Pool Maintenance Guide

TDS 179

Fill and Drain Rates

Swimming pools and fountains which have had tile and stone installed should be filled and drained at a prescribed rate of 1" (25mm) per hour. Following this prescribed fill rate will help to alleviate the rapid expansion of the pool walls due to the weight of the water, moisture expansion of the tile and thermal gradient variation. While the movement joints and sealant will accommodate most of the movement, they will be stressed during the fill period so a slow fill can help the movement joints better fulfill their intended purpose.

Initial alkalinity of pool water may be very high, due to exposure to plaster, grouts and mortars so careful and frequent balance of the pool water is required. The pool or fountain should not be filled if potential thermal gradients are present (e.g. very cold water source, pool exposed to direct sunlight for extended periods, etc…). Maintain a differential of 10°F (5.5°C) or less between the fill water and substrate temperatures during fill and drain cycles, and fill pool with water at rate of 2 ft. (600mm) per 24 hours to allow gradual exposure to water pressure, thermal and moisture differentials.

During the drain periods the slow rate will allow the movement joints and tile system to shrink back at a slower and safer rate. As the tile or stone, immersed in water for extended periods, dry out they will experience shrinkage movement due to the loss of moisture. The weight of the water in the pool goes down and the walls can shrink back due to the loss of pressure. The slow empty rate allows for a normal process to take place without damage to the pool or tile system. The slow drain rate also helps to prevent hydrostatic pressure from causing delamination of tile in pools without a waterproofing membrane.

NOTE: The prescribed fill and drain rate described above is recommended for pools, fountains and water features which have received a tile or stone installation. Filling or emptying these vessels which have received other finish types may not be necessary or recommended. Please check with the finish material manufacturer for their recommended fill and drain rates. While the prescribed rate of 1" (25mm) per hour may seem rather slow, damage caused by filling or emptying too quickly can be far more time consuming and costly than waiting a few days longer to properly fill the pool.

Opening and Closing Seasonal Swimming Pools and Water Features

Opening – Opening a swimming pool, depending on the climate, is an annual rite of spring for pool owners. The process of opening a swimming pool involves many different tasks and allows for routine inspection and maintenance to be performed.

For swimming pools in a northern climate, the list includes;

- Remove, clean and store the pool cover
- Test water balance, pH, calcium, cyanuric acid, and alkalinity levels
- Inspect electrical service, filters, ladders, diving boards, plugs, gauges, and other important components of the system
- Lubricate fittings, valves, o-rings, and plugs.
- Inspect tile and grout installations, and clean tiles and skimmer with cleanser.
- Clean and inspect pool deck
- Skim pool water surface and vacuum pool bottom

- Backwash filter if necessary
- Perform oxidation treatment as required by local code and facility operating procedures. This may include chlorine-based superchlorination or non-chlorine oxidation systems, depending on the pool's sanitation method.

Failure to inspect and correct any problems during the opening may result in downtime of the pool during the warmer season when the pool will be utilized the most.

For swimming pools in southern climates, where the pool will be open year-round, it is still necessary for an inspection and maintenance regimen to be followed. This will help keep the pool sanitary and safe for the users and prevent significant down time due to improper upkeep. In many cases a professional pool maintenance company is utilized to make sure that the pool is running efficiently, the pool mineral and chemical levels are properly maintained, and that the entire pool system is working correctly.

Closing – Closing a pool for the winter is also a common sight in cold weather climates. The process of closing a pool is just as important to the long-term performance of the pool as the opening. Some of the steps to closing the pool properly typically include (check local guidelines for proper pool closing requirements);

- Balance pool water chemistry, typically to the following levels;
    - pH: 7.2 – 7.6
    - Alkalinity: 80 – 120 parts per million (ppm) [80 – 120 mL/L]
    - Calcium Hardness: 180 – 220 ppm
- Remove skimmer baskets, cleaners, ladders, wall fittings, and solar blankets from the pool
- Lower the water level in the pool to below the skimmer level
- Drain all pumping, filtering, heating, and sanitizing equipment to prevent damage caused by freezing
- Lubricate o-rings, valves and plugs to make opening the pool in the spring easier
- Clean and vacuum the pool
- Winterize the plumbing by blowing out the lines and plug the lines with expansion plugs
- Add winterizing algaecide
- Cover the pool with a tight fitting cover

In warmer climates many people simply reduce the amount of filtration times per day and also find that the pool requires fewer chemicals. As the use of the pool decreases, the opportunity to inspect and provide maintenance to the pool increases.

NOTE: It is important to note that swimming pools and water features which are in use year round also require the same regular attention and maintenance as seasonal swimming pools and water features.

Water Treatments and Tile Installations

Water Chemistry – Water, by itself, is rarely free of harsh minerals and various chemicals or contaminants (e.g. bacteria, ammonia, living organisms, and other pollutants). Some of these contaminants are evident in the water used to fill the pool, some come from certain environmental factors, and others result from pool chemistry. The fact is that the majority of these minerals and impurities must be eliminated from your pool. To do this requires the addition of certain chemicals to combat the undesired effects caused by the contamination, and to have the proper amount of minerals to achieve "balanced water". Alkalinity, pH, and hardness are your water balancers and are responsible for creating optimal water chemistry. If these levels are within their desired ranges, if water circulation is adequate, and a proper maintenance program is followed, the result will be clean, clear sparkling blue water.

When water is considerably less than saturated (minerals) it is said to be in a corrosive or aggressive condition. When water is over saturated and can no longer hold the minerals in solution it is in a scaling condition. Balanced water is that which is neither over-saturated nor under-saturated. Water which is under saturated will attempt to saturate itself by dissolving everything in contact with it in order to increase its own mineral content. Water which

is over saturated will attempt to rid itself of this content by precipitating minerals out of solution in the form of scale. This gives a whole new meaning to the phrase “water seeks its own level”.

Once water chemistry is balanced, though, it can be lost within 24 hours. Maintaining proper water balance requires constant monitoring, testing and chemical additions. Unfortunately, water chemistry balance is not as easy as adding one pound of treatment every other day; it requires knowledge, good record-keeping, patience, and dedication to keep the pool functioning properly and the users of the pool safe.

To get a better understanding of pool water balance we will look at several aspects of water treatment;
Sanitizers – a pool sanitizer and its accompanying shock is commonly referred to as a sanitizer, a disinfectant or an oxidizer, but, these products must be able to able to perform all 3 tasks.

- Sanitizing – killing all bacteria, living organisms and other contaminates that are present in water;
- Disinfecting – kills all potential disease-carrying capabilities of these bacteria, living organisms and other contaminates
- Oxidizing – oxidizes any ammonia that is present in the pool due to environmental factors, fertilizers blowing into the pool, or swimmer waste (e.g. urine, saliva, perspiration, suntan lotions, saliva, body oils, etc…). Ammonia is usually only oxidized using a pool shock suitable for use with the sanitizer being used in the pool.

There are currently several methods for sanitizing pools, fountains and water features;

Chlorine – Chlorine is the most commonly used pool sanitizer in the industry today. Chlorine will take a leadership role in sanitizing, disinfecting and oxidizing when present in any water. Unfortunately, it is not as easy as adding chlorine to your pool from time to time, expecting the water to stay crystal clear and sparkling. The chlorine levels must be monitored on a continual basis based on environmental conditions (e.g. temperature, humidity, sunlight, rain, wind, and evaporation) and bather load. Failure to do so can cause the water to turn murky and green with the growth of algae.

For a better understanding of chlorine and how it works we will look at some terminology regarding this type of chemistry;

- Chlorine Demand – the amount of chlorine needed to kill bacteria, living organisms and other pollutants in the water.
- Free Chlorine – the chlorine not presently being used to kill bacteria, living organisms or other pollutants in the water.
- Chloramines – formed when chlorine combines with ammonia in pool water. Chloramines are ineffective at sanitizing, disinfecting and oxidizing pool water.
- Total Chlorine – the combined reading combination of Free Chlorine and Chloramines.

Chlorine levels are measured on two scales; Total Chlorine and Free Chlorine. The results of testing for Total Chlorine tells you when to shock the pool to get rid of excess chloramines and ammonia, and, the test results for Free Chlorine tells you when to add chlorine to the pool. When chlorine is added to water, a dissociation occurs. In other words, Cl_2 (chlorine) + $2H_20$ (water) = HOCl (hypochlorous acid) + HCl (hydrochloric acid). Hypochlorous acid is the active by product of this reaction that is responsible for killing bacteria, living organisms or other pollutants in the pool water. The chlorine molecule or ion kills microorganisms by entering through cell walls and destroying inner enzymes, structures and processes. When this occurs the cell is effectively deactivated or oxidized. The hypochlorous molecule or ion continues working until it combines with a nitrogen or ammonia compound, becoming a chloramine, or is broken down into its component atoms, becoming deactivated itself.

Chlorine is available in many forms for use in a swimming pool;

- Granular Chlorine – Granular chlorine has many advantages; it is fast dissolving, typically has 63% available chlorine, contains cyanuric acid, has a long shelf life, has a pH level of 6.8 (fairly close to the desired level),

does not add any by-products to the water, and can be used both for sanitizing and shocking. Disadvantages include a cost higher than chlorine tablets and less available chlorine than tablets.

- Chlorine Tablets – easily the most common form of chlorine sold for pool treatments. Chlorine tablets contain about 90% available chlorine, possess cyanuric acid, have long shelf life, and are less expensive than granular chlorine. The disadvantages are few and are easily corrected. Chlorine tablets have a pH between 2.8 – 3.0, which can lower the pH level in the pool water. If the pH level is not monitored and corrected often then degradation of metal in the pool, as well as cement based tile and stone installation materials (e.g. grout) can occur.
- Liquid Chlorine – Liquid chlorine is inexpensive, easy to use, and begins working immediately after it is added to the pool or fountain. Disadvantages include the fact that liquid chlorine provides only about 12 – 15% available chlorine which can be exhausted quickly due to exposure to sunlight and a short shelf life. The use of liquid chlorine may also add unwanted salts to the pool water (a result of the production process of the liquid chlorine).
- Chlorine Gas – Chlorine gas is reasonably inexpensive, provides 100% available chlorine and adds no by-products to the pool water. This form of chlorine is rarely used in swimming pools mainly because of its one significant disadvantage – if misused, chlorine gas is deadly. Chlorine gas is difficult to handle, making misuse easy.

Cyanuric acid is a necessary addition to any pool treated with a chlorine product. Chlorine tablets and granular chlorine are *Cyanurates*, which simply means they contain cyanuric acid. Typically sold as either "Conditioner" or "Stabilizer", cyanuric acid protects chlorine from being destroyed by sunlight. Cyanuric acid needs to be added whenever a pool is drained, cleaned and refilled because tap water contains almost none of this chemical. The recommended range for cyanuric acid is 30 – 80 ppm (30 – 80 mL/L) with a maximum of 100 ppm. If the level of cyanuric acid rises above 100 ppm the only way to achieve a suitable reading is to drain the pool completely and refill with new water. Cyanuric acid has a pH of 4.0, so if the pH level is not monitored and corrected often then degradation of metal in the pool, as well as cement based tile and stone installation materials can occur.

Bromine – Bromine is an effective alternative to chlorine that comes in both tablet (far more commonly used) and granular forms. Bromine is far more stable at higher temperatures, and, as such, is used more often than chlorine to sanitize, disinfect and oxidize spas. Due to the presence of ammonia in pool water, bromamines (like chloramines) will be present in pool water. But, unlike chloramines, bromamines are at least marginally effective at assisting in sanitizing, disinfecting and oxidizing the water. Unlike chloramines, bromamines will breakdown by themselves but they should be removed from the water by regular shocking to maintain a stable water environment.

The main drawback of bromine, coupled with its non-chlorine shock, Potassium Peroxymonosulfate (required to get rid of ammonia and bromamines), is its expense. Bromine is more expensive than chlorine and only equally effective at producing results. Another drawback is that it will be destroyed by sunlight and that it cannot be protected by the use of cyanuric acid. Bromine has a pH of 4.0, therefore, constant monitoring of the pool water will be necessary to avoid possible problems caused by low pH (acidic).

Bromine by itself, cannot oxidize. In other words, to be effective, bromine requires a catalyst; and the catalyst is often chlorine. The tablet mixture is typically around 60% bromine, 28% chlorine and 12% inert ingredients. Bromine levels should be maintained at 2.5 – 4.0 ppm (2.5 – 4 mL/L) with an industry accepted minimum level of 2.0 ppm (2.0 mL/L). It is best to add bromine when the level reaches 2.5 to avoid any potential problems.

Ozone – In its natural state, ultraviolet (UV) light from the sun converts oxygen molecules into ozone molecules. Ozone is the earth's natural purifier and cleaner; and this fact makes it a perfect choice to assist in the sanitization of swimming pool water. Ozone is a supplement to be used with chlorine or bromine to fully sanitize the pool water. In combination the end result is crystal clear, sparkling water at a fraction of the cost of using chlorine and bromine alone. In fact, ozone has been proven to purify, clean and sanitize pool water faster and more effectively than traditional chlorine or bromine alone.

When used in conjunction with chlorine or bromine, ozone will kill or get rid of all bacteria, living organisms, ammonia, swimmer wastes, algae, dirt, debris, and other contaminants virtually on contact. This is done with no odor and without leaving any by-products in the water, other than oxygen.

The ozone sanitizing process works by placing an ozonator in-line with the pool circulation equipment after the filter. Water flows through the pump and passes through the filter where any dirt, debris or particles are trapped. The water continues through the heater (if present) and then through the ozonator where the water will be exposed to a specific wavelength of UV light. The UV light converts oxygen molecules into ozone molecules where the water is cleaned naturally.

Salt-Water – (Salt Chlorine Generation)

Saltwater pool systems sanitize water through an electrolysis process that generates chlorine from dissolved salt. These systems consist of three primary components: salt dissolved in the pool water, a salt cell containing electrically charged plates, and a control unit that regulates chlorine production.

Although saltwater pools are often perceived as "saltwater" environments, they are not equivalent to seawater. Ocean water contains extremely high salt concentrations, while saltwater pools operate at significantly lower salt levels and are classified as freshwater systems. At typical operating levels, saltwater pool water does not taste salty and is generally considered comfortable for bathers.

In a saltwater pool system, pool water passes through the salt cell, where an electrical current is applied across a series of plates. This process, known as electrolysis, separates sodium chloride into its basic components and produces free chlorine, which provides sanitization. The control unit regulates chlorine output by adjusting the duration and intensity of electrical current applied to the salt cell, allowing the system to maintain required sanitizer levels during normal operation.

Salt concentration, operating range, and maintenance procedures must be maintained strictly in accordance with the salt system manufacturer's requirements and applicable local or state health department codes. Generic salt concentration values should not be substituted for manufacturer specifications, as improper salt levels can impair system performance, shorten equipment life, or violate regulatory requirements.

Saltwater systems do not provide rapid oxidation capability. When elevated sanitizer demand occurs, such as during heavy bather loads or contamination events, supplemental oxidation may be required. This is typically accomplished using chlorine-based superchlorination or other oxidation methods permitted by local code and facility operating procedures. Because chlorine generated by saltwater electrolysis is still chlorine, stabilizer (cyanuric acid), where permitted by code, may be required and must be maintained per local regulations and pool water specialist guidance.

Saltwater systems inherently increase Total Dissolved Solids (TDS) in the pool water due to the presence of dissolved salt and the by-products of ongoing chemical additions. Elevated TDS alone does not necessarily indicate poor water quality; however, improper control of pH, total alkalinity, calcium hardness, or overall saturation balance can increase the risk of scale formation, efflorescence, and deterioration of cement-based finishes.
From a tile and stone installation perspective, saltwater pool environments require careful attention to water balance and material selection. Improperly balanced water chemistry can contribute to mineral deposition, surface scaling, and chemical attack on cementitious materials. Regular inspection of tile, grout, sealant, and exposed finishes is essential, particularly in saltwater pools where elevated TDS and electrochemical activity may accelerate visible symptoms of imbalance.

Maintaining proper water balance, following salt system manufacturer requirements, and complying with applicable local health department codes are critical to the long-term performance of the pool, its equipment, and the tile and stone installation system

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Mineral Balance – When discussing minerals in water chemistry the reference is usually to the presence of copper, iron, calcium, manganese, and magnesium, as well as various other minerals. Water is a solvent, in fact, it is often

referred to as the universal solvent. As a solvent, when water chemistry is out of balance, water will dissolve any metallic material that it comes in contact with to satisfy its own needs for certain minerals and to achieve saturation point. After achieving saturation point, water will rid itself of any excess dissolved material (also known as the precipitation point of water). In fact, water has the ability to dissolve, corrode, stain, scale, or calcify any surface in your pool in which the water comes in contact. This list of surfaces includes walls, floors, ladders, handrails, light fixtures, internal pump and filter parts, grout, adhesives, and stone. The fact that water is extremely volatile and must be kept under close supervision is critical to the long term performance of any pool system. The effects of improper mineral (metal) balance can also lead to colored water, stains and the formation of scale.

Measurement of pool chemicals and minerals utilize parts per million (PPM) as their reading and pH is measured using the pH scale.

Chemical	Minimum	Ideal	Maximum
Chlorine	1 ppm (0.001 mL/L)	2 - 3 ppm (0.002 – 0.003 mL/L)	4.0 ppm (0.004 mL/L)
Cyanuric Acid	25 ppm (0.025 mL/L)	30 - 80 ppm (0.03 – 0.08 mL/L)	100 ppm (0.1 mL/L)
Bromine	2 ppm (0.0002 mL/L)	2.5 - 4 ppm (0.0025 – 0.004 mL/L)	5 ppm (0.005 mL/L)
Total Alkalinity	60 ppm (0.06 mL/L)	80 - 120 ppm (0.08 – 0.12 mL/L)	180 ppm (0.18 mL/L)
Calcium Hardness	150 ppm (0.15 mL/L)	200 - 400 ppm (0.25 – 0.4 mL/L)	1000 ppm (1.0 mL/L)
Total Dissolved Solids	NA	NA	Shall not exceed 1500 ppm*
Cyanuric Acid	0 ppm (0 mL/L)	0 ppm (0 mL/L)	0.1 ppm (0.0001 mL/L)
pH	7.2	7.4 - 7.6	7.8

* Total Dissolved Solids (TDS) should be evaluated relative to source water quality and the pool's sanitation system. For modern pools, including saltwater systems, TDS is commonly managed as the source water baseline plus an allowable increase established by local code, equipment manufacturer requirements, and pool water specialist guidance.

Saltwater pools will inherently operate at higher TDS levels due to salt content. Elevated TDS alone is not necessarily problematic; however, excessive TDS may reduce chemical effectiveness and should be evaluated by a qualified pool water professional

pH - Although a pH of 7.0 is considered "neutral" for everyday water, it is not ideal for pool water. The ideal pH range for pool water is 7.2 - 7.8, which is slightly alkaline. Therefore, for a swimming pool, the pH scale has to be revised:

- A pH level between 1.0 - 7.19 will be considered acidic
- A pH level between 7.2 - 7.8 is ideal for a pool.
- A pH level between 7.81 - 14.0 will be considered alkaline

pH can be raised or lowered with the addition of certain chemicals. Sodium Bisulfate is commonly used to reduce pH and Sodium Carbonate is commonly used to raise pH.

Alkalinity – Alkalinity is often confused with pH as a unified and singular water-balancing chemical. While alkalinity has a definite affect on pH, they are certainly not the same. A pH test will show the acidity or alkalinity of water, while the Alkalinity test will show the quantity of alkaline material in the water. Some alkaline material is required in the water to maintain proper water chemistry. Both pH and Alkalinity play a role in achieving and maintaining water chemistry; therefore, both must be adjusted on a regular basis. It should also be known that the Alkalinity level must be adjusted first and then the pH. This is because Alkalinity acts as a buffer for pH; if Alkalinity is in range, the pH is far less likely to fluctuate.

Hardness – The Hardness of pool water is related to Alkalinity. Hardness measures the amount of certain minerals which are present in pool water. Hardness typically gets into the water from the source where water can come into contact with different minerals. If the minerals are easily dissolved, then the Hardness level will be high. Concurrently, if the minerals are not easily dissolved then the Hardness level will be low.

Typically, Hardness levels should be maintained between 200 – 450 ppm (0.2 – 0.45 mL/L) with a maximum of 500 ppm (0.5 mL/L). Maintaining Hardness levels within the accepted range is important and levels too high or too low can lead to a variety of problems. If the Hardness level gets too low these problems may occur;

- Dissolved metallic parts of your pool
- Stained and etched concrete or cement products in your pool (including cement based grout)
- Stained liner in vinyl-lined pools
- Blistering or delamination of fiberglass in fiberglass pools
- Minimizes the effects of chlorine or bromine
- Foam
- Eye and skin irritation

If the Hardness level in a pool is too low, it can be raised with the addition of Calcium Chloride.

If the Hardness level gets too high the following problems can occur;

- Cloudy water
- Scale formation (heavy metal minerals in suspension which form deposits on interior pool surfaces)
- Poor filtration (caused by scale build up in plumbing which restricts water circulation)
- Minimizes the effects of chlorine
- Eye and skin irritation

If the hardness level is too high then lowering it should be done immediately, however, it is not possible to lower the Hardness level with the addition of a chemical or treatment. The Hardness level can only be lowered by draining the pool, either partially or completely.

Metals - Metals can be introduced into the pool or spa from source water at the time of filling and through subsequent water replacements, or, can come from metal fixtures located in the pool or water treatment algaecides. Pool maintenance personnel should test the source water prior to filling the pool to determine initial levels of metals. The use of a Metal Sequestering Agent is recommended to rid the water of the excess minerals which lead to elevated Hardness levels.

Metal	Sources	Colors	EPA Limits
Copper	Copper algaecides, ionizers, corrosion of copper pipes, fittings and heaters	Blue, green, blue/green, black, dark red, purple, or teal	1.0 ppm
Iron	Source water, corrosion of iron pipe and fittings	Dark red, brown, black, gray or green	0.3 ppm
Manganese	Source water	Pink, red, black, or red	0.05 ppm

Total Dissolved Solids (TDS) – Total dissolved solids is a measurement of the total amount of matter (minerals, chemical residue and other particles) that remain in water after evaporation. As water evaporates, only the water itself evaporates while the particulate matter remains in the pool water. It is necessary to replace water lost to evaporation with tap water, or other source, as well as additional chemicals. This new addition of water and chemicals will increase the TDS in the water.

This process will continue for extended periods and the TDS will continue to rise. However, if the amount of solids in the pool water gets too high then the particulate matter will acts as a sponge and minimize the effects of new pool chemicals added to the water. Typically, it takes 6 – 8 years for the TDS level to reach a critical level, and the

only way to correct the problem is to empty water from the pool and replace with new water. TDS should never exceed 1,500 ppm.

If the Total Dissolved Solids get too high, the following indicators or problems may occur;

- Continual addition of excess chemicals
- Water chemistry tests fine but water is not clean and sparkling (water has an unusual appearance, but you can still see the pool bottom)
- Algae growth despite a good chlorine reading and pool water chemistry
- Varying and false readings on chemical tests

Langelier Saturation Index (LSI)

The Langelier Saturation Index is an indication of the calcium carbonate solubility of the pool water and its effect on pool surfaces and equipment. In swimming pools, the LSI should be maintained between a minimum of -0.3 and a maximum of 0.5, and ideally between 0.0 and 0.5. The LSI is used to predict the tendency of the pool water to form calcium scale, or its ability to etch plaster, concrete and cementitious grout. There may also be an indirect impact on corrosion of metal surfaces. Values below 0.0 indicate a net ability to be corrosive, while values above 0.0 indicate a tendency to scale.

The Langelier Saturation Index (LSI) is commonly used as a screening tool to evaluate the scaling or corrosive tendency of pool water. Manual LSI formulas are approximations and may not account for modern water chemistry variables such as cyanuric acid correction, elevated TDS, or saltwater systems.

Current best practice is to use digital LSI calculators or pool water management software and to follow guidance from a qualified pool water professional and applicable local health department requirements when establishing acceptable ranges.

The Langelier Saturation Index formula is **LSI = pH + TF + AF + CF – 12.1**. The 12.1 is a constant applied when Total Dissolved Solids (TDS) is between 0 and 1,000 ppm. When TDS is greater than 1,000 ppm consult with your local pool water specialist or refer to ANSI/APSP-11 2009 for more information.

Temperature		Total Alkalinity†		Calcium Hardness	
°F	**TF**	ppm	**AF**	ppm	**CF**
32	0.0	25	1.4	25	1.0
37	0.1	50	1.7	50	1.3
46	0.2	75	1.9	75	1.5
53	0.3	100	**2.0**	100	1.6
60	0.4	125	2.1	125	1.7
66	0.5	150	2.2	150	1.8
76	0.6	200	2.3	200	1.9
84	**0.7**	250	2.4	250	2.0
94	0.8	300	2.5	300	2.1
105	0.9	400	2.6	400	**2.2**
		800	2.9	800	2.5

Use the reading closest to your actual reading in choosing the factor.

† Total alkalinity in this context refers to the total of carbonate and bicarbonate alkalinity. If cyanuric acid is used, a correction factor must be used (refer to local pool water specialist for the cyanuric acid correction factor).

Source: ANSI/APSP-11 2009

For example: The Langelier Saturation Index of pool water (without cyanuric acid correction factor) with a pH of 7.6, a temperature of 81°F (TF), Total Alkalinity (AF) of 100, and Calcium Hardness (CF) of 400 is calculated as **LSI = 7.6 + 0.7 + 2.0 + 2.2 – 12.1 = 0.4.**

Pool Water Chemistry and How It Affects Tile or Stone Installations

Maintaining pool water chemistry at proper levels is extremely important, not only to the owner and users of the pool, but also to the tile or stone installation or plaster located in the pool. Pool water, which is out of balance, can be unhealthy, unsightly, as well time consuming and expensive to correct. Correcting any problems with pool chemistry can take the pool out of use for a period of time until the proper balance is achieved to ensure the safety and well-being of the pool users.

Tile and stone installations may also be affected by pool chemistry. A big difference between correcting the pool water chemistry and fixing the tile or stone installation is how long the pool may be out of commission to make repairs. Let's look at how pool water chemistry can cause problems with a tile or stone installation;

The pH of pool water should be between 7.2 and 7.8 on the pH scale. If the pH level gets too low, then any cementitious material within the pool can be affected. Portland cement is reactive when exposed to acids and this exposure can have a deteriorating affect on the concrete or cement based product (e.g. grout, plaster, gunite). While the level of acidity is usually not very strong, there can be cumulative effects if the problem is not treated promptly or repeats over periods of time. If the pH of the pool is too low (acidic) the effects on the tile or stone installation can be;

- Etched cement based grout or plaster
- Cement based grout or plaster erosion
- Blotchy cement based grout or plaster
- Fading cement based grout color
- Calcite loss in marble and limestone (loss of stone surface material)
- Calcium loss in portland cement based installation materials which can lead to weakening and erosion of materials.
- Stains on horizontal grout or plaster

If the pH of the pool water gets too high (alkaline) the effects on the tile or stone installation can be;

- Scale formation on pool walls and floor
- Greater potential for algae growth

If the Total Alkalinity and/or Total Hardness of the pool water get outside of their specific ranges there could be an effect on a tile or stone installation. If the Alkalinity or Hardness gets too low the effects on tile or stone can be;

- Staining and etching of cement based grout or plaster
- Stains (in the stone and/or grout) caused by dissolving metallic components of the pool

A problem resulting from Alkalinity and/or Total Hardness of the pool water being too high can lead to this effect on the tile or stone installations;

- Scale formation on pool walls and floors

Pool water balance issues are very common in public pools and water features. The use of epoxy based grouts and setting material is a great choice to help overcome some of these potential issues. Epoxy materials will not be affected by the etching or erosion problems inherent in cement based products by pH, alkalinity and hardness imbalance. LATICRETE recommends the use of SPECTRALOCK® PRO Premium Grout* for all submerged pool, fountain, spa, or water feature installations. SPECTRALOCK PRO Premium Grout utilize non-pigmented technology which means that the grout will not become blotchy or fade due to imbalanced pool water chemistry.

LATAPOXY® 300 Adhesive or LATAPOXY BIOGREEN™ 300 will provide the ultimate in adhesive performance in submerged installations. Providing incredible bond strength and high chemical resistance, LATAPOXY 300 Adhesive or LATAPOXY BIOGREEN™ 300 are the products of choice for direct bond installations in pools and spas with steel or fiberglass shells.

Tile Installation Maintenance and Repairs

It will be necessary, from time to time, to inspect the pool for possible problems with plumbing, lighting, fixtures, tile or stone, and fittings/connections. Improper water balance and exposure to chemicals can lead to potential problems with these installations so routine inspection is required. During some of these inspections, repairs and water balancing treatments it will be necessary to drain the pool.

Replacing tile, stone or grout should only be attempted when a pool is drained and sufficiently dry to accept a tile or stone installation. There should be no repairs or replacement attempted while submerged. To replace any tile, stone or grout in a pool, fountain, water feature or spa the use of any of the LATICRETE materials listed in the LATICRETE Tiled Swimming Pools, Fountains and Spas Technical Design Manual - Section 7 can be used for the particular substrate in question. After repairs are made, allow for an ample amount of time for the tile setting materials (e.g. thin-set, grout, sealant, etc...) to fully cure prior to filling the pool at the prescribed rates as stated earlier.

NOTE: Do not use acidic-based cleaners on LATICRETE® grouts or other LATICRETE® system materials at any point during installation, curing, or prior to filling the pool with water. Neutral pH cleaners, such as STONETECH® Stone & Tile Cleaner, should be used for routine maintenance of tiled pools and water features.

This Technical Data Sheet provides general guidance on pool water behavior and its interaction with tile and stone installation systems. It is not intended to establish water chemistry limits or treatment procedures for swimming pools, fountains, water features, or spas. All water chemistry targets, operating parameters, and maintenance practices must be established and verified by the Authority Having Jurisdiction (AHJ), applicable local and state codes, and a qualified pool water professional familiar with the specific pool and geographic conditions.

For industry resources and reference publications, consult the Pool & Hot Tub Alliance (PHTA) at www.phta.org

* United States Patent No.: 6,881,768 (and other Patents)

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LATICRETE International, Inc ■ One LATICRETE Park North, Bethany, CT 06524-3423 USA ■ Tel 1.203.393.0010 ■ Toll Free 1.800.243.4788 ■ Fax 1.203.393.1684 ■ laticrete.com