



Aquatic Consulting Services

1220 Rosecrans Street #915 • San Diego • California • 92106

Pool Tip #52: Recommended Pool Chemical & Natatorium Air Levels

Oxidation reduction potential (ORP)	750 - 900 mV (Commercial) 650 mV (Residential)
Free available chlorine	3.0 - 5.0 ppm or as needed to maintain a 750 mV ORP
Combined available chlorine	< 0.3 ppm
Total available chlorine	No more than 0.2 ppm higher than FAC
Total bromine	4.5 - 6.5 ppm or as needed to maintain a 750 mV ORP
Cyanuric acid	0 ppm (Indoors) 10 - 30 ppm (Outdoors)
UV Light	<p>Disinfectant level is related to light intensity and exposure time.</p> <p>Dosage: 6,000 to 10,000 microwatt seconds per square centimeter (MWS/cm²) or a minimum of 40 - 60 millijoules per square centimeter (mJ/cm²) are needed to destroy pathogenic organisms.</p> <p>Low pressure (with an electromagnetic spectrum between 185 and 254 nanometers) Medium pressure high intensity (with a wider electromagnetic spectrum between 180 and 400 nanometers, and not affected by water temperature). UV is most germicidal in wavelengths between 240 and 280 nanometers. Organic compounds are best photo oxidized by hydroxyl radicals in wavelengths below 230 nanometers. The bond between chlorine and nitrogen is broken, and chloramine destruction is most effective in the range of 245 and 340 nanometers, making low pressure bulbs a poor choice for chloramine destruction.</p> <p>Replace on a 9 month to 1 year basis, or after 8,000 hours of continuous use. Operate continuously on a 24 hour basis.</p>
Ozone	Minimum 25 - 33% slip stream. Generator output should equal 4 - 6% ozone by weight concentration. Utilizes an oxygen prep

	<p>unit, contact chamber (sized at gpm x 4), ozone destructor of either granulated activated carbon (GAC) or a manganese dioxide catalytic converter prior to introduction into the main stream and pool (chlorinated pools), and vents off-gassed air to the outside. ORP after the reaction tank > 850 mV.</p> <p>Sizing: Circulation flow rate in gallons per minute x 0.227 x dose rate in mg/liter (recommend 0.4 mg/l with 4 minutes of contact time in order to achieve a 1.6 CT value) = grams per hour</p>	
Polymeric biguanide (PHMB)	30 - 50 ppm	
Salinity (Electrolytic cells)	2,500 - 6,000 ppm (4,000 ppm ideal)	
Sulfates	< 250 ppm	
Hydrogen peroxide	30 - 40 ppm or as needed to maintain a 750 mV ORP	
pH	7.2 - 7.8	
Acid or base demand	Neither	
Total alkalinity	80 - 120 ppm	
Calcium hardness	200 - 400 ppm	
Total dissolved solids (TDS)	< 1,500 ppm	
Langelier saturation index	0 (+ or - 0.3 acceptable)	
Ryznar Stability Index	6.3 – 6.7	
Iron	0 - 0.2 ppm	
Copper	0 - 0.3 ppm	
Manganese	0 - 1.5 ppm	
Nitrates	< 10 mg/L (Uncontrollable algae growth at 25 mg/L)	
Phosphates	0.2 - 0.5 ppm maximum, < 125 ppb	
Clarity	<p>Crystal clear</p> <p>0.25 Nephelometric Turbidity Units (NTU)</p> <p>0.2 Jackson Turbidity Units (JTU)</p>	
Water level	Skimmers Gutters	Mid-point of skimmer weir Constant overflow at quiescence
Turnover Time	6 hours 2 - 4 hours 1 hour	<p>(Multi-use and competitive swimming pools)</p> <p>(Therapy pools, swim school pools, warm water pools or pools with heavy bather load to water volume ratios)</p> <p>(Wading & activity pools, flume catch pools)</p>

	<p>< 30 minutes (Spas)</p> <p>Minimum 1,400 gallons per day to be circulated for each anticipated bather per day</p>
Water circulation pattern	Uniform circulation and absence of dead spots
Pipe sizing	<p>Velocity = (0.32 x Flowrate in gpm) ÷ Pipe area in inches²</p> <p>Discharge pipe 8 - 10 feet per second (maximum)</p> <p>Suction pipe 6 - 8 feet per second (maximum)</p>
Filter sizing (Design flow rate)	<p>Rapid sand 1.5 - 5.0 gpm/ft² (3.0 gpm/ft² typical)</p> <p>High rate sand 10 - 15 gpm/ft² (commercial), 20 gpm/ft² (residential)</p> <p>Multi-cell sand 3 - 7.5 gpm/ft²</p> <p>Vacuum sand 0.5 gpm/ft²</p> <p>Hi-rate bi-flow vacuum sand 6.25 - 15 gpm/ft²</p> <p>Diatomaceous earth 1.5 - 2.0 gpm/ft² (commercial), 2.5 - 3.0 gpm/ft² (residential)</p> <p>Cartridge 0.375 gpm/ft² (commercial), 1.0 gpm/ft² (residential)</p>
Water temperature	<p>104° F (Maximum spas)</p> <p>86° - 94° F (Therapy pools)</p> <p>78° - 82° F (Competitive pools)</p> <p>83° - 86° F (Multi-use pools)</p>
Air temperature	<p>2° - 7° F above pool water temperature</p> <p>Compliance with ASHRAE Standard 55-1992: "Thermal Environmental Conditions for Human Occupancy"</p>
Relative humidity	50 - 60% maximum
Air distribution	<p>Air introduced from low to high, passed over the water surface</p> <p>No noticeable drafts of temperature gradients</p> <p>Compliance with ASHRAE Standard 62-1989: "Ventilation for Acceptable Indoor Air Quality"</p>
Ventilation	<p>0.5 cfm of outside air for each square foot of natatorium area</p> <p>15 - 25 cfm for each person in the natatorium</p> <p>At least 6 and preferably 8 complete air exchanges per hour</p> <p>Maintain CO₂ levels below 0.1% or 1,000 ppm</p> <p>Percentage of fresh air introduced: Recommended minimum 40%, maximum 100% depending on usage patterns,</p>

	natatorium design, and equipment installed										
Pressurization	Natatoriums should be positively pressured in relation to the out of doors, and negatively pressured in relation to surrounding occupied spaces Note: Pollutants travel from positive to negative pressure areas										
Chemicals in air 6" over the pool	<table> <tr> <td>Chlorine</td> <td>1.0 ppm maximum TWA, 0.5 ppm TLV-TWA 30 ppm IDLH</td> </tr> <tr> <td>Bromine</td> <td>1.0 ppm TLV-TWA 10 ppm IDLH</td> </tr> <tr> <td>Ozone</td> <td>0.1 ppm maximum TWA</td> </tr> <tr> <td>Carbon dioxide</td> <td>5,000 ppm TLV-TWA</td> </tr> <tr> <td>Chloroform</td> <td>10 ppm TLV -TWA</td> </tr> </table>	Chlorine	1.0 ppm maximum TWA, 0.5 ppm TLV-TWA 30 ppm IDLH	Bromine	1.0 ppm TLV-TWA 10 ppm IDLH	Ozone	0.1 ppm maximum TWA	Carbon dioxide	5,000 ppm TLV-TWA	Chloroform	10 ppm TLV -TWA
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Total coliforms	<p>Membrane filtration technique: < 1 colony per 100 milliliters</p> <p>Multiple tube fermentation method: None - fewer than 15% of samples in the series</p> <p>Presence - absence test: Absent</p> <p>Standard agar plate count: < 200 bacteria per millimeter</p>										
Standard (Heterotrophic) Plate Count	Colony forming units (CFU) < 200 colonies per milliliter										
Pseudomonas aeruginosa	<table> <tr> <td>Membrane filter technique:</td> <td>< TNTC</td> </tr> <tr> <td>Presence - absence test:</td> <td>Absent</td> </tr> </table>	Membrane filter technique:	< TNTC	Presence - absence test:	Absent						
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Acoustics	Reverberation time 0.8 - 2.4 seconds to drop to 60 decibels										
Illumination level 6" over pool	100 footcandles (Indoors) / 60 footcandles (Outdoors)										