Customer Name	Joe Q. Customer	Sample No.	HZ100
Collection Date	2/16/2018	Lab Technician	K.Brooks

	Test Performed	Test Results	Possible Ranges: Unacceptable	Low	Ideal	High	Unacceptable	Comments
	Alkalinity		< 125	125	**137**	150	> 150	Slightly low; more difficult to control pH level. Add pH/Alkalinity UP (sodium hydrogen carbonate)
1	Total alkalinity (TA as $CaCO_3$)	120 mg/L	120					
	Hardness (mineral content)		< 150	150	**175**	200	> 200	Low; add calcium hardness increaser.
2	Total hardness (as $CaCO_3$)	120 mg/L	120					
	Potential for Hydrogen (pH)		< 7.4	7.4	**7.5**	7.6	> 7.6	High; too alkaline. First correct alkalinity levels, then retest water. If still high, then add pH/Alkalinity DOWN (sodium bisulfate)
3	Sample pH	8.4					8.4	
4	Sample temperature	19.7 °C						
	Total, Free, and Combined Chlorine		< 1.0	1.0	**2.0**	3.0	> 3.0	No FC; SPA is unsanitary and unsafe for use. Add granulated sodium dichlor in accordance with manufacturers instructions
5	Free chlorine (FC)	0.0 mg/L	0.0					
6	Combined chlorine (CC)	0.2 mg/L	CC and TC are dependent variables (FC=TC-CC)					
7	Total chlorine (TC)	0.2 mg/L						

I hereby certify these test results to be accurate within the tolerances of the test equipment and procedures used. Samples were handled, stored, and tested in accordance with approved ORMECO laboratory procedures and quality assurance program.

Kevin Brooks

Digitally signed by Kevin Brooks
DN: cn=Kevin Brooks, o=ORMECO, ou, email=kevin.brooks@usormeco.com, c=US
Date: 2018.02.25 17:22:00 -05'00'

Technician, Level II *Date*

All tests were performed by a properly trained lab technician, qualified under an ORMECO program that follows the American Society for nondestructive testing (ASNT), Recommended practice No. SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing.*

Understanding your test results

ORMECO technicians performed a four-panel water chemistry test on your submitted sample. These tests are designed to characterize your current water chemistry, particularly when obtaining baseline chemistry is necessary. Although we include suggestions for how to adjust your water chemistry, you are strongly encouraged to follow guidance published by your pool or SPA manufacturer in determining how best to interpret your test results.

Alkalinity

Alkalinity is important to water quality, as it determines the ability of water to neutralize acids and resist changes in pH level. For example, knowing the alkalinity of a stream or pond will indicate how well the water can neutralize acidic pollution or runoff. For pools and spas, stable alkalinity is vital, because pH cannot be properly controlled if alkalinity is unknown or is outside the tolerance recommended by the manufacturer. If your pH is too low, you will likely see large swings in the pH level; if too high, pH will also read high and you will have trouble lowering it.

Total alkalinity (TA) must be determined before any changes are made to pool or SPA water chemistry. TA is the sum of all titratable bases. It is determined by titrating sulfuric acid into the sample until all alkaline compounds in solution are neutralized. The alkalinity is then calculated and reported in terms of mg/L of $CaCO_3$.

For the high range test, ORMECO technicians added a phenolphthalein indicator to the water sample. Sulphuric acid was then used as a titrant to determine the phenolphthalein alkalinity in terms of total hydroxide and one-half the carbonates in the sample. Next, Bromcresol Green-Methyl Red indicator was added, and a second titration performed. The resulting value quantified the methyl orange alkalinity in terms of $CaCO_3$. Total alkalinity (TA) is a measure of all carbonate, bicarbonate, and hydroxides in the sample solution.

Our tests show that your alkalinity is slightly low. We suggest you add granulated dichlor to the water in accordance with the original equipment manufacturers (OEM) instructions. Unless otherwise directed by the OEM, your target alkalinity range is between 1.0 and 3.0 mg/L $CaCO_3$. Correct your alkalinity before attempting to correct other water chemistry deficiencies.

Total Hardness

Calcium and magnesium ions (Ca^{2+} and Mg^{2+}) and are responsible for causing water hardness. Water, being an excellent solvent, readily dissolves minerals; these are then held in solution. This mixture of hard water and dissolved carbonates eventually forms an insoluble precipitate, which is then deposited on the interior surfaces of pipes and heating appliances. In time, these deposits often cause significant blockage and therefore pressure drop, particularly in pipes. In the home, magnesium and calcium ions mix with soapy water, forming insoluble salts which then precipitate out as soap scum on the surfaces of bathtubs and sinks.

The following table shows the various ranges of hardness in terms of mineral content. Note: these values will vary, depending upon the reporting agency or organization. ORMECO adopts values reported by the Water Quality Association (WQA), which are established by the American Society of Agricultural Engineers (ASAE), standard S-339.

Hardness Scale		
Grains per gallon (gpg)	mg/L (ppm)	Classification
< 1.0	< 17.0	Soft
1.0 – 3.5	17.1 – 60	Slightly Hard
3.5 – 7.0	60 – 120	Moderately Hard
7.0 – 10.5	120 – 180	Hard
> 10.5	> 180	Very Hard

For your sample, drop titration was used to determine relative hardness based on the presence of calcium ions (Ca^{2+}). Because calcium is responsible for much of water hardness, magnesium content is ignored. ORMECO reports hardness in terms of calcium carbonate.

We used a chelating agent, Ethylenediaminetetraacetic acid, or EDTA as a titrant to determine your water hardness. This reagent readily forms bonds with metal ions, creating stable coordination compounds; the formation of these compounds is engineered to be selective to carbonate ions, making it possible for us to measure your water hardness.

For these tests, we added a buffer solution (2-Amino-2-methyl-1-propanol) and a hydroxylamine hardness indicator to your water sample. We then titrated using EDTA; using the titration data, the amount of carbonate ions present was determined mathematically. The test results and the required range of hardness appears on the test report, along with suggestions for how to correct any improper levels.

Our tests show that your water is hard, but too soft for the SPA. We suggest you add calcium hardness increaser to bring the hardness within normal OEM tolerances. If water is too soft, corrosion and staining of the walls will begin to occur. Correct your hardness level before attempting to correct other water chemistry deficiencies.

Potential for Hydrogen (pH)

pH is a unitless scale that quantifies relative acidity or alkalinity of your water sample; it is a logarithmic scale that ranges from 0 – 14, with a pH of 7 being neutral. Values below a pH of 7 are acidic; those above 7 are basic. Drain cleaners, bleach and similar solutions are basic; sodas, fruit juices, and vinegars are acidic. Because the pH scale is logarithmic, each division represents a 10-fold change in pH. For example, a pH of 8 is 10x more alkaline than a pH of 7. In terms of pools and SPAs, pH is important because it reveals changing chemical conditions of the water. If pH is too low, the acidity of the water degrades the effectiveness of chlorine; it will also corrode metal pipes. If pH is too high, chlorine is similarly degraded, and scale will start to form inside pipes and other wetted surfaces. ORMECO performs temperature-compensated pH measurements using calibrated instrumentation. The test results and the required pH range appears on the test report, along with suggestions for how to correct any improper levels.

Our tests show that your pH is too alkaline. Within this pH range, you may experience water cloudiness, ineffective chlorination levels, scale formation, and troubles with your filter media. We suggest you add pH/Alkalinity DOWN (sodium bisulfate) to bring the pH within normal OEM tolerances.

Total, Free, and Combined Chlorine

When mixed with water containing microorganisms, chlorine has three distinct forms: free, combined, and total; each of these are related mathematically such that

Total Chlorine (TC)=Free Chlorine (FC)+Combined Chlorine (CC)

Free chlorine is the amount of the substance still available for sanitization purposes. On the other hand, combined chlorine is the amount of the substance that is already reacted with ammonia and nitrogen in the water; substances that are byproducts of the biological degradation of organic matter in the water. CC is already consumed and no longer useful for sanitization.

Once the amount of combined chlorine is known, a process called super-chlorination (or overdosing) is used to restore proper levels of free chlorine to ensure properly sanitized pool or SPA water. In fact, a tenfold increase in free chlorine is typically required to offset combined chlorine levels.

To test your water sample, ORMECO technicians used a chemical called N,N Diethyl-1,4 Phenylenediamine Sulfate (DPD) in conjunction with a process called color comparison. The test results and the required range of chlorination appears on the test report, along with suggestions for how to correct any improper levels.

Our tests show that your water is unsanitary; the SPA should not be used until water chemistry is corrected. Bacteria, viruses, and other unwanted organisms can grow within your water. We suggest you add granulated sodium dichlor to increase the free available chlorine (FAC) in your water, then follow the OEM recommended water treatment program.