Palintest pool & spa

Spa Chemistry Guide

Contents

Introduction

This Palintest Spa Chemistry booklet will go over all the necessary parameters that you may wish to test for, the frequency of testing, and the multiple testing methods available to you.

The information in this guide collates industry best practice but we always recommend you seek advice on the local regulations from your local advisory board.

Spa Health & Safety Guidance

Spas tend to have a higher ratio of bathers to water volume in comparison to swimming pools. This increases the risk of contracting diseases from the water. The highest risk is from spas that are either poorly designed or not well maintained. Key advice for a healthy spa is;

- Bather numbers should not exceed the number of seats or stated bather load.
- In commercial settings, specifically holiday lets, the hot tub should be completely drained, cleaned, refilled and disinfected weekly or after each rental.
- When refilling a hot tub, sufficient hypochlorite should be added to keep the chlorine residual at 5.0 mg/L.
- Regular cleaning and replacement of cartridge filters where applicable.
- During commissioning, or after a hot tub has been left empty or unused, it should be shock dosed with chlorine at 50 mg/L for 1 hour, with the pH maintained between 7.0 - 7.4, and then fully drained.
- Follow a suitable water treatment programme.

Why do we test the water?

Every user of the spa has a right to feel safe and comfortable whilst bathing. This doesn't just mean the physical safety and comfort, but the water should also be tested to make sure it is suitable for people to bathe in. There are four main reasons for water testing:

- Bather safety and comfort
- Removal of contamination
- Care of plant and spa surrounds
- Control of chemicals used

Failure to test the water correctly can easily lead to bather illness, irritation or problems with the spa, so a regular testing procedure should be drawn up and followed.

Parameter Testing

The number of parameters tested in a spa or hot tub tends to be less than that found in a pool. However, as spas tend to be a smaller pool of water, it is important that you follow a correct testing regime.

Disinfectant

Normally bromine is used to disinfect spa water as it's more effective at higher temperatures. However, both bromine and chlorine can be used to keep it free of harmful bacteria.

Whichever disinfectant you are using, the levels should be tested regularly as outlined in the normal operating procedure (NOP). National legislation will determine frequency of testing required. Remember the more testing you carry out, the safer and better run the spa is.

All advice given in this booklet is generalised information, and you should always check your local legislation and guidelines.

Bromine

Generally, bromine is used to treat hot tubs and spas and chlorine is used for the treatment of pools, although there is much cross-over. Bromine is more active at higher pH levels and more stable and effective at higher temperatures than chlorine. For those with sensitive skin, bromine can be preferable as it does not cause as much skin and eye irritation as chlorine.

Recommended bromine levels in the UK for pools and spas are 4.0 – 6.0 mg/L with shock dose of 10 mg/L, although this can vary if additional chemicals such as sodium hypochlorite are also added to the water.

Chlorine – Free and Total

It is important to monitor both the free and total chlorine levels. When chlorine reacts with nitrogen containing molecules in the water, they form combined chlorines. Although combined chlorines still have disinfection properties, they are not as efficient as free chlorine.

In the UK, if chlorine is being used in a well-designed spa you should be looking for a free chlorine residual of 3.0 - 5.0 mg/L. The combined chlorine (a measure of unwelcome disinfection by-products) should be as low as possible and certainly less than half the free and never more than 1 mg/L. The exact requirements for your spa may vary and will be stated in your NOP.

Ozone

Ozone can purify water 3000 times faster than chlorine. It is also very effective at killing *Cryptosporidium* and *Giardia* which are unaffected by chlorine disinfection.

Ozone use does not affect the pH level of the spa. It does have a large initial cost, but when using ozone, the free chlorine levels can be much lower (0.5 mg/L for a pool, and 2 – 3 mg/L in spas and hydrotherapy pools).

pH

The pH is a measure of how acidic or alkaline the water is, and can affect how other spa chemicals work, as well as bather comfort and lifetime of spa fittings. The heating of the spa water will **increase the pH.**

Ideally you are looking for a pH of 7.2 – 7.4 as this allows effective disinfection but is also comfortable for the bather. An overall range of 7.0 – 7.6 is acceptable in most spas. pH should **always** be measured at the same time as the disinfectant.

Total Alkalinity

Alkalinity protects the water from dramatic changes in pH when the spa is in use.

Total alkalinity should be measured at least once a week and the levels should be in the range 80 – 200 mg/L $CaCO_3$. Levels below 80 mg/L could make the pH unstable whereas above 200 mg/L the pH could become difficult to change.

Cyanuric Acid

Cyanuric acid is commonly referred to as a chlorine stabilizer and can be used on outdoor spas. Without cyanuric acid present, chlorine is more quickly degraded by UV light.

Levels should be below 200 mg/L, with many authorities suggesting levels between 25 and 50 mg/L are ideal.

Calcium Hardness

If calcium levels in the water are low, spa surrounds or grout can be eroded by the water. Likewise, if there is too much calcium, deposits will start dropping (as in a kettle) and can leave 'hard water' marks. Calcium hardness should be measured once a week, and a level between 80 – 200 mg/L maintained.

Phosphate

Phosphate is naturally present in water and promotes the growth of algae. Control of phosphates is especially important for outdoor spas. The level of total phosphates in the spa water should be 0.01 mg/L or below.

Dissolved solids

Mains water is likely to have several hundred mg/L total dissolved solids (TDS). Spa chemicals and pollution will increase this - so high TDS is a warning that the spa water quality is decreasing. It should not be allowed to rise more than 1,000 mg/L above that of the mains water - up to a maximum of 3,000 mg/L. Measure it weekly with an electronic meter: if it's too high, dilute.

Turbidity

The turbidity of the water is a measure of how cloudy the water is. This has recently become more frequently tested in pools. In spas the testing of the turbidity is more difficult due to the bubbles, but this can be tested once the air jets are off and the water has settled.

Traditionally it has been that if you can see the bottom of the pool at the deep end then the clarity is sufficient. However, recent recommendations state that pool water should be measured, and the level of turbidity should be 0.5 NTU (Nephelometric Turbidity Units) or less. This level is below that which the human eye can see, and so a meter specifically designed for turbidity measurement should be used to test the water weekly.

Checking the turbidity also can indicate other problems such as:

- Poor water chemistry
- Deteriorating filter quality
- Inadequate backwashing routine
- Incorrect flow rate or pipe sizing

Water balance

Water balance describes how likely the water is to scale or corrode its surroundings and is important when considering the lifetime of your fixtures and fittings. If the water will dissolve minerals around it, then it is described as corrosive. If the water will tend to deposit minerals it is considered scaling.

The most commonly used Water Balance index for spas is the Langelier Saturation Index. The Ryznar Stability Index is an alternative scale to use.

In order to calculate the Water Balance, you must combine measurements of the pH, calcium hardness, total alkalinity, temperature, and TDS of the water. The resulting value from the Water Balance Calculation will give you an indication of whether the water needs the balance addressing.

Microbiological testing

Microbiological testing is checking there are no dangerous pathogens which can cause bathers serious illness present in the water.

Regularly you need to take a water sample for three tests of microbiological water quality - colony counts, coliforms and *E. coli.* (also test this if the spa has been shut down).

Your local authority may request this is done by an accredited laboratory, or alternatively you can carry out an on-site test using Colitag™ or Nutridisks.

These are the results you need to be reassured everything is safe for bathing.

Colony Count	Not more than 10 CFU per 100mL
Total Coliforms	Absent in 100 mL
E. coli.	Absent in 100 mL
Ps. Aeruginosa	Absent in 100 mL
Legionella	Absent in 100 mL

How often should I be testing?

This will be stipulated by your local authority, and will depend on the amount the spa is used, but as a general rule;

Daily

- Disinfectant Residual (Chlorine, Bromine, Ozone etc.)
- pH
- Total Dissolved Solids

Weekly

- Alkalinity
- Calcium Hardness
- Cyanuric Acid
- Water Balance

Monthly

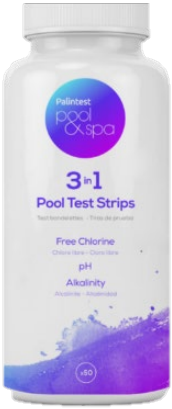
- Turbidity
- Microbiological (*Legionella* quarterly)

Test Method Selection

When testing parameters in spa's there are several options in terms of the test method. The type most suitable to you will depend on costs and spa usage.

Test Strips

Test strips are the simplest and most economical form of testing and although common in the domestic spa market, should be viewed as producing results that are indicative only.



Colorimetric Methods

Colorimetric techniques involve the addition of reagents to water samples, producing a colour change which is proportional to the concentration of the parameter under test.

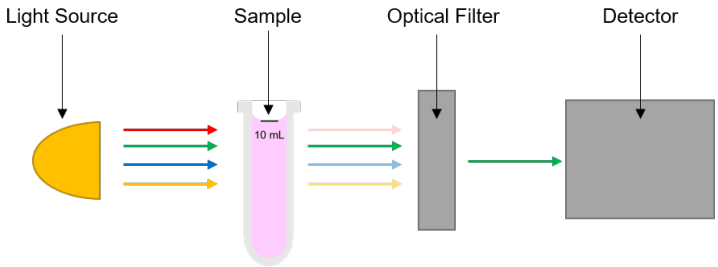
Comparator Visual Systems

Comparator discs and block systems are utilised throughout the industry and are manufactured against verified colour standards, therefore are suitable for reporting purposes. They are a step up from test strips in terms of accuracy, whilst still being relatively low cost and easy to use. However, these systems can have wide incremental result steps, involve a degree of interpretation and are prone to variations in colour perception by the human eye.

Photometers

The use of photometers removes the human element from the result reading process by digitally analysing test colours, referring to calibration data stored within the instrument. Although more costly than visual techniques, photometric instruments are more accurate and reliable. In addition, test results can be stored by instruments, then downloaded to computer-based databases via cable or Bluetooth. This is particularly useful for auditing purposes.

A photometer works by measuring the amount of light that passes through the sample and optical filter and hits the detector. The darker the sample colour, the less light will pass through it.



Electrochemical Methods

Electrochemical techniques, such as meters for measuring pH, TDS, and conductivity, are employed within the spa market but to a much lesser extent than colorimetric techniques. TDS and conductivity can only be measured electrochemically and not using colorimetry.

Well maintained electrochemical meters are highly accurate and not influenced by many of the interfering factors seen with colorimetric measurement of some parameters.

Turbidity

Only instrument-based techniques are suitable due to the recommended levels of turbidity being below the capability of the human eye. Specialist turbidity meters can quickly provide assurance that the pool turbidity is below 0.5 NTU.

Choosing a Sample

When testing the key parameters of a pool and spa, getting the sample is key.

Many modern spas have multiple outlets and inlets across the spa, and so samples should be taken at various parts of the spa at a depth of 100 – 300 mm.

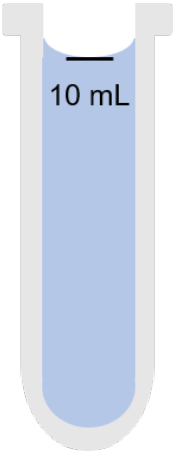
These locations should become the routine sampling points, and together will give an overall view of the spa water quality.

Best Practice for Water Testing

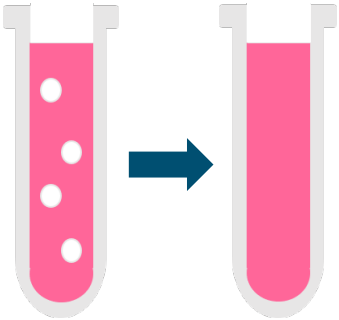
1. Testing equipment should be kept clean, with no water marks, fingerprints, scratches or stains and preferably, rinsed with distilled water where applicable. Note that plasticware can deteriorate over relatively short periods of time and should be replaced regularly
2. Test methods must be followed carefully as per instructions.
3. Reagent tablets must be fully dissolved before you try to read the result.
4. Ensure that test reagents are within the best before date.
5. Do not mix and match reagents and test kits from different manufacturers
6. If deposits or bubbles form, leave for a few minutes to clear unless the test is time specific. Bubbles can usually be cleared using a crushing rod or by tapping the side of the test tube gently.
7. For results that are above the range of the test, use the dilution method and test again.
8. Analytical instruments should be serviced annually.

Hints and Tips to Testing with Photometers

1. To prolong the lifetime of your instrument and get the best performance, you should have full calibration checks each year. Check standards can help you quickly see if your instrument is within specification.
2. Always follow the test procedure carefully, making sure you add the reagents in the right order and stick to the recommended standing times and temperature conditions.
3. Test tubes must be kept in a clean condition. Always wash and dry them thoroughly after use. Dirty tubes may be soaked in a weak detergent solution but must be carefully rinsed after. Any tube that is scratched or stained must be replaced.
4. Caps and crushing rods should be cleaned immediately after use and discarded if they become stained.
5. When measuring the sample volume required, make sure that the lowest point of the meniscus in exactly on the fill line (see diagram).



6. The blank is a test tube filled with the sample water, but no reagents. The photometer uses this as a background to compare to your test sample colour.
7. Do not touch the tablet reagents when transferring them to the test tube as it will contaminate them, and you will not get accurate results.
8. Ensure you fully crush the tablet. After the standing period, do not shake or invert the test tube. Some tests form fine particles which sink to the bottom and will not influence the test.
9. If bubbles adhere to the sides of the tube, rub them away gently using the crushing rod.
10. Always use the light cap on your photometer to get accurate results.
11. Never shake the tube to mix the contents, always stir it with a crushing rod.
12. The results for these tests are given in a number of different units, always quote the units when reporting your data, and check all data is expressed in the same units when making comparisons.



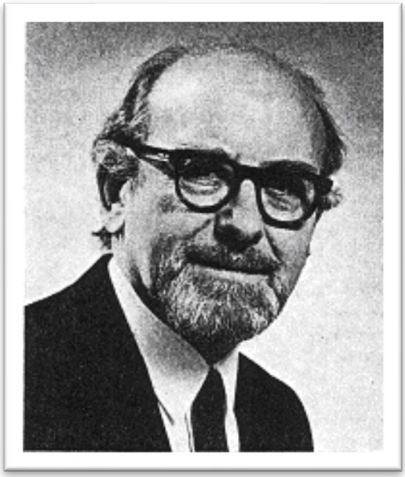
Spa Troubleshooting

Issue	Possible Cause	Possible Solution
pH not within limits	pH < 7.0 – too much acid pH > 7.6 – not enough acid	Adjust the pH by using pH plus or pH minus to either lower or raise the Ph levels. Recheck the pH after 15 mins. Repeat until within limits.
Disinfectant not within limits	Chlorine: < 2 mg/L or > 5 mg/L	If levels below recommended limits close the spa and add disinfectant, retest until within recommended limits.
	Bromine: < 2 mg/L or > 6 mg/L	If above recommended limits partially drain the hot tub and replace with source water, and retest till within respected limits.
Cloudy hot tub water	Spa not been in use	Check over the hot tub for everything functioning, and review control strategies.
	Circulation pump failure	Restart the pump, and ensure both pH and disinfection levels are within limits
	Low disinfection levels	With lower levels of disinfection, microbial growth is likely. Shock dose the spa to 50 mg/L for 1 hour. Empty,

Cloudy hot tub water		clean and disinfect, bringing the spa back into correct operation.
	Incorrect dosing of chemicals	Chemicals should be completely dissolved before being added to the spa.
	Filter cleaning	Filters require to be rinsed following backwashing, enabling the dirt to be discharged.
	Algal/bacterial growth	Raise disinfection to 10mg/L and leave overnight. Remove any algal deposits by scrubbing, then return disinfection to normal operating levels.
	High bather load	Filter not capable to cope with high bather loads, clean filter and replace water.
	Presence of foam	Remove water, and refill. Discontinue using cleaning products with detergents.

A little about Palintest

At Palintest we make water analysis technologies which help to safeguard consumers around the world each day. A critical part of the leisure industry, our technologies ensure that we can all bathe and play safely.



Our company name comes from one of the pioneers of our business, Dr Tom Palin.

Dr Palin was instrumental in the development of standard DPD methods for measuring chlorine levels in water. A key figure across the industry, Dr Palin worked at Palintest, developing chemical reagents in the form of tablets for measuring different parameters of water quality. Since then we have been continuing his legacy by making water testing simple and accessible for everyone, officially changing our name to Palintest in 1989 to honour Dr Palin's work.

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