

TEST DESCRIPTION & RECOMMENDED RANGES

CHLORINE & BROMINE

When added to fresh water, chlorine produces a powerful sanitizer called *free chlorine*. But as free chlorine destroys algae and bacteria and reacts with swimmer wastes and other contaminants, it converts to a less effective form called *combined chlorine* or *chloramines* (free chlorine + combined chlorine = total chlorine). When combined chlorine accumulates, it irritates bathers' eyes and causes strong odors. The bromine reaction differs in that combined bromine is an effective sanitizer, therefore no distinction from free is required.

Recommended Range:

Free Chlorine: 2.0 to 4.0 ppm (spas higher) / Bromine: 4.0 to 6.0 ppm
Combined Chlorine: None

When to Test:

Daily (or as bather load demands)

Potential Problems:

- too low—inadequate sanitation / bacteria & algae growth
- too high—uneconomical use of sanitizer

pH

pH shows whether water is acidic, neutral, or basic (alkaline). At a value of 7 pH is neutral; above 7 water becomes more basic; below 7 more acidic. pH can vary for many reasons: It is affected by some sanitizers and can be altered by the addition of make-up water. pH control is important because it affects bather comfort, sanitizer efficiency, and overall water balance.

Recommended Range:

pH: 7.4 to 7.6

When to Test:

Daily

Potential Problems:

- too low—corrodes surfaces / irritates eyes & skin
- too high—scale deposits / cloudy water / poor sanitizer efficiency

TOTAL ALKALINITY

Total alkalinity is the measurement of the alkaline materials in your pool or spa water that act as buffering agents to avoid "pH bounce" and to help prevent changes in pH that could result in corrosion and staining. Maintaining the correct total alkalinity in your pool or spa water will help prevent costly equipment repairs and the extra expense of additional treatment chemicals.

Recommended Range:

Total alkalinity: 80 to 120 ppm

When to Test:

Weekly

Potential Problems:

- too low—pH difficult to maintain / corrosion tendency
- too high—pH difficult to adjust / potential for scaling

TROUBLE PREVENTION CHART

SYMPTOM	CAUSE	POTENTIAL SOLUTION
Plaster etching, concrete pitting, grout dissolving. Scale on walls & fixtures. (Common in new inground pools.)	Imbalanced water.	Have pH, total alkalinity & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier.
Corrosion of metal fixtures in contact with pool water. Rust & copper stains.	Imbalanced water.	Have pH, total alkalinity & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier. Add chelating or sequestering agent per instructions to prevent more stains.
Bleached hair or bathing suits. Eye irritation.	Excessive chlorine.	Add sodium thiosulfate or sodium sulfite to neutralize.
Eye irritation and / or itchy skin. Water has foul odor. Complaints of "too much chlorine" in water.	High combined chlorine, low free chlorine.	Adjust pH to 7.2 – 7.8.* Perform breakpoint chlorination to eliminate combined chlorine. Do not reenter water until free chlorine level drops below 5 ppm.
Skin / eye irritation.	Improper pH.	Adjust pH to 7.2 – 7.8.*

SYMPTOM	CAUSE	POTENTIAL SOLUTION
Hazy, cloudy water. No sparkle.	Early algae growth.	Superchlorinate or shock.
	Poor filtration.	Check filter for proper operation.
	High pH.	Lower pH to 7.2 – 7.8.*
	High total alkalinity.	Lower total alkalinity to 80 – 120 ppm.
Red-brown water.	Iron.	Seek expert advice on source of metals & treatment solution.
Purple-black water.	Manganese.	
Blue-green water.	Copper.	
Green, slippery pool surfaces & cloudy or green water. Black spotty patches on pool surfaces. Yellow powdery deposits on shady side of pool.	Algae.	Adjust pH to 7.2 – 7.8.* Superchlorinate to 30 ppm. Concrete: Brush sides & bottom with stainless steel brush. Vinyl liner: Use soft nylon brush. Repeat if necessary. Use algacides.

* Always bring total alkalinity into recommended range before adjusting pH.

POOL & SPA WATER TESTS

1. Keep test kit out of reach of children.

2. Read precautions on all labels.

3. Store test kit in cool, dark place.

4. Replace reagents once each year.

5. Do not dispose of solutions in pool or spa.

6. Rinse cells / tubes before and after each test.

7. Obtain samples 18" (45 cm) below water surface.

8. Hold dropper bottle vertically when dispensing reagent.

Instr. #5817

Free, Combined & Total Chlorine / Total Bromine Test

1. Rinse and fill chlorine / bromine cell to mark with water to be tested.
2. Add 5 drops R-0001 and 5 drops R-0002. Cap and invert to mix.
3. Match color with color standard. Record as parts per million (ppm) free chlorine (Cl₂) or total bromine (Br₂). For chlorine: See Dosage Chart for adjustment. For bromine: See manufacturer's instructions for adjustment. For total chlorine: See Step 4.
4. Add 5 drops R-0003. Cap and invert to mix.
5. Match color immediately. Record as ppm total chlorine (Cl₂).
6. Subtract free chlorine (FC) from total chlorine (TC). Record as ppm combined chlorine (CC) as Cl₂. Formula: TC – FC = CC. For combined chlorine: See Dosage Chart for adjustment.

pH Test

1. Rinse and fill pH cell to mark with water to be tested.
2. Add 5 drops R-0014. Cap and invert to mix.
3. Match color with color standard. Record as pH units and save sample if pH needs adjustment. If sample color is between two values, pH is average of the two. To LOWER pH: See Acid Demand Test. To RAISE pH: See Dosage Charts.

Acid Demand Test

1. Use treated sample from pH test.
2. Add R-0015 dropwise. After each drop, count, cap and invert to mix, and compare with color standards until desired pH is matched. See Dosage Charts to continue.

Total Alkalinity Test

1. Rinse and fill sample tube (#4034) to 25 mL mark with water to be tested.
2. Add 2 drops R-0007. Swirl to mix.
3. Add 5 drops R-0008. Swirl to mix. Sample will turn green.
4. Add R-0009 dropwise, swirling and counting after each drop, until color changes from green to red.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) total alkalinity as calcium carbonate (CaCO₃). See Dosage Charts to continue.

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CHLORINE DOSAGE CHART

Volume of Water (gallons / liters)	TO RAISE CHLORINE 1 PPM USING CHLORINE COMPOUND*					
	% Available Chlorine					
	10%	12%	45%	60%	65%	75%
250 gal / 1,000 L	0.32 fl oz / 10.0 mL	0.27 fl oz / 8.35 mL	0.07 oz / 2.22 g	0.06 oz / 1.67 g	0.05 oz / 1.54 g	0.04 oz / 1.42 g
400 gal / 1,500 L	0.51 fl oz / 15.0 mL	0.43 fl oz / 12.5 mL	0.12 oz / 3.33 g	0.09 oz / 2.50 g	0.08 oz / 2.31 g	0.07 oz / 2.13 g
1,000 gal / 4,000 L	1.28 fl oz / 40.0 mL	1.07 fl oz / 33.3 mL	0.30 oz / 8.89 g	0.22 oz / 6.67 g	0.21 oz / 6.15 g	0.20 oz / 5.63 g
5,000 gal / 20,000 L	6.40 fl oz / 200 mL	5.33 fl oz / 167 mL	1.48 oz / 44.4 g	1.11 oz / 33.3 g	1.03 oz / 30.8 g	0.95 oz / 28.3 g
10,000 gal / 40,000 L	12.8 fl oz / 400 mL	10.7 fl oz / 333 mL	2.97 oz / 88.9 g	2.23 oz / 66.7 g	2.05 oz / 61.5 g	1.77 oz / 56.3 g
15,000 gal / 60,000 L	1.20 pt / 600 mL	1.00 pt / 500 mL	4.44 oz / 133 g	3.34 oz / 100 g	3.08 oz / 92.3 g	2.66 oz / 84.5 g
20,000 gal / 80,000 L	1.60 pt / 800 mL	1.33 pt / 667 mL	5.94 oz / 178 g	4.45 oz / 133 g	4.11 oz / 123 g	3.77 oz / 113 g

CHLORINE

If you choose to use chlorine as a disinfectant and sanitizer, learn to use it ECONOMICALLY and EFFECTIVELY.

Effective use is largely dependent on pH. At a high pH (>7.8), chlorine's ability to disinfect is significantly reduced. But at a lower pH (7.2 to 7.8), chlorine's disinfecting ability is enhanced. Therefore, at lower pH levels, you get more disinfection for your money.

Remember:

- Keep the pH at 7.8 or below.
- Keep FREE CHLORINE between 2.0 and 4.0 ppm (spas higher).
- Periodically eliminate COMBINED CHLORINE by breakpoint chlorination. (Breakpoint dosage equals 10 times the amount of combined chlorine.)
- Chlorine-free shocks may be used to aid in the elimination of bather wastes and other organic contaminants that lead to combined chlorine.

*Chlorine products contain different amounts of available chlorine. Adjust treatment amounts accordingly.

pH DOSAGE CHARTS

Volume of Water (gallons / liters)	TO LOWER pH USING DRY ACID (SODIUM BISULFATE, 93.2%)*			TO LOWER pH USING MURIATIC ACID (20° BAUME/31.45% HCl)			TO RAISE pH USING SODA ASH (SODIUM CARBONATE, 100%)**		
	Drops of Acid Demand Reagent			Drops of Acid Demand Reagent			From 7.2	From 6.8	From 6.5
	1	2	3	1	2	3			
250 gal / 1,000 L	0.31 oz / 9.25 g	0.62 oz / 18.5 g	0.93 oz / 27.7 g	0.23 fl oz / 7.15 mL	0.46 fl oz / 14.3 mL	0.69 fl oz / 21.5 mL	0.31 oz / 8.70 g	0.96 oz / 27.0 g	1.20 oz / 33.8 g
400 gal / 1,500 L	0.49 oz / 13.9 g	0.99 oz / 27.7 g	1.48 oz / 41.6 g	0.37 fl oz / 10.7 mL	0.73 fl oz / 21.5 mL	1.10 fl oz / 32.3 mL	0.50 oz / 13.1 g	1.51 oz / 40.5 g	1.92 oz / 50.6 g
1,000 gal / 4,000 L	1.23 oz / 36.9 g	2.46 oz / 73.8 g	3.70 oz / 111 g	0.92 fl oz / 28.6 mL	1.83 fl oz / 57.3 mL	2.75 fl oz / 85.9 mL	1.24 oz / 34.8 g	3.84 oz / 108 g	4.80 oz / 135 g
5,000 gal / 20,000 L	6.16 oz / 185 g	12.3 oz / 369 g	1.16 lb / 554 g	4.58 fl oz / 143 mL	9.16 fl oz / 286 mL	13.7 fl oz / 430 mL	6.20 oz / 174 g	1.20 lb / 540 g	1.50 lb / 675 g
10,000 gal / 40,000 L	12.3 oz / 369 g	1.54 lb / 738 g	2.31 lb / 1.11 kg	9.16 fl oz / 286 mL	1.15 pt / 573 mL	1.72 pt / 859 mL	12.4 oz / 348 g	2.40 lb / 1.08 kg	3.00 lb / 1.35 kg
15,000 gal / 60,000 L	1.16 lb / 554 g	2.31 lb / 1.11 kg	3.48 lb / 1.66 kg	13.7 fl oz / 430 mL	1.72 pt / 859 mL	1.28 qt / 1.29 L	1.16 lb / 522 g	3.60 lb / 1.62 kg	4.50 lb / 2.03 kg
20,000 gal / 80,000 L	1.54 lb / 738 g	3.08 lb / 1.48 kg	4.62 lb / 2.21 kg	1.15 pt / 573 mL	1.15 qt / 1.15 L	1.72 qt / 1.72 L	1.55 lb / 696 g	4.80 lb / 2.16 kg	6.00 lb / 2.70 kg

pH

To LOWER pH to desired value, add either dry acid (sodium bisulfate) or muriatic acid according to chart.

To RAISE pH to 7.5, add soda ash (sodium carbonate) according to chart.

Note:

An adjustment in pH can change total alkalinity. Recheck total alkalinity after pH adjustments.

* Sodium bisulfate percentage may vary. Adjust treatment amounts accordingly.

** Dosages calculated on the basis of pool water with the following values:

Total Alkalinity ~100 ppm CaCO₃
 Calcium Hardness ~200 ppm CaCO₃
 Total Dissolved Solids ~500 ppm
 Temperature ~75° F (24° C)

If actual values differ from these experimental values, dosages may need adjustment.

ALKALINITY DOSAGE CHARTS

Volume of Water (gallons / liters)	TO LOWER ALKALINITY USING DRY ACID (SODIUM BISULFATE, 93.2%)*	TO LOWER ALKALINITY USING MURIATIC ACID (20° BAUME/31.45% HCl)	TO RAISE ALKALINITY USING BAKING SODA (SODIUM BICARBONATE, 100%)
	Desired Change in ppm = 10 ppm	Desired Change in ppm = 10 ppm	Desired Change in ppm = 10 ppm
250 gal / 1,000 L	0.86 oz / 25.8 g	0.64 fl oz / 20.0 mL	0.56 oz / 16.8 g
400 gal / 1,500 L	1.37 oz / 38.6 g	1.02 fl oz / 29.9 mL	0.90 oz / 25.2 g
1,000 gal / 4,000 L	3.44 oz / 103 g	2.56 fl oz / 79.9 mL	2.24 oz / 67.1 g
5,000 gal / 20,000 L	1.07 lb / 515 g	12.8 fl oz / 399 mL	11.2 oz / 336 g
10,000 gal / 40,000 L	2.15 lb / 1.03 kg	1.60 qt / 799 mL	1.40 lb / 671 g
15,000 gal / 60,000 L	3.21 lb / 1.55 kg	1.20 qt / 1.20 L	2.10 lb / 1.01 kg
20,000 gal / 80,000 L	4.30 lb / 2.06 kg	1.60 qt / 1.60 L	2.80 lb / 1.34 kg

ALKALINITY

Charts are based on a decrease / increase of 10 ppm. To effect a 20 ppm change, multiply dosage by 2; for 30 ppm, by 3; etc.

To LOWER total alkalinity, add either dry acid (sodium bisulfate) or muriatic acid according to chart.

To RAISE total alkalinity, add baking soda (sodium bicarbonate) according to chart.

Note:

An adjustment in total alkalinity can change pH. Recheck pH after total alkalinity adjustments.

*Sodium bisulfate percentage may vary. Adjust treatment amounts accordingly.