiring appropriate disposal.
Special Venues	**4.12**	**Special Venues**
Spas	**4.12.1**	**Spas**
Maximum Water Depth	4.12.1.2	Spas are designed for sitting and the expectation is that it will not be over the average 11-year-old child's head. That depth is about 48 inches (1.22 m). The TC felt that 24 inches (0.6 m) is reasonable since it's half of the maximum

[26] Shields JM, et al. Prevalence of Cryptosporidium spp. and Giardia intestinalis in Atlanta metropolitan area swimming pools. Emerg Inf Dis 2008;14:948-950.
[27] Schets FM, et al. Cryptosporidium and Giardia in swimming pools in the Netherlands. J Water Health. 2004 Sep;2(3):191-200.

Keyword	Section	Annex
		depth previously stated (4 ft) and would allow for the vast majority of the population to sit comfortably with their head above water. The TC also consulted the ISPSC and their maximum depth of 28 inches is pulled from APSP which has been utilized by industry for some time, The TC recommends additional studies to determine if decreasing the spa seating depth is necessary.
Handholds	4.12.1.3	Even though a person is seated in a spa, a sufficient number of positive handholds are needed to assist with standing up. Handholds at the edge of the pool above the water line are visible and easily reachable.
Perimeter Deck	4.12.1.5	This is to provide adequate area for life saving and rescue purposes. The AHJ may allow a smaller rescue area based on the assessment of a local emergency rescue agency. Spas elevated for transfer wall or other purposes need to be provided with an effective barrier so that the elevated wall is not used as a platform to access the adjacent pool. An effective barrier shall be one that does not allow bathers to walk on the elevated wall. Small and/or narrow spas are examples where the AHJ may allow a relief from the 50% minimum deck requirements. The rationale is that if a spa is of a limited size or width then it can be entirely be guarded effectively from one side or one location.
Elevated Spas	4.12.1.5.4	For example, if an elevated spa is next to or within 4 feet (1.22 m) of another pool, a guard rail or post-and-rope system would be a couple options as effective barriers which would discourage patrons to use this elevated wall to jump into the other pool.
Temperature	4.12.1.7	Excessive temperature above 104˚F is essentially inducing a fever in the bather's body as internal temperature rises. It is also teratogenic to fetuses so that pregnant women should consult their physician before using.
Timers	4.12.1.14	The "Fifteen Minute Rule" – complies with most state codes The timer for the hydrotherapy pump is for the safety of the bathers. Longer times can be hazardous to bathers and the therapy pump shutting off at least reminds the bather to get out and reset the timer.

Keyword	Section	Annex
Emergency Shutoff	4.12.1.15	Emergency shutoffs should be located between 5 feet (1.5 m) and 50 feet (15.2 m) and within sight of the spa structure.
Waterslides and Catch Pools	**4.12.2**	**Waterslides and Catch Pools**
Design and Construction	***4.12.2.1***	***Design and Construction***
Additional Provisions	4.12.2.1.1	The designs of waterslides are governed by amusement ride regulations such as ASTM that have appropriate experience. However, the design of the catch pool along with associated water quality and circulation is regulated by this standard.
Flumes	***4.12.2.2***	***Flumes***
Flume Exits	***4.12.2.3***	***Flume Exits***
Exit into Catch Pools	***4.12.2.4***	***Exit into Catch Pools***
		Present practices for safe entry into Catch Pools include: • a water backup, and • a deceleration distance.
Catch Pools	***4.12.2.5***	***Catch Pools***
Decks	***4.12.2.6***	***Decks***
Means of Access	***4.12.2.7***	***Means of Access***
Slide Run-outs	***4.12.2.8***	***Slide Run-outs***
Drop Slides	***4.12.2.9***	***Drop Slides***
		Drop slides are being highlighted because of one incident that resulted in a fatality in Massachusetts. Slides, particularly those that drop bathers into the water (vs. being delivered to water entry point), from a height above the water require diligent monitoring by staff at the top of the slide and the water entry point to ensure there is adequate spacing between slider users so that people do not land on top of each other. Each slide user must have time to move out of the collision zone before another slide user is allowed down the slide. The incident cited resulted

Keyword	Section	Annex
		in the drowning of a slide user and a multi-day time for discovery of the victim because of the high turbidity of the water.
Pool Slides	***4.12.2.10***	***Pool Slides***
Signage	***4.12.2.11***	***Signage***
Wave Pools	**4.12.3**	**Wave Pools**
General	***4.12.3.1***	***General***
Access	***4.12.3.2***	***Access***
Safety	***4.12.3.3***	***Safety***
No Diving Signs	4.12.3.3.3	The pool will still have side wall ladders for egress purposes (and therefore partial trafficking) and the Technical committee still felt that "No Diving" signage should still be required for all areas around the wave pool regardless of water depth due to the freeboard.
Water Quality	***4.12.3.4***	***Water Quality***
Therapy Pools	**4.12.4**	**Therapy Pools**
Leisure Rivers	**4.12.5**	**Leisure Rivers**
General	***4.12.5.1***	***General***
Access and Egress	***4.12.5.2***	***Access and Egress***
Means	4.12.5.2.1	Since there is moving water in a leisure river, less frequent means of ingress/egress are acceptable. The moving water propels people around a leisure river quickly and with less effort to the next means of egress. Rivers can be several hundred feet long. They are often constructed with side walls that make it difficult to exit the pool. This distance will make it so that a bather will never be more than 75 feet (22.9 m) from an exit. The distance to the nearest exit for a large regular pool can be as much as 50 feet (15.2 m). This distance can be farther for a river because of the current. If water is flowing at 1 – 4 feet/second around the river, then a person floating around a river will never be more than 2.5 minutes from a means

Keyword	Section	Annex
		of egress.
Deck	4.12.5.2.3	Leisure rivers are of necessity closed (or mostly closed) loops. The wall for the inside of a river loop is an island which may be designed for people but is most often not. Therefore, a perimeter deck is only needed for the outside of the river loop, or only on one side of the river.
Bridges	4.12.5.2.4	7 feet (2.13 m) minimum clearance overhead is required since it is consistent with requirements of building code minimum ceiling clearances. Most rivers are closer to 3.5 feet deep making the clearance 7.5 feet if you adhere to the 4 foot clear requirement above the water surface. The MAHC Technical Committee chose 7 feet because it's the typical building code minimum height requirement for ceilings whereas the 6'-8 inches min clearance is usually only applicable to doorways.
Water Quality	***4.12.5.3***	***Water Quality***
Safety	***4.12.5.4***	***Safety***
Movable Floors	**4.12.6**	**Moveable Floors**
General	***4.12.6.1***	***General***
Slip Resistance	***4.12.6.2***	***Slip Resistance***
Safety	***4.12.6.3***	***Safety***
Not Continuous	4.12.6.3.1	Examples of adequate safety precautions for entering the other area of the pool include but are not limited to the following: 1) A moveable bulkhead, located at least at the water surface, to enclose the area of the moveable floor; 2) A highly visible floating line installed over the moveable floor surface, two (2) feet in front of the end of the moveable floor. A four (4) inch wide contrasting marking shall be provided at this leading edge. 3) A railing system that shall be anchored into the moveable floor.

Keyword	Section	Annex
Underside	4.12.6.3.2	When the moveable floor is not continuous over the entire surface area of the pool, the underside of the moveable floor shall be denied access when it's not flush with the pool floor. Examples of adequate measures to prevent access under the moveable floor include but are not limited to the following: 1) Position a bulkhead at the end of the moveable floor; 2) Have a trailing ramp that hinges to the moveable floor and extends to the pool floor.
Movement	***4.12.6.4***	***Movement***
Speed	4.12.6.4.1	There are no U.S. regulations on moveable floors. This velocity was obtained from European design standards. • European Standard EN 13451-11:2004.
Water Depth and Markings	***4.12.6.5***	***Water Depth and Markings***
Bulkheads	**4.12.7**	**Bulkheads**
Entrapment	4.12.7.3	All bulkhead parking positions should be designed such that lifeguards can see under 100% of the bulkhead from their station on the pool deck.
Gap	4.12.7.6	Bulkheads designed with greater gaps may result in bulkheads veering off its intended path.
Handhold	4.12.7.7	During FINA sanctioned events, full height touchpads will be on most bulkheads. But the majority of bulkheads in the U.S. allow for wide holes at the waterline for handholds and USS / NFSHSA / NCAA touchpads which are hung from these holes and are below the waterline. Touchpads aren't normally installed during normal operating hours. End wall concrete parapets that cantilever over the gutter that require full height FINA touchpads for those level of competitions do not negate the requirement for handholds (though behind) in these locations.
Width	4.12.7.10	Any bulkhead that is intended for foot traffic for use by officials shall be at least 1 meter (3'-3") wide which is the current minimum width provided by commercial manufacturers.

Keyword	Section	Annex
Starting Platforms	4.12.7.10.1	Any bulkhead that dictates starting platforms shall be installed shall be at least 3'-9" (1.14 m) wide in order to allow for sufficient trafficking space for officials and athletes behind the starting platforms.
SprayGrounds	**4.12.8**	**SprayGrounds**
Sloped	4.12.8.3	An example for an acceptable design solution would be a diverter valve installation.
Hazard	4.12.8.10	While consistent with many state codes, the MAHC Technical Committee has determined that this topic needs more research regarding water velocity and eye safety.[28]
Signage	4.12.8.12	Since there is no standing water on sprayGrounds, depth markers and "No Diving" warning signs are not required. This was included because it deviates from the regular marking and warning signage requirements for typical pools as stated in this code. Other signage requirements such as diaper changing reminders and "do not drink" would likely be appropriate.
Wading Pools	**4.12.9**	**Wading Pools**
Barrier	4.12.9.2	A more stringent requirement is stipulated for separating wading pools from other bodies of water (compared with the spacing between other pools) is due to the fact that the predominant users of wading pools are small toddlers, most of whom cannot swim, and the inherent dangers posed by larger and deeper pools in close proximity.
Shallow Water	4.12.9.2.2	Rationale of 24" (0.6 m) deep rule is that if adjacent water is not substantively deeper than the wading pool, there is no need to segregate them.

[28] Duma SM, et al. Eye injury risk from water stream impact: biomechanically based design parameters for water toy and park design. Curr Eye Res. 2012 Apr;37(4):279-85.

A Note About Resources:

The resources used in all MAHC modules come from peer-reviewed journals and government publications. No company-endorsed publications have been permitted to be used as a basis for writing code or annex materials.

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  - Section 1-6.
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- American Society of Heating, Refrigerating, and Air-Conditioning Engineers Handbook—Fundamentals
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- Federation Internationale de Natation
- International Mechanical Code
  - Section 304.1
  - Section 502
  - Section 701
- Material Safety Data Sheets
  - Sodium Hypochlorite Health Hazard Data
  - Calcium Hypochlorite Health Hazard Data
  - Hydrochloric Acid Health Hazard Data
  - Muriatic Acid MSDS, Health Hazard Data
- National Fire Code

- National Collegiate Athletic Association
- National Electrical Code
    - Article 100 “Location, Wet”
    - Article 110-26 “Minimum clearances”
    - Article 110.11 “Deteriorating Agents”
    - Article 300.7 “Raceways Exposed to Different Temperatures”
- National Electrical Manufacturing Association Standard 250
- National Fire Protection Association
    - National Fuel Gas Code Sec. 8.1.2
    - National Fuel Gas Code Sec. 8.1.6
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Additional Resources

- 29 Code of Federal Regulations 1910

- ACCA – Air Conditioning Contractors of America
  - 2800 Shirlington Road, Arlington, VA 22206
  - www.acca.org

- ADA – Americans with Disabilities Act

- AMCA – Air Movement and Control Association
  - 30 West University Drive, Arlington Heights, IL 60004
  - www.amca.org

- ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers
  - 2013 ASHRAE Handbook—Fundamentals: https://www.ashrae.org/resources--publications/handbook/description-of-the-2013-ashrae-handbook--fundamentals

- Ceramic Tile Institute
  - http://www.ctioa.org/reports/cof16.html

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- Occupational Safety & Health Administration
  - 200 Constitution Ave., NW, Washington, DC 20210
  - www.OSHA.gov

- National Fire Protection Association
  - 1 Batterymarch Park, Quincy, Massachusetts 02169-7471
  - www.nfpa.org
  - See: Zalosh, Robert, Dust Explosion Fundamentals

- SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
  - 4201 Lafayette Center Drive, Chantilly, Virginia 20151-1219
  - www.smacna.org

- United States Access Board,
- August 2003 Memorandum: http://www.access-board.gov/adaag/about/bulletins/surfaces.htm)
- US Army Corps of Engineers . 2012. Air Leakage Test Protocol for Building Envelopes. Accessed at:
  - http://www.neec.net/sites/default/files/neec_codes/Air-Tightness-A_Leakage_Final.pdf
  - http://www.wbdg.org/pdfs/usace_airleakagetestprotocol.pdf