Guidance on water quality for heated spas
Guidance on water quality for heated spas

Clive Broadbent
Reviewed by John Ingham, Heather Hill and Andrew Langley

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Preface

The National Environmental Health Forum has been established by the Directors of Environmental Health from each State and Territory and the Commonwealth with a secretariat provided by the Commonwealth Department of Health and Family Services.

The National Environmental Health Forum is publishing a range of monographs to give expert advice and guidance on a variety of important and topical environmental health matters. This publication is the second in the water series. A list of published monographs appears opposite.

The Directors of Environmental health, in expediting publication of this document, have undertaken targeted consultation only.

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Published monographs

**Water Series**

**Soil Series**

**Metal Series**
2. Zinc (1997)
3. Copper (1997)

**Air Series**
1. Ozone (1997)
2. Benzene (1997)

**General Series**
1. Pesticide use in schools and school grounds (1997)

**Indigenous Environmental Health Series**
1. Indigenous Environmental Health No. 1 (1999)

**Exposure Series**

**Counter Disaster series**
1. Introduction

An estimated 20,000 public and private heated spa pools are sold each year in Australia along with 55,000 spa baths. While they provide an enjoyable form of recreation for many Australians, studies by the NSW Health Department have shown that a high percentage of public spa pools in use are poorly maintained and inadequately disinfected. It is reasonable to assume that many private spa pools are also poorly maintained. Australian State and Territory health departments have recognised the need for legislation covering public spa pools. Regulatory approaches are summarised in Section 8.

Good management of spas is essential to ensure that bathers are not subjected to health risks. Spas are more difficult to maintain than swimming pools and water quality may deteriorate rapidly. In the absence of an effective disinfectant, the warm, turbulent and aerated conditions of a spa provide an ideal environment for rapid growth of undesirable microorganisms. The risks include mild to very severe skin, eye and ear infections. In extreme cases, lung infections including Legionnaires’ disease fatalities have occurred in Australia.

If the spa and its associated equipment have been constructed to a satisfactory standard, adherence to some simple basic operating procedures can ensure safe use of the spa. These include frequent or continuous monitoring of disinfectant levels, appropriate disinfectant dosing and attention to water chemistry.

Particular care is needed to keep the walls and surrounds of a spa clean and the filter operating correctly. The water in spa pools should be dumped when it is dirty or when debris accumulates. Bathers’ behaviour should be controlled both within and around the spa to avoid injury.

1.1 Spa construction

Spa baths and spa pools are recreational pools designed for sitting in rather than for swimming. Occupants are submerged up to the chest or neck. Spa baths differ from spa pools as they are smaller, may not include a water filter and are emptied after use. No chemical water treatment is generally used. Spa pools often seat four or more; the water is filtered, chemically treated and usually not drained after each use.

Spas (the generic term) are usually heated to about 37°C and have air and water jets to produce turbulence. A large number of bubbles rise to the water surface and burst.

Spa pools may be installed outdoors or inside whilst spa baths are invariably installed only indoors. Indoor spa pools and spa baths should be in well-ventilated rooms.

General guidance on construction and operation of spas is provided by Standards Australia in standard AS 2610-1993. Part 1 of this standard covers public spa pools and part 2 covers private spa pools. Materials that come into contact with water should comply with the requirements of AS 3855 and AS 4020.

The spa pool should incorporate a weir off-take or skimmer system that continuously takes away surface water whilst the spa pool is in use.
Spas

Spa baths are covered by AS 3861-1991. All spa baths are required by this standard to be constructed such that the water pump, pipework and bath itself completely drain and are left dry. Older spa baths generally were not provided with a water heating system but newer models often incorporate a system at the pump for heating the recirculating bath water. For more details on spa baths refer to: Operation of spa baths p 23.

Manufacturers can provide advice on optimal pH and alkalinity levels for the protection of particular spa surfaces and equipment. Higher alkalinity levels than those recommended are generally acceptable as they do not interfere with disinfection, but the pH should never measure less than 7 or greater than 8 under any circumstances.

1.2 Microbiological quality

For prevention of spa pool-related infections it needs to be appreciated that water quality (covering water chemistry, microbial load and filtration effectiveness) in a spa pool can deteriorate very rapidly with an increase in the number of users. Great care should be taken in following the guidance in this booklet to maintain spa water quality.

Infection is usually associated with high numbers of micro-organisms in poorly maintained spa pools. High bacterial loads can cause infection in a significant proportion of users of a particular spa. The practice of washing thoroughly prior to entering a spa pool will help to reduce organic and microbiological spa water loads. Pseudomonas aeruginosa is the most common cause of health-related problems. The spa ecosystem, being both warm (above 26°C) and aerated, promotes growth of this organism. Other serious pathogens such as Legionella species and Naegleria species have also been found in spas and have caused disease and death. More information on Legionella can be found in ‘Guidance for the control of Legionella’ which is available from State or Territory health departments or government bookshops.

The range of health problems that might be associated with heated spas is summarised in Table 1. In the absence of epidemiological studies, most of these problems are difficult to quantify and some, such as gastro-intestinal infection, may be quite rare. However, skin, eye and ear infections are frequently reported problems. Such infections may be contracted from the spa environment and individuals with a recent history of illness or injury may be particularly susceptible to serious infection. Other infections may be caused by the normal bacteria on the bather's own skin as these multiply to abnormal levels by long exposure to warm water.
Table 1: Potential health problems associated with spa pools

<table>
<thead>
<tr>
<th>Health problems</th>
<th>Causative organisms/agent</th>
<th>Predisposing factors to infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Follicular dermatitis</td>
<td><em>Pseudomonas aeruginosa</em></td>
<td>High numbers of micro-organisms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long exposure time or high temperatures</td>
</tr>
<tr>
<td>2. Skin, ear and eye</td>
<td>*Pseudomonas aeruginosa; Pseudomonas cepacia, Mycobacterium marinum, Papilloma viruses,</td>
<td>Injury</td>
</tr>
<tr>
<td>infections</td>
<td><em>Acanthamoeba</em></td>
<td>Spa environs and materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skin lesions from recent trauma or immune deficiency</td>
</tr>
<tr>
<td>3. Skin irritation</td>
<td>Chloramines</td>
<td>Inadequate dumping frequency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low chlorine disinfectant levels</td>
</tr>
<tr>
<td>4. Dermatitis - irritant</td>
<td>Choice of disinfectant, e.g. bromine</td>
<td>Sensitivity to disinfectant or excessive exposures</td>
</tr>
<tr>
<td>or allergic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Respiratory infection</td>
<td><em>Legionella, Pseudomonas spp.</em> Enterobacteriaceae, aerobic amoebae, adenoviruses</td>
<td>Aerosol dispersion of contaminated water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor disinfection practice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immersion of the head</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre-existing respiratory disease</td>
</tr>
<tr>
<td>6. Gastro-intestinal</td>
<td><em>Giardia, Cryptosporidium, Enterobacteriaceae - Klebsiella, Yersinia</em></td>
<td>Ingestion of faecally polluted water</td>
</tr>
<tr>
<td>infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Heat stress (hyperthermia)</td>
<td>Excessive exposure to heat</td>
<td>High temperature, especially above 40°C (or above 38°C for those at risk such as the elderly or those with heart conditions)</td>
</tr>
</tbody>
</table>

*Note:* In some studies hyperthermia of pregnant women in early pregnancy has been associated with an increased risk of birth defects in their offspring.

People at risk of, or concerned about, possible health effects should consult their doctor before using a heated spa.

1.2.1 Micro-organisms found in spa pools

Spa pool contamination largely arises from the pool users themselves. In addition, dust, tree leaves and lawn clippings contribute to the contaminant load and foster microbial growths.

The main groups of micro-organisms found in spa pools are algae, protozoa, bacteria and viruses. Fungi and yeasts may also be present at wet areas.

**Algae**

Algae are microscopic plants. Two varieties of importance are found in pools; one variety which floats freely in the water and a more persistent variety which embeds itself into pores and crevices of the water contact surfaces. The presence of sunlight, carbon dioxide, mineral
matter and nitrogenous compounds or atmospheric nitrogen and other organic nutrients is essential for algal growth.

Algae will harbour and foster bacterial growth and retard the action of some disinfectants such as chlorine. For spa pools disinfected with chlorine, algal growth is objectionable because it reacts with the chlorine to create odours, cause turbidity, discolor the water and produce slimes.

A heavy algal growth may increase the chlorine demand in spa pools disinfected with chlorine to a point where the ordinary levels of free chlorine will not kill the algae. It is then necessary to superchlorinate the spa pool by maintaining a free chlorine level in excess of 10 mg/L whilst the spa pool is not in use. Following this treatment the algae should brush off quite readily. If not, the dose can be repeated. The dead algae should be removed by physical means before the spa pool is made available for use.

The presence of algae in spa pool water disinfected with chlorine is an indication that free chlorine is not being maintained.

Algae can also be controlled by the use of an algicide. Quaternary ammonium compounds (e.g. benzalkonium chloride) should be avoided as these cause excessive foaming.

**Protozoa**

*Acanthamoeba* species and *Naegleria fowleri*, are ubiquitous protozoan organisms naturally occurring at low numbers within the environment. Under suitable conditions such as those found in poorly maintained spa pool water, they can cause a fatal form of meningoencephalitis. These protozoa invade the swimmer through the nasal cavity and then migrate to the brain. They are readily destroyed by maintaining the required level of disinfecting agent within the spa pool water.

Other pathogenic protozoa found in poorly maintained spa pools include *Cryptosporidium*, which causes amoebic dysentery, and *Giardia* which also causes intestinal infections.

**Bacteria**

The presence of organic matter in spa pool water provides a suitable medium for the growth of bacteria. This spa pool water pollution is derived from humans, animals, birds and the environment. Disinfecting agents are used to destroy or inactivate these harmful bacteria and it is for this reason that health authorities require disinfection of spa pool water.

Pathogenic micro-organisms found in inadequately disinfected spa pools include *Escherichia coli*, *Staphylococcus* species, *Streptococcus* species, *Pseudomonas aeruginosa*, *Legionella* species, *Mycobacterium marium* and *Salmonella* species. (see Table 1) *Escherichia coli* is used as an indicator for the presence of faecal pollution. Staphylococci and Streptococci are more resistant to disinfecting agents than the coliform organisms.

**Viruses**

Many viruses can be transmitted from one person to another via spa pool water. Most viruses, especially the enteroviruses, are more resistant to chlorine than bacteria such as *Escherichia coli*. The enterovirus group includes polio, coxsackie and hepatitis A. These viruses may: cause gastro-enteric infections, jaundice, or a variety of skin rashes or may involve the nervous system. Adenoviruses are associated with pharyngitis, conjunctivitis and fever.

Regular disinfection, (Table 4), supplemented by periodically draining the spa pool and scouring and cleaning all surfaces, will destroy harmful viruses.

Table 1 provides further information on a range of potential health effects associated with spa pool use.
1.3 Disinfection practice

1.3.1 Means of disinfection

To minimise the risk of infections, the spa pool must be disinfected. Disinfection of spa water needs to be able to destroy bacteria that grow throughout the system, including filter surfaces, walls and floor, and the water line where scum tends to accumulate. Disinfection is also necessary to reduce indirect transmission of disease organisms between bathers.

Disinfection of water can be achieved in a number of ways and requires both the action of a disinfecting chemical or process (Table 4) and chemically balanced water (refer to Spa pool operation p 14). Chemically balanced water is not subject to violent fluctuations in acidity, i.e. changes in pH. Water that is not balanced is difficult to disinfect. The disinfecting agent needs to be:

- easily applied to water
- able to rapidly kill a wide range of disease-causing micro-organisms
- capable of simple on-site measurement of concentration in the spa pool water.

Chlorine and bromine meet these requirements and have the additional advantage of being able to oxidise many pollutants, such as organic matter, that are not removed by filtration.

Systems that use ozone or ultraviolet light to disinfect the recirculating water near the filter do not have any disinfection activity in the spa pool itself. Such systems need to be supplemented with a disinfectant able to maintain ongoing residual disinfection of the water in the spa pool.

1.3.2 Chemical dosing frequency

Commercial or municipal spas (i.e. public spas) should be dosed on a continuous basis with regular monitoring for disinfectant levels. Even short periods without disinfection can result in rapid growth of micro-organisms. Spa pool water should be recirculated at a rate of at least 2 cycles, i.e. two full turnovers of the spa pool volume, per hour.

Private spas should be dosed half to one hour before use. When automatically dosed, the disinfection system should be switched on at least half to one hour prior to use.

For public and private spa pools, further dosing of disinfectant after bather use should be practised with the filter pump switched on, and measurements taken to confirm that disinfectant levels are achieved while the system is idle. Weekly shock dosing (Table 4) is needed to consistently achieve a satisfactory disinfectant level. Shock dosing is also necessary to kill algae, potentially harmful amoeba cysts and, with chlorine disinfection, to destroy obnoxious chloramines.

Chemicals are not to be added directly to the water when the spa pool is in use. Localised high concentrations can cause distress to users due to eye, nose and skin irritation.

2. Disinfection chemicals

Some chemicals may affect some spa construction materials e.g. the use of an oxidising biocide such as chlorine will affect chromed, plastic surfaces. The compatibility of spa chemicals with construction materials should be checked before use.

Cyanuric (isocyanuric) acid or cyanurated chlorine compounds as pool stabilising agents should not be added to indoor spa pools or bromine treated pools.
The use of pool stabilisers in outdoor spa pools is not recommended as the levels cannot be measured with test strips (levels can be measured with DPD). At concentrations greater than 100 mg/L of cyanuric acid, the disinfection power of free chlorine is reduced.

### 2.1 Chlorine

Many spa pools are disinfected using chlorine-releasing compounds including sodium hypochlorite in a liquid form and lithium hypochlorite in a granular form. Calcium hypochlorite, in a powder form, is inexpensive and popular for cold water pools but is not suitable for hot pools (over 26°C) such as spas as it will promote scaling on heat exchangers and piping.

Chlorine-based disinfectants are effective, but only when maintained at levels of at least 2-4 mg/L (as free residual chlorine). Lower concentrations result in ineffective disinfection and higher concentrations can cause eye, skin and respiratory irritation.

Levels of chlorine are rapidly reduced with bather use and regular checks should be made to ensure maintenance of disinfection. In water, chlorine forms hypochlorous acid which is a very effective disinfecting agent as its molecules are able to penetrate cell walls of micro-organisms and destroy internal enzymes. Above pH 7.8 disinfection capacity is seriously impaired due to near-complete conversion of hypochlorous acid to the ineffective hypochlorite ion (Tables 3, 4).

Because high levels of chlorine can have adverse health effects on users it is recommended that users should not be present in the spa pool water during superchlorination (shock dosing) or when the chlorine residual exceeds 10 mg/L, even if the chemical addition is carried out off-pool.

Spa comfort and disinfection can be compromised by excessive build up of unpleasant smelling chloramines. Urine and perspiration contribute to their formation. High chloramine levels can be irritating to the skin and eyes, and are a common cause of odours in spas. Adequate ventilation of indoor spas and periodic superchlorination (Table 4), as well as regular emptying of spas, will resolve such problems.

It is necessary to shock dose the spa pool water to destroy accumulated organic matter. The spa pool water should be replaced if there is a failure to achieve a free chlorine residual of 0.5 mg/L after shock dosing or if the total chlorine level less the free chlorine level cannot be reduced to 1 mg/L or less.

Shock treat the public spa water at the end of daily use. Note that this requires the spa to be taken out of service. When the public spa pool is in heavy use (i.e. 50 users per day), test and record the free chlorine (or bromine) residual range at least hourly. This can be most easily achieved by auto-dosing and auto-monitoring. In other circumstances, test and record the free chlorine (or bromine) at least twice a day.

When a private spa pool is in frequent use, test and record the free chlorine (or bromine) at least twice a day before and after use. Shock treat the private spa water once a week unless there has been an unusually heavy load (e.g. a ‘spa party’).

Some adjustment of pH is required for most forms of chlorine disinfection, which is aided by maintenance of the total alkalinity levels shown in Table 5. Hypochlorites are stabilised with small amounts of caustic soda. Sodium hypochlorite and lithium hypochlorite are currently available for use in spas.

Where chlorine gas is used, a fairly high alkalinity needs to be maintained to remove the acid formed during dosing and subsequent breakdown reactions of hypochlorous acid. Use of chlorine gas is not recommended for most spa pools, although it may be suitable for large public pool and spa complexes where the safety and handling requirements can be met. The dependence of chlorine effectiveness on pH is shown in Table 2.
Table 2: Chlorine effectiveness

<table>
<thead>
<tr>
<th>pH</th>
<th>% free chlorine as hypochlorous acid (i.e. disinfection effectiveness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>97</td>
</tr>
<tr>
<td>7.0</td>
<td>75</td>
</tr>
<tr>
<td>7.2</td>
<td>63</td>
</tr>
<tr>
<td>7.5</td>
<td>49</td>
</tr>
<tr>
<td>7.6</td>
<td>39</td>
</tr>
<tr>
<td>7.8</td>
<td>28</td>
</tr>
<tr>
<td>8.0</td>
<td>23</td>
</tr>
<tr>
<td>9.0</td>
<td>3</td>
</tr>
</tbody>
</table>

Not recommended

Recommended operating range

Ineffective

2.2 Bromine

To achieve similar disinfection, bromine needs to be used at levels twice those of chlorine. Bromine is less stable than chlorine when exposed to ultraviolet light.

Bromine is available commercially either as sodium or potassium bromide used in conjunction with sodium hypochlorite or potassium persulfate, or (more commonly) as 1-bromo-3-chloro-4,4-dimethylhydantoin (BCDMH) supplied in tablet or granule form.

Continuous dosing of bromine can readily be achieved, but depending on the bromine-producing chemical used, the amount of disinfecting agent available to satisfy the immediate bather load may vary. Therefore, care should be taken to ensure that the necessary levels of bromine disinfectant are maintained whilst the spa pool is in use. There tends to be less odour problem associated with the use of bromine than chlorine. Elemental bromine is too dangerous (corrosive) to handle and should not be used.

BCDMH is more acidic than some other disinfectants and it will reduce the total alkalinity of spa pool water more rapidly than other disinfectants. To compensate for this factor, it is necessary to ensure that the total alkalinity level in the spa pool water is maintained within the range of 150 mg/L to 200 mg/L (Table 5). As a disinfecting agent and oxidant, bromine remains active at higher pH levels than chlorine (see Table 3).

In the presence of ammonia, bromine will rapidly form relatively unstable ammonia bromamines which possess disinfection efficiencies comparable to that of free bromine.

It is unnecessary to destroy ammonia bromamines because they do not produce irritating odours, they have a relative lack of stability, and their disinfection efficiency approximates that of free bromine.

Shock dosing of bromine disinfected spa pools is achieved by superchlorination (i.e. using a chlorine-releasing product). (refer to Spa pool operation).
Table 3: Bromine effectiveness

<table>
<thead>
<tr>
<th>pH</th>
<th>% free bromine as hypobromous acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>100</td>
</tr>
<tr>
<td>7.0</td>
<td>98</td>
</tr>
<tr>
<td>7.2</td>
<td>96</td>
</tr>
<tr>
<td>7.5</td>
<td>94</td>
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<tr>
<td>7.6</td>
<td>91</td>
</tr>
<tr>
<td>7.8</td>
<td>87</td>
</tr>
<tr>
<td>8.0</td>
<td>83</td>
</tr>
<tr>
<td>9.0</td>
<td>32</td>
</tr>
</tbody>
</table>

Recommended operating range

Effective but not recommended due to ot adverse effects of high pH

2.3 Ozone

Ozone is a very powerful oxidant and is effective against viruses. It can only be generated at the point of use and commercial units are generally safe to use. Ozone dosing is only practical where there is water circulating off-pool because adequate mixing is essential for maximum oxidation.

Ozone does not provide the water with a residual disinfectant therefore a supplementary free disinfectant residual is essential for the spa pool water. In addition, the spa pool should be shock dosed with chlorine once a week.

Ozone generators may be of the ultraviolet lamp or corona discharge type. Owners need to be aware that the ultraviolet lamp efficiency reduces with time and ultimately the lamp requires replacement as does the associated activated carbon filter.

Ozone is a respiratory irritant and elevated levels should not be allowed to occur in the air around the spa. Therefore it is necessary to pay close attention to ventilation of the spa location and to adhere to manufacturers’ directions.

2.4 Ultraviolet light-hydrogen peroxide

Ultraviolet light, like ozone, is sometimes used for off-pool water disinfection. Ultraviolet light has no effect on pH or colour and has little effect on the chemical composition of the water. However, the colour, turbidity and chemical composition of the water can interfere with ultraviolet light transmission. Bacteria may be protected by turbidity, clumping or by the presence of slimes.

Therefore, the water must be adequately treated prior to ultraviolet light exposure. Hydrogen peroxide is often used for this purpose as it is relatively safe in low concentrations, non-flammable and has the innocuous byproducts of oxygen and water.

Hydrogen peroxide is a powerful oxidising agent. In its concentrated form it is a clear liquid with a sharp odour. It provides a residual capacity to oxidise organic material derived from user load and other sources in the spa pool water thus inhibiting microbial growth within the remainder of the system. For the ultraviolet light plus hydrogen peroxide system to be
effective it must operate 24 hours a day. The concentration of free hydrogen peroxide in the spa pool should be at least 40 mg/L at all times.

Ultraviolet light disinfection is not pH dependent, but the addition of hydrogen peroxide to spa pool water results in slightly acidic conditions.

This, combined with the oxidation of organics from bathers, requires pH balance to overcome bather discomfort and maintain protection of the spa pool surfaces, pool water plant and metal fixtures. To achieve satisfactory spa pool water chemistry, the total alkalinity level should be maintained within a range of 60 to 200 mg/L for this system (see Table 5).

Hydrogen peroxide is sometimes used in swimming pools in conjunction with a disinfectant called polyhexamethylene biguanide (Baquacil®). This disinfectant is not suitable for spa pools due to excessive foaming.

Microbiological testing of new systems is advisable to ensure that the spa is effectively disinfected.

*Note:* Some regulatory authorities do not support the use of UV-hydrogen peroxide systems due to poor performance in trials.

### 3. Water chemistry

To ensure that the disinfectant is effective, the spa pool water must be sparkling clean and the water chemistry must be correct. Parameters that need to be carefully controlled are pH, alkalinity, hardness, clarity, solids and temperature.

#### 3.1 pH and total alkalinity

It is desirable to maintain the pH of spa pool water close to neutral. The pH should be maintained in the range 7.2 to 7.8 as estimated by commonly available test equipment. The practical benefits of maintaining optimum pH include:

- bather comfort and safety;
- disinfection effectiveness (most critical for chlorine disinfection where pH should never exceed 7.8);
- avoidance of the formation of undesirable byproducts; and
- avoidance of corrosion, etching and staining of spa pool surfaces, metal fixtures, pipework, pumps and ancillary equipment. Increasing alkalinity is the best means of controlling etching of cement-finished surfaces.

Therefore, the pH range must be limited and its tendency to fluctuate must be controlled by ensuring a minimum level of total alkalinity. Total alkalinity refers to the amount of certain alkaline buffering compounds in the water.

Total alkalinity levels greater than 200 mg/L may result in scaling of fittings and surfaces particularly with hard waters. Consequently, hard waters may require treatment prior to being added to a spa pool. Table 5 details the range of pH and total alkalinity values for disinfected spa pool waters.

#### 3.2 Hardness

Hardness is often used to describe the level of calcium: ‘hard’ water has high levels of calcium. The level of calcium in the water is important for water quality and chemical balance. This is particularly important if rain water (which has low levels of calcium) is used to fill the spa pool. Low levels of calcium can lead to corrosion of equipment and staining of surfaces. Excessive calcium will result in scaling and reduced efficiency of the equipment.
Calcium levels need to be maintained between 100 and 200 ppm. Spa pool outlets can assist with water testing for calcium.

### 3.3 Water clarity

The purpose of achieving clarity in spa pools is to:-

- confirm the absence of particles which may shield micro-organisms from direct contact with the disinfectant
- enable people to estimate depth
- provide a pleasant appearance to the water.

The internal surfaces of spa pools must provide high light reflection from the underwater surfaces. This can help in detecting:-

- poor water quality
- poor cleaning practices

The spa pool water clarity can be checked using a turbidity disc as defined in AS 2610.2-1993 or alternatively it should be such that ‘heads’ or ‘tails’ on a 50 cent piece can be determined when the coin is at the deepest part of the spa pool and there is no turbulence in the spa pool water.

Removal of suspended and colloidal matter by filtration will assist in maintaining spa pool water clarity.

### 3.4 Suspended and dissolved solids

Spa pools have a much higher level of suspended matter than swimming pools because of their reduced water capacity, higher bather load-to-water volume ratio, increased operating temperature, aeration of the water in the spa pool and elevated organic contaminant loading. To lessen the impact of this elevated level of suspended matter on disinfection efficacy, the spa pool water needs to pass through the filter at least on a half hourly basis.

Spa pools must be regularly drained to prevent a build up of total dissolved solids. This is to ensure disinfection efficacy and to enable cleaning of the floors and walls to be done prior to refilling with clean fresh water. Inground spa pools must be constructed and installed to prevent movement due to external pressure when drained.

As a guide, public spa pools should be drained at least weekly and private spa pools should be drained at least every three months.

### 3.5 Water temperature

The ideal range for spa pool water is 35-37°C. See Table 5. Use of the spa should be restricted to 15 minutes at this temperature.

AS 2610 Part 1-1993 requires temperature of spa pools to be automatically controlled by a thermostat to prevent water temperature exceeding 40°C. A second thermostat of the manual reset type is required for added safety to ensure water temperature never exceeds 45°C.
Table 5: Spa pool water characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Range: Min - Max</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. pH</td>
<td>7.2 - 7.8</td>
<td>If pH is below 7.2, then the possibility of:-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- eye discomfort from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- rapid loss of chlorine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- etching of exposed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- corrosion of metals</td>
</tr>
<tr>
<td></td>
<td>7.2 - 8.0</td>
<td>If pH is above 7.8, then the possibility of:-</td>
</tr>
<tr>
<td></td>
<td>if disinfectant is bromine or another non-chlorine process</td>
<td>- reduction of chlorine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- increased chlorine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- eye discomfort</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- drying of skin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- cloudy water, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- scale formation</td>
</tr>
<tr>
<td>2. Total alkalinity</td>
<td></td>
<td>If total alkalinity is below 60, then possibility of:-</td>
</tr>
<tr>
<td>when disinfected with:</td>
<td></td>
<td>- pH fluctuation due to</td>
</tr>
<tr>
<td></td>
<td>60 - 200 mg/L</td>
<td>- corrosion of metals</td>
</tr>
<tr>
<td>- lithium hypochlorite</td>
<td>60 - 200 mg/L</td>
<td>Alkalinity for BCDMH should not fall below 150 as it is more acidic</td>
</tr>
<tr>
<td>- sodium hypochlorite</td>
<td>150 - 200 mg/L</td>
<td>than other disinfectants.</td>
</tr>
<tr>
<td>- BCDMH</td>
<td>80 - 100 mg/L</td>
<td>Higher alkalinitities do not interfere with</td>
</tr>
<tr>
<td>- ozone</td>
<td>60 - 200 mg/L</td>
<td>disinfection (as does high pH).</td>
</tr>
<tr>
<td>- hydrogen peroxide</td>
<td>150 - 200 mg/L</td>
<td></td>
</tr>
<tr>
<td>- gaseous chlorine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Temperature</td>
<td>Spa pools - 40°C max</td>
<td>If the temperature is too low, then users may experience discomfort.</td>
</tr>
<tr>
<td></td>
<td>Ideal 35 - 37°C</td>
<td></td>
</tr>
<tr>
<td>4. Hardness - calcium</td>
<td>100 - 200 ppm</td>
<td>If the calcium level is too low, corrosion of equipment and staining of surfaces occur.</td>
</tr>
<tr>
<td>levels - important if</td>
<td></td>
<td>If the calcium level is too high, scaling and reduced equipment efficiency occur.</td>
</tr>
<tr>
<td>rainwater is used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Spa pool operation

4.1 Keeping a balance

Recommended procedures for spa pool operation are set out in the Australian Standard, AS 2610 Part 1 - 1993 Appendix C. This Standard contains useful information including procedures for calculating whether the water is ‘balanced’, i.e. that pH, total alkalinity, calcium hardness, water temperature and dissolved solids are all at their ideal values. Correct water balance is essential for spa pools that are used by the public (e.g. at hotels, gymnasiums or holiday resorts). For most applications, calcium hardness and dissolved solids are readily kept under control provided the other factors are well-managed.

Quantities of chemicals added depend upon spa pool water volume. This needs to be calculated. Most private spas have a capacity of 1000 to 5000 L.

4.2 Alkalinity

To ensure total alkalinity is within the recommended range, add appropriate chemicals:

- to increase total alkalinity by 10 mg/L add 17 g of sodium bicarbonate for each 1000 L of spa water
- to lower total alkalinity by 10 mg/L add 20 mL of hydrochloric acid or 24 g of Dry Acid (sodium bisulfate) for each 1000 L of spa water.

When dosing the spa water with chemicals always operate the filter pump but do not use the air blower.

4.3 pH

To lower the pH:

If the total alkalinity is low, add acid so the spa pool water is slightly below the desired pH and re-correct the total alkalinity by raising the pH to the desired level with the addition of a weak base (alkali) such as sodium bicarbonate.

If the total alkalinity is high, just add acid until the correct pH is obtained.

To raise the pH:

If the total alkalinity is high, add soda ash (strong base) until the correct pH is obtained.

If the total alkalinity is low, add sodium bicarbonate (weak base) until the correct pH is obtained.

4.4 Water disinfection

The disinfectant should be introduced into the water at least an hour before use. After dosing, check that the required disinfectant levels (Table 4) are achieved and adjust quantities as needed. Dose again after use, while operating the filter pump for at least one hour.

Liquid chlorine-based products lose effectiveness more rapidly than other disinfectants with storage time, and dosing quantities may need to be increased over time.

If the spa pool is not in regular use, add a single normal dose of disinfectant every day (or drain the water) to prevent gross contamination.

After heavy use of the spa, shock dose the water. Use a chlorine-releasing compound for shock dosing irrespective of the disinfectant used for normal use. If your test kit is unable to measure the concentration (10 mg/L free chlorine) required for shock dosing, ask your pool...
products supplier how much product to use to achieve an adequate concentration. Check the level of disinfectant before use, with the filter pump operating.

4.5 Water testing

Parameters

Monitoring of simple water quality parameters is essential. Provide testing equipment to measure:

- concentration of disinfectant in use
- pH level
- total alkalinity.

Test kits are available from recognised spa pool and swimming pool retailers. As with all chemicals, the test kit should be stored in a cool, dark place as excessive heat or very cold temperatures may alter the indicator solutions. Note: Some regulatory authorities require that only approved test kits are used and these may not be available from all retailers.

The most commonly used method of measuring chlorine and bromine concentrations in spa pool water is by use of the DPD colorimetric comparator system. Although separate discs are available for measurement of chlorine and bromine, the colour developed in this method is the same for both disinfectants. However, the intensity of colour is different for the same concentration.

The DPD method involves use of chemical reagents in tablet form. The tablets are convenient and simple to use.

Free chlorine within the spa pool water reacts with diethyl-p-phenylene diamine (DPD), No. 1 tablet, in a buffered solution to produce a pink colouration. The intensity of the colour is proportional to the free chlorine concentration. With the subsequent addition of excess potassium iodide, No. 3 tablet, a further reaction is induced with any combined chlorine present. The resultant colour intensity is now proportional to the total chlorine concentration and this increase in the intensity represents the combined chlorine concentration. With the aid of the appropriate comparator disc it is possible to differentiate between free and combined chlorine present in the sample.

In bromine disinfected spa pools, it is acceptable to use a chlorine disc in this comparator device to measure bromine. This is done by comparing the colour developed against a chlorine disc and then multiplying the reading by 2.25.

Alternatively, the bromine concentration may be stated as chlorine equivalent. Where ozone is used as a disinfectant this is usually in conjunction with chlorine or bromine which can be similarly measured.

The pH level is measured with a purpose-made electronic pH meter or by a colorimetric method similar to the DPD type.

Total alkalinity is measured by titration, i.e. progressive additions of an indicator liquid to the water sample until a change of colour takes place. Common indicators are methyl orange, bromocresol green and bromophenol blue.

Total alkalinity can also be measured with alkalinity tablets in a similar manner to the DPD method. The test is based on counting the number of tablets required to achieve a permanent colour change from yellow to bright pink in a measured volume of pool water.

Test kits are available to measure calcium hardness of the water.
Note: Private spa pool owners will probably find test strips simpler to use than the DPD/titration procedures. Test strips are available from pool shops and are able to measure:

- bromine or chlorine
- total alkalinity
- pH

Each strip is about 8 cm long and 0.5 cm wide. Each contains several pads which react with the water, and the colour change can be compared with reference colour patches. Test strips are typically purchased in quantities of 50. They are ideal for testing immediately before spa use. Always closely follow the instructions for use of the test strips.

All test results for public spas should be recorded in a register for the purpose. This is a regulatory requirement in some states. Such a register (sometimes called a log book) is an important aspect of spa pool maintenance as it provides a chronological record of chemical and other parameters for spa pool water quality. A log book for private spas will assist in developing patterns of maintenance and sorting out problems.

Details to be recorded in the register should include

- date and time of test
- water temperature
- number of spa pool users between tests
- water pH level
- chlorine (free residual)
- chlorine (combined residual)
- alkalinity
- operational remarks.

**Microbiological monitoring**

Routine monitoring for the microbiological quality of water is recommended, particularly for heavily used public spas.

This monitoring can provide a guide to the effectiveness of a given disinfection program and can determine the real effect of chemical dosing in individual spas. Table 6 lists microbiological criteria for heated spas. *Pseudomonas aeruginosa* should be measured because it is the most likely bacterium to cause problems. The heterotrophic colony count is an indicator of disinfection efficacy.

For spas operated by clubs, motels, gymnasiums and other organisations to which the public has at least limited access, i.e. public spas, the frequency of monitoring needs to be adjusted to suit local conditions. As a guide, these spas should be monitored weekly for one month to ensure that the water quality is satisfactory, and then at monthly intervals.

With a new or previously unmonitored spa system or with a new operator managing the pool, weekly monitoring is recommended until it is demonstrated that a satisfactory microbiological water quality is achieved. Once a disinfection routine is proven to be satisfactory, greater confidence can be placed on measured levels of disinfectant residuals. Spas which consistently fail to meet chemical or microbiological criteria should be closed until disinfection problems are resolved.
Private spa owners would not normally be expected to carry out microbiological monitoring but do need to ensure that problems are averted by careful attention to water chemistry and guideline disinfectant levels before, during and immediately after use of the spa.

Table 6: Microbiological criteria for heated spa pools

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Guideline value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heterotrophic colony count</td>
<td>Less than 100/mL</td>
<td>Level should be readily obtainable during use if the spa is adequately disinfected; at other times counts should be significantly lower.</td>
</tr>
<tr>
<td>(37°C, 48 h, pour plate technique using plate count agar per AS 4276.3.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <em>Pseudomonas aeruginosa</em>,</td>
<td>Not detected in 100 mL</td>
<td>If exceeds guideline value, then immediate shutdown, dump water, clean filter, refill with fresh water and superchlorinate the spa pool. Resampling is required. Investigation followed by remedial action is needed where problems persist.</td>
</tr>
<tr>
<td>Coliform organisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. <em>Legionella</em></td>
<td>Not detected in 1,000 mL</td>
<td>If exceeds guideline value, then immediate shutdown, dump water, clean filter, refill with fresh water and superchlorinate the spa pool. Resampling is required. Investigation followed by remedial action is needed where problems persist.</td>
</tr>
<tr>
<td>4. Pathogenic amoebae i.e. <em>Naegleria fowleri</em></td>
<td>Not detected in 1,000 mL</td>
<td>If exceeds guideline value, then immediate shutdown, dump water, clean filter, refill with fresh water and superchlorinate the spa pool. Resampling is required. Investigation followed by remedial action is needed where problems persist.</td>
</tr>
</tbody>
</table>

4.6 Filter

An important item associated with spa pools is the filter. These may be granular (e.g. diatomaceous earth) or cartridge/cannister type. While filters are essential to maintaining proper water quality, they are also capable of concentrating a heavy organic or microbial loading at the filter itself. Micro-organisms such as *Legionella* and *Pseudomonas aeruginosa* have multiplied in and on filter material and in the filter housing and led to fatal cases of Legionnaires’ disease. For filters of the cartridge type, at least one backup filter element should be stored nearby in a ready state at all times.

The filter should be inspected weekly, or more often. Look for cracks, breaks, damaged internal components, and excessive buildup of dirt or organic matter.

Granular media filters should be backwashed at least daily if the public spa pool is in frequent use. Where possible observe the backwash action for uniformity of flow over the filter surface.

Continue the backwash cycle for several minutes after the point at which the sight glass indicates clean flow. These filters need to be inspected monthly for cracks, mounds or holes which are tell-tale signals for a lack of uniform filtration capacity.

*Note:* Before opening a filter housing, make sure the pressure has been relieved.

For granular media filters, monthly inspection for excessive organic/dirt buildup is needed. Use a clear-plastic container, with stopper, to extract a sample so that the settling action can be observed. If after 30 minutes of settling, there is a measurable layer of sediment within, or on top of, the filter media or if there is a fine, coloured suspension in the water then the...
For either cartridge or granular media filter systems, always ensure the filter is in line (full flow) during normal spa operations (i.e. no bypass valves open).

A cartridge filter in a private spa should be cleaned with water from a high-pressure hose weekly, and soaked in a chlorine containing disinfectant for twenty minutes, once a month.

4.7 Pool cover

Outdoor spa pools should be fitted with a cover to prevent the introduction of leaves, dirt or pollen into the water.

4.8 Routine cleaning

When cleaning spa pools, thoroughly scrub above the scum line and all weirs and skimming devices where possible. All associated piping and filters should be purged with clean water at the end of the cleaning cycle. If air injection has been discontinued, the air injection piping should be isolated or sealed from the spa pool to ensure dirty water cannot be re-entrained back into the main spa system during routine operations.

4.9 Spa water replacement

Spas in use accumulate considerable amounts of soluble organic contaminants including urine, perspiration, skin fats and oils. Debris such as hair, nasal mucus and other matter will be collected on the filter and regular backwashing is recommended.

Both the soluble and filtered organic material greatly reduce the effectiveness of spa disinfection partly by consuming disinfectant and also by promoting growth of undesirable micro-organisms. As mentioned, some disinfectants, notably chlorine, have the potential to produce a range of irritant and unpleasant smelling byproducts (chloramines) that gradually build up even with adequate disinfection. Ultimately the organic loading can only be reduced by disposing of the spa water and refilling the unit with fresh water which must then be treated.

Whenever a spa pool is emptied or partially emptied, exposed spa pool surfaces should be thoroughly scrubbed and then swabbed with a concentrated, chlorine-based disinfectant. Elbow-length PVC gloves should be worn during this process. The filter should then also be cleaned and backwashed or the filter cartridge changed to discourage bacterial growth and to ensure adequate filter performance. Filter maintenance should be performed before refilling spa.

For private spa pools used once daily, a useful guide is to remove and replace at least 10 per cent of the water weekly and to empty the spa pool at least every three months. A suitable face mask with a P2 filter, complying with AS/NZS 1716 1994, should be worn when working at the filter.

Heavily used public spa pools may need a change of water once or twice weekly. Spa baths for which no disinfectant is used should be drained after each use.

4.10 Backwash water discharge

Water drained from spa pools and filter backwash water should be disposed of in a manner that does not create an offensive situation or nuisance or be injurious to health. Filter backwash water or spa pool water itself should not be discharged on to the ground surface within or adjacent to the pool enclosure. Where possible, it should be discharged to a sewer or common effluent drain if the relevant authority is prepared to accept the discharge. If this is not possible, it should be discharged to subsurface soakage areas sized on hydraulic
loading and soil percolation capability. Under no circumstances should this water be discharged into a septic tank system.

Note: In remote areas, local authorities may provide arrangements for superchlorination and re-use of backwash water.

### 4.11 Common spa pool problems

Problems with spa pool water may be due to a wide variety of reasons such as inadequate disinfection, need for maintenance or incorrect chemical levels.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Reason</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine odour and eye irritation</td>
<td><em>Combined chlorine level too high</em></td>
<td>Increase free chlorine level to oxidise combined chlorine</td>
</tr>
<tr>
<td>Discoloured water</td>
<td><em>Various metals such as copper entering spa pool, e.g. as corrosion product, being oxidised by chlorine</em></td>
<td>Increase pH to 7.4 or use a chelating agent to remove metals</td>
</tr>
<tr>
<td>Water has dark appearance</td>
<td><em>Products from breakdown of large amounts of organic material (e.g. tannins)</em></td>
<td>Check filter operation</td>
</tr>
<tr>
<td>Green water and slippery surfaces</td>
<td><em>Algae growth due to inadequate chlorination</em></td>
<td>Superchlorinate or use algicide</td>
</tr>
<tr>
<td>Metal fixtures corroding</td>
<td><em>Water pH too low</em></td>
<td>Increase pH to 7.4</td>
</tr>
<tr>
<td>Scaling on spa pool surfaces or heater</td>
<td><em>Calcium hypochlorite (powder) added directly to spa pool water</em></td>
<td>Change to sodium hypochlorite (liquid)</td>
</tr>
<tr>
<td>Cloudy water</td>
<td><em>Excessive combined chlorine, or free chlorine rapidly dissipated</em></td>
<td>Superchlorinate</td>
</tr>
<tr>
<td>Cloudy water</td>
<td><em>Poor filtration</em></td>
<td>Check filter medium and backwash or clean</td>
</tr>
<tr>
<td>Cloudy water</td>
<td><em>Calcium hypochlorite added directly to spa pool water</em></td>
<td>Change to sodium hypochlorite</td>
</tr>
</tbody>
</table>

### 4.12 Precautions when handling chemicals

Common sense spa pool chemical handling precautions are:

- Ensure all chemical containers are labelled.
- Handle the chemicals in accordance with the label instructions and avoid breathing the vapours.
- Wear appropriate protective, impervious gloves when handling the chemicals. Wearing goggles will avoid eye damage from splashes.
- Use a separate measuring device for each chemical. Each measure should be clean, dry and made from a suitable material.
- If you get any disinfectant (e.g. chlorine-containing compounds) on yourself, rinse the area of contact with plenty of water.
- If you spill disinfectant outside the pool, clean it up and wash the area with water.
• Never mix different kinds of chemicals.
• Disinfectant and acid should not be added to your spa pool at the same time. Allow approximately one hour between application of chlorine and acid.
• When adding disinfectant or acid to the spa pool water, do it carefully. When the product is powder or granular, add it close to the surface of the water so that particles will not be blown by the wind.
• When you add disinfectant or acid to the water, be sure the filter is in operation to assure adequate dispersal. Leave filter on for at least one hour.

4.13 Precautions for storing chemicals

Ensure you follow all regulatory provisions in your state or territory in regard to
• dangerous goods
• hazardous substances
• occupational health and safety requirements.

Common sense precautions are:
• Store chemicals in a cool, clean, dry, well ventilated, secure area out of the reach of children. When not in use, keep chemical containers sealed with the original closure.
• Do not store spa pool chemicals in the same room as substances such as motor mower fuel, turpentine, pesticides, oils or other chemicals used in the operation of the facility. The inappropriate storage of chemicals may give rise to dangerous situations because, in the event of a spill or leak, the chemicals may mix and react explosively or produce toxic substances, e.g.
  – acids will react with sodium or calcium hypochlorite to release toxic chlorine gas
  – chlorinated cyanurates will react with either acid or alkaline substances to produce explosive conditions due to the release of chlorine dioxide.
  – calcium hypochlorite in contact with organic or oxidisable and combustible substances such as chlorine or petroleum products or acids may form a mixture that spontaneously bursts into flames and in some instances may erupt violently.
  – depending on its concentration, hydrogen peroxide may ignite combustible materials and may react violently with fuels and oils.

No-smoking signs should be displayed in the areas where spa pool chemicals are stored, prepared or applied.

4.14 Warning notice

A sign displaying the following advice should be positioned in a prominent position immediately adjacent to the spa where it can be read by users intending to enter the spa.

<table>
<thead>
<tr>
<th>Warning Notice</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DO NOT put your head under the water.</strong></td>
<td><strong>DO NOT use the spa while under the influence of drugs or alcohol.</strong></td>
</tr>
<tr>
<td><strong>DO NOT use the spa for more than 20 minutes at a time.</strong></td>
<td><strong>DO NOT allow children to use the spa unsupervised.</strong></td>
</tr>
<tr>
<td><strong>DO NOT swallow spa water.</strong></td>
<td><strong>DO NOT use the spa if you have an open wound, feel unwell or are pregnant.</strong></td>
</tr>
</tbody>
</table>
4.15 Pool operators

Some regulatory authorities require operators of public spa pools to be suitably qualified. In any case, operators should have a sound knowledge of first aid, life saving and resuscitation techniques, as well as competency in the water chemistry covered in this guidance document.

5. Operation of spa baths

While AS 3861-1991 requires spa baths to be installed such that they are self-draining, considerable care must be taken to ensure that this is so in practice. To achieve a self-draining system:

- the pump must be located as close as practicable to the side of the bath if not within its perimeter
- the pump must be located at a height so that there is a fall from the pump back to the bottom of the bath suction fitting (pump must be between the lowest jet and the suction fitting).

The recirculatory system should be flushed with a spa bath cleaner at least monthly. Apply the cleaner to the recirculating water for at least 15 minutes. The bath should then be drained and wiped clean with a damp cloth.

6. Bibliography


7. Glossary of terms

acidic water with a pH between 0 and 7.
algicide a chemical that is capable of killing algae.
alkaline (basic) water with a pH between 7 and 14.
backwash the process of cleaning a pool filter by reversing water flow through the filter.
breakpoint chlorination the process of maintaining sufficient free available chlorine in the pool water to chemically convert chloramines and ammonia-nitrogen compounds to inert nitrogen gas.
bromine hypobromous acid/hypobromite ion (irrespective of the mode of addition or formation)
buffered water containing chemicals able to maintain a specified pH value.
calcium hardness a measure of the amount of dissolved calcium compounds in the water.
chloramines compounds formed from reaction of chlorine with nitrogenous contaminants (e.g. urine).
chlorine hypochlorous acid/hypochlorite ion (irrespective of the mode of addition or formation). Typical chlorine-containing compounds are sodium hypochlorite (liquid) and lithium hypochlorite (granular). The amount of hypochlorous acid determines the disinfectant efficacy.
clearance clearness or lack of cloudiness in the spa pool water; indicated by the distance through the water at which an object can be seen.
coliforms bacteria normally present in the colon, e.g. Escherichia coli.
combined chlorine chlorine that has combined with ammonia, ammonium compounds or organic matter containing nitrogen to form chloramines. In this form chlorine has only about 1% of the disinfectant action of free chlorine.
disinfectant Also called sanitiser or biocide. Compound or substance used for disinfection. (Note that household disinfectants are NOT suitable for spa pools and may be a health hazard when used in spas).
disinfection Also called sanitising. Process intended to kill or remove pathogenic (disease causing) micro-organisms.
DPD method The N,N-diethyl-p-phenylene diamine method of measuring chlorine or bromine concentration in the spa pool water.
filter a device for removing suspended particles from the spa pool water.
free bromine bromine that has not combined, but is free to kill bacteria and algae and destroy organic pollutants introduced into the spa pool water.
free chlorine

Also known as ‘free available chlorine’ or ‘free residual chlorine’.
Chlorine that has not combined with contaminants notably ammonia or other nitrogen compounds but is free to kill bacteria and algae and oxidise organic pollutants introduced into the spa pool water. When chlorine is added to a spa pool, it immediately goes to work to attack and kill bacteria, algae, and other foreign organisms in the water. In the course of destroying these organisms, the chlorine literally gets ‘used up’. It is also dissipated more rapidly by sunlight and lost by water splash-out. The chlorine that is left to protect the spa pool water against incoming bacteria and algae is called the ‘free chlorine’.

halogen

chemicals in the halogen group, including chlorine, bromine and iodine.

hydrogen peroxide

a powerful oxidising agent which, in its concentrated form, is a clear liquid with a sharp odour.

hyperthermia

increase in core body temperature that may lead to heat stroke and heart rhythm disturbances

make-up water

water used to replace lost spa pool water.

mg/L

milligram per litre. For practical purposes this is assumed to be equal to parts per million (ppm).

mL

millilitre.

off-pool

away from the main body of pool/spa water

operator

the person who has control and management of the spa pool, is knowledgeable in its operation and is sufficiently competent to ensure that the spa pool complies with the requirements of the relevant regulations. 
(Note: The regulatory authority definition may differ from, and takes precedence over, this usage of the term).

ozone

a powerful oxidising agent that is an unstable blue gas with a pungent odour.

pH

a scale (ranging from 0 to 14) that indicates the amount of acid or alkali present in the water. Water with a pH of 7 is neutral.

pool water inlet

the point where the treated water is returned to the pool.

pool water outlet

the point where pool water is taken from the pool.
<table>
<thead>
<tr>
<th><strong>Spa Term</strong></th>
<th><strong>Definition</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>private spa</strong></td>
<td>a spa pool that is used in connection with a dwelling and is available only to the residents of the dwelling and their guests.</td>
</tr>
<tr>
<td><strong>public spa</strong></td>
<td>any spa pool other than a private spa.</td>
</tr>
<tr>
<td><strong>shock dose</strong></td>
<td>the addition of pool chemicals to spa pool water to achieve concentrations of at least 10 mg/L of chlorine for the destruction of combined chlorine, algae, and other impurities.</td>
</tr>
<tr>
<td><strong>skimmer gutter</strong></td>
<td>a drainage system provided to collect surface water flow from the spa pool and return it to the treatment plant or to waste.</td>
</tr>
<tr>
<td><strong>skimmer weir</strong></td>
<td>a device provided to ensure that spa pool water is drawn from the surface for return to the treatment plant or to waste.</td>
</tr>
<tr>
<td><strong>spa bath</strong></td>
<td>a bath fitted with a water recirculating system and/or an air injection system. A water heater may be included but a water filter is generally not included. Spa baths are emptied after each use.</td>
</tr>
<tr>
<td><strong>spa pool</strong></td>
<td>a pool or other water-retaining structure designed for human use (but not for swimming):</td>
</tr>
<tr>
<td></td>
<td>(a) that is capable of holding more than 680 litres of water;</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td></td>
<td>(b) that incorporates, or is connected to, equipment that is capable of heating water contained in it to above 26°C and injecting air bubbles or water into it under pressure so as to cause general turbulence in the water.</td>
</tr>
<tr>
<td><strong>superchlorination</strong></td>
<td>the addition of sufficient chlorine to spa pool water to raise the level of free chlorine to at least 10 mg/L for the destruction of combined chlorine (chloramines), algae, and other impurities.</td>
</tr>
<tr>
<td><strong>total alkalinity</strong></td>
<td>sometimes called reserve alkalinity. A measure of the total amount of dissolved alkaline compounds in the spa pool water, usually expressed as ppm calcium carbonate.</td>
</tr>
<tr>
<td><strong>total chlorine</strong></td>
<td>the sum of combined chlorine and free chlorine.</td>
</tr>
<tr>
<td><strong>total dissolved solids</strong></td>
<td>a measure of the total amount of dissolved compounds in the spa pool water.</td>
</tr>
<tr>
<td><strong>turbidity</strong></td>
<td>the degree to which suspended particles in spa pool water obscure visibility.</td>
</tr>
<tr>
<td><strong>turnover rate</strong></td>
<td>the period of time required to achieve complete exchange of the spa pool water through the filter.</td>
</tr>
</tbody>
</table>

**Spas**
8. Regulatory approaches to spa pools by Australian States and Territories

Regulatory approaches throughout Australia are remarkably consistent in their technical requirements. All recognise the potential for serious health effects resulting from poorly maintained spa pools. Differences around the country tend to reflect differing political reactions to public health matters.

**New South Wales**

Legislation is described under the Public Health Act 1991 No. 10, the Public Health (Amendment) Act 1992 and the Public Health Regulations 1991, Part 4, and provides for the closure of public spas for any period during which they are considered to be a risk to public health. Occupiers of premises must not allow a person to use a public spa unless the spa is disinfected in such a way as to prevent transmission of disease. Adjacent facilities and spa pool surrounds must also be maintained in a clean condition.

Management of the Regulations is by Environmental Health Officers and local authority Health Surveyors.

Following an extensive survey of swimming and spa pools throughout the state, the NSW Government tightened the spa pool requirements which now include the need for continuous dosing with disinfectant, keeping of log books and strict adherence to disinfectant parameters. These requirements are contained in the Public Swimming Pool and Spa Pool Guidelines, June 1996. A legal defence is compliance with these Guidelines.

**Victoria**

Pools open to the public are regulated by the Health (Infectious Diseases) Regulations 1990. These impose on persons in charge of public swimming and spa pools the obligation to not allow anybody to use a pool unless the water in it has been disinfected in a manner approved by the Chief General Manager of the Health Department.

Disinfection is to comply with the requirements of the Water Purification Standards (Health Department Victoria) 1990. These Standards provide only for chlorination and bromination. However there is provision in the Regulations for application to the Chief General Manager for the use of other methods of disinfection.

The Regulations and these Standards have been specifically referenced in the Health (Brothels) Regulations 1990.

**Queensland**

Legislation specifically targeting spa pools is under consideration. Requirements for general disease control is covered by The Health Act 1937 which provides an overriding head of power to make specific legislation regulating spa pools. The Department of Health accepts and recommends compliance with the Australian Guidelines for Heated Spa Pools, 1989 (NHMRC).

**Western Australia**

Under Section 134 (48A) of the Health Act 1911, the Executive Director Public Health or any Local Authority may make by-laws to regulate the construction, equipment, maintenance and use of spa pools that are controlled or used by or in connection with any club, school, business, association or body corporate.
This section also prescribes powers to control the quality and treatment of the water to be used and measures to be taken to prevent and abate any nuisance and to close any such amenity. Monthly microbiological analysis is required for spas used by the public.

Currently minimum acceptable construction and operational criteria are contained within the Health Act (Swimming Pools) Regulations 1964 and the Australian Standard AS 2610 Part 1 1983, Spa Pools Part 1 - Public Spas.

Additional requirements for public-use spas include:

- all make-up water must be introduced through the filtration system
- equipment must include a mechanical disinfectant injection system controlled by a suitable oxidation-reduction potential (ORP) device.

**South Australia**

Spa pools available for public use are specifically regulated under the Public and Environmental Health Regulations 1991. Technical details such as water quality, pH, disinfection levels, filter and turnover rate and other characteristics are tightly specified in the Regulations and Code Standards.

All spa pools covered by the definition under the Public and Environmental Health Regulation are required to be provided with automatic equipment that continuously analyses and controls the pH and disinfection levels whilst the spa pool is available for use by the public.

A series of comprehensive Codes supporting the Regulations were produced including:

- SAHC Standard for the Operation of Swimming Pools and Spa Pools in SA.
- Supplement A Waterslides.
- Supplement B Hydrotherapy Pools.
- SAHC Code of Practice Standard for the Inspection and Maintenance of Swimming Pools and Spa Pools in SA.

These Codes apply to swimming pools and spa pools as defined by the Public and Environmental Health Regulations. The Codes set out the approved methods of disinfection and treatment for swimming pool and spa pool waters. Each has been prepared as a guide to assist local councils with the administration of the legislation. Additionally they each provide a useful guide for pool owners and operators and will assist them to comply with the provision of the Public and Environmental Health Act 1987 and the Regulations.

**Tasmania**

All spa pools open to the public are regulated under the Public Health Act 1962. The specific regulations are the Public Health (Places of Assembly) Regulations 1974. The Department of Community and Health Services has adopted, as policy, the Australian Guidelines for Heated Spa Pools, 1989 (NHMRC). It is anticipated, as policy, this will be replaced with the current document.

Management of the regulations is via local government under delegation from the Director of Public Health.
**Australian Capital Territory**

For new installations, permits under the Building Control Act are required for public spas. Applications for building approval are to be accompanied by a statement from a qualified mechanical engineer that the requirements of AS 2610 Part 1 are met.


All public spa pools are inspected and the water quality monitored as part of the Service’s health protection program. New ACT Public and Environmental Health legislation is being drafted which is intended to adopt the Code of Practice and be administratively and technically uniform with other States.

**Northern Territory**

Although the Territory does not have specific legislative requirements for spa pools, provisions of the Public Health (Nuisance Prevention) Regulations provide mechanisms for the abatement of conditions at any premises which are injurious or prejudicial to health. If the condition of a spa pool is such that it presents a hazard to health then these provisions may be used to remedy the situation. Guidance on appropriate standards for spa pools is provided in the ‘Water Quality and Hygiene Standard for Spa and Hydrotherapy pools’ published by Territory Health Services in January 1996.